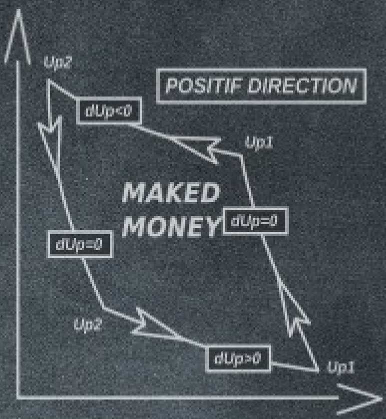
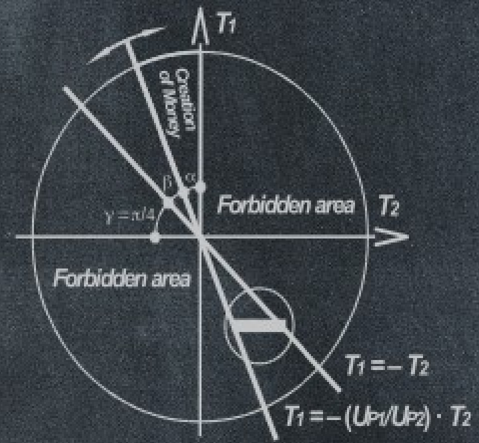
- PIERRE CAMPERGUE -

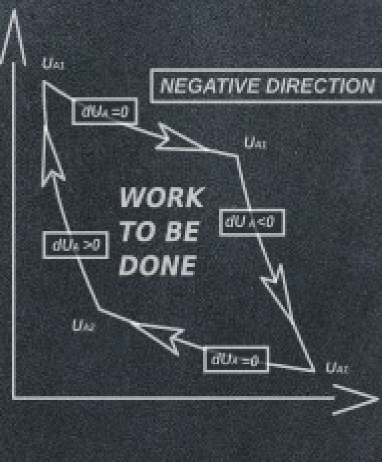
REFLECTIONS

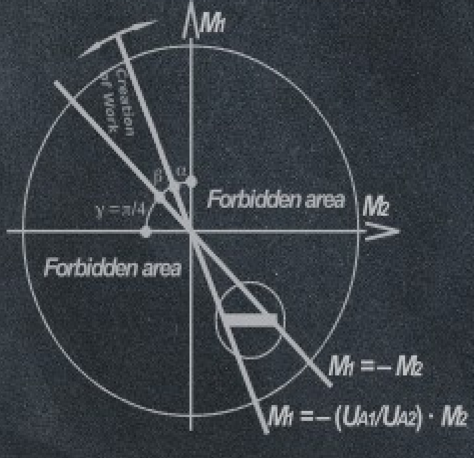
ON THE ECONOMIC POWER OF WORK





& THE MECHANICAL POWER OF MONEY





ABSTRACT

This study attemps to understand the economic transformations of work into money by considering them similar, but not identical, to the energy transformations of heat into work. It proposes a new explanatory and predictive approach to the economic phenomena that have allowed the transition :

- from a society of subsistence, if not starvation,
- to a society of abundance, if not waste.

However, because of its analytical nature, it obviously allows us to understand how it could evolve :

- from a society of opulence, if not plethora,
- to a society of sufficiency, if not well-being.

For several decades now, and in view of the environmental disruptions that can now be observed, there has been much talk of questioning the current economic approach to development that has prevailed since the 17th century, consisting of the fatest possible growth, which is only possible due to ever more complex and therefore knowledge – and energy – intensive technological advances. However, these facts are only observed historically and empirically, but without any real explanatory and especially predictive approach. We are therefore entitled to ask ourselves why, whatever the political system, the following questions are raised

1. Western countries (Great Britain, France, Germany, the United States, …) have each initially borrowed this procedure;
2. other societies (Jpan, Taiwan, South Korea, Singapore, …) then copied this approach;
3. all the other economic systems (Brazil, Russia, India, China, etc.) are finally replicating this method or aiming to apply it.

It is only the answer to this question that is likely to recommend the application of appropriate economic and political measures. Indeed, two paths are classically advocated to modify the current development process, namely

1. the continuation of its highest pursuit but by different means: use of renewable energies, circular economy, symbiotic economy, economy of functionality, etc. ;
2. stopping or even decreasing it (degrowth).

However, there is no effective and safe way to make a sound and rational choice between these two or possibly other possibilities, notwithstanding that many arguments can be made for each of them. The key question is therefore to understand how the increase in living standards has led to these environmental damages, or how we have moved from a subsistence society to an affluent society. This essay should only be understood as a proposed answer to this question.

We know that any measure, even in economics, is always a function of the value of the unit used and the number of that unit. However, as a general rule, in all disciplines except economics, dimensions are always measured using a unit that as precise as possible and absolutely fixed, in order to allow comparaison between several measurements and to avoid the hazards of its possible variation. The cheating and fraud of the lords of the Middle Ages, who had several different measurement standards depending on the purchase or sale of goods and commodities, are well known examples.

However, the economy dispenses with this constraint and appropriates the prerogative to modify the value of the unit over time. This faculty has unfortunate consequences for the understanding of economic

phenomena and renders null and void the possibility of discovering possible economic laws if this variation of the monetary unit is not taken into account.

Indeed, since in economics a measure is a function of two variables: the value of the unit and the number of units, there are four possibilities of evolution, unlike in other disciplines where there is only one: the number of units. Consequently, this requires the independent analysis of each possibility. Thus, the attempt to understand economic phenomena in their totality, in a holistic way, is doomed to failure; an overall economic evolution being dependent on the proportions of each of the four partial possibilities of this evolution. Without knowledge of each of them, it seems obvious that any result can be obtained. Thus, a general development defined by a mixture of the four possibilities can always be refuted by a different mixture of these possibbilities.

- Without taking into account the four possibilities of evolution, any attempt to understand economic phenomena can only be reduced to attempts at explanation.

Now, of these four possibilities, three are subordinated in one way or another to the variation in the number of units and only one is totally and strictly autonomous from it, which is nevertheless capable of creating wealth, money. However, it should be noted that any variation in the number of units existing in an economic system can only be due to human action. So the only possibility exempt from any anthropic character must be related to physics, like the Natural Sciences.

Economics, as it is currently understood, only deals with flows (goods, services, money) and possibly stocks. But in nature, a flow does not exist as such but only as the consequence of a transformation induced by a difference in a certain characteristic (force, voltage, temperature, etc.). For example : the current (flow) of a river exists only as a result of a difference in the force of gravity; the electrical current as the effect of a difference in voltage. It is therefore the transformations generated by these differences that it is useful to master.

Since all rational intellectual progress must be based an absolutely certain foundations that cannot, or only with great difficulty, be called into question, the best way to limit doubt, if not eradicate it, is to rely on mathematical analysis, even is it is only the rudiments. Thus, the first two chapters “00 − Monetary Developments” and 00 − CORE Elements” constitute respectively the foundations and the base on which the essay is erected. In these articles, and particulary in the first one, the analysis implies the necessary use of the thermomechanical formalism. The absence of these chapters would severely limit the credit that can be given to the validity of the study. This makes their reading a priority and imperative.

This essay, which is focused on economic exchanges (except finance) and located outside any conventional interpretation, requires first the conception and then the application of characteristics specific to the economy. This implies that their definition and properties are compatible with the aformentioned formalism, knowing that it is able to translate sufficently slow and regular behaviours of systems of appropriately defined variables. The three chapters “01- Prolegomena”, “02 – Value of the monetary unit” and “03 – Basic definitions” circumscribe the expression of this validity.

Almost all the other chapters are a copy of the usual banal calculations of classical thermodynamics, where the characteristics of physics are only replaced by the new ones of economics.

The Carnot and Calyperon -like diagrams from this essay thus allow us to understand how money can be created (destroyed), ie how a society can become richer (poorer). Moreover, it builds a bridge:

- on the one hand, between the money created and the energy spent to create it;
- on the other hand, between the two main subdivisions of micro and macroeconomics.

Summary

PREAMBLE

00- MONETARY DEVELOPMENTS

ABSTRACT: This chapter is of great importance because it constitutes the foundations on which the whole essay is built and thus gives it all its consistency and credit. Indeed, notwithstanding the fact that the elements of mathematical analysis used represent only its rudiments, they cannot normally be questioned. The direct consequences that are drawn from it form the core of this chapter. Its two main points are that, in any economic system:

1. *any variation in the number of monetary units can only derive from a human will and induces absolutely no overall change in the wealth of the system. Only a new distribution of money within the system can possibly result from this. This fact, characterized by a compulsory human action and by the strict ab. This fact, characterized by compulsory human action and the strict absence of work, can only be a matter for the human sciences;*

2. *any variation in the value of the monetary unit can only be the result of work done, more or less, which necessarily generates a global modification of the system's wealth. This fact, singled out by the imperative positive or negative supply of work and by the strict absence of human action, can therefore only come from the Natural Sciences.*

The work referred to above must be specified only as energy and not as something to be done, a labour to be performed, a task to be accomplished, etc.

In conclusion, it can be argued that any change in the wealth of an economic system, i.e. the improvement of the purchasing power of the people, can be considered as a change in the quality of life. of the purchasing power of the agents constituting it, can only be generated by the execution of work with an economic purpose and that any other factor is absolutely useless.

Creation – Distribution – Use

Knowing that the laws must be absolutely general and to simplify the writings, the "*Product*" is defined as everything that is manufactured, elabourated, realized, accomplished, by Human and can therefore be a good or a service.

It is possible to give some synonyms for the three terms in the title of the paragraph, such as:

1. creation ⇒ elabouration, manufacture, confection, shaping, construction, *etc.*
2. distribution ⇒ allocation, sharing, ventilation, arrangement, cutting, *etc.*
3. use ⇒ operation, activity, working, use, *employment*, *etc.*

Whoever is convinced that points 1 (creation) and 3 (use) undeniably belong to the "Natural Sciences" and that point 2 (distribution) is systematically related to the "Human Sciences". Indeed, any system, whether natural or artificial :

- can only be created first and then function by being subject to the Natural Laws governing the march of the Universe. By definition everything that exists naturally is subject to the Laws of Nature. But everything that exists artificially, *i.e.* everything that is first conceived, then created and then used by Human is also subject to these same Laws. All objects, tools, artefacts, goods, machines, commodities, *Products*, goods, services, movements, *etc.*, could only be shaped and used in accordance with the laws of nature,
- can be finally distributed only by being subservient to a decision, will and action of the Human Being.

For example :

- the manufacture and operation of a boomerang are obviously dependent on the laws of physics, but the purpose for which it's intended may vary according to the will of the user,
- The elabouration (production) of a cake as well as its digestion (consumption) are subject to the laws of chemistry, but its cutting is totally independent of these laws because it depends only on the good will of the housewife,
- The administrative division of the Earth (natural system) into countries, regions, fields, meadows, *etc.*, is undoubtedly a matter for human rules and not for the Laws of Nature.
- *Etc.*

An almost infinite list of examples could be presented.

It should be noted that creation is always relative to “production” and use is always relative to “consumption” which are necessarily staggered in time: production being, of course, always prior to consumption. Therefore, by way of evidence, it's possible to argue that use is always subsequent to creation.

It has been seen above that any creation, identical to any use, can only be subject to Natural Laws. However, a banker granting a loan not covered by previous deposits only executes a human action resulting from his decisions and will. His actions therefore strictly belong to the Human Sciences, which are totally ineffective in generating any kind of evolution, an exclusive domain of the Natural Sciences as will be seen and demonstrated below by mathematical analysis.

If there is an important Law orchestrating the functioning of the Universe, it's well that :

- ***only work generates change, all other criteria are inoperative.***

What follows demonstrates in the most formal way that this Law is obviously still valid whatever the discipline considered and in this case the Economy. Human being is a component like any other of the Universe, he can only conform to all the Laws that govern him and can in no way emancipate himself from them. All the actions of the Human being are compulsorily in conformity with them.

Preliminary reflection

As no construction, whether intellectual or architectural, can rest on moving or wobbly foundations, it's necessary and even imperative to guarantee that the base on which it's erected is perfectly stable. Therefore, any building must be supported on absolutely secure foundations so that they cannot be questioned or be open to criticism and dispute. Since mathematical analysis has always produced results in accordance with the facts, its use is naturally essential and cannot be challenged *a priori*. So, when one says :

1. That bankers create money means that they increase the number (n) of monetary units existing in the economic system of which they are a component,
2. That each country (economic system) has its own money, reference is made to the monetary unit (u). For example, the Yen for Japan, the Shekel for Israel, *etc.*,
- That the money held in the pocket of an Italian is 47 €, in that of an Englishman 34£, *etc.*, it's considered to be the mathematical product ($n.u$) of the number of monetary units (n) by the unit (u).

However, these three sentences are *a priori* correct. But :

1. in the first case, the money is defined as a number (n),
2. in the second, the money is considered as a unit (u),
3. in the third, the money is fixed as a multiplication ($n.u$).

We are therefore in the presence of three different meanings. Therefore, two are wrong and only one is likely to be possibly correct. In order to solve this problem it's therefore necessary to discriminate between these different hypotheses in order to determine which one, if any, would be correct.

Coherent monetary developments

By definition (Larousse L3-1970), a measure is defined as :

- **"the evaluation of a quantity made according to its relationship with a quantity of the same species, taken as a unit and as a term of comparison".**

This means that in any discipline, any measurement of any quantity or dimension is always determined as follows :

$$Measurement(M) = number(n)\ of\ units \times value(u)\ of\ the\ unit$$

Consequently, in Economics the measurement of money, which cannot be an exception, is therefore defined by the relation :

$$Money(M) = number(n)\ of\ monetary\ units \times value(u)\ of\ the\ monetary\ unit$$

either:

$$M = n . u$$

whose differential :

$$dM = n . du + u . dn$$

Solving this equation returns all four, and only four, results:

1.	$dn = 0$	and :	$du = 0$	⇒	$(\partial M)_{n,u} = 0$	⇒	**No evolution**
2a.	$dn > 0$	and :	$du < 0$	⇒	$dM = 0$	⇒	**No evolution**
2b.	$dn < 0$	and :	$du > 0$	⇒	$dM = 0$	⇒	**No evolution**
3a.	$dn = 0$	and :	$du > 0$	⇒	$(\partial M)_{n,} > 0$	⇒	**Creation of money**
3b.	$dn = 0$	and :	$du < 0$	⇒	$(\partial M)_{n} < 0$	⇒	**Destruction of money**
4a.	$dn > 0$	and :	$du = 0$	⇒	$(\partial M)_{u} > 0$	⇒	**Creation of money**
4b.	$dn < 0$	and :	$du = 0$	⇒	$(\partial M)_{u} < 0$	⇒	**Destruction of money**

These four results are the only ones capable of showing the different possible coherent evolutions. Of course, it's possible to highlight that in possibility 2 (2a, 2b), if the variations ($|dn|$, $|du|$), in absolute value, of the number (n) and the unit (u) are not equal, then the variation (dM) of the *Money* (M) isn't zero. This is correct, but in this hypothesis the economic system under examination can only be subject to distortions, alterations, *etc.*, which disguise the proper functioning of the system, as will be seen later in the paragraph "Incoherents evolutions". In any case, these four possibilities list and record absolutely all conceivable natural evolutions. To refute this would be to call into question the validity of the mathematical analysis and therefore lack reason. It should be noted that :

- the first two hypotheses (1, 2) are ineffective in creating money, although the number of units may vary,

- the last two hypotheses (3, 4) are effective in changing the quantity of money: either upwards or downwards.

However, regardless of the case under consideration :

- ***any variation in the number of monetary units is due solely to human will.***
- ***if there is no human action, no change in this number is possible.***

Indeed, it's quite obvious that a variation in the number (n) of monetary units can only be due to a human decision. The emission or withdrawal of monetary units is indeed a consequence of the actions of the individuals who are empowered to hold this power. Therefore, after eliminating possibility 1 (identified as the refusal of credit by a banker) which has no interest, analysis of the table listing the different possibilities discerns :

- ***those that necessarily require human action, i.e. possibilities 2 and 4,***
- ***that which is strictly and totally independent of it, namely the possibility 3.***

As a result :

- everything that derives from possibilities 2 and 4 can only come to light in sociology, anthropology, philosophy, *etc.*, that is to say, in the “Human Sciences”,
- everything that emanates from possibility 3 can only relate to physics, *i.e.* the “Natural Sciences”.

Taking this last possibility into account changes everything, because any consequence of human presence is absolutely, rigorously and strictly forbidden, identical to the “Natural Sciences”. It is therefore by referring to these disciplines that a rational explanation of economic exchanges can be developed.

Thus, possibilities 2 and 4 systematically result from an intention, a project and an intervention by Human requiring no energy expenditure, in the form of work, intended to vary the *price* (as will be seen below). In fact, striking a metal blank with a face value of 10 monetary units ($, £, €, ...) requires no more energy than 1 unit. Printing the number 1,000 on a piece of paper doesn't require 100 times as much energy as printing the number 10. A banker is no more tired (400 times) by granting a loan of 200,000 $ for the construction of a house than by granting a loan of 500 for the purchase of a dishwasher. It should be noted that possibility 4 always results in the same phenomenon. If human doesn’t increase or decrease the number (n) of units, then we find ourselves in hypothesis 3. In this possibility (3a, 3b), it's clear that after a variation (u) in the unit, if the same inverse variation (n) in the number of units is made, it brings the unit back to its original value. Human is therefore authorised to emit or destroy a certain number (n) of monetary units in such a way that :

$$\Delta u = 0$$

In conclusion, it can be argued that :

- ***any variation in the number of monetary units automatically and inexorably generates the same inverse variation in the value of the unit, implying the impossibility of creating money.***
- ***the variation in the number of units is always and exclusively caused by the Human Being, without the exercise of any work.***

Therefore, by granting a credit, not covered by deposits, a banker :

- makes the number (n) of units increase ($dn > 0$)

- causes the value of the unit (u) to fall ($du < 0$)

in accordance with possibility 2a, as it can in no case keep the unit (u) constant (possibility 4a). Indeed, in this case he would be obliged to perform work (energy), which he doesn't do. Thus, according to the above, a banker never creates money in the strict sense of the word. So to say that a banker creates money would be a simplification instigating an abuse of language. The only thing that can be said is that bankers create monetary units and only monetary units, but by systematically varying the unit in an inversely proportional manner. Conversely, the repayment of a loan is similar to possibility 2b, with :

- makes the number (n) of units to fall ($dn < 0$)
- causes the value of the unit (u) increase ($du > 0$)

Thus the increase in the number of monetary units (granting of a loan not covered by deposits) doesn’t create money and its decrease (repayment of a loan) doesn't destroy it.

The various developments represented by all the possibilities (1, 2, 3, 4) listed above exist and form a mixture that shapes daily reality.

Whichever economic system is considered, it follows from this paragraph that any change in the number of monetary units doesn't alter the overall *wealth* of that system. This is due to the fact that no *Work* (energy) commensurate with this change is required, as it derives from human initiative and behaviour following an accounting procedure. The result can only be a change strictly within the system, but without any global modification of the system. Any economic policy measure that doesn’t involve *Work* expenditure leaves the existing quantity of *Money* in the system constant, but inexorably leads to flows in it, *i.e.* :

- ***What one component of the system gains, another loses, and vice versa.***

<u>*Implications*</u>

Of all the possibilities for *Money* development listed above, only the one referred to in 3a, namely :

3a. $dn = 0$ and : $\partial u > 0$ $\Rightarrow$ $\partial M > 0$

allows its creation, which is logically sought after since it's the one that increases *wealth.* Once this creation has taken place, it would possibly be possible for any issuer to strike, as far as necessary, a number (n) of monetary units in order to keep the unit (u) constant, which would correspond to possibility 4a, *i.e.* :

4a. $\partial n > 0$ and : $du = 0$ $\Rightarrow$ $\partial M > 0$

Thus, in order to increase the *wealth* of any economic system, it's imperative to increase the value (u) of the monetary unit (possibility 3a). The only way to do this is to decrease the *price* of the *Products* (goods and services) put on the market. In fact, if yesterday a 1$ coin made it possible to buy 1 kg of pasta and today the *price* per kilogram falls to 0.9$, then the consumer keeps 0.1$ in his or her pocket, which he or she holds in addition, and has therefore become richer. This operation (*price* drop) causes the number (n) of units to remain constant (0.9 + 0.1 = 1), but also the unit (u) to increase by 11.1% since 1$ consents to the purchase of this extra pasta (1 / 9 = 0.111). It is only later that the consumer will use the extra *Money* he holds after a *price* reduction to purchase another good or service.

However, all conventional economic doctrines consider *Money* to be that which circulates from the consumer to the supplier in exchange for a good or service, which circulates in the opposite direction. As a result, they are always obliged to conceive, imagine, and construct “initial endowments” that allow consumers to acquire goods and services. *A contrario*, following this new approach, it's possible to write :

- ***The Money is what a consumer holds in addition after a price drop.***

It is only later that this *Money* will circulate from the consumer to the supplier in exchange for a *Product* (good or service). Thus, this new definition captures how these initial endowments could be generated and, as a result, *wealth* and increased *purchasing power*.

Genesis of the money

To achieve this *price* reduction it's normally necessary and indispensable to increase productivity in order to manufacture the good or service as quickly as possible (*caeteris paribus*). However, this increase in productivity necessarily requires the execution of additional *Work* (defined here as energy and not as a task, a work, a labour, something to be done).

Consequently, it's therefore possible to exhibit the following phenomenological sequence:

- **Additional work of the supplier ⇒ increased productivity ⇒ *price* decline ⇒ increase of monetary unit ⇒ creation of money ⇒ additional money of the consumer.**

It should be noted that this *price* reduction should not be used to feed dividends, salaries, profits or anything else. Indeed, in this case and as already mentioned, this would only be an accounting procedure that doesn't involve any energy expenditure since it's the result of an individual's choice and resolution, whereas *price* reduction is a physical process that necessarily requires the expenditure of energy in the form of work.

- **The supplier's work can be carried out by any entity, *i.e.* : individuals, slaves, employees, animals, motors.**

In this enumeration, individuals, slaves, wage earners and animals can be considered as natural sources of labour, while engines can be understood as artificial sources. Sources such as wind, waterfalls, *etc.*, are commonly referred to as natural, but in the context of this study they are to be qualified as artificial, despite the fact that all existing sources in the Universe are obviously always natural. It isn't the intrinsic source that is taken into account, but more precisely the transmission or transformation system. Although wind is a natural source, a windmill must be considered an artificial source of work because it requires a whole system transmitting the energy of the wind to the millstones, a technical system that doesn't exist in nature.

The power of natural sources is always limited (conventionally 1 HP = 0.736 kW - practically a workhorse has about 2 kW of power), whereas, *a priori*, that of engines isn't (a modern turbojet engine provides 80,000 kW). It seems that it's the availability of these low-cost artificial sources of energy over the last two centuries that has made the transition possible:

- ***of a subsistence society, if not of scarcity,***
- ***to a society of abundance, if not of waste***

(at least in "rich" countries), as a result of a general and consequent fall in the *price*s of goods and services. The case of "consumer" electronic products, as well as "low-cost" air travel, are blatant current examples. All this is very similar to the facts which occur daily in all companies, namely: working as hard as possible to increase the speed of production and thus reduce *price*s (at least "cost *price*s").

Work (energy) that allows a reduction in the cost *price* can be described as "productive *Work*", while work that doesn't allow a reduction in *price* can be defined as "unproductive work".
For example, if the selling *price* is kept constant despite this drop in cost *price*, then it's possible to consider that there are two variations, namely :

1. ***a prior reduction in price which is related to physics,***
2. ***a subsequent consecutive price increase which is related to accounting.***

- ***The first is therefore a matter for the "Natural Sciences", while the second is a matter for the "Human Sciences".***

Indeed, entrepreneurs are, in liberal systems, free to put any *price* on the labels of their *Products*. They are the sole judge and person responsible for selling *price*s, but always subject to the external constraints (competition, regulations, *etc.*) to which they are subject. Consequently, since *price*s are only set according to a human choice, this is a matter for applications, possibly clarified by the classical and conventional doctrines of Economics. *A contrario,* the hypothesis exposing a possible drop in cost *price*s necessarily involves *Work* (energy) as its cause, its driving force, which imposes a physical approach to the phenomenon. It is only this part (physical approach) which is the object of the study which follows from these first considerations.

As a result:

- ***before any distribution of wealth, being part of the Human Sciences, it's imperative to have ensured its creation according to a physical formalism dependent on the Natural Sciences.***

Notes

From the above, for any *Product* (good or service), the more *Work* has been done to make it, the less expensive it's and the less it can be assumed to be included, supported by that *Product.* Then it can be argued that :

- during an exchange, there is a growing imbalance, depending on productivity, between the *Work* done by the supplier and the *Money* he receives, or :
  - ***more Work flows from the supplier to the consumer, less Money flows in the opposite direction.***
- For the same reason:
  - ***it's the supplier who enriches the consumer.***

- if two copies (A, B) of the same *Product* are considered, they are normally indistinguishable. But, if B was manufactured faster than A, then B required a higher *Work* expenditure than A, requiring B's cost *price* to be lower than that of A. Consequently :
  - ***a variation ($\pm$) in Work is never used to manufacture a Product, but exclusively to change ($\mp$) its price in the opposite way.***

This *Work* is still mechanical *Work*, but it no longer serves to increase the speed of movement of a mobile, but to increase the speed of production of a *Product* (good or service). So :

- ***this work is no longer work with a mechanical purpose (W), but becomes Work with an economic purpose (T).***

From these three remarks it's now possible to postulate that :

- ***the SUPPLEMENTARY WORK performed by the supplier is TRANSFORMED into SUPPLEMENTARY MONEY held by the consumer.***

So, we are in the presence of :

1. a transformation, which is relative to physics, and no longer a flow, which is relative to accounting,
2. a balance between the *Work to be done* destroyed and the *Money created* (first principle of conservation).

This is in accordance with the First Principle of Conservation of Physics. Indeed, the decrease (destruction) of the *Work to be done* is compensated by the increase (creation) of the *Money* generated and *vice versa*: the respective inverse variations of the *Work to be done* and of the *Money* leaving their sum constant (in an isolated system). It is therefore possible to pose :

$\underbrace{dT}_{cause} + \underbrace{dM}_{effect} = 0$ to be compared to : $\underbrace{dQ}_{cause} + \underbrace{dW}_{effect} = 0$ of physics.

We have seen above that a variation of *Work* induces an inverse variation in *price* and, as a result, the creation or destruction of *Money.* Knowing that every consumer exerts a force (F) (pressure) on the supplier to lower the *price*, then it's possible to ask :

$dM = - F \cdot dp$ to be compared to : $dW = - P \cdot dV$ of physics.

So, as an attempt to understand economic exchanges (transformations), it's possible to draw up the following sequences:

1. First of all ⇒ **Heat** $_{\text{consumed}}$ ($\boldsymbol{Q}$) $\xrightarrow{\textit{TRANSFORMATION}}$ **Work** $_{\text{done}}$ ($\boldsymbol{W}$) ⇒ thermodynamics
2. then ⇒ **Work** $_{\text{of the supplier}}$ ($\boldsymbol{T}$) $\xrightarrow{\textit{TRANSFORMATION}}$ ***Money*** $_{\text{of the consumer}}$ ($\boldsymbol{M}$) ⇒ ecodynamics

A *price* change according to assumption 3 (3a, 3b) leaves the number (n) of units constant. This implies that the change in the monetary unit (∂u) of the economic system is an inverse function of the *price* change (∂p) in relation to the number (N) of monetary units circulating or existing in that system. In analytical form, it's therefore possible to write :

$$(\partial u)_N = - \frac{n}{N} \cdot \partial p$$

It should be noted that monetary aggregates (Base M0, M1, ...) which only emanate from human decisions don’t have to be taken into account because they are foreign to the physical approach used here.

Incoherent monetary developments

It is possible to analyze possibility 2 (2a, 2b) when the respective variations in the number (n) of units and the unit (u) are not equal in absolute value. In this case there can only be four possibilities, namely :

2a1.	$dn > 0$	and :	$du < 0$	with :	$\lvert dn\rvert > \lvert du\rvert$	⇒	$dM_{created} = 0$	⇒ inflation
2a2.	$dn > 0$	and :	$du < 0$	with :	$\lvert dn\rvert < \lvert du\rvert$	⇒	$dM_{created} = 0$	⇒ devaluation
2b1.	$dn < 0$	and :	$du > 0$	with :	$\lvert dn\rvert > \lvert du\rvert$	⇒	$dM_{spent} = 0$	⇒ **deflation**
2b2.	$dn < 0$	and :	$du > 0$	with :	$\lvert dn\rvert < \lvert du\rvert$	⇒	$dM_{spent} = 0$	⇒ **revaluation**

These possibilities are only abnormal evolutions, as the provision of *Work* only partially exists, being only consequences of human decisions. For possibilities 3 (3a, 3b) and 4 (4a, 4b) the changes in the number (n) and unit (u) are also not equal, but this is due to the fact that *Work* is done to compensate for these differences (this is beyond the scope of this condensed and elementary presentation). Consequently, it should be noted that when the variation in the number of units is known precisely then the variation in the value of the unit's not, and *vice versa*. It is therefore necessary to write :

2a1.	$dn > 0$	and :	$\delta u < 0$	with :	$\lvert dn\rvert \; > \; \lvert \delta u\rvert$	$\Rightarrow$	$\delta M_{created} = 0$	$\Rightarrow$	**inflation**
2a2.	$\delta n > 0$	and :	$du < 0$	with :	$\lvert \delta n\rvert \; < \; \lvert du\rvert$	$\Rightarrow$	$\delta M_{created} = 0$	$\Rightarrow$	**devaluation**
2b1.	$dn < 0$	and :	$\delta u > 0$	with :	$\lvert dn\rvert \; > \; \lvert \delta u\rvert$	$\Rightarrow$	$\delta M_{spent} = 0$	$\Rightarrow$	**deflation**
2b2.	$\delta n < 0$	and :	$du > 0$	with :	$\lvert \delta n\rvert \; < \; \lvert du\rvert$	$\Rightarrow$	$\delta M_{spent} = 0$	$\Rightarrow$	**revaluation**

These monetary developments correspond to the phenomena of inflation, devaluation, deflation and revaluation, which are well understood classically as anomalies. The explanation of these four singularities is presented below.

Before anything else, it's necessary to specify that :

- ***it must always be remembered that the true value of a product is directly related to the number of units but also to the value of the latter, as it must be taken into account for a rational estimate of its cost. Considering only the labelled price, i.e. the number of units displayed, without taking into account the value of the unit with which it's measured, makes it impossible to understand monetary developments.***

- ***<u>Possibility 2a1 – Inflation</u>***
  The variables evolve as follows:

- $dn > 0$ and : $\delta u < 0$ with : $|dn| \; > \; |\delta u|$

  As the number n increases the consumer has more units available but the value of each unit decreases. But because the value decreases less as the number increases, the consumer gets richer. This fact encourages him to increase his consumption, which is well observed in reality. Little by little, the difference between the number n and the value of the unit u increases. However, if the consumer wins, the supplier loses. This causes the company's income to decrease and encourages it first to separate from the manpower, and then eventually leads it to stop its activities, thus instigating an increase in *unemployment*.

Inflation can be thought of as an overvaluation of the monetary unit that can lead to the ruin of the economic system.

- ***<u>Possibility 2a2 – Devaluation</u>***
  The variables evolve as follows:

- $\delta n > 0$ and : $du < 0$ with : $|\delta n| \; < \; |du|$

The overvaluation of the *Money* due to inflation necessarily leads to its revaluation in the more or less long term. Normally, an increase in the number n logically implies the same decrease in the unit u. But since inflation has increased the consumer's *purchasing power*, it's imperative that it should decrease so that he loses what he has previously gained.

It is therefore necessary for the unit u to decrease more than the number n increases in order to destroy unduly earned *Money*.

It is possible to conceive of devaluation as a return of the value of the unit to its real level of reference, which favours and causes the economic system to be put back in order.

- ***Possibility 2b1 – Deflation***
  The variables evolve as follows:

- $dn < 0$ and : $\delta u > 0$ with : $|dn| > |\delta u|$

Since the number n decreases the consumer has fewer units but the value of each unit increases. However, because the value increases less as the number decreases, the consumer becomes poorer. This fact encourages him to decrease his consumption, which is well observed in reality. Little by little, the difference between the number n and the unit u increases. However, if the consumer loses, the supplier wins. *A priori*, the entrepreneur is happy. However, since the consumer loses, he consumes less. This causes the company's income to decrease and encourages it first to separate from the manpower and then leads it to stop its activities instigating an increase in *unemployment*.

It is possible to conceive of deflation as an undervaluation of the monetary unit that can lead to the ruin of the economic system.

- ***Possibility 2b2 – Revaluation***
  The variables evolve as follows:

- $\delta n < 0$ and : $du > 0$ with : $|\delta n| < |du|$

The undervaluation of the *Money* due to deflation necessarily leads to its revaluation in the more or less long term. Normally, the decrease in the number n logically implies the same increase in the unit u. But since deflation has reduced the *purchasing power* of the consumer, it's imperative that it increases so that it gains what it has previously lost.

It is therefore necessary that the value of the unit u increases more than the number n decreases.

It is possible to conceive of revaluation as a return of the value of the unit u to its real reference level, which favours and causes the economic system to be put back in order.

Comparing the cases of inflation and deflation shows that the natural trend in *price* evolution is inflation, since this is what consumers are looking for: this hypothesis allows them to acquire a *Product* supplement. This is indeed what has been observed historically: inflationary episodes, which are advantageous for consumers (but not for savers), being much more numerous than deflationary phases, which are detrimental to them (but not for savers). Since devaluation and revaluation phenomena are linked to inflation and deflation respectively, then, as a corollary, devaluation episodes are also much more numerous than revaluation circumstances. From this it can be argued that :

- ***Inflation being good for consumers is relative to "demand policy",***
- ***deflation being advantageous for suppliers is related to the "supply policy".***

This can be presented in another way, namely :

- ***the "demand policy" tends to inflation,***
- ***the "supply policy" contributes to deflation.***

All this corresponds well to the facts that can be seen in reality. Therefore, whatever the policy envisaged, they are always harmful since their evolutions are incoherent: their consequences being only alterations, disturbances, deregulations, *etc.*, of a correct and adequate functioning of the economic system. It is therefore possible to argue that :

- ***only the balance between supply and demand policy is to be sought,***

so that developments remain coherent (possibilities 2a, 2b).

As long as the speed of *price* increases remains lower than that of consumption, all consumers are winners and savers are losers. But when the speed of inflation becomes higher, all consumers also lose out because they no longer have enough time to consume before *price*s rise again. They can therefore be described as savers. The latter hypothesis can be defined as a state of hyperinflation.

Conclusion

We have already seen that, by definition, any quantity is measured according to the relationship :

$$Measurement(M) = number\ (n)\ of\ units \times value(u)\ of\ the\ unit$$

With the exception of Economics, all disciplines, whatever they may be, define the value of the unit (u) as accurately as possible. This temporal and spatial stability has the sole purpose of ensuring that the measurement can only return a single number (n). This is because it's possible to take up the various possibilities of evolution for any given quantity G, namely:

1.	$dn = 0$	and :	$du = 0$	$\Rightarrow (\partial G)_{n,u} = 0$	$\Rightarrow$ **Constance**
2a.	$dn > 0$	and :	$du < 0$	$\Rightarrow dG = 0$	$\Rightarrow$ **Constance**
2b.	$dn < 0$	and :	$du > 0$	$\Rightarrow dG = 0$	$\Rightarrow$ **Constance**

3a.	$dn = 0$	and :	$du > 0$	$\Rightarrow (\partial G)_{n,} > 0$	$\Rightarrow$ **Increase**
3b.	$dn = 0$	and :	$du < 0$	$\Rightarrow (\partial G)_{n} < 0$	$\Rightarrow$ **Decrease**
4a.	$dn > 0$	and :	$du = 0$	$\Rightarrow (\partial G)_{u} > 0$	$\Rightarrow$ **Increase**
4b.	$dn < 0$	and :	$du = 0$	$\Rightarrow (\partial G)_{u} < 0$	$\Rightarrow$ **Decrease**

Then, leaving aside possibility 1 for which there is no variation, it's easy to see that only hypothesis 4 (4a, 4b) leaves the value of the unit constant ($du = 0$). Consequently, any measurement returns only one number, the number (n) of units. Thus, for a particular measurement, whatever the device, operator, location, time, the number (n) will always be the same (disregarding fluctuations and measurement errors). Thus, it's possible to compare several quantities with each other. Since any theory must be free of any anthropic criteria, this prohibits any human reference, as the executor of the measurement has no influence on the result. As stated, this faculty is no longer valid in Economics, because the value of the unit (u) is eminently variable in time and space. As a result, the operator (banker, politician, speculator, *etc.*) can play on the number (n) of monetary units since he is no longer obliged to keep the value of unit (u) constant. The analysis of daily facts shows that financiers (in the general sense) and political decision-makers do not hesitate to juggle with the number of units by intervening in the issue or withdrawal of cash, particularly through the distribution of credits. In short, while all disciplines always consider the value of the constant unit (u), only the economy avoids this requirement, as this value can vary, but always according to the different possibilities indicated above. However, these variations don't in any way call into question the accuracy and validity of the basic relationship, *i.e.* :

$M = n \cdot u$ and its differential : $dM = n \cdot du + u \cdot dn$

It has just been analytically demonstrated that, in any economic system, any change in the number (n) of monetary units :

- ***is always due only to a decision, will and action of the Human Being,***
- ***causes an equal change, of opposite sign, in the value of the monetary unit,***
- ***leaves the quantity of money constant and therefore* doesn't *change the overall wealth of the system,***
- ***requires absolutely no energy expenditure in the form of work.***

Thus, any change in the number of monetary units existing in an economic system is absolutely futile in changing (upwards or downwards) the quantity of *Money* in the strict sense of the word and thus enriching or impoverishing the system. Any economic policy oriented towards the internal distribution of *Money* within the system under consideration can only serve to decrease or increase inequalities. Knowing that only the work provided is likely to increase *purchasing power*, all economic doctrines centred on the evolution of the quantity of monetary units, such as that of “trickle-down effect”, are totally sterile and therefore ineffective in increasing *wealth.* In fact, since no *wealth* is created, then the so-called “trickle-down” *wealth* has been compulsorily taken from other agents beforehand. Bankers, being unable in any hypothesis that it's possible to envisage, creating *Money* in the strict sense, are in the total impossibility of increasing the *wealth* of any economic system. It is therefore the same for speculative finance. Indeed, speculative finance only plays on the sole characteristic of *Money*, by bringing no consideration to *Work*: this concept being totally foreign to it. However, it's never written here that bankers, in their actions, cannot be useful for the smooth running of society, it's only shown that they are totally incapable of creating *Money* in the strict sense, but only monetary units by directly modifying their number (n) and indirectly their value in the opposite way. However :

- ***the hiding of the variation of the unit prohibits the rational apprehension of any economic phenomenon.***

Of all the above, it would only be the process of *price* reduction that would gradually induce an increase in *purchasing power*, and thus make it possible to understand how *wealth* can be increased and thus generated. However, this would only be possible by providing more and more *Work*. When this *Work* is performed exclusively by natural sources, it cannot be very important since they are limited. Conversely, if the *Work* is provided by artificial, non-limited sources, then it can be considerable and cause significant *price* reductions, thus increasing the *purchasing power* of consumers and favouring the *wealth* of the individuals making up the economic system under consideration. It is for this reason, therefore, that, since only limited natural sources are used, *purchasing power* and, incidentally, the standard of living remained constant from the Neolithic period until the 18th century. From then on, it was the excessive use of artificial sources with no power limits that allowed their amplification. Moreover, it has been shown that, if the distribution of *wealth* is a matter for the Human Sciences, its genesis can only be relative to the Natural Sciences and more particularly to physics. Therefore, any study whose aim is solely the creation of *Money* must be free of any reference to the Human Being. Its presence in reasoning, whether real or implied, formal or implicit, must be absolutely excluded, prohibited, proscribed, otherwise the study must be rejected without delay and unconditionally in the field of applications; its explanatory and predictive validity reduced to nothing. As a consequence, and contrary to all classical economic doctrines, all research deriving from the above premises must be absolutely free and exempt from any criteria and arguments of an anthropic nature. It is possible to conclude by stating that :

- ***it was the discovery of the laws governing energy transformations and then their control that allowed for the almost exponential proliferation of artificial sources of work, leading to a fall in the price of Products and, as a result, to the enrichment of the Society.***

This is all about Economics and in no way about the effects, impacts, repercussions or other environmental impacts of the plethora of energy in the form of *Work* made available to us. This note has shown that :

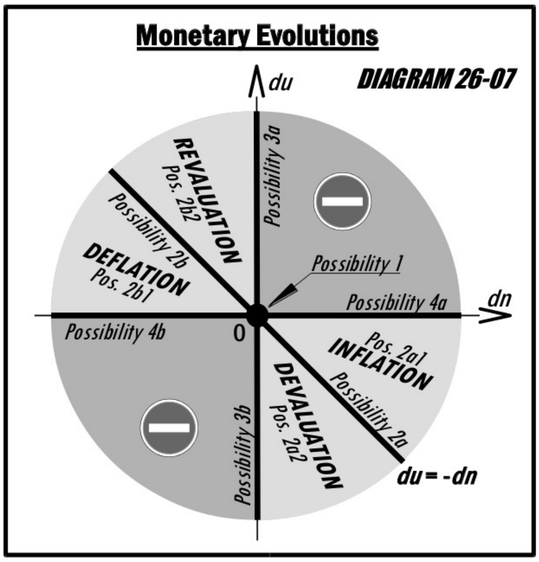
- only a positive variation ($du > 0$) in the value (u) of the monetary unit causes an increase in the quantity of *Money* (*wealth*, *purchasing power*) existing in the system under consideration,
- only an expenditure of energy due to the exercise of *Work with an economic purpose* allows this increase.

However, these few pages say absolutely nothing about the process of transformation of the *Work provided* into the *Money obtained*, nor about the phenomena likely to occur and the conditions of their existence.

- ***Therefore, this reflection exhorts us to look for the laws that orchestrate, no longer the energetic transformations of heat into work, but those that govern the economic transformations of Work into Money, considering them similar but not identical.***

SYNTHESIS

Diagram 26-07, on the right, (extract chapter 26) lists all the possible coherent and incoherent developments in the *Money* that have just been defined above. The dark shaded areas represent the variation dn in the number n of units and the variation of the unit u simultaneously either positive or negative, which is strictly impossible as this would call into question the validity of the Sacred Principle of Conservation.



00 – CORE ELEMENTS

ABSTRACT: This chapter is the foundation on which the essay is built. Because the previous chapter strongly encourages the application of the formalism of thermodynamics, it is necessary to present the principles and premises, without however justifying them analytically here, which are in conformity with and subject to it.

It therefore sets out those specific to economics, namely: the second principle of evolution, the first principle of principle, the principle of equivalence, the principle of least action, as well as certain premises relating to the creation of the creation of wealth.

Second principle – Principle of Evolution

In an absolutely general way, any economic agent, both in time and space (in accordance with the Principle of Homogeneity), saves :

1. ***his Work when it acts*** *(develops a Product, a good, a service, ...),*
2. ***his Money when it acquires*** *(buys a Product, a good, a service, ...),*
- ***BUT ALWAYS SUBJECT TO THE EXTERNAL CONSTRAINTS TO WHICH HE IS SUBJECT.***

Consequently, it's relevant to state that :

- ***the Economy of Work naturally always increases towards a maximum, limited by external constraints,***
- ***the Economy of Money naturally always increases towards a maximum, limited by external constraints.***

These statements are strictly of the same nature as that of the “Second Principle” of thermodynamics, namely :

- ***Entropy naturally always increases towards a maximum, limited by external constraints.***

First principle – Conservation Principle

In an absolutely general way :

- ***in a barter, there is no Money exchanged. The exchange takes place because the respective Utilities of the exchanged Products are equal,***
- ***during an change, there is no Work exchanged. The exchange takes place because the respective Utilities of the Cash are equal.***

Consequently, it's relevant to state that :

- ***there can be no Money without a difference in the Utility of the Products exchanged,***
- ***there can be no Economic Work without a difference in the Utility of the Cash exchanged.***

These statements are strictly of the same nature as that of the "First Principle" of thermodynamics, *i.e.* :

- ***there can be no mechanical work without a temperature differenc****e.*

<u>*Premises*</u>

Let us suppose that the manufacturing of any *Product* requires, initially, a duration of 8 hours and that, after an increase in productivity, this duration decreases to 6 hours. Let us suppose moreover that the cost per hour of work is 20 $, then *caeteris paribus* :

- according to the first hypothesis (8hrs. of *Work*) the cost *price* of the *Product* is 160 $,
- according to the second hypothesis (6hrs. of *Work*) the cost *price* is 120 $, *i.e.* 40 $ less.

But the laws of physics state that the higher the speed, the more energy is expended, in the form of *Work*, to increase that speed. The second hypothesis therefore requires more *Work* than the first (about 78% more). This thought experiment, valid for any *Product*, everywhere and always in accordance with the Principle of Homogeneity, shows without ambiguity that more *Work* was necessary for the elabouration of a *Product* less is the *cost price* (*caeteris paribus*). An analysis of the daily facts shows that all companies are always seeking to improve *productivity*, *i.e.* to accelerate the speed of production, in order to reduce the *price* of the goods produced. But in order to do so, it's essential to work more, and this by any means (individuals, slaves, animals, employees, mainly motors or machines for the last 2 centuries).

It has just been shown that the more *Work* there is in a *Product*, the cheaper it's. Therefore, in an exchange there can only be an imbalance, more and more accentuated according to productivity, because this means that :

- ***more Work done flows from the supplier to the consumer, less Money flows in the opposite direction.***

However, when the *price* of a *Product* decreases due to higher *Work*, the consumer keeps an additional quantity of *Money* equal to this decrease in *price*. The result is that :

- ***The more Work is included in a Product, the more Money the consumer has at his disposal.***

This thesis shows that there is now a possible balance (conservation principle) between the additional amount of *Work* performed by the supplier and the additional amount of *Money* held by the consumer. Consequently :

- ***the Money created that can be taken into account is that which the consumer holds in addition after a price reduction and not that which circulates from the consumer to the supplier.***

The consumer can therefore use this *Money* at a later date, in principle at his convenience. It is this *Money* that moves *a posteriori* from the consumer to the supplier at the time of the acquisition of any *Product*. Consequently and beforehand, the consumer must have this *Money* at his disposal, which only comes from a *price* reduction prior to its use during a purchase. It follows from all this that :

- **a *WORK VARIATION* is never used to manufacture a *Product* but exclusively to *VARY* its *price.***

- **This *Work* is always a *mechanical work* (*W*) but its purpose, its goal, its objective, is no longer physical but *economic* (*T*).**

In fact, if two copies of the same *Product* are produced at different times, their *cost price* is different, but they are nevertheless totally indistinguishable.

It has just been exposed that :

- **the *Additional Work* performed by the supplier is *TRANSFORMED* into *Additional Money* held by the consumer.**

So we are indeed in the presence of a transformation and no longer a flow. This totally changes the conception of economic exchanges and therefore urges us to consider them as belonging to a model similar to that of thermodynamics. This is therefore strictly in accordance with the first principle stipulating that:

- ***nothing is created, nothing is lost, everything is transformed.***

But in addition, it should be noted that :

- ***it's the supplier who enriches the consumer.***

It is therefore reasonable to consider this "*economic transformation*" as similar, but not identical, to an "*energy transformation*" where heat is transformed into mechanical work.

The *offer of a Product* can be defined as the number of times the manufacturing cycle is performed per unit of time. For example, it's possible to say that :

- ***The offer is 444 pairs of Charentaises manufactured per day.***

This definition is strictly analogous to the definition of the rotational speed of a motor. In fact, the rotation speed is the number of times the mechanical work cycle is performed per unit of time. The economic cycle can be sequenced as follows, with the steps of the thermodynamic cycle in accordance:

1. Raw material purchase	⇒	Isophele transformation	⇔	Isothermal transformation
2. Manufacturing	⇒	Adiabatic transformation	⇔	Adiabatic transformation
3. Sales contract for the Processed *Product*	⇒	Isophele transformation	⇔	Isothermal transformation
4. Use	⇒	Adiabatic transformation	⇔	Adiabatic transformation

It is remarkable to note that for both cycles (economic and thermodynamic) :

- **Steps 1 and 3 are performed *WITH CONTACT* between the agents (consumer and supplier) and the heat sources (hot and cold) but *WITHOUT MODIFICATION* either of the *Product* or of the *temperature*,**

- **Steps 2 and 4 are performed *WITHOUT CONTACT* between the agents (consumer and supplier) and the heat sources (hot and cold) but *WITH CHANGES* to the *Product* and the *temperature.***

Obviously, this leads us to look for explanations of economic phenomena at the level of the production cycle and not in the “law of supply and demand”, as is customary. In fact, at constant income, each time the cycle is run with greater speed, *i.e.* the *Product* is manufactured more quickly, the *price* of a *Product* can be lowered, thus enriching the consumer. This is how, at least in “occidental” countries, we have passed :

- ***from a society of subsistence, if not scarcity,***
- ***to a society of abundance, if not waste.***

Conclusion

At this stage, when only a few ideas are presented, it's out of the question to go into them in depth in a few lines, it must therefore be admitted, *a priori*, that :

- the *Work* is considered here as *economic Work* (with an economic purpose) and no longer physical work, likely to cause a fall in the *price* of the *Product.* This *Work* doesn’t have the same analytical definition as physical Work, despite its similarity,

- *Economic Work* and *Money* are logically considered two different forms of *Economic Energy*, just as heat and mechanical work are considered two different forms of physical energy,

- only the *Work to be done* must be taken into account and not the *Work performed*. In fact, the economically interesting Work is indeed the first one because it's the one that will define the *job*, the second one being of no further use because the machines will be stopped and the employees unemployed.

In addition, it's necessary to consider :

- ***the Product as the vector-support of the economic Work,***
- ***the Cash as the vector-support of the Money,***

identical to thermodynamics where :

- ***gas (steam) is the vector-support of the heat.***

It is possible to show analytically that among the different possibilities (four) of monetary evolution, the only ones that allow the real creation of *Money*, that is, the only ones that allow the increase of *Wealth* (*purchasing power*) necessarily require the expenditure of *Work* (for economic purposes). The fact that the execution of *economic Work* has as a corollary the creation of *Money* urges us to consider this phenomenon as a transformation.

Mathematical analysis, having never been taken for granted as to the explanation of Nature's phenomena, therefore points the way forward. Consequently, the formal and normally hardly questionable similarities presented above therefore incite to :

- ***the exclusive application of formalism, reasoning and thermomechanics to economic exchanges, but prohibiting the use of the characteristics, variables and functions of physics.***

In particular, entropy doesn't have to be used in this context. Indeed, in economics, there is neither heat nor temperature, which automatically prohibits the use of entropy.

Therefore, by posing :

M = *Money*
T = *Economic work to be performed (no longer mechanical work W - with always $T < W$)*
g = *transformation coefficient*

it's always possible to write :

$$M = g \cdot T$$

which can be considered as the "Equivalence Principle" and which can be compared to that of thermodynamics, *i.e.* :

$$W = J \cdot Q$$

However, it's logical to think that the transformation coefficient g should be a constant, which isn't necessarily the case in Economics, but this is beyond the scope of this summary and abbreviated presentation.

Furthermore, we know that a consumer always exerts a *Force F (pressure)* on the supplier to cause a decrease in the *price dp.* So the *Money* can be defined as follows:

$$dM = - F \cdot dp$$

This relationship is to be compared to that of thermodynamics, *i.e.* :

$$dW = - P \cdot dV$$

In considering the *Work to be done* (and not the *Work done*), it comes under the sense that it decreases as it's executed, while the *Money realized* increases accordingly (provided that g is constant), in the same way as in physics, the quantity of heat decreases while the mechanical work increases accordingly during the transformation. Therefore (in an *isolated system*), it's allowed to pose that :

$$\underbrace{dT}_{cause} + \underbrace{dM}_{effect} = 0$$

which can be considered as the first principle (energy conservation) and which can be compared to that of thermodynamics, *i.e.* :

$$\underbrace{dQ}_{cause} + \underbrace{dW}_{effect} = 0$$

- ***Once these Principles and Premises are presented analytically, their mathematical development leads, through the application of the formalism of thermomechanics, to the definition in Economic Science of cycles equivalent to those of Carnot and Clapeyron, as well as the Raveau diagram in Physical Science.***

- ***Indeed, we know that this formalism is capable of expressing the sufficiently regular evolution of certain suitably defined variables. Consequently, this approach allows us to grasp and understand how wealth can be created (destroyed) and how it's thus possible to increase (decrease) the standard of living.***

- ***In addition, this study builds a bridge between the economic and physical domains.***

The difference between the classical approach and this new point of view resides in the perception of the *Money* considered in the reasoning and calculations. Indeed :

1. ***In all conventional doctrines, the Money is systematically defined as that which the consumer gives to the supplier in exchange for a Product,***

2. ***In this new proposal, the Money created is defined as that which the consumer holds in addition after a price reduction and which he can use later, in principle, as he wishes.***

The validity of this second hypothesis cannot be questioned *a priori.* The reference to different definitions of *Money* between these two approaches prohibits their assimilation, which constitutes, therefore, a new starting point for the apprehension of economic exchanges because it's :

- ***Absolutely and totally unrelated to any balance of conventional theories of microeconomics.***

In addition :

- whereas all classical doctrines are oriented towards the study of flows, thus addressing a single characteristic (either of money or of goods and services), this new approach always takes into account two characteristics (Money and Work) which can be transformed into each other,

- if the repartition or distribution of monetary wealth is undeniably part of the "Human Sciences", its intrinsic creation necessarily belongs to the "Sciences of Nature".

It should also be noted that the Human Being behaves in total conformity with the extreme principle of least action, since he must be considered only as one element among others in the Universe and without any particular property. He can therefore only submit to Natural Laws, and, of course, without any possibility of emancipation from them.

DEVELOPEMENT

01 – PROLEGOMENA

ABSTRACT : These prolegomena are only a very simplified and succinct approach to certain basic notions which are much better explained, described and clarified in the corpus of the Development. However, they allow for a subsequent understanding of the intellectual path followed.

Since the procedure followed here is no longer strictly related to the usual approach, new characteristics (variables and functions), etc., are indispensable. However, it is obvious that their properties should not be contradictory to the thermomechanics formalism but, on the contrary, fully adhere to it.

This chapter therefore explains how these characteristics fit into the thermomechanics formalism and in particular their definition and evolutions. For example :

- *since heat does not exist in economics, it is mandatory to replace this notion by another one related to that discipline. The same applies to temperature, entropy and others. However, their properties must be similar or equivalent;*
- *It is shown in this chapter that the reference to the law of supply and demand has no justification in the context of this study. Consequently, a new law, similar to the Boyle-Mariotte law, must be exhibited. In Indeed, any theory is normally based on some principles and at least one experimental law;*
- *etc.*

<u>*Preliminary thoughts*</u>

For all the disciplines that it's possible to envisage, theory is always distinguished from its applications.. Of course, all the theories belong to the “Natural Sciences” because they exist outside the Human Being, whereas the applications are systematically dependent on a human decision and are therefore related to the “Human Sciences”. No argument allows the Economy to derogate from this absolutely general rule.

However, all current economic doctrines only relate to the distribution of *wealth* or resources, but never indicate how these could be generated. That the distribution of *wealth* isn't a matter for the exact sciences, but exclusively for the humanities, is an obvious fact to which one must subscribe entirely, for the distribution of all things is always due only to the decision and will of one (or more) individual. This automatically excludes the existence of Natural Laws that can orchestrate any distribution of *wealth*. Each time that Human acts having defined a choice, his action is *ipso facto* linked to applications. However, this action must always be compatible with the theory and can never contravene it. All Natural Laws being free and exempt of any anthropogenic character requires that the march of the Universe and therefore the Economy be totally independent of the

individual: Nature considering Human only as an element composing it without any particular attribute.
But it's equally obvious that before any distribution can take place, it's imperative to hold what is to be distributed. The cutting of an apple tart is only relative to the choice of the housewife, but the preparation of the pastry is totally different: the recipe being independent of the cook. For the same cake, the size of the slices can vary considerably because it's only due to human resolution, whereas the recipe is dissociated from it because it's immutable whatever the operator: indeed, it comes from physics and more particularly from chemistry.

In Economics, all explanations relating to the sharing and distribution of *wealth* thus require the invention, conception and imagination of original resources conventionally referred to as "initial endowments", but whose genesis is never indicated, mentioned and even less revealed, demonstrated. It can therefore be argued that :

- ***the creation of wealth is always a matter for the "Natural Sciences",***
- ***the distribution of this wealth is still a matter for the "Human Sciences".***

Therefore, the distribution of *wealth* is relative to accounting but its genesis is related to physics. This antinomy thus exhibits the total separation of their respective explanatory methods: the reasoning followed and the formalisms used are fundamentally incompatible. This study is only interested in the first point above and therefore has no link with the usual considerations and in particular with the "Theory of General Equilibrium (TEG)". Consequently, any attempt to bring this essay closer to conventional theses must be prohibited: any attempt to integrate them is doomed to failure.

In conclusion, this essay only seeks to explain the phenomena that have led to the formation of *wealth*, or how a society can evolve from a state of subsistence to a state of abundance. Therefore, by way of a proposal, it's possible to postulate that :

- ***economic and energy exchanges are governed by the same formalism: but that their respective characteristics (variables and functions) are specific.***

Since in Economics, there is no heat and no temperature, any reference to entropy is therefore excluded and expelled from the study.

Four centuries and more ago, some pioneers (Copernicus, Bruno, Galileo, Kepler, ...) had the audacity and often the temerity to emancipate themselves, at the risk of their lives, from the dogmas and doctrines that rested on foundations that considered the Human Being as the one and only reference. At that time, the scholastics impregnated and imbued with their prerogatives and privileges, and thus perplexed by the certainty of knowing, could not subscribe to the fact that Nature considered them only as one element among others composing it. It was unbearable for them to consent to the questioning of their supremacy and precellence over all the other elements. To place Human at the center (at the edge) or above (below) all things is a chimera. To consider him different from the other constituents of Nature is a lure, a trap leading inexorably to deception and error. It is thus the simplest means and the shortest way to stray from reason and become blinded by ideological blunders while enjoying the illusion of knowledge. We now know that all Natural Laws apply, without any distinction, to Human as well as to any other element of the Universe. The beginning of the knowledge of these laws was only possible by systematically eliminating the presence of the Human Being in the reasoning. He must be considered as any part of Nature, neither more nor less, that is to say, without any particular characteristic, property, faculty, attribute, *etc.* Humany people boast of possessing a critical mind in spite of the systematic absence of criticism of their own, causing their thoughts to indulge in "common sense" but stops and even forbids any reflection towards "reason". Either :

- ***common sense to be banished, reason to be sought.***

Almost all economists are absolutely convinced that there can be no natural laws to govern and orchestrate their discipline, yet they are totally unable to prove it, to demonstrate it. Others look at the possible links that might exist between statistical thermodynamics or concepts of self-organisation and macroeconomics. This study only seeks to understand how individuals in "occidental" countries became "rich". It relies exclusively on the formalism of classical thermomechanics and therefore only at the microeconomic level. Some will consider this to be outdated by new approaches. However, in technology and in the 21st century, engineers who design any engine or boiler-turbine assembly still rely only on the relationships of classical thermomechanics and don't resort to formalisms relating to statistical mechanics or dissipative systems. They use the same methods as the designers of a steam locomotive in the 19th century.

It has just been stated above that the reality of laws can only be admitted if the presence of Human is banished from any interpretation of physical phenomena and the Economy cannot be an exception. Indeed, all doctrines, thesis, economic explanatory systems, *etc.*, always include a human will and/or decision: this presence being real or supposed, formal or implied. As no current economic doctrine is autonomous and free from human presence, it follows that they can only emerge from the applications of a possible theory and not from it *stricto sensu*, because a theory is always free, devoid of arguments and anthropic criteria. All known physical laws make absolutely no difference between the Human Being and the other constituent elements of Nature. The latter affects all its components in an identical way and doesn't discriminate any of them and in particular the Human Being.

- ***Since human beings don't have to be singularised in relation to the other elements of Nature, the Human Sciences are absolutely proscribed and therefore excluded from this essay.***

Of course, individuals in their daily lives make very different choices. The study of these options is therefore a matter for philosophy, sociology, anthropology, politics, *etc.* But this paper is totally indifferent to the choices made. It doesn't matter whether an individual decides to acquire a dishwasher, a subscription to the opera or any other good or service. What matters is to know by what means he is able to realise, to materialise, the choice, *i.e.* how can he buy this appliance, this service, or anything else? In Europe, in the first quarter of the 20th century very few people were able to acquire an automobile, whereas now, a century later, almost everyone is able to own one. In order to have this possibility, how is it that people's resources have been increased during this time? Consequently, philosophy, sociology, anthropology, ethics, *etc.*, must be banished from economic theory: the use of these disciplines can only be appropriate for the applications of the latter. Any explanation and apprehension of economic phenomena can only emanate from physics alone, supported by mathematical analysis, in accordance with the historical observation of the exact sciences of the last centuries.

Everyone is aware that it was the consumption of cheap energy that enabled the spectacular increase in the standard of living, particularly in “occidental” countries, during the 19th and 20th centuries. However, this is only an observation and by no means a demonstration: no physical relationship, neither qualitative nor quantitative, is proposed as to the dependence of *wealth* on the amount of energy used. This essay follows and scrupulously respects the formalism of thermomechanics, knowing that it has already demonstrated, in several fields of scientific knowledge, its interpretative, explanatory and predictive qualities. Indeed, until now, it has never been questioned for reasonable speeds and masses of the human order, *i.e.* mesoscopic. So, since this note has as its foundations principles and concepts of the same type, of the same essence, they can only be very difficult to challenge, question and even possibly discuss. Moreover, knowing that mathematical analysis generally allows the apprehension of natural phenomena, using the same procedures, it can only return results, in principle, normally irrefutable and above all in conformity with the facts.

Humany seek a physical explanation for the Economy by postulating analogies with thermodynamics. These studies always refer to a macroscopic level, *i.e.* to phenomena occurring at the level of an economic system of the order of a country. In contrast, this essay is strictly confined to understanding the facts and events occurring during the development, exchange and use of a single good or service, and not all of them in the system under consideration. Indeed, thermomechanical studies are limited to a single engine or machine and not to all of them operating in a geographical area (city, region, country, ...). For example, an engineer is indifferent to the total installed power in Kazakhstan of all types of engines (thermal, electric, hydraulic, wind, ...). His interest and efforts are only focused on the best possible adaptation of the engine he designs to the desired goal. It is therefore the same for this note which only deals with microeconomic phenomena and which is exempt from any explanatory idea of a macroeconomic and holistic nature.

All microeconomic doctrines always refer only to the distribution or redistribution of *wealth* but don’t take into account its origin. In order to do this, “initial endowments” are systematically imagined, designed and integrated into the explanatory corpus, because it's indeed imperative to create the cake before sharing it. It seems obvious that research efforts should, prior to its distribution, focus on the recipe for its creation, and therefore on the genesis of the *wealth*.

However, nobody can deny the fact that the lower the *price*s, the higher the *purchasing power*, *caeteris paribus*, *i.e.* at constant income. This is in fact what we see in everyday life, where all companies try to obtain a minimum cost *price* (according to the external constraints to which they are subject) in order to lower the selling *price* while keeping the same profit. In particular, almost all everyday goods and services see their *price* decrease over time (always at constant income): the cost of electronic equipment being a blatant example. So, this makes it possible to replace the traditional perception of money, namely :

- ***money is that which circulates from the consumer to the supplier in exchange for a good or service,***

by the following :

- ***the money created is that which the consumer holds in addition as a result of a price reduction.***

Thus it's this extra money that can be used later, at the convenience of the consumer who has become *wealth*y, to purchase a good or service.

Of course, some potential readers will take exception to the assertions in this paragraph. So, at this stage, their references and arguments can only be *a priori*, preconceived ideas, prejudices, biases, *etc.*, which are not always clear. Like anything else, it's only knowledge of the field being explored that allows one to assess its relevance, but only through rational arguments, and thus to give it a positive or negative appraisal, approval or contestation. Therefore, as in the case of the exact sciences :

- ***the concordance of the results with the facts must be the only final criterion of validity, all other considerations must be prohibited, excluded, eliminated and disregarded.***

Thus, since any theory must be free and exempt from anthropic characters, economic doctrines referring to the Human Being in any way whatsoever must be returned to the field of applications. Therefore, they can in no way be perceived as explanatory and predictive of economic phenomena. Some considerations and arguments, of a general nature, encourage us to postulate that economic exchanges, but not finance, belong to physical phenomena and therefore to the so-called “exact” sciences. In fact :

- The Human Being is a component like any other of the Universe, he can only be subject, subservient, enslaved, to the Laws that govern himself, and can in no way emancipate himself from them. Moreover, we know that the Universe is determined and guided by supreme principles, such as that of “least action”. However, every individual, in all time and space, in accordance with the General Principle of Homogeneity, always saves :
  - his work when he acts,
  - its money when it acquires.

It therefore spends the minimum amount of work and the minimum amount of money, but always subject to the external constraints to which it's subject, in a manner that is fully and strictly in accordance with the above-mentioned principle of least action.

- All current economic doctrines are based on the study of flows, either of cash (money) or of goods or services (work). They take into account only one entity. As a result, they are always governed by accounting-type procedures (addition or subtraction, multiplication or division, even when derived from statistical models such as econometrics). However, accounting can only record and describe, but can never explain anything.

- It is obvious that all tools, goods, services, utensils, engines, machines, *etc.*, in the most general sense, whatever they are and of any kind, imagined and then designed by Human, can only be elabourated and then fulfil their function by marrying the Laws of Nature. Now, money, which undoubtedly comes from the fertile imagination of the human brain, cannot be an exception. The functioning of this tool, favouring exchanges, can only be subject to it. For more than two millennia we have known that "*ex nihilo nihil*" and that money, like anything else, must normally conform to this sentence, although some individuals are convinced of the contrary.

- Since until now "*nothing comes from nothingness and nothing goes there*", from which the principle of conservation emanates, namely "*nothing is created, nothing is lost, everything is transformed*", then money is the result of a transformation that the note presents, if not exhibits. This principle of conservation, which has never been taken for granted, is considered the "*touchstone*" of all natural phenomena. Indeed, if during a change, modification, evolution, *etc.*, a certain characteristic of the cause is different from that of the consequence, then there are serious doubts as to the validity of the explanation. Thus, in this paper, it's possible to have unscrupulous confidence in the application of this principle.

- In order to facilitate calculations, accounting in this case, the law of supply and demand only refers to quantities of goods or services offered and requested at a given moment, which is a major logical error. Reason dictates that time must be taken into account, *i.e.* supply and demand must be considered as speeds and more precisely as flows. Supply and demand must be defined as quantities offered or demanded per unit of time. Saying that the supply is 200,000 vehicles means absolutely nothing, because it's then possible to argue that the supply is 1,000 or any other number as long as the duration of the supply isn't specified. It is absolutely indispensable, obligatory, imperative to state that the offer is 200,000 cars per month, 1,000 per working day, 2,400,000 per year. Presented in this way, supply and demand are defined in exactly the same way as the speed of rotation in mechanics. It is thus possible to pose, respectively for physics and for economy, that :

- the speed of rotation is a direct function of the speed with which each production cycle of mechanical work is performed,

- the offer is a direct function of the speed with which each production cycle of the good or service in question is performed,

- the demand is a direct function of the speed with which each cycle of use of the good or service in question is performed.

Knowing that :

- it's at the level of the mechanical work production cycle that the amount of mechanical energy that can be made available to the user comes into play,

then:

- it's at the level of the production cycle of goods and services that the amount of money that can be made available to the consumer is decided.

Indeed, the faster the product (good or service) is manufactured, the lower its *price* (cost *price*) will be, *caeteris paribus*. As a result, the consumer will have at his disposal an additional quantity of money equal to the reduction in *price* and will thus have become richer. Conversely, if the cycle is slowed down, the *price* of the product will rise and the consumer will become poorer. It is reiterated here that, just like physics, all this must happen "*all things being equal*". This is quite obvious because, despite the fall in the cost *price* of the product, if the manufacturer decides to increase its profit, the consumer will be harmed. However, as already specified, this is a matter for applications and not for understanding trade, since this increase in profit's the result of an individual's decision and will, which must be absolutely rejected for any explanation. This shows that :

- subsequently, it's this quantity of money held in addition by the consumer that enables him to acquire the product (good or service) he covets,

- previously, a *price* reduction has necessarily, obligatory, imperatively, taken place.

This is how, little by little, with each decrease (increase) in *price*s, the *wealth* of any economic system can be increased (decreased), and this is how "occidental" countries have evolved:

- **of a state of subsistence, if not scarcity,**
- **to a state of abundance, if not waste**.

However, anyone would agree that in order to lower the *price*, and thus increase the speed of production, it's essential to "spend" more energy in the form of work. The more work, the lower the *price* and the more money available to the consumer, and *vice versa*. Of course, it's reiterated that this only applies *caeteris paribus*. It is therefore possible to express that :

- ***THE EXTRA WORK DONE BY THE SUPPLIERS IS TRANSFORMED INTO EXTRA MONEY OWNED BY THE CONSUMER.***

- During discussions it's often argued that "*air is very useful and yet costs nothing*". This sentence underpins the fact that the Economy submits like everything else to the rules that govern the functioning of the Universe. Indeed, any evolution can only be generated by a difference. In this case, however, the utility of air is considered to be constant, so there is no difference, which results in a zero cost. On the other hand, each time the air has to be moved, treated, filtered, *etc.*, then a difference in utility is created between before and after transformation, evolution, thus necessarily implying a cost.

This list is of course by no means exhaustive. Other reflections and observations could be reported.

This shows and confirms that money, like everything else, cannot be created *ex nihilo*. Since the industrial revolution, *i.e.* since mechanical energy in the form of work has been available in abundance, this has been the procedure historically practised.

Believing and maintaining that the Human Being, in his actions, stands out by escaping from the universal servitudes that bind him to Nature, can only lead to the ruin of reason. In spite of his total free will, Human is systematically constrained, without escape, by natural laws which are inviolable, intangible, immarcescible. To reject this expresses an unmistakable anthropocentrism, which is always perfectly prohibitive for the advancement of knowledge and the certainty of getting lost in ill-founded and sterile digressions.

An individual is absolutely free to make his choices, but obviously subject to his ability to express them, *i.e.* subject to the constraints that apply to him. This note isn't concerned with choices in the strict sense, but only with the possibility of exercising them. The options of the poet (Bernard Dimey) to "*see Syracuse*" or to "*see the land of the morning calm*" are relative only to a human decision, which is a matter for sociology and therefore totally foreign to the spirit of this study, whose object is only to examine the capacity to realise these alternatives. Wishing to own a computer, savour a succulent feast, acquire an ironing board, get curlers, treat oneself to a fly swatter, do "la java de Broadway" or anything else is part of an individual's free will, but this doesn't indicate how he or she can satisfy his or her choice. Yet, from a strictly economic point of view, it's the phenomena allowing this possibility, this potential, this faculty that it's necessary and profitable first to define and then to master. Now, the procedure, the method, the process, authorising the realisation of the choice, whatever it's and for any individual in all time and space, are always identical and therefore capped, encompassed, directed, by the "*General Principle of Homogeneity*". Thus, it's permissible to consent to this possibility of choice being governed by general natural laws.

This study is therefore limited to a search for these laws and presents a proposal for them. However, it refrains completely from discussing the consequences (economic, climatic, social, environmental, ...) that could possibly occur and which are the subject of other research. However, a few rules must always be respected or applied for any proposal for a new explanatory model, such as: systematically excluding any reference to any authority, referring only to the facts and agreeing to submit to them, applying Ockham's razor, rejecting the emission of *ad hoc* hypotheses, leaning on the efficient causes and rejecting the final causes, *etc.*

In all that follows, it's out of the question to envisage complex economic systems. Only elementary systems consisting of a single exchange are considered. However, the system under consideration can be defined as large as one wants. For example, in mechanics, a TGV engine or the engine of its scale model both operate according to the same physical laws and are absolutely not comparable in terms of power. It is the same in this study. The considerations of the parties involved (supplier and consumer) are identical both when negotiating the purchase of a TGV train and its scale model. Indeed, the supplier wishes to sell his good or service at the highest possible *price* and, *a contrario*, the consumer wishes to obtain it as cheaply as possible.

Conventional microeconomics looks at how it would be possible to determine the balance between two (or more) individuals between two (or more) quantities of goods that provide them with the greatest mutual satisfaction. For example, how do two people, one with apples and the other with pears, trade in such a way as to maximise their enjoyment? But it's quite certain that at the end of these exchanges there is always the same respective number of these fruits. Since then, a great deal of research has been performed in order to define a possible general equilibrium, *i.e.* whether there is a *price* for a product (good or service) that balances its supply and demand. However, the Economy isn't static, as the search for a balance advocates, it's very dynamic because it varies continuously. It is dynamic because it's constantly changing:

- ***Balance is the absence of force, it's rest, it's death!***
- ***Dynamics is the existence of force, it's evolution, it's life!***

This note is only a paper of the application of thermomechanical reasoning to economic exchanges. However, it's remarkable that this application never goes against what happens in everyday life. A striking example of this is provided by the rigorous analogy existing between the thermodynamic transformations occurring during the relaxation experiment in a vacuum and economic monopolies, which will be seen later in the chapter "Monopolies". In the type of relaxation cited above, the experimenter has created certain conditions of study so as to free himself from external constraints and that it's exactly the same for monopolies which are only particular situations enacted by human regulations so as to escape the constraints of the market (*i.e.* external) and which only end up going against natural evolution.

In all that follows, it will be considered that the application of analytical reasoning can be applied to economic phenomena on the condition that the variations in the characteristics of the economic system are small enough and close enough in time to be judged as continuous. For example, the evolution of the *Utility* of a *Product* can be considered as continuous in time for a consequent number of agents (some having a high *Utility* of a *Product* and others less). Similarly, the evolution of the *price of a Product* may be considered continuous because it doesn't generally change abruptly over a long enough period of time. Obviously this isn't always the case in reality, as shown by the example of sales where *price*s fall by 10 to 50% (or more) in one go. It is quite obvious that in this case, the evolution of *prices* is difficult to assimilate to a continuous and regular variation. However, at the end of the sales, *prices* return substantially to their previous level and this period can be assimilated as a temporary transitional anomaly which doesn't call into question the pseudo continuity of the evolution over time.

Economists often state the contradiction between their discipline and physics by explaining that in Economics "everything acts on everything", unlike the exact sciences where only discrete phenomena are studied. However, whatever the discipline, it's asserted that "everything is linked". Indeed, in physics, turning the ignition key of one's vehicle increases the general pollution of the entire atmosphere and thus contributes to the rise in the water level of the oceans and the melting of ice floes, glaciers, permafrost, *etc.* However, it's well known and accepted that in order to simplify the approach to physical phenomena, the "reductionist method" has made it possible to understand and, above all, control many of these phenomena.

Therefore, this whole trial has been conceived and elabourated according to reductionism, knowing that any parasitic effect of an event can be studied, by isolating it, as a phenomenon in its own right. For example, the relations apprehending the fall of bodies in physics disregard air resistance. However, the latter phenomenon is analysed and relatively well understood independently. Knowing, in physics, the various and numerous successes obtained by the application of the reductionist approach, it's authorized, justified and even legitimate to submit to it in Economics. Thus, to challenge or reject *a priori* this procedure isn't admissible.

- ***Throughout the study, the accounting approach is totally banned, only the physical approach is mentioned.***

All accounting techniques (general accounting, cost accounting, *etc.*) are therefore rejected from this note. Consequently, in an absolutely general way, everything that refers to these techniques (counting, enumeration, census, flows of goods or services, flows of cash or money, ...) is deleted from this note. The use of classifications relating to the balance sheet (profit and loss account, working capital, profits, overheads, investments, depreciation, direct or indirect charges, stocks, taxes, ...) as well as all designations and definitions relating thereto is prohibited. In physics, only variations in characteristics are taken into account; these variations may only take three and only three values, namely: positive, nil, negative (higher, equal, lower).

- ***Any interrogation, questioning or other, not referring to these developments are expelled from this essay.***

The term "*Work ("T")*", used below, is a characteristic of an economic nature and no longer mechanical (*W*), but is always considered as energy (economic energy). In this essay, *Work* is never considered as a quantity of things to be done, a task to be performed, a work to be elabourated, *etc.* It is always considered as an energy (economic energy). It is always considered as economic energy and no longer as mechanical energy. In fact, in order to carry out any activity, action, task, it's systematically necessary to spend a certain amount of energy in the form of mechanical work. However, in the economic field, this mechanical work in some cases takes on an economic property, *i.e.* it has an economic objective, purpose, an intention, end, as will be specified later. This mechanical work which is necessary and indispensable for the realisation of any modification or displacement of any *Product* doesn't always imply the creation of monetary *wealth*. When this work (*W*) generates *wealth* creation, its purpose becomes economic and thus acquires the appellation "*Work (T)*". It will be seen later what is meant by *wealth* creation. For example, no one can say that a parish priest generates by his professional occupations any *monetary wealth*, but creates spiritual *wealth*; his function being useful and salutary for Catholics.

By focusing exclusively on the costs inherent in the manufacture of any *Product* (good or service), it excludes the purchase cost of the materials to be produced (intrants, *inputs*, ...). In the formation of a *cost price* there are a large number of expenses that can be classified into two groups, namely :

- costs that are directly related to the manufacture of the *Product* (good or service) such as, for example, manpower costs. The *cost price* of a *Product* is obviously a direct function of the number of hours of *labour*. The greater the number of hours, the higher the *price*, and inversely, the lower the number of hours, the lower the *price*. Consequently, the greater the amount of *Work*, *i.e.* the more energy has been consumed, the lower the *price*, all other things being equal,

- costs that don't depend on the manufacture of the *Product*, such as, for example, the cost of heating the offices. Assuming that the cost of heating is 120 \$/day and that 3 copies of the *Product* are manufactured during this period, then this *cost* in the *price* is 40 \$. If by an increase in productivity 4 copies of the *Product* are now produced, the heating costs are reduced to 30 \$ per copy. However, for this cost to decrease, productivity must be increased. The energy expended in the form of mechanical work (W) must increase; it then has an economic quality and becomes *Economic Work* (T). Therefore, as in the previous case, the more *Work*, the lower the *price*.

In conclusion, it emerges that in order to ensure an increase in *wealth*, *i.e.* for the consumer to have an extra amount of *Money* at his disposal, which he can then use as he wishes, it's essential for the supplier to make an additional expenditure of energy in the form of *Economic Purpose Work* ("*T*") in order to reduce the manufacturing time (*caeteris paribus*).

This study is merely an attempt to explain economic exchanges (excluding finance). However, we know that thermomechanics is capable of proposing a rational explanation of the dynamic evolution of physical phenomena. Consequently, and knowing that its formalism can express the notably homogeneous evolutions of sets of suitably defined variables, it's then authorized to apply it to economic exchanges but by prohibiting the use of the characteristics (variables and functions) of physics. Indeed, many attempts to apply thermodynamics to the Economy have been made while always keeping the concept of entropy in the reasoning. However, in Economy, temperature and heat obviously don't exist, which is why the use of entropy isn't acceptable and should be rejected. On the other hand, it's imperative to replace this characteristic by another one of similar form and substance but specifically related to economic exchanges and no longer thermal. This obliges us to replace the physical characteristics by other typically economic ones. In this note, experimenting with the application of the formalism of thermomechanics to economic exchanges implies reasoning as a physicist and rejecting any accounting approach.

We know that until the industrial revolution individuals (apart from the nobility and the high clergy) had little income. The third state, which formed the vast majority of the population, lived almost in autarky and was confronted with a continuous and regular search for the minimum subsistence level, which was essentially food. After the industrial revolution, the resources released by the rise in the standard of living were gradually transferred to clothing, housing, transport, health, culture, leisure, *etc.*, which were then used to provide a living for the entire population.

Purpose of the study

It is necessary to specify here that the aim of this study is only to understand how a society has been able to evolve in such a way as to increase the purchasing power of the individuals composing it. It says that this requires more work, which some readers may find antisocial or otherwise. But work can be done by anyone and by anything, namely: entrepreneurs (craftsmen, merchant, farmers, ...), slaves, employees, animals, engines. However, it's certain that since the beginning of the 19th century it's the engines that provide the essential part of the work.

Moreover, any theory must be strictly neutral with regard to Human, i.e. neither good nor bad. Thus, this essay only shows the procedure for enrichment and is limited to that. However, the related economic phenomena inexorably induce environmental, social, etc. consequences, which can now be described as unfortunate if not harmful and even disastrous. The economic policies that will be or will have to be implemented to combat these effects don't need to be dealt with here, as they relate to applications and no longer to the understanding of the phenomena.

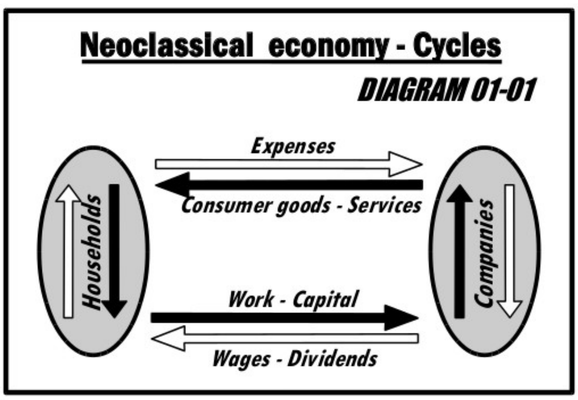
All conventional microeconomic doctrines are reduced to seeking a balance between the supply of a good or service (*Product*) and its demand by agents (consumers) who are seeking their maximum well-being, or at the very least their optimal well-being. Studies therefore focus on exchanges between suppliers and consumers, having first imagined and allocated certain resources to the latter.

However, it's always and systematically passed over in silence how these endowments arrived in the consumers' pockets: hoping that no one believes that they fell from the sky. Suppose an economist researching people in the United States and another researching people in Burkina Faso. It is likely that the initial endowments will be very different depending on the hypothesis studied: those of Americans being much higher than those of Burkinabe. So how is it possible? Saying that Americans are richer is only a statement of fact, but doesn't explain anything. But it's certainly important to know the origin of these endowments. How can they be generated? Generally speaking, it's to understand, as already presented, how "occidental" countries have passed :

- ***of a subsistence society, if not of scarcity,***
- ***to a society of abundance, if not waste.***

Diagram 01-01 below represents the economic exchanges between enterprises and households as understood by neoclassical economic theory. Usually, these exchanges are represented by two cycles moving in opposite directions, namely :

1. on the one hand, goods and services in exchange for money,
2. on the other hand, work and capital in return for wages and dividends.



This representation says absolutely nothing about the evolution of these exchanges, *i.e.* how the above-mentioned characteristics (expenditure, goods and services, labour and capital, wages and dividends) may possibly vary. From this pattern it's possible to assume that from both entities, households and enterprises, some constant quantities of these characteristics enter and exit.

In physics, these exchanges would be described as "permanently stationary", *i.e.* the quantity entering is equal to the quantity leaving. Consequently, according to the neoclassical approach, these cycles would have the property of being "eternal", which is absurd and undeniably contrary to the facts. In fact, all these characteristics must be considered as variables and not as constants, because it's indisputable that they can vary in time and place.

Therefore, the interest isn't the intrinsic knowledge of these cycles, but their change, their variation. The important thing is to understand the causal phenomena leading to any evolution as well as the consequences of the latter. Evidence suggests that households (at least in "rich" countries) currently have a much greater spending capacity than individuals had during the Middle Ages. The *purchasing power* of Europeans as well as the Japanese was lower in 1948 than it was a decade earlier. The crisis of 1929 changed the *wealth* of Americans dramatically and impacted the *wealth* of many Europeans and others. It would be easy to list a large number of examples of temporal variation in the *wealth* of the agents of any economic system. Moreover, an analysis of the facts undoubtedly shows that :

- households want to have the maximum wages and dividends to achieve maximum spending,
- companies want to own as much work and capital as possible to produce as many goods and services as possible.

Obviously, the maximum reached is a function of the external constraints that are independent of the will of the economic agents involved (households and enterprises) to which they are subject.

Thus, this note is limited exclusively to the search for the causes giving rise to an increase in the *purchasing power* of individuals and to the understanding of the phenomena linking them. If the latter can be treated analytically, then understanding them will allow both negative and positive developments to take place. The only truly important question is how to act to increase spending to acquire as many goods and services as possible. In order to achieve them (producing the goods and performing the services), it's essential that the maximum amount of *Economic Purpose Work* is perfomed. Once again, it's made clear that the study is limited only to this understanding and therefore has no nature, property, attribute, character with social, environmental, *etc.* connotations.

According to the diagram, it would be possible to review all the possibilities for the evolution of the different characteristics (expenditure, goods and services, *etc.*) that are likely to vary. However, since the aim is to increase expenditure, then two and only two hypotheses are possible, namely :

- or wages and dividends increase, but at constant *prices* for goods and services,
- or the *prices* of goods and services fall, but at constant wages and dividends.

These two hypotheses are absolutely equivalent and lead to the same result, the increase in the *wealth* (*purchasing power*) of individuals. Because of this equivalence only one cause exists. All other hypotheses diminish it or leave it constant. As a consequence :

- ***The increase in purchasing power is always induced by the fall in prices in relation to income.***

Before going on, it's necessary to make it clear that financial capital has absolutely no use whatsoever, because a mountain of paper-money will never be able to excavate a building, pour the foundations, erect the walls, put up the framework, *etc.* No matter what is done, banknotes or any other support of money (cheque, draft, *etc.*) are absolutely useless for the production of any good or service (*Product*). Even the physical capital (tools, engines, machines, ...) acquired by financial capital has no use. At the very least, it's only capable of providing the work necessary for production. Consequently, it's only the energy in the form of *Work* (and only *Work*) which enters the *system* which allows the manufacture of the *Product* which comes out. This *Work* (energy) is provided exclusively by Human (individual, slave, employee), by the animal or by motors and machines. However, it should be specified that even the factors of production (engines, machines, ...) don't produce any *wealth*, it's only the work provided by these factors that is useful. This is exactly the same as in mechanics where a variation in speed is totally independent of the mobile (human, animal, vehicle, boat, plane, ...). It is only the work done that allows this variation and not the motive.

The laws of physics teach us that in order to accelerate any speed, it's imperative to perform mechanical work, *i.e.* to expend energy. In our case, this work causes an increase in the speed of execution of the various operations involved in the manufacture of a good or the performance of a service. This increase in speed implies a reduction in the duration of these manufacturing operations. As a result, and all other things being equal, the *cost price* also decreases.

In conclusion, it's the provision of more work by enterprises that allows *prices* to fall and thus increases the *purchasing power* or spending capacity of households.

Everyone understands the absolute necessity to produce work, defined here as energy, before being able to use it. No one disputes the obligation to have energy, in whatever form (mechanical, thermal, electrical, chemical, *etc.*), before being able to make use of it. For example:

- a crane must have electrical energy which is converted into mechanical energy (work) to lift any weight,
- a grader must have chemical energy (fuel) that is converted to mechanical energy (work) to level a high-speed rail line platform,
- a mason must possess chemical energy (food) which is changed into mechanical energy (work) to position one rubble stone over another when building a wall,
- *etc.*

Natural laws tell us that in order to modify or move anything, it's absolutely necessary to have mechanical work that originally comes from a certain amount of heat, through transformation.

- ***It is therefore imperative to produce the work prior to its use.***

In Economics, it's strictly the same. In fact, before being able to use the *Money* for any purchase, it's obligatory to have produced and created it. It is undeniable that 1 unit of any *Money* (Dinar, Rupee, Yen, Peso, Shekel, ...) will have more or less value according to the *purchasing power* it has, that is to say according to the quantity of *Product* it allows to buy. In order for this unit to increase in value, in order for it to consent to the acquisition of a greater quantity of *Products*, it's imperative that the *price* of the *Products* decreases. The lower the *price* of goods or services, the greater the *wealth* of the economic *system.* When the *price* of a *Product* falls, the consumer of this *Product* keeps a quantity of *Money* equal to this *price* decrease.

If we look at any *economic system* and consider only the number (n) of monetary units circulating in it, then several cases of evolution of its *monetary wealth* can be detected depending on whether the *prices* of the *Products* are fixed or variable. Four hypotheses, and only four can occur, namely :

- ***the number (n) of monetary units is fixed***
  In this hypothesis two alternatives are possible:
  1. or the *prices* of *Products* are constant; the *wealth* of consumers doesn't vary,
  2. or the *prices* of *Products* rise or fall; if they rise, consumers become poorer by losing *purchasing power*, and conversely become richer if *prices* fall.

- ***the number (n) of monetary units is variable***
  In this hypothesis two other alternatives are also possible:
  3. either the *prices* of the *Products* are constant; if the number (n) of units decreases consumers become poorer since they have fewer units, and conversely become richer if the number (n) increases,
  4. or the *prices* of *Products* evolve either upwards or downwards; the *wealth* of consumers doesn't vary, because if the number (n) of units increases *prices* also increase, and conversely if the number (n) decreases *prices* also fall.

Of course and as already mentioned, you have to reason as a physicist and not as an accountant. In fact, some disgruntled minds will say that if the variations in *prices* and the number of units are different, non-proportional, other hypotheses will come true. But the analysis of the latter, *i.e.* their complete study, will show that it always comes down to those just outlined above.

From the four development possibilities described, it's clear that :

- the two hypotheses N°1 and N°4 are absolutely inoperative in instigating any variation (positive or negative) in *wealth*, which therefore remains constant,
- the two other hypotheses N°2 and N°3 are the only ones that allow the enrichment (impoverishment) of consumers, *i.e.* the increase (decrease) of their *purchasing power.* However, of these two combinations, point N°3 can be summarised as case N°2. In fact, to maintain that *prices* being constant the number (n) of units increases is equivalent to saying that *prices* fall with a constant number of units, and *vice versa*, which is in line with possibility N° 2.

As a result, after a reduction in *prices*, consumers may use this quantity of *Money* to purchase another *Product* or a new copy of the same *Product* at their discretion. In this way, and as in the case of work :

- ***It is therefore imperative to produce the Money prior to its use.***

As in mechanics, this is always in accordance with the “General Principle of Causality”. Like everything else the *Money* cannot be created *ex nihilo* as some suggest. Of course, it's possible to manufacture coins, banknotes, cheques, bills of exchange, as well as all forms of value support (cowries, salt bars, cloth, feathers, ...) in a relatively simple way, but increasing the value of these supports so that they provide an additional purchase, necessarily requires the execution, the expenditure of additional work. It is this work performed by the supplier that causes the *price* of the manufactured *Product* to decrease and allows the consumer to possess an additional quantity of *Money* created.

All current economic doctrines are based on the replacement of one *Product* by another and in particular the “Theory of General Equilibrium” (TEG). For example: how does a consumer exercise his choice between apples “or” pears, or between a refrigerator “or” a washing machine, *etc.*? This approach to the Economy necessarily implies a static vision of exchanges. However, it's certain that every individual seeks to improve his standard of living, *i.e.* to have a decent and comfortable home, furniture and basic household appliances (refrigerator, washing machine, vehicle, dishwasher, television, computer, *etc.*), with the rest (travel, holidays, cinema, reading, *etc.*) to be added to this. What you need to know is how can the individual obtain apples “and” pears, a refrigerator “and” a washing machine, *etc.*? Therefore, it's no longer the conjunction “or” but the conjunction “and” that must be considered. This approach therefore now refers to an evolutionary, and therefore kinetic, vision, and thus implies a dynamic rather than static approach to exchanges.

Moreover, all economic theories have the “law of supply and demand” as their basis. Knowing that any theory, in addition to a few axioms, must be based on at least one experimental law, this study no longer refers to the law of *supply* and *demand*, and is therefore outside the scope of conventional academic analysis. As it never refers to this doxical law, there can be no similarity between this approach and the usual ones.

- ***Theories on the law of supply and demand***
  For all the theories that look for any method to balance *supply* and *demand*, certain quantities (*Product*, *Money*) are always allocated to the agents, which are considered as original data. All these theories start from the “initial endowments” held by the agents involved, which they then exchange among themselves in order to maximise their welfare. However, it's never mentioned, in any way whatsoever, how these endowments were created, *i.e.* by what recipe do economic agents possess these means of exchange? Now, it seems obvious that it's the knowledge of the phenomena generating this creation that must form the starting point of the Economy; exchanges can only take place later.

- ***Game Theory***
  There is no question here of entering into the mysteries of the different hypotheses in which the players may find themselves, nor of knowing their respective strategies. It doesn't matter whether one player prefers one strategy to another, whether he uses this or that tactic, whether he wins or loses, and so on. The only important thing is how the players can have starting bets. Indeed, the win must come from somewhere, and the same applies to the loss, because the losing player obviously had to have it beforehand. It is therefore the origin, and more particularly the

creation, production, genesis, of the starting funds that constitute the objective to be reached. In all the cases, that is to say of the different games that may exist, the human mind, eager for classifications, has been ingenious in differentiating between zero-sum and non-zero-sum games.

- For zero-sum games, the famous proposition "*nothing is lost, nothing is created, …*" still makes sense, as the principle of conservation isn't called into question. In this type of game, what one player wins, the other loses and *vice versa*. But then, we are entitled to ask ourselves the question where does what was lost come from, that is to say, what did the losing player possess? Consequently, before the game began, agents had to have bets, resources, funds, *etc.*, in some form or another, at their disposal. Here again, what is important is to understand how these resources, these riches, could be created, because it's only after this stage that they can be used in the game. Of course, at the origin of the game the stakes can be zero. Thus, nobody wins and nobody loses; the game can then be described as fun, as a pastime to furnish long winter evenings, *etc.*

- For non-zero-sum games, *a contrario*, since the result isn't zero something is annihilated or hatches out of nothing, which goes against the principle of conservation, thus generating inconsistency. It is therefore imperative to abolish this contradiction. To do this, it's possible to express a simple example commonly found in the literature :

  Either 2 agents (A and B) each with 2 different strategies (1 and 2). There are therefore the following 4 game possibilities: (A1, B1), (A1, B2), (A2, B1) and (A2, B2). According to the respective strategies of the 2 agents, let's suppose that their winnings are those presented in the matrix below (the 1st number being agent A's winnings and the 2nd being agent B's winnings).

		Agent B	
		Strategy 1	**Strategy 2**
Agent A	**Strategy 1**	**(300, 150)**	**(250,150)**
	Strategy 2	**(200, 500)**	**(600, 000)**

The analysis of this matrix shows that the sum of the earnings of the 2 agents is variable according to the strategies adopted, these total earnings ranging from 700 (A2, B1) to 400 (A1, B2) via 600 (A2, B2) and 450 (A1, B1). However, the essential point, which is always overlooked, is to know where these gains come from, with the assurance that they don't fall from heaven or rise from hell. So by considering the origin of the earnings, it's easy to see that their absolute sum is constant. Indeed, an agent X (or a set X of agents), outside the matrix loses :

⇒ 450 for the strategy (A1, B1) which allows to win 300 + 150, *i.e.* 450
⇒ 400 for the strategy (A1, B2) which allows to win 250 + 150, *i.e.* 400
⇒ 700 for the strategy (A2, B1) which allows to win 200 + 500, *i.e.* 700
⇒ 600 for the strategy (A2, B2) which allows to win 600 + 000, *i.e.* 600

Taking into account the direction of the exchanges, this game is always a zero-sum game. It cannot be otherwise, otherwise it would invalidate the principle of conservation.

In conclusion, while classical research always focuses on the exchange of an original endowment already allocated, this study is only interested in the creation of this endowment prior to its subsequent distribution or redistribution. Consequently, it lies in another field of apprehension, which automatically excludes any desire for rapprochement with conventional doctrines, and consequently the systematic and absolute rejection of the "*law of supply and demand*". It is common to hear assertions such as :

- "the fruits of growth must be shared",
- "the *wealth* produced must be redistributed",
- *etc.*

The study is limited to the apprehension of the phenomena that allow this growth, that allow the creation of this *wealth.* It doesn't deal in any way with strategy, tactics, governance, economic policy, because all this is necessarily only due to human decision and will and therefore doesn't relate to a theory but only to its applications.

In mechanics, the relationships of kinetics apply to both acceleration and deceleration. For example, a motorist starts when accelerating but brakes when he wants to stop using the same laws of physics. These laws are absolutely independent of his will, but it's this will and his decision that allows him to exercise the choice of accelerating or slowing down. The theory is valid outside the existence of Human, but its application is indispensable to him. In this essay, it's exactly the same: relationships are free and devoid of any human mark. Consequently, any economic policy, which is always only an application, is systematically rejected because it relates to the presence of Human and therefore has no place in this study. Faced with the consequences, at the present time harmful, of the acceleration of manufacturing processes, which are beginning to become truly disastrous, it's imperative to modify the purpose of current economic processes, *i.e.* always to seek an increase in *productivity.*

This study has only one goal: that of understanding, in a total and strictly analytical way, how and by what means is it possible to produce this *Money*, to create this *wealth*? By generalising and as already stated, it's necessary to apprehend the phenomena that have allowed the "developed" countries to pass :

- ***from a society of subsistence, if not scarcity, to a society of abundance, if not waste.***

But because of its analytical nature, it allows us to conceive the transition:

- ***from a society of opulence, if not plethora, to a society of sufficiency, if not well-being.***

It can also be said that the purpose of this study can be summed up as follows:

- ***to define the engine that enables this evolution, but above all to understand how it works.***

Thus, all considerations (concepts, ideas, notions, reflections, arguments, doctrines, definitions, ...) which are not directly related to this mechanism, have absolutely no reason to be used here. Consequently, any reference (formal or implied) to any of these considerations doesn't have to be formulated and/or expressed.

Theory - applications

When we speak of Economy we always refer to phenomena that are the result of human intention. However, whatever the discipline studied, we know that a theory must be systematically and totally devoid of any character relating to Human. To consider any economic evolution whose cause is due to an explicit or implicit deliberate decision, formal or implied, can only emerge from the applications of an eventual theory but not from the theory *stricto sensu*, this obviously being a matter for sociology, anthropology, philosophy, *etc.* No one can dispute the fact that :

- ***all the theories are related to the "Natural Sciences",***
- ***all applications are related to "Human Sciences".***

The Economy cannot escape this requirement. For example, an engineer defining the profile of a reactor combustion chamber exercises his free will in his choices but is always limited by the constraints imposed by the theory and only admissible within the framework of its validity, this being absolutely general. Therefore, it's only by freeing oneself of all references to projects, requests, resolutions, wills, decisions, human, that a subsequent economic theory can be proposed. This essay is therefore limited to the facts and, consequently, doesn't advocate any economic policy at all, since it's free and exempt of any attribute relating to the Human Being. In the same way as in physics, where theory and its applications are never confused, the same is true here. The whole note should be looked at only in terms of its veracity, that is to say, its concordance with the facts and the coherence of the analytical model followed. A theory must derive from rational concepts, principles or axioms, the latter not being demonstrable but never questioned experimentally. However, the analytical canon used in this essay has already proved its relevance in thermomechanics and can therefore be applied normally without fear.

The only criticism that can be made of this approach therefore concerns the initial concepts (Principles, Experimental Law, *etc.*). If these concepts are considered to be in conformity with the General Basic Principles of Relativity, Causality, Homogeneity, Isotropy as well as that of Least Action (Parsimony), it's then possible to use them without exacerbated scruples. However, the conformity of the results with the facts must be the essential, if not the only, criterion validating the approach followed. An additional justification for the approach employed can be sought in invariances (conservation laws), *i.e.* concordance with Noether's theorem.

Any reading of this note with an anthropological, sociological, philosophical, ethical or other aim can only be prohibited, as it's then obligatorily relevant to the applications, which is beyond the interpretative and explanatory scope of this study. In the latter, reference is made to the "*economy of Work*" of the producer, manufacturer and supplier, *i.e.* these agents always seek to expend the minimum amount of energy, which seems contradictory, and therefore incompatible, with the above-mentioned statement that this study has no anthropic character.

- ***the presence of human beings must be denied for any theory and required for any application.***

If the first condition (absence of the Human Being) isn't acquired, the doctrine presented cannot be related to Natural Laws and consequently its validity cannot be recognised as an explanatory and predictive theory.

<u>*Semantic*</u>

More than two centuries ago, Condorcet was already showing that :

- *"in meditating on the nature of the moral sciences, one cannot help but see that, based as the physical sciences are on the observation of facts, they must follow the same method, acquire an equally exact and precise language, reach the same degree of certainty".*

In economics, as in physics, each characteristic must be named univocally and ideally monosemically. For example, each characteristic should be named in a monosemic way:

- The "dew point" is perfectly unambiguously defined in physics and only has this definition. There can be no confusion with anything else, so this term, this characteristic, is monosemic,

- the "second" (duration) is perfectly specified univocally in physics but also has a mathematical sense of angle measurement and a common sense of enumeration synonymous with "second", all this without any relation to the physical definition. There can therefore be confusion with something else, so this term, this characteristic, is polysemic.

Generally speaking, in science or technology, definitions are always sought that apply to a single object, entity, concept, *etc.*, as opposed to the usual language where generality is aimed at. This is therefore the case in this note, where characteristics are named in a unique way. It is obvious that in Economics the basic characteristics, such as *Money* and *Work* are never defined in an "exact and precise" way as Condorcet recommends. First of all, therefore, it's necessary to define these concepts. Of course, everyone is convinced that they have mastered their meaning. However, what follows shows that this is far from being self-evident.

- <u>***Work***</u>
  Discussion during a meeting with a high school economics teacher:

  - ***Me – Suppose you are a craftsman working 8 hours a day and I ask you to make a sofa like the one we are sitting on. Let's further suppose that you estimate the manufacturing time to be 5 days. You then admit that the work is something fixed, constant, corresponding to the sofa to be made.***

- ***Him – Absolutely.***
- ***Me – All right! Now, needing this furniture very quickly, I ask you to make it in 3, not 5 days. Is it the same work?***
- ***Him – But, not at all!***
- ***Me – However, you have just agreed that the sofa was the work to be done, so the work is the same regardless of how long it takes to make it. So, is the work something fixed or is it variable depending on the speed of production?***
  Does the work correspond to a quantity of things to be done, a task, a labour, or should it be characterised as energy?
- ***Him – ... ??? ... ...***

- ***<u>Money</u>***
  When we say :

1. that bankers create money, it means that they increase the number (n) of monetary units circulating in the economic system of which they are a component.
2. that each economic system has its own money, reference is made to the unit (u) of money. For example, the Yen for Japan, the Shekel for Israel, *etc.*
3. that an individual from the USA has 17$ of money in his or her pocket, it's considered the product ($n.u$) of the number of monetary units (n) by the unit (u).

However, these three sentences are *a priori* correct. But :

1. in the first case, the money is defined as a number (n),
2. in the second, the money is considered as a unit (u),
3. in the third, money is understood as a mathematical product ($n.u$).

Consequently, only one definition is accurate and the other two can only be simplifications instigating language abuse. In order to avoid confusion, mistakes, misunderstandings and errors, sentences should be presented as follows:

1. bankers create monetary units (not money in the strict sense).
2. each economic system has its own monetary unit (not money in the strict sense).
3. an individual from the USA has 17 $ in his pocket (money in the strict sense).

Indeed, in any field of knowledge, any size, any dimension, any measure is always characterised by the relation :

$$\text{Size, Dimension, Measure (M) = number of units (n)} \times value\ of\ unit\,(u)$$

which becomes for the measurement of money :

$$Money\,(M) = number\ of\ monetary\ units\,(n) \times value\ of\ monetary\ unit\,(u)$$

or, for the above-mentioned example :

$$M = n \times u$$
$$17\ \$ = 17 \times \$$$

This shows that it's imperative, or it will be confused, to specify all the characteristics univocally, and in this case the *Work* and the *Money.* The definitions of these characteristics will be defined in a precise and analytical manner later.

In Economics, reference is constantly made to the notion of "value". This term associated with just about anything and everything (value-labour, value-utility, value of money, value of the pension point, ...) should not be used in any discipline. Indeed, in physics, the noun "value" isn't used, only the name of the characteristic is mentioned. Expressions such as: value of intensity, value of temperature, value of concentration, value of weight, value of tension, *etc.* are not used. Only the names: intensity, temperature, concentration, weight, tension, *etc.* are specified. Consequently, the same applies here where the noun "value" isn't normally used.

Symbolism

It is necessary to present here the main symbols used in this study, namely :

p = price of a Product
l = work to be performed (thing to be done, work to be developed, task to be performed)
M = Money
T = work with economic purpose (no longer W = work with mechanical purpose - with always T < W)
U_P = Utility of the Product
P = Economy of Work
A = Economy of Money
F = Force (pressure) exerted by the consumer on the supplier to lower the price
S = supply of a Product
D = request for a Product
➚ = *upward variation (increase)* ⇒ $dx > 0$
➘ = *downward variation (decrease)* ⇒ $dx < 0$
➔ = *zero variation (constant)* ⇒ $dx = 0$

The symbols used in this paper may differ from those classically and conventionally used because it's entirely based on a physical formalism and different from the classical approach to economics. For ease of reading, these symbols will generally be used in the *corpus* of the study.

Introduction

About 2 million years ago, Homo *habilis* and, certainly even before him, his ancestor *Australopithecus* and his cousin *Paranthropus*, were able to modify a stone to use it as a tool. In doing so, it's absolutely undeniable that they increased the *Utility* of the object; the use of the cut stone (fitted pebble, *chopper*) made it easier to achieve their purpose. They have therefore transformed not only the stone but also their environment, very little it's true, but not in a null and void manner. Indeed, they modified the object well but also produced waste such as debris and residues of the original stone. The material can neither be created nor destroyed. Indeed, the weight of the cut stone and all the pieces, detritus, dust, *etc.*, is equal to the weight of the original stone. Over time, no one can and will not be able to dispute the fact that the process is and will always be rigorously identical.

Even today, the procedure still consists of provoking a difference in *Utility* by any modification in order to improve the adaptation of the object (*Product*) to the required function, but regardless of this transformation, waste will be inexorably produced, *i.e.* loss of usable material. This difference in *Utility* is always sought as much as possible but is always limited by certain constraints independent of the will of H. *habilis* and now of H. *sapiens* and therefore external to the latter. The starting stone first became a simple shine, then a two-sided one, then specialised instruments (arrows, harpoons, eye needles, scrapers, ...) more and more suitable for different uses, even modern tools (engines, machines, transport devices, household appliances, communication devices, ...).

However, if the *Product* is transferred from one place to another, its intrinsic *Utility* doesn't change because it's not transformed. Nevertheless, it's undeniable that it's more useful at the place where it's now than before. Displacement therefore causes an increase in *Utility.* If it already exists in the place where it's to be used, there is no reason to move it. All this is perfectly commonplace, and the ancestral stonemasons complied with this process in every respect. Indeed, when they needed a flint pebble, they would most often go and fetch it near a river or in the bed of an ancient stream. However, to say that they needed it implies that they had some use for it. From this, it follows that the making of a *Product* is relative to a "good" and its transport to a "service".

It should also be noted that to transform stone our very distant ancestors used energy, mechanical work, identical to what is happening today for any transformation. But any displacement also requires an expenditure of energy in the form of mechanical work. This spent work necessarily comes from a certain amount of heat consumed according to the principles and laws of thermodynamics. For example, H. *habilis* generated more carbon dioxide while cutting the stone than if he had been asleep, because he consumed more energy. It is now always like this, therefore, at least since H. *habilis*, nothing more has been invented, because all this comes from the nature of things and therefore from the things of Nature, from its Laws, which are inviolable, intangible, immutable. The first principle of thermodynamics states that energy can neither be created nor destroyed, but only transformed, that is to say that it's always preserved. However, H. *habilis* put more effort than the strict minimum required to carve the flint because there is inexorably energy waste (qualified as waste in the vehicular language). The terms "waste" and "loss" can now be used interchangeably.

Any modification, any transformation, any change, requires a difference of a certain characteristic. Thus, if there is no difference, there can be no evolution, and any difference necessarily implies a change. For example:

- in electricity ⇒ voltage difference,
- in mechanics ⇒ difference in force,
- in thermal ⇒ temperature difference,
- in chemistry ⇒ difference in concentration,
- *etc.*

This applies to physics as well as to economics. Of course, in the time of crafty men, there was no *Money,* but they were already spending *Work* in order to improve, to transform, to modify, natural *Products* into tools, very exactly and identically to what we are doing now. In the end, and whatever the context, the heart of the change is only or only reduced to an evolution of *Utility* and therefore to a difference from it, but systematically consuming minimal *Work* and producing waste of material and energy. Since matter and energy can neither be created nor destroyed, but only modified, then any change :

1. ***requires a difference, which diminishes in the course of evolution,***
2. ***ceases when the difference is cancelled,***
3. ***is always partial, never total.***

This last point (3) reveals that, during and at the end of evolution, the initial matter or energy is found in two quantities:

1. one being a transformed quantity, which generally represents for Human the goal to be reached, that is to say the interesting, profitable quantity to be obtained,
2. the other being an unprocessed quantity, which symbolises for Human a result to be eliminated or limited to the maximum, *i.e.* an unfavourable, harmful quantity.

This second part, classically referred to by the terms "loss", "waste", "leakage", *etc.*, have a meaning, a scope, a value, exclusively anthropogenic. For Nature, these terms have absolutely no meaning, because as we now know, it's totally indifferent to human presence. In Nature, on any scale considered, we can always find differences between certain places. Therefore :

1. ***transformation, variation, evolution, ..., can only be the rule,***
2. ***monotony, permanence, immutability, ... cannot exist,***
3. ***creation, genesis, occurrence, ..., ex nihilo are impossible.***

From time immemorial and in a very general way, every individual (except recluse, anchorites, cenobites, stylites, ...) has always tried to dispose of the maximum amount of energy, essentially in mechanical form and to a lesser extent in thermal form. For this purpose, *Homo,* very limited in its intrinsic possibilities of energy expenditure (about 150 W/h), has always endeavoured by every possible means to satisfy its needs in mechanical energy. First he used the slave and the animal, then he invented a few devices with a simple kinematic chain driven by the wind (windmill, sailboat, ...) or water (noria, water mill, ...), then he controlled the transformation of heat into work, following the invention of differential and integral calculation. Indeed, it's from this mathematical tool that the understanding and control of certain physical phenomena were possible, which allowed the development of powerful and efficient mechanical energy sources (heat engines, electric motors, *etc.*). As a result, the construction of increasingly complex machines made it possible to replace and, above all, increase the work that had to be done by *H. sapiens*, who became *H. ingenius*. However, as stated above, any modification leads to the creation of waste and the laws of physics teach us that this is all the more important as the speed of transformation is itself consequent. This dramatic increase in the amount of work (energy) available has led to a very large increase in the loss of matter and energy, with the environmental (climatic and other) impacts that we can now see.

The multiplicity and abundant quantity of the tools manufactured led to a proliferation of exchanges which necessitated the creation of another tool to facilitate them: the tool-*Money* (shells, cowries, feathers, teeth, salt, nuggets, metal, paper, electrons, *etc.*). The quantity of this tool-*Money* is an inverse function of the *Work* (energy) necessary for the elabouration of the tool-*Product*. In fact, it's argued here that this function is an inverse function, because for the manufacture of a given *Product*, the greater the expenditure of energy (in the form of *Work*), the faster it's elabourated, the less time it takes to make it and therefore the less expensive it's, all other things being equal. In fact, if we assume 2 identical copies of any *Product*, one of which is made in 8 hours and the other in 4, it's certain that the latter will cost less than the former (*caeteris paribus*). However, this second copy will have required, at least, theoretically, 4 times more energy (mechanical work) than the first one to be produced. Consequently, the more *Work* included in a *Product*, the more *Money* the consumer keeps in his purse. For this reason and as already presented in the chapter “00- Preamble - Monetary evolutions”, it's possible to show that :

- ***the Additional Work performed by the supplier is Transformed into Additional Money held by the consumer.***

So, as an attempt to understand economic exchanges, it's possible to draw up the following sequences:

1. First of all ⇒ **Heat** $_{\text{consumed}}$ (***Q***) $\xrightarrow{\textit{TRANSFORMATION}}$ **Work** $_{\text{done}}$ (***W***) ⇒ thermodynamics
2. then ⇒ **Work** $_{\text{of the supplier}}$ (***T***) $\xrightarrow{\textit{TRANSFORMATION}}$ ***Money*** $_{\text{of the consumer}}$ (***M***) ⇒ ecodynamics

In the economic transformation :

- *Work* (*T*) is the cause of evolution and plays the same role as heat (*Q*) in thermodynamics,
- *Money* (*M*) becomes the consequence and interprets the same function as the work (*W*) in mechanics.

In view of these two transformations, it's obvious that the *Work* (*T*) of the supplier (transformation 2) isn't the same as the *work* (*W*) provided (transformation 1). The work provided (*W*) is work with a mechanical purpose, whereas the *Work* of the supplier (*T*) is *Work with an economic purpose*. These two works therefore don’t apply to the same thing and don’t have the same value. The mechanical Work (*W*) is related to a space (*e*) while the *Economic*

Work (T) is related to the thing to be done, to a task, to the *Product* to be elabourated, *i.e.* to a *labour* (l).

Despite the fact that everything is linked, there is no known bridge between these two transformations; scientists dealing with the heat→work transformation and economists having to deal with the *Work→Money* transformation. However, there is necessarily, at least, a relationship between *Money* and heat. Nothing prohibits it, it's therefore permitted, especially by way of experiment, to consider the above second transformation in a manner analogous but not identical to that of thermodynamics, provided that only the formalism, the method, the reasoning are similar but that the characteristics, variables and functions are different.

These two transformations, condensed as follows :

- $$Heat(Q) \xrightarrow[\ ]{\substack{TRANSFORMATION \\ PHYSICAL}} (W)\,Work(T) \xrightarrow[\ ]{\substack{TRANSFORMATION \\ ECONOMIC}} (M)\,Money$$

normally show that the higher the *monetary wealth* (*Money* held by the consumer), the greater the fuel consumption and therefore the greater the environmental change. We can then understand environmental degradation no longer in a historical but in an analytical way. All *monetary wealth* comes only from the transformation of *Work into Money*, the *Work* itself coming from the previous transformation of heat. The above presentation of the two transformations exhorts us to consider the economic one of the same essence as the physical one, *i.e.* thermomechanical.

The analogy between these two transformations (thermomechanical and economic) can be accentuated as the following operational sequences present it:

- In physics, the greatest possible temperature difference is sought,
- in Economy, the greatest possible difference in *Utility* is sought.

It should be noted that the work that is the consequence of the thermodynamic transformation (transformation 1) becomes (partially) the cause of the economic transformation (transformation 2).

However, the availability of mechanical energy is a function of the cost of thermal energy, and in particular the cost of fossil fuels. The lower the *price* of fuels, the more cheaply mechanical work can be produced and hence the *Product* produced. But then, the share of manpower costs in the *cost price* of the *Product* increases as the cost *price* of energy decreases. This leads to an increase in the trend towards the elimination of manpower (relocation, replacement of manpower by motors and machines, redundancies, *etc.*).

It is therefore possible to write the following two sequences respectively with economic and physical characters :

1. ***Decrease in energy prices ⇒ decrease in the cost price ⇒ increase in the share of manpower costs ⇒ increase in the propensity to crowd out local wage earners ⇒ increase in local unemployment ⇒ increase in inequality.***

2. ***Decrease in energy prices ⇒ increase in available work ⇒ increase in the speed of production ⇒ increase in the number of products produced ⇒ increase in waste ⇒ increase in environmental degradation.***

If *prices* increase, consumers' *purchasing power* decreases, which encourages them to buy useful and simple *Products* and to reject futile and complex *Products.* The increase in energy *prices* also has a clear impact on transport, which means that the distance between production sites and consumption sites will be shortened and industries will have to relocate. Of course, the standard of living will be affected (limited or diminished), but if GDP is degraded, the HDI indicator will certainly be favoured.

Some will point out that between two copies of a *Product*, if one is made in twice the time of the other, it will cost twice as much. This is absolutely correct, but the problem isn't how to compare the *prices* of two or more copies, but how to lower *prices* so that people can buy the one they want. Indeed, a comparison isn't an explanation. Working hours are very often confused with *Work* itself.

Contrary to the doxa, if the duration of the work increases, the work and the energy expended decreases and *vice versa.* However, we know that the energy expended (W) varies as the inverse of the square of time ($1/t^2$). To divide the production time by 2, and therefore the *price* by 2 (*all other things being equal*), the energy expended must then be at least 4 times greater.

Mechanical work – Economic work

It only makes sense that in the two sequences set out above, *i.e.* :

1. **Heat** $_{\text{consumed}}$ ($\boldsymbol{Q}$) $\xrightarrow{\textit{TRANSFORMATION}}$ **Work** $_{\text{done}}$ ($\boldsymbol{W}$) ⇒ thermodynamics
2. **Work** $_{\text{of the supplier}}$ ($\boldsymbol{T}$) $\xrightarrow{\textit{TRANSFORMATION}}$ ***Money*** $_{\text{of the consumer}}$ ($\boldsymbol{M}$) ⇒ ecodynamics

all the mechanical work supplied (W) obtained from heat (thermodynamic transformation) isn't necessarily employed, as mechanical work of the supplier (T), in the creation of money (economic transformation). Indeed, in daily life, a lot of mechanical work (W) is spent without in any way enriching the economic *system.* We know that physical transformation can only take place if there is a difference in temperature, but that economic transformation can only take place according to a difference in the *Utility of the Product* elabourated. Therefore, if the latter difference doesn't exist, the creation of *Money* is impossible, and thus the enrichment of society, despite the fact that a mechanical work expenditure (W) may be consequent. For example:

- an aircraft carrier spends a lot of mechanical work (W) but doesn't lower the *price* of anything,
- a team of rugby players, basketball players, ..., consumes mechanical work but doesn't enrich society in any way,
- a magistrate in his professional occupations,
- an annuitant,

- a wholesaler, a retailer, a distributor, don't in any way vary the *Utility of the Product* they handle,
- *etc.*

It is well known that the large distributors (through their central purchasing groups) generally allow them to offer *Products* that are cheaper than the traditional small neighbourhood shops. It would be a mistake to describe this *price* reduction as an enrichment. It is only a lesser loss. Indeed, by posing :

p_v = *selling price*
p_a = *purchase price*
V = *Value added*

it's possible to write the following relationship :

$$p_v = p_a + V$$

However, for the consumer the *added Value* (V) is always considered a loss. So even if, for whatever reason, the *Value added* decreases it will never become negative, as this would correspond to a sale at a loss for the supplier (which is normally prohibited). It is for this reason that consumers choose the distribution channels with the minimum number of intermediaries because, in general and in principle, they are the cheapest.

The *Work* used to modify the *Utility* of the *Product* may allow a variation in the *price* and, in the case of a decrease, cause the creation of *Money*. This *Work*, which has the property of creating *Money*, will henceforth be defined as an *economic Work* (T) and no longer as a *mechanical Work* (W). In fact, *mechanical Work* (W) is always related to a space (displacement), while *Economic Work* (T) is related to a thing done or to be done, that is to say, to a good or service (*Product*).

History shows that the more a society develops, the fewer individuals there are who change the *Utility of Products*. It is now possible to present the different sequences as follows:

- ***heat (Q)*** ⇒ ***mechanical work (W)***
  - ➚ ***1.economically useful mechanical work (T)*** ⇒ ***Money (M)***
  - ➘ ***2.socially useful mechanical work (W)*** ⇒ ***heat (Q)***

It is reiterated that :

- ***the accounting point of view of the Economy is banned from* this note*, only the physical approach is dealt with.***

The result of this approach is that only individuals who vary the *Utility of a Product* are economically useful to society because they enable the creation of *Money*, while other individuals are not useful in strictly monetary terms because they don't create *Money*. This in no way means that they cannot render eminent services in other fields, for example in the cultural, educational, medical, social, security, fiscal, religious, *etc.* fields. Some very well-meaning people say that in France the cost of manpower is too high, which can lead to *unemployment* due to bankruptcies, relocations, *etc.* However, they never consider their own manpower to be too expensive. Thus, they implicitly but in the most formal and absolute way discriminate between two classes of individuals, namely :

- those whose remuneration is received too much, of which they are never a part,
- those whose salaries are considered sufficient or too low, of which they are always part.

At this stage, it's therefore necessary to understand on what criteria their sorting and selection is based. Everyone is well aware that if the cost of manpower decreases, *prices* (at least *cost prices*) are likely to fall. It is therefore the *prices* of the *Products* put on the market that are the essential criteria; but the *price*s of which *Products*? It is always only the *Products* (goods or services) that have been developed according to a difference in *Utility.* It is perfectly discernible that certain individuals produce goods or services they might need, from a pot maker to an aeroplane pilot. They understand very well that these *Products* must be as inexpensive as possible so that the maximum number of consumers can benefit from them.

To conclude, by taking up the sequential transformations above:

- individuals arguing that manpower is too expensive are relative to hypothesis 2 (socially useful mechanical *work*), and don't enrich the *economic system* of which they are a part.
- individuals whose manpower would be too expensive are related to hypothesis 1 (mechanical *work* that is economically useful), and who are the sole creators of *monetary wealth*, of *Money.*

All this is taken up again later and much better developed in the core of the paper.

Natural sciences – Human sciences

As already presented, almost all economists are convinced that their discipline doesn't belong in any way to the Natural Sciences but exclusively to the Human Sciences, but they can in no way demonstrate this. To justify their statements, they rely on the fact that individuals each have their own psychology and consequently that their production and consumption choices are different for each of them: this should prevent the application of general explanatory Natural Laws. But, as already stated, we know that Human agrees and submits himself, like all things, to the law orchestrating the march of the Universe. It is undeniable that the *Money* is an invention of the Human being, and this cannot be disputed. However, because of this fact, some people swear that it cannot be revealed to the natural sciences. But in order to function, it's quite certain that all finds, inventions, artefacts, artifices, objects, *etc.*, generated by human imagination can only be subject to natural laws. For example:

- if a television transmitter is out of order, this means that it no longer operates according to natural law,
- if a vehicle doesn't start, it means that the natural law isn't respected,

- if when a point is driven in it twists, it means that the natural law still exists but is no longer properly observed,
- *etc.*

It is therefore necessary to distinguish between cases where physical laws can be applied and those where human sciences would govern them. For all things first conceived, then created, then distributed and finally used, it's therefore possible to present the following three chronological sequences, namely :

1. creation, manufacture, elabouration, ⇒ Natural Sciences,
2. distribution, allocation, ventilation, ⇒ Human Sciences,
3. use, functioning, usage, ⇒ Natural Sciences.

Before the distribution (sequence 2) of anything, the creation (sequence 1) must have taken place beforehand. Similarly, use (sequence 3) can only take place after it has been distributed.

However, the manufacture of any object, whatever it may be, and its correct functioning can only be carried out in accordance with natural laws, as stated above. On the other hand, its distribution is only subject to a decision and action of the human being. Therefore :

- **creation and use depend on the Natural Sciences,**
- **the distribution is related to the Human Sciences.**

For example, it's undeniable that the recipe (creation) of a cake as well as its use (digestion) are part of the natural sciences (chemistry) but that its cutting (distribution) is totally independent of them, being relative only to the good will of the lady of the house and therefore to the human sciences.

Thus, since these sequences don't belong to the same fields of knowledge, it's out of the question to want to incorporate them into the same corpus. To say that the Economy cannot be governed by natural laws is to reduce this discipline to the sole distribution of either *Money* or *Products* (goods or services), while concealing their creation and use, effectively discriminates against these sequences.

The following example shows the difference between the accounting point of view and the physical approach to phenomena by assuming an economic *system* consisting of a factory manufacturing automobiles.

- ***<u>Accounting</u>***

  According to this point of view, the cost of the factory in the *price* of the vehicles will be all the lower as the production will be important per unit of time. In all car *pricing* calculations, only the *Money* is taken into account. For example, we will ask :

$$cost\ price = manufacturing\ cost + \frac{factory\ cost}{number\ of\ vehicles\ manufactured}$$

which is the classic procedure. But it says absolutely nothing about how to make production evolve, neither more nor less. Accounting is therefore totally outside any technical considerations. It only records changes, but never explains them. In order to reduce the *cost price*, it's therefore imperative to increase the speed of production (*productivity*), which accounting is incapable of doing.
Everyone will agree that only the physical approach is likely to provide a solution to this increase in production.

- ***Physics***

It is obvious that in order to manufacture extra cars, it's necessary to spend more mechanical work. This work, which is aimed at accelerating the speed of elabouration in order to lower the *price*, is therefore defined as *Economic Work*. But, moreover, this *Work*, which reduces the *price*, allows the consumer to have an extra amount of *Money* at his disposal.

If we know the relations existing between the *Work* provided by the producer and the *Money* thus created which is available to the consumer in addition, then the same will be true for the construction of the factory. The relationship between the *Work* spent on its construction and the additional money held by the automobile manufacturer (the factory *price* having decreased) will also be known. The same will be true for the cranes used in the assembly of the plant as well as for the steel used to make the cranes. Etc.

Then and only then will it be possible to know the impact of the increase in production due to the *Work* provided on the *price* decrease.

It is the search for these relationships that is the subject of this study.

The *Money* and consequently economic exchanges, like any invention, can only conform to Natural Laws and absolutely not depart from them. We know these natural laws which determine and govern the evolution of physical (thermomechanical) phenomena, these laws having been discovered by engineers and scientists of the 18th and 19th centuries (Newcommen, Watt, Carnot, Clapeyron, Thomson, Clausius, Helmholtz, Gibbs, ...). Their acquisition and mastery therefore now enable us to ensure and properly manage the regulation of these phenomena in principle for our benefit. For example:

- the ball regulator allows a smooth operation of the steam engines,
- the accelerator and brake pedals on a car allow speed variations,
- the potentiometer adjusts the loudspeaker sound power,
- the variable capacitor tunes the receiving frequency to the broadcasting frequency of the transmitting station,
- the thermostat limits the temperature within the assigned range,
- *etc.*

It is strictly the same for the other physical disciplines whose laws of evolution have been brought to light. It is quite obvious that if the laws governing these disciplines were still unknown, all the above-mentioned apparatuses would not exist and it would therefore be impossible to ensure the regulation of any phenomenon. The only possible thing would be to passively undergo the physical manifestation under consideration and its possible consequences. This is what happened from the dawn of time until the invention of differential calculus, which made the industrial revolution possible. However, in Economy we don't know any Natural Laws that are exercised there, which doesn't mean that they don't exist at all. This lack of knowledge therefore implies the absolute impossibility of ensuring the efficient management of the Economy. Only a historical approach (econometrics is one of them) and a completely empirical one can provide a semblance of a solution. Consequently, there can only be a large number of opinions that anyone can formulate and amplify into doctrines. However, it's quite certain that those of the strongest, most powerful, most important institutions or individuals (thus forming an "Authority"), will be taken into consideration although their positions and theses are not necessarily the best and possibly the worst. Only when Natural Laws are correctly expressed will it then be possible to counter force with reason. Since it's necessary to regulate physical phenomena in order to make them available to us, economic phenomena must also and imperatively be subject to regulations most probably of the same essence, of the same species. Therefore, the Economy, in order to function properly, must be subordinated to regulations. These regulations, which must be applied at the level of a system such as a country, if not the whole world, can only be defined and elabourated at the level of these entities. The control and possibly the sanctioning of their application is therefore a matter for the States. But all this is outside the scope of this study and therefore doesn't need to be discussed here.

Suppose an engineer designing a small household appliance. It is completely free to exercise his free will as regards the material of the bodywork (aluminium, stainless steel, wood, plastic, *etc.*), the colour (bright, gradient, harmonious, contrasting, *etc.*), the ease of assembly and disassembly (screwing, fitting, gluing, welding, *etc.*), *etc.* But for any choice applied, it's obliged to comply with the natural laws that govern each stage of manufacture.

For the motorway crossing of the Tarn valley, near Millau (France), several viaduct projects were presented which can be classified into five main types (cable-stayed, sub-banded, central arch, constant thickness deck, variable thickness deck). For each of these types, numerous variants were defined. As a result, the choice of project had to be made between several dozen variants. This choice could be made for various reasons (aesthetics, cost, ease of construction, local politics, prestige politics, ...). It is certain that the people who presided over the choice of the project did so according to their psychology, not all of them having the same opinions. As a result, they didn't all propose the same solution. However, whichever solution was chosen, the viaduct was built according to the natural laws of resistance of materials which are immutable and which no one can evade.

An extensive list of such examples could be presented. For example:

- ***the choice in the strict sense is a matter for the Human Sciences, the realisation of the choice is a matter for the Natural Sciences.***

In order to simplify subsequent entries, the notions of “goods” and “services” will henceforth be condensed by *Product*, because we know that laws must be general and apply without discrimination to any natural element. For any applied choice, *i.e.* whatever the solution defined by the engineer, the contractor manufacturing the small household appliance will always carry out the following three sequential operations, as follows :

1. purchase of the raw *Product* to be manufactured as cheaply as possible,
2. manufacture of the *Product* as economically as possible,
3. sale of the *Product* elabourated as expensive as possible.

It should be noted that the final consumer of this *Product* acts in exactly the same way. In fact, he will always carry out these three operations as follows:

1. purchase of the *Product* to be used as cheaply as possible,
2. use of the *Product* as economically as possible,
3. possible sale of the most expensive second-hand *Product* possible.

From these two enumerations it can already be seen that the terms “make” (manufacture) and “use” (utilization) are differentiated only according to the position of the agent. This is therefore covered by the General Principle of Relativity and will be better explained later in the paragraph devoted to it. It must therefore be admitted that whatever the actor (supplier or consumer), economic agents act in a strictly and totally identical way because of the generality of natural laws. *A priori*, therefore, there is no criterion for discrimination at this level, since whatever the position of the agent, he always acts in the same way. This is obviously valid in all time and space in accordance with the General Principle of Homogeneity. Indeed, whether a Patagonian or a Chukchi, a Japanese or a Portuguese, *etc.*, from the time of the Romans, to the Renaissance, since the Industrial Revolution, *etc.*, any individual has acted, acts and will always act similarly. Of course, the actions relating to each of the three above-mentioned sequences are, as already stated, always limited by external constraints. So, let us suppose three economic agents defined chronologically as follows:

1. a Seller ⇒ manufacturing any *Product* and selling it to a Transformer,
2. a Transformer ⇒ continuing to develop the *Product* and selling it to a Buyer,
3. a Buyer ⇒ continuing to develop the *Product* or using it.

Throughout the study, the Transformer is considered as a reference, that is to say, as being situated within the *economic system*, that is to say, it observes what other agents do but also what it does itself. *A contrario*, the Seller and the Buyer are treated as being outside this *system*, *i.e.* they are considered as examiners of the operations performed by the Transformer. Then comes the following sequential steps:

1. ***Step 1*** ⇒ ***Manufacturing by the Seller***
   The Seller produces a copy which it makes as cheaply as possible, thereby increasing the *Money* held by the Transformer.

2. ***Step 2*** ⇒ ***Seller-Transformer negotiation and transaction***

The Seller sells the *Product* for the highest possible *price*, which has the effect of reducing the *Money* owned by the Transformer.

3. ***Step 3*** ⇒ ***Manufacturing by the Transformer***
The Transformer produces the cheapest possible *Product*, but this always has a cost, which has the effect of reducing the *Money* he owns.

4. ***Step 4*** ⇒ ***Tractation and Transaction Transformer-Acquirer***
The Transformer sells the *Product* for the highest possible *price*, thereby increasing the *Money* held by the Transformer.

5. ***Step 5*** ⇒ ***Use by the Acquirer***
Same as step 1, it starts another new cycle. During the use of the *Product* by the Acquirer, the Seller makes a new copy of the *Product* which he produces as cheaply as possible, which has the effect of increasing the *Money* held by the Transformer.

As the Seller has made another copy of the *Product* during the manufacture by the Transformer, the negotiation between these two agents can start again and the sequences will continue again. These four steps (steps 1 and 5 being equivalent) thus define a cycle which is perfectly analogous to the thermodynamic cycle (Clapeyron cycle). It should be noted that :

- Steps 1 (or 5) and 3 are performed without contact between the Transformer and the Seller or Buyer but with modification of the *Product* (*Utility*), similar to an adiabatic transformation in physics where the temperature varies,

- steps 2 and 4 are performed with contact between the Transformer and the Seller or Buyer but without modification of the *Product* (*Utility*), identical to an isothermal transformation in physics where the temperature remains constant.

This is strictly identical to the thermodynamic cycle of production of mechanical work and is difficult to refute. Thus, these operations are perfectly free of any anthropic character, which implies that they are outside of any psychological apprehension and therefore fall within the scope of the Natural Sciences and not the Human Sciences.

Principle of relativity

Suppose a jigger on the hull of any sailing ship, which moves at a constant speed in a straight line parallel to the coast. The skipper inadvertently drops his splicer. So, let's say :

1. A helicopter pilot who has placed his machine vertically above the mast and is holding on to it, watches what is happening. He notices nothing in particular, always sees the tool in the same position near the mast and concludes that it can be represented by a point (dimension 0),

2. A deckhand on the deck of the ship observes the scene. He notices that the splicer falls at the foot of the mast in a straight line (dimension 1),

3. A naiad walking along the foreshore also contemplates the phenomenon. She notices that the tool also planted itself at the foot of the mast but that it followed a simple parabolic curve (dimension 2),

4. A Martian examining our planet sees the scenery, his sharp eye glued to the eyepiece of a telescope. He notes that the splicer hits the bridge at the foot of the mast and that the trajectory followed is described by a complicated curve (dimension 3).

Moreover, depending on the position of the sailor on the deck, that of the wave on the coast, that of Mars in its orbit induce different characteristics of the curves. Thus :

- the sailor always sees a straight segment, but more or less long,
- the bather always perceives a parable, but in a different form,
- the alien always observes a curve of the same appearance but with a different contour.

But also, the length of the different paths travelled are dissimilar according to the observers, despite the fact that the duration of the phenomenon is the same for each one. The path seen :

- by the helicopter pilot, is of zero length,
- by the deckhand, is a straight segment whose length is more or less long depending on its position on the boat,
- by the nixe, is longer than that designated by the sailor,
- by the Martian, is even longer.

It follows from this that, for each observer, the speed of the mobile (splicer) is different since the fall is unique. In conclusion, the aphorism “everyone sees noon at his doorstep” perfectly sums up the relativity of the phenomena according to the characteristics of the reference frame used (position of the origin and direction of the axes). Knowing that nothing is ubiquitous and therefore that no object can follow distinct paths, then all the above-mentioned observers are either mistaken or true. In front of the court of reason, everyone can swear to the great gods that they have seen and seen well what they have observed. From this enumeration, it's deduced that each situation is a particular case of observation of the same phenomenon, because each observer chooses his own frame of reference, since two observers cannot be in the same place simultaneously. As a result, two observers never see exactly the same thing. So, it must be admitted that the visualisation of a trajectory taken as well as the speed with which it's travelled is meaningless as long as the position of the observer isn't specified, *i.e.* knowing the referential in which the route followed is situated. To maintain, as Thomas “the incredulous” did, to believe only in what one sees is thus the shortest path that leads to error. In fact, it's then defining oneself as a reference point, as a reference, choosing oneself as the origin of the frame of reference and consequently ignoring others who have another frame of reference.

Everyone sees the sun rising in the east, being at its zenith in the middle of the day and setting in the west. This sequence of situations is absolutely unquestionable. However, the conclusion drawn from it “the Sun is turning” is relatively accurate or false, depending on the chosen frame of reference:

- this assertion is only admissible if the reference frame adopted is the Earth and only that one,
- it's erroneous, *i.e.* false, for any other chosen frame of reference and in particular for the one from which the Sun is taken as origin.

The poet (Pierre Corneille) who wrote "*That obscure brightness that falls from the stars...*" could very well have stated that the brightness was rising and not falling, and no one could have disputed this assertion. It only depends on where the observer was and the direction in which he was looking.

What has just been presented for physics typically applies in the same way to Economics. We know that the elabouration of any *Product* requires the existence of a fairly large number of manufacturers placed chronologically one after the other. Three of these manufacturers have been conventionally designated as Seller, Transformer and Buyer, as indicated above, with the Buyer being a final consumer who uses the *Product* in question. If the final consumer is perceived as the observer of an event (use of a *Product*), then he analyses :

- the *Utility* increasing during the different phases of production,
- the *Utility* diminishing during its use by itself.

However, each manufacturer, whoever he may be, presents himself as a consumer in relation to the previous manufacturer, *i.e.* as a user, and is observed as a supplier in relation to the next manufacturer. So, every manufacturer presents himself as a Transformer to the previous manufacturer and as a Seller to the next. Thus, if the Transformer is considered as the observer of an event (development of a *Product*), then he considers :

- the *Utility* increasing during the elabouration of the *Product* by the Seller,
- the *Utility* diminishing during the manufacture of the *Product* itself,
- the *Utility* increasing during the utilization of the *Product* by the Acquirer.

In fact, the more the Acquirer uses the *Product*, the sooner it will be put out of use and the sooner it will be necessary to manufacture a new one.

As every manufacturer plays indifferently, but sequentially, each of the three roles, first Buyer, then Transformer, finally Seller in relation to the others, the three situations listed above are true simultaneously but only according to the position of the observer. The direction (increase or decrease) of the variation of the *Utility* during the manufacture of a *Product* is therefore relative to the position of the observer, in accordance with the General Principle of Relativity. This is a further argument for considering the absolute inviolability of Natural Laws and that the Economy is, of course, rigorously and totally subject to it. It should be added that during the negotiations between the Seller and the Transformer on the one hand and between the Transformer and the Buyer on the other hand, the *Utility* of the *Product* doesn't vary and therefore remains constant.

In conclusion, it can be argued that :

- ***An observer can only observe an event if it's located outside the system, i.e. in a different frame of reference from that of the event.***

- ***an observer cannot notice anything and see nothing if he is placed in the same (or an identical) frame of reference of what he is observing.***

This is why the helicopter pilot sees nothing particular (dimension 0) since it was specified that he was moving in accordance with the boat (identical frame of reference) in order to stay in line with the mast.

Relative approach – Absolute approach

A priori, the Human Being always refers to his common sense and is thus mistaken. He has the particularity of always taking himself as a model, as a reference point, as a reference (paragraph “Principle of Relativity”). In this way, individuals systematically have an anthropic vision of things.

Distinctions between hot or cold, big or small, long or short, heavy or light, brave or lazy, expensive or stingy, selfish or altruistic, beautiful or ugly, shiny or dull, bright or dark, easy or difficult, flat or bumpy, *etc.*, are only possible in reference to the Human Being. Then the approach is relative to Human, which must be proscribed for the understanding of any phenomenon, whether physical or other, for example economic. On the other hand, for a *physicist* a thing is always hot, big, long, heavy, *etc.*, because for him the thing always has a certain temperature, length, weight, and an individual is always lazy, stingy, *etc.* Of course, a thing can be very little hot, very little big, very little long, very little heavy, and an individual can be very little lazy, very little stingy, *etc.*, but these characteristics will never be zero, or else the thing doesn’t exist, that is to say, it's absent. Here the approach is absolute and is therefore outside any human reference, the distinctions listed in the previous paragraph (hot or cold, big or small, ...) no longer having any reason to exist.

For the search for an explanation of economic exchanges, it's therefore necessary to use only the absolute approach of the characteristics that will be used, because it's indifferent to human nature.

Economy of Work – Economy of Money

In accordance with the “Principle of Homogeneity”, it's indisputable that every individual saves:

- his *Work*, when he does anything,
- its *Money*, when it acquires anything.

Consequently, every Human Being behaves in :

1. ***to spend the minimum amount of Work, i.e., to enhance to the maximum his Economy of Work,***

2. ***to spend the minimum amount of Money, i.e., to increase to the maximum its Economy of Money,***

- ***BUT ALWAYS SUBJECT TO THE CONSTRAINTS TO WHICH IT'S SUBJECT.***

It is necessary to specify that the natural growth of the *economy of Work* is valid for all things, for every natural element. Indeed, an animal reacts identically to every Human Being. It is the same for motors or machines which supply or use only the strict minimum of mechanical energy necessary for action, because, for the same amount of energy consumed, as soon as the constraints increase, they slow down inexorably.

The maximum properties of *economy of Work* and *economy of Money* , available to any agent (individual, slave, animal, employee, motor and machine), are obviously limited by the constraints that are exerted on him. But these two properties are perfectly antagonistic, rejecting *Work* and taking over the *Money*. A directed evolution therefore follows. Since *Work* must necessarily be done in one way or another, certain individuals will act in such a way as to avoid, partially or totally, this obligation. The *Work done* by others will therefore be all the higher, which inevitably increases inequalities. There is only one solution to achieve this objective, but it can be applied in two different ways, which are generally referred to as constraints:

1. physical violence, essentially organised in the form of slavery,
2. legislative or regulatory violence, usually arranged in the form of wage-earning.

The result is that those who hold any power compel others, by the two methods mentioned above, to perform more and more *Work* and obtain less and less *Money*. Obviously, this process increases inequalities as long as there isn't a sufficient balance of power or reason to counteract it. However, this is a matter of human will and doesn’t need to be dealt with in this paper.

From now on, *economy of Work* will be called *Laziness* (P) and *economy of Money* will be called *Avarice* (A). Many people will rebel against these designations, arguing that they are neither lazy nor stingy. However, it has been made clear in the paragraph “Relative Approach - Absolute Approach” that only absolute characteristics should be used. It is of course possible to be only very little lazy and very little stingy, but *Laziness* and *Avarice* will never be zero. Moreover, it's obvious that in the context expressed in this note, *Laziness* and *Avarice* have strictly and absolutely no ethical, moral, philosophical, divine law transgression, *etc.* The only thing that counts here is the idea (concept, notion, *etc.*) of “least action”, of “parsimony”, which must necessarily be discriminated against according to whether it's a question of *Work* (*Laziness*) or *Money* (*Avarice*). It is therefore possible to explain these two properties of *Laziness* and *Avarice* as follows:

- ***Laziness naturally always increases towards a maximum, limited by external constraints,***
- ***Avarice naturally always increases towards a maximum, limited by external constraints.***

These two quotations from the economic field are strictly similar to those from the physical field, *i.e.* :

- ***Entropy naturally always increases towards a maximum, limited by external constraints,***

which is specified as the “Second Principle of Thermodynamics”. They can therefore be qualified as the “Second Principle of Economics”.

It should be noted that :

- *Laziness* is always relative to production. It is during the elabouration of a *Product* that *Work* is saved,
- *Avarice* is always related to consumption. It is indeed during the acquisition of a *Product* that the *Money* is saved.

As a result, a single individual can never be both producer and consumer simultaneously. If there is a concomitance, the presence of two individuals is imperative: one producer and the other consumer.

Intactness of the characteristics

The following three sentences are completely identical except that the terms “length”, “money” and “work” are replaced indiscriminately by any of the other two.

1. *If an individual is asked to hold a 10 cm long object in his hand, he will be obliged to take an object of at least 10 cm in length (piece of wood, piece of metal, piece of plastic, string, ribbon, ...), as he will never be able to take this length by himself.*

2. *If an individual is asked to take a 10$ money in his hand, he will be obliged to take any object of which at least the value will be 10$ (cowries, nuggets, teeth, feathers, notes, precious metals, bank card, cheque, ...), because he will never be able to take this value alone.*

3. *If an individual is asked to take 10 W/h of work in his hand, he will be obliged to take any object whose energy is at least 10 W/h (transformed or moved objects, ...), because he will never be able to take this work intrinsically alone.*

This is due to the fact that these three characteristics (length, money, work) are totally intactable, but nobody can refute that they are real. Consequently, it's imperative that these characteristics be incorporated, supported, included in something material, *i.e.* perceptible by touch, sight, *etc.*, and which can be any object (examples cited above).

If a table is made in two specimens, one in six hours and the other in three, these two specimens will be totally indistinguishable, because both objects will have exactly the same characteristics. However, the work (energy) required to make them is theoretically four times greater in the second hypothesis. Now, nobody can deny that the work is a perfectly real, yet totally intactable characteristic. The work is therefore incorporated, supported, included in the two copies of the table.

This example shows that any *Product* can incorporate different *economic Works* according to its manufacturing speed. Therefore, this also implies that different *Products* can include the same amount of *Work*.

It is also reiterated that :

- *throughout the study, the accounting approach is totally prohibited, only the physical approach is mentioned.*

But then, the *price* of each copy of the table is different since they are not manufactured during the same period of time (the copy requiring the least amount of time to prepare being the cheapest). The consumer who has purchased the cheapest piece of furniture has more *Money* at his disposal than the consumer who has purchased the most expensive copy. Thus, the *Work* and the *Money* are two characteristics that are absolutely intactable but perfectly real, which necessarily implies that they must be integrated, inserted, included in a tactile, sensitive support, namely the *Product* and the *Money* respectively.

In fact, although the *Product* and the *Money* can be touched and manipulated, the same cannot be said of the *Work* included in the *Product* and the *Money* included in the *Cash*. To conclude:

- ***no one can touch, feel, check, hold, etc., the real characteristics of the Work and the Money because they must be incorporated into something tactile, which can be anything (respectively any Product and any Cash).***

In conclusion, it's now possible to present the correspondences between these characteristics in the economic and physical fields:

- ***Economy (Transformation Work→Money)*** ⇒ ***Product is the vector-support of Work,***
- ***Economy (Transformation Money→Work)*** ⇒ ***Cash is the vector-support of the Money,***
- ***Thermodynamics (Transformation heat→work)*** ⇒ ***gas (steam) is the vector-support of the heat.***

Product – Work

It is obvious and indisputable that it's imperative to spend energy, *i.e. Work*, to elabourate or move any *Product* (good or service).

It isn't uncommon to hear "*today I have a big job to do*" or "*I have a big job on the board*", or similar assertions, such as "*I did a little quiet work this morning*" (which is rare). Here, work is considered fixed because it's defined as the thing to be done or done. However, if, for example, at the end of the day 3 copies of a *Product* have been made instead of the usual 2, no one will argue that the *Work* is always the same, *i.e.* regardless of the speed of production. Without knowing the physics, everyone understands and is convinced that the higher the speed, the more important the *Work* is. For example :

- shearing a sheep is something fixed, but can be done in variable times, *i.e.* at different speeds. There are even speed contests for this,
- the area of a field is constant and so is its ploughing. On the other hand, depending on the equipment used (hoe, spade, oxen, horses, tractors, *etc.*), the time required can vary considerably,
- the distance between two places along the same route is by definition fixed and the transport of a parcel between these points is also fixed. However, depending on the vehicle used, the duration of the journey is highly variable,
- the forging of an ammonia synthesis tube shell is constant, however, depending on the power of the press used, the speed of processing will vary,
- the cutting of a flint by H. *habilis* always shows the same phenomenon because it's constant, but he could be more or less diligent according to his needs,
- *etc.*, and the same goes for all things.

The laws of physics teach us that the higher the speed, the more energy is used in the form of mechanical work. Consequently, for a given manufacturing method, there is a constant characteristic represented by the thing to be made (mowing, ploughing, moving, forging, cutting, ...) and also a variable characteristic according to the speed of execution of this thing which it's strictly forbidden to confuse, integrate, assimilate. So, let us follow Condorcet's recommendation and call things by their name. In the essay, these two characteristics are defined as follows:

- the constant characteristic is called "*labour*" (to be done or done). It corresponds to the workpiece, the task, the thing to be done or performed. It is possible to understand this characteristic as a quantity of things to be done or performed, which it will therefore be necessary to discern,
- the variable characteristic, which is a direct function of the speed of production, is defined as "*Economic Work*", since this *Work* doesn't relate to a space, to a displacement (as in physics), but to a *labour* (previously referred to).

Economic Work, which is variable, is a function of the *speed* (*productivity*) with which *labour* is performed which is constant for a given method of manufacture. Indeed, in a factory bottling spring or mineral water during extrusion blow moulding, no one can differentiate between two gobs or two bottles, although the filling speed may vary according to the orders; this speed can generally vary from 1 to 3 copies per second. Whether the bottles are made in 1 second or 1/3, they are all equivalent and identical, which implies constant *labour*. However, the *Work* used is at least 9 times greater for the fastest production than for the other hypothesis.

In Economics, it's stated that :

- ***"the value of a good is determined by the amount of work required to produce it".***

Therefore, according to this sentence :

- ***the higher the Work, the higher the price, the more expensive the Product.***

But then and reciprocally, it also means that :

- ***the lower the Work, the lower the price, the cheaper the Product.***

This expresses that the hierarchy of any company must encourage, if not oblige, the employees to work as little as possible, to go as slowly as possible, to spend the minimum amount of energy so that they carry out the minimum amount of *Work* so that the *Products* they produce are as cheap as possible. It is then strongly advised to imagine the atmosphere in the workshops and offices. This pseudo law isn't based on any rational basic criteria and no experience or analysis of reality is carried out to support it. Although it's always possible and even recommended to formulate hypotheses, they must be subjected to experience, or at least to the analysis of facts. If the hypothesis presented is consistent with the experience or the facts, then it may be considered probable or convincing, but if not, it must be systematically rejected.

Now, coming back to reason, let us suppose that the manufacture of any *Product* requires, initially, a duration of 8 hours and that, after an increase in productivity, this duration decreases to 6 hours. Let us suppose moreover that the cost per hour of work is 20 $, then *caeteris paribus* :

- according to the first hypothesis (8 h) the cost *price* of the manufacturing operations will be 160 $,
- according to the second hypothesis (6 h) the cost *price* will be 120 $, *i.e.* 40 $ less.

But it's indisputable that the energy (*Work*) expended to performe the second hypothesis is higher than that of the first; in this case at least 78% more, knowing that the energy varies at least as much as the square of the speed but more generally with a higher exponent. If the manufacturing time had been reduced to 5 hours 40 minutes, the energy required would have been at least twice as high. This thought experiment, valid for any *Product*, everywhere and always in accordance with the Principle of Homogeneity, shows unambiguously that :

- ***the value of a merchandise is determined by an INVERSE function of the quantity of Work necessary for its production.***

The analysis of daily facts shows that all companies are always looking for ways to improve *productivity* in order to reduce the *cost price* of the goods produced. But in order to do this, it's indispensable to work more, and this by any means (individuals$_{(i)}$, slaves$_{(e)}$, employees$_{(s)}$, animals$_{(a)}$, motors$_{(m)}$). Moreover, the historical analysis of economic exchanges over the last two centuries shows, unequivocally, that the industrial revolution brought about a strong increase in productivity, which led to a substantial drop in production costs and thus in the *prices* of the goods put on the market. However, it's difficult to increase continuously and indefinitely the work of humans (individuals, slaves, wage-earners) as well as that of animals. Since the industrial revolution, it's essentially the engines and machines that have made it possible to increase *productivity* without proportionally increasing the *work* of individuals. It has just been shown that the more *work* there is in a *Product,* the cheaper it's. Thus, in an exchange the facts show that there can only be an increasingly accentuated imbalance according to *productivity*, and this means that :

- ***more Work circulates from the supplier to the consumer, less Money circulates in the opposite direction.***

However, when the *price* of a *Product* decreases due to higher *Work*, the consumer keeps an additional quantity of *Money* equal to the *price* decrease. The result is that :

- ***more Work circulates from the supplier to the consumer, the more Money the consumer has.***

This thesis shows that a balance (principle of conservation) can be accepted between the additional quantity of *Work* performed by the supplier and the additional quantity of *Money* held by the consumer. Consequently :

- ***the Money that must be taken into account is the additional Money held by the consumer after a price drop and not the Money circulating from the consumer to the supplier.***

The consumer may therefore use this *Money* thereafter at his convenience, however subject to the external constraints to which he is subject. It is this *Money* that subsequently moves from the consumer to the supplier when acquiring any *Product.* Consequently and beforehand, the consumer must have this *Money* at his disposal, which only comes from a *price* reduction prior to its use during a purchase. It follows from all this that :

- ***a Variation ($\pm$) of Work is never used to manufacture a Product but only to Variate ($\mp$) its price.***

In fact, whatever the speed of manufacture (*productivity*), the copies of a *Product* are all identical, indistinguishable; the only thing that has evolved is undoubtedly the *price.* It has just been explained that:

- ***the additional Work performed by the supplier is TRANSFORMED in Additional Money held by the consumer.***

We are therefore in the presence of a transformation (field of physics) and no longer a flow (field of accounting). This totally changes the conception of economic exchanges and therefore urges us to consider them as falling within a model similar but not identical to that of thermomechanics. However, it should also be noted that :

- ***it's the supplier who enriches the consumer.***

In conclusion, when the *price* of a *Product* decreases, the Acquirer keeps a quantity of *Money* equal to the decrease in *price.* However, all other things being equal, for this decrease to be possible it's indispensable that the speed of production (*productivity*) increase under the effect of a higher *Work* executed and performed by any means, *i.e.* : individuals, slaves, employees, animals, motors. All this is perfectly similar to mechanics. Consequently, the *Money* should not be considered as the one circulating from the consumer to the supplier, but as the one that the consumer holds in addition after a *price* drop and whose subsequent use he possibly controls. It can be deduced, and the essay shows it, that it's the applied work, whatever the means, which is the cause of a fall in *price* due to the increase in the speed of manufacture, *i.e.* in *productivity.*

This fits in perfectly with the reality of what is happening in enterprises where more and more work (by whatever means) is required to be done, and at an ever-increasing rate, in order to bring *prices* down. However, another possible solution would be to reduce or possibly abolish (lay-offs) the remuneration of work (wages, salaries, emoluments, remuneration, ...) but also and equally those of capital or other (profits, profits, interest, dividends, ...). It should be noted that this procedure always and exclusively depends on a human decision and choice, which is obviously in the field of applications and therefore outside the scope of this research and therefore outside the field of validity of this study, since it's outside of all considerations relating to mankind.

In the paragraph “Semantics”, we saw that it was imperative, under being confused, to define the characteristics univocally. In the present case, *Work* (*T*) must be understood only as a mechanical energy, but with a character, a purpose, a goal, economic, *i.e.* allowing a *price* drop, and absolutely nothing else. This energy can be deployed by an individual, a slave, an employee, an animal or a motor. Of course, in “Occidental“ societies the *work done* by slaves or animals can be qualified as null and void. However, an explanation must be able to respond to these assumptions.

The knowledge that the more *Work* in a *Product*, the cheaper it's, shows that the lower the *price* of mechanical energy, the higher the *productivity* can be. Therefore, while the share of the cost of mechanical energy represents only a small part of the *cost price* of the *product*, it's a major contributor to growth. The lower the share, the more important its role is, as indicated in the paragraph “Introduction”.

Cash – Money

From the foregoing it's clear that the *Product* and the *Work* must not be confused under any circumstances. In fact, *the Product*, which is fixed, may contain more or less *Work* depending on its manufacturing speed. In the same way, two different *Products* may contain the same quantity of *Work*, that is to say, they may have required the same amount of *Work* to produce them. This discrimination also applies to *Cash* and *Money.* However, in general, the latter two characteristics (*Cash* and *Money*) are always confused.

The Larousse dictionary (L3-1970) gives the following respective definitions of *Cash* and *Money*:

- *Cash*[1]
  “Any money of this metal - Any money of any metal whatsoever, or any paper accepted as currency - All currency in any form whatsoever (stocks, bonds, bank notes, ...)”.

1 *Cash* is the translation chosen by the translator for Argent in french.

- *Money*[2]
  "Metal coin minted by the sovereign authority for use in trade - Set of coins or notes of small value - Legal instrument of payments - As a settlement instrument, money is a means of settlement or purchasing power that enables the bearer to procure goods or services or to repay a debt - The term money is also used in the sense of a unit of monetary unit, which is used to express the price of goods".

The Cambridge dictionary gives the following respective definitions to *Cash* and *Money* :

- Cash :
  "money in the form of notes and coins, rather than cheques or credit cards".

- Money :
  "coins or notes (= special pieces of paper) that are used to buy things, or an amount of these that a person has".

We have already seen the general relationship valid in all cases of measurement, namely :

$$Measurement(M) = number(n)\ of\ units \times value(u)\ of\ the\ unit$$

For example :

Height = 116 m with: $n = 116$ and: $u = m$ (*meter*)

which becomes for the measurement of *Money* :

$$Money(M) = number(n)\ of\ monetary\ units \times value(u)\ of\ the\ monetary\ unit$$

or:

$$M = n.u$$

For example :

Money = 116 $ with: $n = 116$ and: $u = \$$ (*dollar*)

In physics the constancy of the value of the unit under consideration is normally always ensured by the most rigorous and exact definition possible. In Economics this constancy (of the monetary unit) is no longer valid. Indeed, it's certain that for a constant number (n) of monetary units, the *Money* can evolve more or less according to the value of the monetary unit (u). This value may vary according to the *economic system* under consideration (in space), but also within the same *system*, according to the date of measurement (in time). Therefore, the monetary unit (u) considered (*i.e.* $n = 1$) can take *a priori* any value. Consequently, in a given *economic system*, there can exist a constant quantity (n) ($\partial n = 0$) and a variable quantity (u) ($\partial u \neq 0$).

2 *Money* is the translation chosen by the translator for Monnaie in french.

For this reason, it's forbidden to confuse *Cash* and *Money* by their names, so it's obligatory to discern them. In a given *economic system*, any valuable support (coins, banknotes, cheques, drafts, bank cards, magnetic strips, *etc.*) are objects that can be considered as invariable over time, as opposed to the value supported. For example, if a 1$ coin buys 1 kg of sugar today and tomorrow only 0.9 kg, it's obvious that the coin itself has not changed at all but that the value of its unit has decreased. In the same way, the unit would have increased if another day the coin allowed the purchase of 1.1 kg, without the coin having been modified in any way.

The coin must therefore be considered as a *support of value* :

- ***the support being fixed and the value variable.***

It is possible to say that the support contains more or less value depending on whether it consents to the acquisition of more or less *Product*, *i.e.* depending on the *price* of the latter. It is therefore forbidden to associate, confuse or assimilate the support and its value and consequently it's obligatory to discern, identify and name them differently.

It is reiterated here that the term "value" must not be used unless it's to be used to specify "value of the monetary unit": this noun is far too general. Indeed, it's possible to say "value" of the *Utility*, "value" of the *Product*, "value" of the shares, "value" of the working hour, "value" of the minimum wage, "value" of the retirement point, *etc.* In this paper, the support is defined as *Cash* and the value is defined as the *Money.*

Thus,

- ***Cash* (coins, banknotes, cheques, *etc.*) is the support of the *Money*,**

and

- **the *Money* is the value of the *Cash.***

It is obvious that there is a perfect similarity between the *Product* and the *Work*. In fact, a given *Product* (good or service) is invariable in the same way as *Cash* (coins, banknotes, *etc.*). But the *Product* can contain more or less *Work*, just as *Cash* can contain more or less *Money.* In another way, it's possible to posit that when an economic agent receives any income, he only receives *Cash*, the value of this *Cash* being defined by the *prices* of the *Products* placed on the market. The evolution of the quantity of *Money* can therefore only be obtained according to the two hypotheses below:

1. either by variation of the monetary unit (u) at a constant number of units (n), *i.e.* with : $\partial u \neq 0$ and :$\partial n = 0$
2. or by variation of the number (n) of monetary units to a constant unit (u), *i.e.* with : $\partial n \neq 0$ and :$\partial u = 0$

The choice, *Cash* for the support and *Money* for the unit (value), was dictated by the definitions (Larousse dictionary L3-1970 and the Cambridge dictionary) set out above and summarised below:

- *Cash* being "all metal", "all paper", "all numerals",

- *Money* being “a *purchasing power*”, “an expression of *price*”.

The “creation of money” by the banks is therefore only a view of the mind. A banker can only create monetary units, *i.e.* change the number (n) of units when lending *Money* not covered by deposits. However, this accounting operation necessarily causes an inverse variation in the unit (u) of monetary units. This results in the constancy of the *Money* according to the relationship :

$$M = n.u$$

Without going into the mathematical details of differential calculus here, the resolution of this equation can only return the following four possibilities:

1.	n is constant	and : u is constant	⇒	M is constant
2.	n is variable	and : u is variable	⇒	M is constant
3.	n is constant	and : u is variable	⇒	M is variable
4.	n is variable	and : u is constant	⇒	M is variable

However, a banker's professional actions only comply with :

- possibility N° 1 and only to this one, when he refuses a credit,
- possibility N° 2 and only to this one, when granting a credit not covered by deposits.

These two possibilities indicate the absolute constancy of the *Money*, *i.e.* the *monetary wealth* of the *system* under consideration. The only thing a banker is capable of doing is to increase the number (n) of units, *i.e.* to increase the amount of *Cash* circulating in the *economic system*, but not of *Money*. Of course, there will be those who will argue that *Cash* and *Money* are equivalent or represent the same thing. However, it has indeed been stipulated that in Economics as in Physics it's indispensable to use only univocal and monosemic words, as Condorcet advocates.

A banker's professional actions cannot conform :

- nor to possibility N°3, because it's impossible for him without lending *Cash* (n = constant) to vary the unit (u). Moreover, how could he do so?
- nor to possibility N°4, because likewise he cannot in any way maintain the unit (u) constant while increasing its number (n). Analysis of the facts reveals and expresses irrefutably that increasing the number of existing monetary units in a system irrevocably causes the value of that unit to decrease (inflation).

In conclusion :

- ***a banker never creates Money, but only Cash, and thus never increases wealth.***

Confidence – No-confidence

These properties, used in all discourses on money, are presented as those marking the possibility of markets, *i.e.* exchanges.

According to the definitions of *Cash* and *Money* given above, it's the expression "confidence *in Cash"* that should be used. Indeed, in an exchange the supplier receives *Cash* (coins, banknotes, cowries, ...) whose value is more or less important, *i.e.* which may contain more or less *Money.* A *Money* is often qualified as "strong" or "weak" depending on whether the monetary unit (u) allows the acquisition of more or less goods or services. If the money is strong (high u) the supplier will be satisfied with a relatively small number of units (low n), and conversely, if the *Money* is weak (low u) the supplier will require a relatively large number of units (high n). All this is only the consequence of the constancy of the *Money* in a given place and at a given time according to the relation presented above, namely :

$$M = n \cdot u$$

Here, however, the *Money* (M) has absolutely no reason to evolve, so it's possible to write :

$$M = n \cdot u = \text{Constant}$$

because :

- if u increases, n decreases, and conversely, if u decreases, n increases,
- if n increases, u decreases and conversely, if n decreases, u increases.

But it has already been stated that any theory must be strictly and totally devoid of human properties or qualities, which automatically leads to the rejection of the notion of " confidence or no-confidence in *cash*", undeniably relative to the individual. To be confident or no-confident (or any other denomination) are only qualifiers that only Human can feel or utter. Consequently, for any search for a theoretical explanation, and consequently in the context of this essay, the exclusion of these terms must therefore be imperative.

Analytically, "confidence in *Cash*" has no reason to be. In the year 2000, 1 pound sterling was worth about 2,500 lire. It could be considered that sterling was a strong money and the lira a weak one. But did a Welshman or a Scotsman have a confidence 2,500 times higher than that of a Sicilian or a Lombard? Certainly not! But the Italians had perfect confidence in their money, just as the British had in theirs. The merchants of the French-Italian border zones accepted the lira without reluctance, just like those of the coastal departments of the English Channel, who did not refuse the pounds sterling. To say that one has "confidence in cash" implies that it's possible to have no confidence and conversely, to say that one doesn't have "confidence in cash" implies that it's possible to have confidence. Consequently, this necessarily infers the possibility of variation. This variation applies precisely to the monetary unit (u). Thus :

- ***a positive variation in the monetary unit leads to confidence*** $\Rightarrow$ ***if u*** $\nearrow$ ***($\partial u > 0$)*** $\Rightarrow$ ***confidence***
- ***a negative variation in the monetary unit leads to no-confidence*** $\Rightarrow$ ***if u*** $\searrow$ ***($\partial u < 0$)*** $\Rightarrow$ ***no-confidence***

From this paragraph it can be concluded that "confidence (no-confidence) in cash" is never the cause of a phenomenon but only the consequence of a hypothetical positive (negative) change in the monetary unit. This expression therefore doesn’t need to be used and is therefore excluded from this study where only the variation ($\partial u \neq 0$) of the unit's allowed.

Furthermore, the variation in the monetary unit may be zero or close to zero, which is generally the case. So there is neither confidence nor no- confidence but only indifference. The above is thus modified as follows:

- *a positive variation in the monetary unit leads to confidence* $\Rightarrow$ *if u* ➚ *($\partial u > 0$)* $\Rightarrow$ *confidence*
- *a zero variation in the monetary unit leads indifference* $\Rightarrow$ *if u* ➔ *($\partial u = 0$)* $\Rightarrow$ *indifference*
- *a negative variation in the monetary unit leads to no-confidence* $\Rightarrow$ *if u* ➘ *($\partial u < 0$)* $\Rightarrow$ *no- confidence*

The John Law case corroborates the above in every respect.

The Relationship :

$$M = n \cdot u = Constante$$

is always true even when there is no difference, *i.e.* when the *Work* is nil or absent.

As long as the number (n) of monetary units issued on paper (by the “General Bank”) was equivalent to the metal stocks (gold and silver), the functioning of the *economic system* set up by Law was correct. There came a time when the issuance of monetary units was much higher than the gold and silver held. As the number (n) increased, the monetary unit (u) dropped to ensure the consistency of the previous relationship, since no *Work* was provided. This isn't special to *paper-money* but to any *Cash* (support of *Money*) whatsoever. If, quite unexpectedly, a gigantic deposit containing several hundred thousand tons of gold were discovered (the total gold extraction of all mankind is estimated at 166,000 tons or a cube of about 20 meters in length), then the value of an ounce would similarly fall proportionally. Indeed, the above relationship is absolutely indifferent to the nature of the support of the *Money*, *i.e. Cash*. Whether it's gold, silver, platinum, copper, salt, shells, fabrics, feathers, *etc.*, the problem is always the same. In conclusion, all this is only a matter of the inviolability of natural laws. Human, like any element of Nature, can only always conform to them and never evade them. The taking into account of strictly human considerations such as confidence or no-confidence (relative approach) can in no way make natural phenomena explicit because only mathematical analysis allows it.

This property of “confidence” (no-confidence) is only a consequence of the Natural Law which states that an evolution is always due to a difference and that if the latter is absent then there can be no change. Indeed, without change any variation is by definition null and void, so no dimension can diverge. Thus, the *Money* being constant, the unit (u) of money and the number (n) of these units are related in an inversely proportional way, *i.e.* if one increases the other decreases and *vice versa*. Then :

- to be confident is to have arguments to support this feeling of security,
- to be no-confidence is to have other arguments to reject this feeling.

Confidence or no-confidence are therefore only consequences of clues, signs, indications, arguments, inciting to these contradictory judgements, points of view and opinions. To say that one is confident or no- confidence of a *Money* is, in this case, a semantic error since the *Money* always remains constant. One can only be more or less confident in relation to the monetary unit (u) and, therefore, in relation to the *vector-support* of this unit, for example a 1$ coin, *i.e.* the *Cash.*

To end this paragraph let us return to a physical analogy. During the Middle Ages, some lords and also some merchants had two sets of measuring instruments, one for buying and the other for selling different products (liquid or solid foodstuffs, fabrics, *etc.*). The dimensions of the set intended for purchases were larger than those of the assortment assigned to sales. Naturally, the customers were aware of these practices and acted accordingly. They were therefore very suspicious of the use of these measuring instruments. However, it must be recognised that this no-confidence was the consequence of the falsity of these tools and devices and not at all the other way round. Indeed, no one will argue that their dimensions vary according to the no-confidence of the agents present. It is therefore the same in Economics where the value of the *Money* is absolutely not correlated to the confidence of the agents, but the opposite. It is therefore possible to reiterate that a variation in the monetary unit :

- ***positive leads to confidence,***
- ***nil determines indifference,***
- ***negative leads to no-confidence.***

It was pointed out that, to avoid confusion, only absolute and not relative denominations should be used. However, confidence and no-confidence are by definition relative. There is no reason to be 100% confident or no-confident . Consequently, only one or the other of these properties (feelings) should have been used in this paragraph. However, the simultaneous use of these two properties was only justified for purposes of contrast, opposition. This paragraph shows that there should be no reference to these terms in the note:

- because confidence or no-confidence are only characteristics dependent on Human and are to be excluded from any explanation and reasoning,
- because they are only relative to the direction of evolution (∂u) of the monetary unit (u), *i.e.* positive or negative, knowing that the zero value stipulates an absence of evolution, a stability.

Utility – Marginal utility

The above (paragraph "Natural Sciences - Human Sciences") refers to the idea that any character associated with the individual must be prohibited for the search for natural laws. Therefore, no reference should ever be made to any notion of pleasure, well-being, happiness, satisfaction, contentment, amenity, or other moral criteria. To take into account in concepts the existence of attributes relating to the characteristics of each individual necessarily implies the loss of rationality and the impossibility of discovering natural laws referring to them. Consequently, the search for a dynamic explanation of economic exchanges must be summed up as follows:

- ***the application of rational arguments of a scientific nature, therefore totally devoid of human qualities.***

This is why *Utility* is defined in this note in the sense of Walras, namely :

- ***"I say that things are useful as soon as they can be used for some purpose and allow for satisfaction. Thus, there is no need here to deal with the nuances by which one classifies, in the language of everyday conversation, the useful next to the pleasant, between the necessary and the superfluous. Necessary, useful, pleasant and superfluous, all this, for us, is only more or less useful. Nor is it necessary to take into account the morality or immorality of the need that the useful thing fulfils and which it enables us to satisfy.***
Whether a substance is sought by a doctor to cure a sick person, or by a murderer to poison his family, this is a very important question from other points of view, but completely indifferent to ours. For us, the substance is useful in both cases, and may be more useful in the latter than in the former".

Logic dictates that :

- when we speak of *Utility*, we always refer to a commodity, a merchandise, an object, a material, a utensil, an apparatus, a material, a good, a service, a material, *etc.*, *i.e.*, to a *Product*,
- when speaking of marginal utility, it's always necessary and obligatory to consider a volume, weight, length, dose, portion, share, unit, *etc.*, *i.e.* a quantity.

The first point never concerns any quantity, whereas it's indispensable and imperative in the second, *i.e.* :

- ***Utility is exclusively relative to the Function of the Product,***
- ***marginal utility is always related to the Quantity of the Product.***

Consequently, it's obvious that the two characteristics of *Utility* and marginal utility, not applying to the same characteristic, the same concept, should not be confused in any way and must be imperatively discerned.

As an example, in order to clarify the concept of marginal utility, reference is often made to the possession of two pens, assuming that the second has a lower marginal utility than the first. But, to write anything, the *Utility* of any pen (1st, 2nd, 10th, 1,000th or more) will always be the same because the function is always the same. To write *beaba*, and if a person has a collection of similar pens, he will not choose one in particular but will enter one at random because they all have the same *Utility*. On the other hand, it's certain that the need for each copy decreases according to their number. Moreover, it's obvious that the *Utility* of 2, 10, 1,000 or more pens is by no means the sum of the *Utility* of each one. Regardless of the number of objects, the *Utility* is always constant and is equal to the *Utility* of one, as it's not necessary to have several pens to write any missive.

In physics, quantity (mass) is never identified with temperature. If it takes 1 litre of water at 100°C to cook one egg, it will take 3 liters to cook a dozen, but always at 100°C, because it would never occur to anyone to argue that 1 liter would always be needed at, say, 300°C. As presented above, temperature is an intrinsic characteristic of water regardless of its volume and therefore has nothing to do with its quantity. After carefully placing the dozen eggs in a saucepan, water is poured over them until they are covered. As the eggs are filled, the amount of water required, *i.e.* the need decreases. There is nothing strange about this and the same note can be made about *Utility* and marginal utility: *Utility* is intrinsically related to the *Product*, whereas marginal utility is related to its quantity, to its need.

In a nuclear reactor, all uranium oxide pellets have exactly the same *Utility* both at the beginning of the divergence and at the end of the cycle (except for the operating heterogeneities between certain zones). Indeed, these pellets can be switched without any consequence because they all have the same characteristics. Obviously, at the end of the cycle, the *Utility* of the pellets is lower than at the beginning, but the *Utility* evolves during manufacture and during use. The same could be said about the control bars or about the lid clamping studs on the tank. But if the reactor is 85% loaded it will be able to operate without any problems. However, the requirement for optimum production will be 15%. If it's 95% loaded, the fuel requirement will be only 5%. And so on, until the loading of the last “rod” of the last “assembly” where the need will become zero, but where the *Utility* of the latter will always be equal to that of the former because they will both supply neither more nor less energy (heat).

To give you an idea, all French households have a dozen or so knives in their household. But several knives have absolutely no more *Utility* than a single one. It is only the quantity (need) that must be greater when receiving guests. On a railway line, don't all rails have the same *Utility*? What about the pylons of an electric transmission line? What about the computers in a trading room? And the number keys of a calculator? What about coins or banknotes? Etc. However, the needs of these *Products* evolve according to their number. When building a new railway line or power transmission line, it's obvious that the more work is done, the less need there is for rails or pylons. The same is true for any *Product*. In order to acquire any *Product*, a certain number of monetary units are required, all of which have absolutely the same *Utility,* but the need for these units decreases or increases according to the quantity of them.

Of course, everyone knows the familiar example of the lost traveller in the desert who has to choose between water and diamonds. But it's certain and indisputable that every cm^3 of water has the same *Utility*, because they all have exactly the same characteristics. What varies according to the number of glasses ingested is a need and not a *Utility*. Indeed, the traveller needs a lot of water at the beginning and less and less as he quenches his thirst, which is quite commonplace. However, the last water molecule always has the same *Utility* as the first one because they both play exactly the same role in the organism. Moreover, in this example, it's implicitly admitted that the individual has a *Utility* of diamonds. Indeed, apart from the case of speculation, it's very rare that an individual has a *Utility* of diamonds. In any case, this is a very bad example because one may wonder where the “healthy and undistorted competition” is; the fact that it's a bilateral monopoly situation disrupts if not negates any relevant analysis of this illustration. Of course, in order for the *Utility* to be judged identical between several copies of a *Product*, it's absolutely necessary that the function they assume is itself identical, *i.e.* homogeneous. It cannot be said that the *Utility* of water for the thirsty traveller and the *Utility* of watering a lawn are equal. To say that diamonds are worth more than water is therefore meaningless. Indeed, in this case, the

traveller will pay a much higher *price* for water than for diamonds. The same applies to "air, which is very useful and yet costs nothing". However, if the person who asserts this sentence were to run out of water, he would be perfectly willing to buy it at a very high *price*.
Let's say a motorist needs 10 liters of fuel to visit his sweetheart. He will never argue that the first liter is more useful than the second, that the second is more useful than the third, and so on. For him, each litre has the same *Utility*, but he knows very well that the further he travels the less fuel he needs, this need diminishing as he progresses and becoming nil at the finish line. But let's suppose now that this driver sees the gauge of his tank indicating almost zero and still has to cover about ten kilometers. He will never say that the *Utility* of the fuel increases or decreases as time goes by, but that the need for fuel becomes more and more pressing, because whatever the circumstances, its *Utility* always remains constant, because every drop of petrol has the same effect, emits the same amount of energy.

It was made clear at the beginning of the paragraph that in all this study absolutely no human faculty should be put forward. Only the question of whether or not the function for which the *Product* is designed is relevant. Under no circumstances is it relevant to know the more or less developed contentment engendered by the possession of a more or less large quantity of a *Product*.
For example :

- I currently own 2 wheelbarrows and everyone will agree that I cannot use them simultaneously. The first wheelbarrow, which served me perfectly, had a hole in it, so I had to buy a second one to transport mortar, simply because the function of the first one had become null and void for this office.

- To performed an earthwork, it's possible to use 1 wheelbarrow which will perfectly fulfil the required function. The use of several wheelbarrows by several people will not change the function but only the duration of the work. The *Utility* of several wheelbarrows is no greater than that of a single wheelbarrow, it's only the need which may vary according to the speed at which the work is to be performed.

Because the marginal utility varies according to the number of copies, it's necessary to identify them with a serial number. Therefore, it would be permissible to discriminate them according to this number. However, as all copies of the same *Product* are perfectly identical, they are totally indistinguishable. Indeed, the marking of an identification number can only be done according to a human decision, because it's of course possible to assign any number (except those already used) to any copy (except those already registered).

The adage :

- ***"it's the last straw that breaks the camel's back",***

illustrates perfectly that it's not the *Utility* that is marginal but only a quantity, the *need*. In fact, if in a vase filled with water to the brim, a drop of alcohol, mercury, carbon sulphide, a small ball of lead, copper, aluminium, a grain of sand, rice, or any other *Product* is added, the vase will overflow in the same way. It is therefore not the water that makes the vase overflow but the drop, that is to say a volume, a quantity. Assimilation, confusion, from need to *Utility* must therefore be prohibited because this is a matter of mixing genres by confusing concepts. It is therefore necessary and indispensable to differentiate these two characteristics (*Utility* and *Need*). Now, *Utility* is an intensive characteristic whereas *Need* is an extensive characteristic. By definition, a characteristic is said to be :

- intensive if its value can possibly vary from one place to another within a system. These characteristics cannot be added together and are therefore non-additive. Indeed, it's impossible to add 2 temperatures, or 3 pressures, or 4 concentrations, *etc.*.,

- extensive if it concerns the whole system under consideration. These characteristics can be added and are therefore additive. In fact, it's possible to add 2 weights, or 3 lengths, or 4 flow rates, *etc.*, to the system under consideration.

As an illustration, let's take the example of a mountain torrent. It is possible to list some of the uses of its water as follows:

1. powering a Pelton turbine,
2. feeding of fish farming ponds,
3. supply of storage basins for irrigation,
4. supply of drinking water distribution systems.

Each of these functions has a certain *Utility*, different for each of them. For each user the water of the torrent has a different *Utility,* however, that of each use doesn’t depend in any way on the size of that use, that is to say, it's independent of it. Since the *Utility* of the water varies according to its use (which is considered homogeneous), it's therefore an intensive characteristic. However, it's obvious that adding up these Utilities makes no sense. The *Utility* of the water of the stream is certainly not equal to the sum of the *Utility* of each use. Since the sum of all the *Utilities* doesn’t coincide with any reality, the *Utility* is therefore a non-additive characteristic. But for example, for role 1 each m^3 has an identical *Utility.* It is the same for each of the other three uses in the enumeration. However, it's quite certain that the need varies over time according to the flow rate, *i.e.* the quantity of water already distributed. The greater the volume, the lower the need. The need for each use is indeed a function of the size of that use. But a quantity (volume, weight, size, ...) is by definition an extensive characteristic. However, it's indisputable that it's possible to calculate or measure the quantity of water used at any given time by each of the four above-mentioned items as well as the total consumption. Therefore, *need* (marginal utility) is of course an additive characteristic. Consider any document that requires a hand of paper for printing. No one will argue that the *Utility* of the first sheet is greater than that of the second, which in turn is greater than that of the third, and so on up to the twenty-fifth sheet. However, everyone will agree that at the beginning of the print run the requirement is 25 sheets, then after printing the first sheet the requirement is only 24, and thus decreases by one unit with each edition of one page until the requirement becomes zero at the 25th. This example shows again that the *Utility* of each sheet is constant but that the need (marginal utility) evolves according to the quantity.

Consequently, of all that is explained above, it's possible to pose the following equivalences between Economy and Physics:

- ***Utility*** ⇔ ***Temperature*** ⇒ ***(non-additive intensive characteristics)***
- ***Need*** ⇔ ***mass*** ⇒ ***(additive extensive characteristics)***

Nevertheless, the two characteristics of *Need* (marginal utility) and *Utility* are inseparable, in the same way as mass and temperature in physics. Indeed :

- it's impossible to determine the temperature of nothing, because one can only determine the temperature of something, *i.e.* of a certain quantity of matter (solid, liquid, gas, plasma),

- it's impossible to determine the *Utility* of nothing, because one can only speak of *Utility* of something, *i.e.* a certain quantity of *Product* (good, service).

Moreover, an intensive characteristic must be associated with an extensive characteristic. For example, in physics :

- temperature (intensive characteristic) is combined with entropy (extensive characteristic),
- pressure (intensive characteristic) is matched to the volume (extensive characteristic).

However, the product of these characteristics must give an extensive characteristic, namely :

- temperature (int. cha.) × entropy (ext. cha.) = heat (ext. cha.) ⇒ $T \cdot dS = dQ$
- pressure (int. cha.) × volume (ext. cha.) = work (ext. cha.) ⇒ $P \cdot dV = dW$

It can only be the same in Economics and particularly in the case that concerns us. Of course, *Utility* is a completely intactable characteristic (like temperature) but nevertheless perfectly real. If it's possible to measure need, the same cannot be said for *Utility*. However, in physics, we had to wait until the 17th century with Galileo Galilei, but especially the 18th century with Réaumur, Fahrenheit, Celsius, to begin to apprehend the measurement of temperature. However, this didn't prevent individuals from having perceived and grasped the notions and concepts of temperature (hot, warm, cold, icy, ...) and heat (quantity) long before these scientists. Nevertheless, as one should never prejudge the future, there is nothing to say that this characteristic can never become measurable one day (in a statistically similar way to the temperature based on the average energy of the components). However, in the absence of measurement, it's always possible to classify *Products* according to their *Utility*, just as in physics it's possible to order them according to their temperature (very hot, hot, warm, cold, ...).

Moreover, the laws of thermodynamics have existed since the "*Big Bang*", *i.e.* long before these laws were revealed and temperature could be measured. This didn't prevent individuals from applying these laws, without knowing them, sometimes wisely, for example to refresh their drink by exposing the container surrounded by a damp cloth to the sun. Even some birds (terns), during the incubation of their brood exposed to the sun, would have learned to exploit this phenomenon to cool their eggs in order to keep them at an adequate temperature.

The fact that at the present time the measure of *Utility* cannot be exercised shouldn't be an argument to refute this presentation of economic exchange. In physics, the understanding of phenomena doesn't depend on the possibilities of measuring characteristics. For example, the rules for the composition of forces are valid even if there are no devices to measure them. The individuals who had to tow the monoliths of Göbekli Tepe or other sites, knew how to position themselves individually and collectively in such a way that they could exert the minimum effort for the maximum effect, *i.e.* obtain the best efficiency. So, it's possible to state that :

- marginal utility always concerns the evolution of the *price* of several copies of a *Product*, of different *Utility* for a single consumer,
- *Utility*, defined here in the note, always applies to the evolution of the *price* of a single copy of a *Product*, of different *Utility* for several consumers.

Moreover, as all calculations are analytical, using differentials that are by definition infinitesimal, the use of marginal characteristics becomes irrelevant. What is relevant is why several consumers are likely to buy the same *Product* at different *price*s. For an individual, the higher the *Utility* of a *Product* (for whatever reason), the more likely he or she is to buy it at a higher *price*, but this depends on the *offer*. If the offer is low, it's the consumers with the highest *Utility* of the *Product* who will buy it at a high *cost*. Consumers with low *Product Utility* will not buy it at this *price*. On the other hand, if the supply is strong, the distributor wishing to free himself of his goods will sell them at a lower *price* than before and it's the consumers with a lower *Utility* who will take possession of them. If the offer of the *Product* becomes excessive, the *price* will be low so that the least interested consumers can acquire it. But again, in marginalist theory, reference is made to the marginal rate of substitution (MRS), which implies the choice of a consumer between two *Products* X or Y. However, this study is situated in another situation, *i.e.* in a totally different context from that generated by the replacement of one *Product* by another. The problem inherent in this evocation presupposes a static and not an evolving world. Nobody can object that, since the industrial revolution, the standard of living has risen sharply in the so-called “Occidental” countries. What matters is to know by what means and, consequently, according to what laws this evolution has taken place. The problem isn't to replace *Product* X with *Product* Y, but to be able to have *Product* X as well as *Product* Y at one's disposal. It is therefore legitimate to make the following contradictory comparison:

- *Marginalism* ⇒ *Product X or Y*
- *Dynamic* ⇒ *Product X and Y*

Consequently, this paragraph condemns any reference to any existing economic theory and in particular to the "General Equilibrium Theory (GET)".

Note on Utility – Mixing and reaction

In the paragraph “*Utility* - marginal utility”, it was stated that under no circumstances should the need and *Utility* of a *Product* be equated, just as in physics the quantity of a product (mass) isn't confused with its temperature. In physics, two containers each containing 1 liter of water at 50°C will, after mixing, always make 2 liters of water at 50°C. In Economy, it's strictly the same. It has been seen that a dozen knives have no more *Utility* than one, but that the need may be greater to invite friends to a feast. However, with regard to knives, it should be noted that the blade has, in principle, a greater *Utility* than the handle. Now the *Utility* of the knife is greater than that of the two separate components, so this seems to undermine what has just been said (non-additivity of *Utility*), but a better analysis of the analogy with physics confirms this fact, on the contrary, because it's imperative to also distinguish between mixing and reaction.

If one places powdered sulphur in a jar filled with oxygen, one obtains a mixture of sulphur and oxygen, but if by some means one provokes the reaction, one obtains sulphur dioxide which has nothing more to do with the starting products. In Economy, if we mix screws and nuts in a box, we obtain a mixture and we will have to spend energy to sort them out, which is pure thermodynamics. If, on the other hand, we combine screws and nuts, we obtain a bolt that no longer has anything to do with the starting *Products* and has its own *Utility*. It is possible to consider the combination of a screw and a nut, no longer as a mixture, but as a reaction. In the manufacture of a knife, before the handle and blade are assembled, it's possible to consider the whole as a mixture, but the combination (usually by riveting) of these elements causes a reaction in order to obtain a *Product* whose *Utility* is greater than that of the separate elements. Whether in physics, chemistry or economics, it's impossible to separate the components after a reaction. Indeed, after combustion of the sulphur, it's no longer possible to separate the sulphur from the oxygen and the same is true after riveting the handle. The same applies to a bolt, which has to be dismantled if the components are to be sorted out. In physics, the aim is to obtain the best exothermic reaction and in Economics to provoke the reaction increasing the *Utility* as much as possible, which could possibly be called "exophelic" (from the Greek *opheleia* = *utility*). Experience shows that in all cases, Transformers seek to obtain maximum *Value added* and to achieve this goal, they develop *Products* with the greatest possible variation in *Utility* between the purchase of raw materials and the sale of the *Product*.

As a general rule, it should be noted that :

- for a mixture, the name of each element is stipulated (mixture of sulphur and oxygen, mixture of screws and nuts, mixture of blades and handles, ...),
- for a reaction, a new name is used which includes the name of the different elements (sulphur dioxide, bolt, knife, ...).

Flows – Transformations

This study sticks to the facts and doesn’t concern itself in any way with its applications, *i.e.* it only seeks to uncover the laws that govern economic exchanges. Consequently, it doesn't concern itself in any way with knowing whether these laws are good or bad, favourable or detrimental to the Human Being, identical to physics where a theory is always indifferent to human nature. As already stated, she shows that :

- ***all monetary wealth comes only from the transformation of Work into Money, Work itself coming from the transformation of heat,***

Therefore, there is necessarily at least a relationship between the *Money* created and the amount of heat used. An analytical relationship that may play this role of association is proposed in the chapter “Link heat consumed - money created”. Furthermore, it's reasonable to assume that their respective variation is of the same sign. This is in line with ecology, which isn't the aim of this study.

However, it's possible to present that :

- ***these transformations systematically degrade the environment,***
- ***these degradations are more than proportional to the square of the speed of the transformations,***
- ***these transformations cannot be infinite.***

For some decades now there has been a growing awareness, mainly in the industrialised countries, of the effects of an anarchic technical development whose sole aim is the maximum possible profit in the shortest possible time. These effects are undoubtedly detrimental at present, but may become disastrous in the future. It is out of the question here to deal with these consequences, which are the subject of numerous essays, papers, colloquia and other notes and which relate to the last three points, *i.e.* which concern ecology in its entirety. All studies referring to "Sustainable Development" or "Degrowth" postulate first the rarefaction and then the depletion of natural resources, fossil or not (oil, gas, uranium, coal, metals, sand, water, ...), which will lead *ipso facto* to the inevitable cessation of the consumption of these *Products* and consequently of quantitative growth as it's currently defined and understood. In general, these studies only discuss energy flows , *Product* or *Cash.*

In Economics, it's the *Money* that is the main feature. However, it's indisputable that the search for the maximum acquisition of goods or services by individuals requires the possession of *Money.* Moreover, the increase in entropy is systematically presented as the main criterion of this evolution. However, this increase in entropy is never the cause but always the consequence of heat consumption according to the following well-known thermodynamic relationship :

$$dQ = T\,.\,dS \qquad (\textit{heat variation} = \textit{Temperature} \times \textit{entropy variation})$$

Indeed, it seems obvious that in a society where there would be no fuel consumption, entropy would not evolve or would evolve only in very small proportions and the ecological consequences would be negligible or, at most, minimal: Nature would be perfectly able to cope with it. But entropy is only relative to heat and only to heat alone, according to the differential relationship above.

In economics, however, the classical explanations are always based only on approaches of census, enumeration and transfer of either goods or monetary units, which is a matter for accounting and not physics, as the three boxes below clearly show:

1	**Conventional economy (accounting)**
	Product $\xrightarrow{\textit{Flow}}$ ***Product*** ***Money*** $\xrightarrow{\textit{Flow}}$ ***Money***

2	**Thermodynamic**
	Heat $\xrightarrow{\textit{TRANSFORMATION}}$ ***Work*** ***Work*** $\xrightarrow{\textit{TRANSFORMATION}}$ ***Heat***
3	**Physical economy (ecodynamic)**
	Work $\xrightarrow{\textit{TRANSFORMATION}}$ ***Money*** ***Money*** $\xrightarrow{\textit{TRANSFORMATION}}$ ***Work***

1. Frame 1 represents the flows (known or statistical) of *Products* or *Money* circulating between any two economic entities and corresponds to conventional research in Economics,

2. Frame 2 shows the classic transformation (engine) of thermodynamics and its return (machine),

3. Frame 3 outlines the transformation of *Work* into *Money* that is studied in this essay and presents:
   - the existing difference with the usual explanation in box 1. this requires us to free ourselves from the conceptual habits that are common in traditional explanations. Although this emancipation is far from easy, it's nevertheless indispensable,

   - the similarity with the thermodynamic approach of frame 2, which encourages, if not exhorts, the intellectual path of this discipline. It is therefore necessary to submit completely to its formalism by banishing the usual approaches.

Consequently, the use of entropy can only be accepted in the study of frame 2 and must be prohibited in the study of frame 3 since the latter shows that heat doesn't exist in Economics. Entropy doesn't therefore have to be used for this study, but this implies however that it's necessary and imperative to propose another characteristic playing a similar role. It has already been described (paragraph "Economic of Work – Economic of *Money*") that Laziness and Avarice in Economics are equivalent to entropy in Physics. Moreover, as presented in the table above, the flows (frame 1) are related only to accounting while the transformations (frames 2 and 3) are related to physics. It is therefore no longer necessary to consider the flows, but to apprehend and control the following transformations in an appropriate manner:

1. ***first of all, the physical transformation of heat into work,***
2. ***in a second stage, the economic transformation of Work into Money.***

The first point, already well known and mastered, forms the classical thermodynamics; being out of question here to consider economic exchanges as having analogies with statistical physics. The second is the subject of this note. Conversely, this essay is extracted entirely from studies that discuss ecology, sustainable development or degrowth, *etc.*, from which sociological, anthropological, ethical considerations, *etc.*, are deduced. It is therefore devoid of any anthropic criteria and only exposes a physical approach of an analytical nature to the second transformation cited above, but whose formalism has been copied from that of thermomechanics.

Manufacturing – Consumption

We have already defined three types of participants (Paragraph “Natural Sciences - Human Sciences”), namely: a Seller, a Transformer and a Buyer who, over time, each occupy each situation. Indeed, each agent is successively :

- first ⇒ Buyer of the raw *Product*,
- then ⇒ *Product* transformer,
- finally ⇒ Seller of the elabourated *Product*.

Consequently :

1. by considering the agents as Transformers, it's possible to assume that there are a large number of manufacturers situated chronologically one after the other. At the very beginning of the manufacturing process, there is a lot of work to be done (paragraph “*Product* - Work”). This amount of work decreases as the *Product* is developed and reaches zero at the end of the manufacturing process, with each manufacturer reducing the amount of *labour* they performed themselves. During this evolution (reduction of the amount of *labour to be done*) the *price* increases. It is possible to synthesize and write, for the Transformer agents :
   - the amount of *labour to be done* decreases from a maximum to zero, ($dl < 0$)
   - *price* increases from zero to a maximum, ($dp > 0$)

2. Considering agents as Buyers, it can be argued that there are a large number of consumers placed in time in single file. Then, at the very end of the manufacturing process, there is no more *Labour to be done* (paragraph “Product - Work”) and its value is zero. But at this point, the last Transformer must acquire a *Product* from the previous (second to last) Transformer in order to complete the manufacture of a new one. This penultimate Transformer must itself purchase a *Product* from the Transformer located before it (penultimate) in the list of manufacturers. And so on and so forth. It follows that the *Labour to be done* increases to a maximum for the Transformer who performed the first operation on this new copy of the *Product*. However, during this evolution (increase in the amount of *Labour to be done*) the *price* decreases. For example, a baker buys the flour more expensively than the miller bought the grain from the cooperative, which itself bought the grain cheaper from the farmer, *etc.* So it's possible to synthesize and write, for the buying agents:
   - the *price* decreases from a maximum to zero, ($dp < 0$)
   - the *Labour to be done* increases from zero to a maximum, ($dl > 0$)

It should be noted that, whatever the case, the *price* and the *Labour to be done* evolve in opposite ways, which doesn't in any way mean that their respective variations are equal: one can evolve rapidly and the other slowly. Thus, the maximum amount of *Labour to be done* and the maximum *price* can obviously vary according to the amount of *Work* and *Money* spent. So, case 1 above relates to the transformation *Work→Money* and case 2 to the transformation *Money→Work*: these transformations are listed in the table in the paragraph “Flows - Transformations”.

Then :

1. If we consider the *Money* as the main characteristic, the transformation *Work→Money* is the only interesting one. So :
   - a decrease in *price* causes the creation of *Money* and the increase in the *purchasing power* of the consumer,
   - a *price* increase leads to the destruction of *Money* and a reduction in the consumer's *purchasing power*.

2. If we consider *Work* as the main characteristic, the transformation *Money→Work* is the only interesting one. So :
   - a decrease in the amount of *Labour to be done* leads to the destruction of *Work* and the reduction of the supplier's *employment*,
   - an increase in the amount of *Labour to be done* causes the creation of *Work* and an increase in the supplier's *employment*.

Supply – Demand

It is undeniable that the law of "*supply* and *demand*" has a strong macroeconomic character. It is therefore inoperative as an explanation for microeconomic phenomena and must therefore be rejected in this study. Indeed, this law interests a large number of actors and consequently exchanges. The justification of this law can possibly only be approved for a significant number of consumers and, as a general rule, for several suppliers. Because of its macroeconomic character, its use isn't justified at least in the case that concerns us here, *i.e.* in the dynamic vision of a microeconomic exchange. However, this exchange can be considered as large as one wants. It can therefore be considerable provided that it's the only one to be examined.

The poet (Gilbert Bécaud) sang that "*throughout the markets of Provence*", there are a large number of suppliers selling "*[...] for 100 Francs of thyme from the garrigue, a little saffron and a kilo of figs, [...]*" and even more consumers. Once the market is over, the *supply and demand* for these herbs and fruits can be counted. However, it's undeniable that every shopper at these markets doesn't care whether these foodstuffs were easy or difficult to produce, how much tonnage is on display on the stalls and how many customers judge their qualities and their *price*. In the same way, when a morning person goes to fetch his crispy baguette, he doesn't ask the baker how many have been produced. Likewise, he doesn't ask his butcher how many meters of sausage are dried in his warehouse. For a given consumer, the only thing that matters is the level of *Utility* of the *Product* he wants and its *price*. Any other consideration is nothing but rambling and intellectual digressions.

If we consider the two characteristics of supply and demand of any *Product*, it's possible to write the following reversible chronological sequence:

$$\cdots \leftrightarrow \text{Supply} \leftrightarrow \text{Demand} \leftrightarrow \text{Supply} \leftrightarrow \cdots$$

But, this sequence has neither tail nor head, has neither sense (direction, orientation) nor meaning (significance, justification). Indeed, it can be reversed without any consequences because it will always be identical to itself, whether it's read from left to right or from right to left. On the other hand, if another characteristic is inserted in this sequence, this reversibility disappears. In fact, by introducing the *price* as a third criterion, two possibilities come into play, namely :

··· ➔ Supply ➔ price ➔ Demand ➔ ···

··· ➔ Demand ➔ price ➔ Supply ➔ ···

This amounts to intercalating the *price*, either between *supply* and *demand* or between *demand* and *supply.* There are therefore now two different and temporally ordered sequences, because this operation has implicitly provoked the introduction of :

- ***the time arrow,***

which always moves inexorably in the same direction. Consequently, only one of the two sequences defined above is in agreement with reality, the other can never happen because :

- ***the great clock of the universe can never be turned upside down,***

because it's imperative to discern time and the phenomenon, which always takes place in time.

These two sequences correspond to the two commonly accepted visions of the causes of the evolution of an *economic system.* In fact, some argue that *supply* is the main characteristic and *demand* is the consequence. The increase in *supply* causes the increase in *demand* by stating that :

- ***supply creates its own demand,***

while others argue that it's demand that is the cause of change by saying that :

- ***if demand increases, supply increases.***

It is therefore necessary to know the only valid ordered sequence of these three elements (*supply*, *price* and *demand*), *i.e.* the one that is compatible with the direction in which the event is taking place. It must be the only one that represents the evolution and the basis on which reasoning will eventually have to be based. It is necessary to know the possible interrelationships between the *price* of a *Product*, its *supply* and its *demand*, in order to define in an irrefutable way how the possible influences of a variation of these three characteristics on the other two are combined, without ever ignoring time. Indeed, although it doesn't appear in these sequences, its presence is constant, underlying and its hold on economic or other phenomena is total.

All economics textbooks present *supply* and *demand* as quantities supplied and demanded at a given moment and therefore never stipulate the length of time during which these quantities are offered or demanded. This way of understanding these characteristics is totally illogical.

Indeed and as proof:

Any individual maintains that the *demand* for automobiles is 1,944,000 units. A second individual claims that the *supply* is 162,000 vehicles. Anyone will judge that the *supply* is significantly lower (12 times) than the *demand*, but if we consider that the first character determines his response over the year and the second over the month, then the balance exists. Logic dictates, of course, that *supply* and *demand* must be understood within the same time frame and, therefore, that this time frame must always be specified. Considering *supply* and *demand* as quantities is a matter of accounting, whereas conceiving them as speeds or flows (quantities offered and demanded per unit of time) switches them *ipso facto* into the field of physics and that changes everything. Thus, it follows that :

- ***it's obligatory, imperative, to reason as a physicist and not as an accountant.***

Now, there is a branch of physics, in this case thermodynamics, where time is omnipresent without ever appearing in relations. It always plays its part in marking irreversibility. The failure to take the time factor into account is always a redhibitory error in the understanding of phenomena, whether economic or otherwise.

According to the law of "*supply* and *demand*", it's customary in classical microeconomics to draw a diagram combining the following two functions:

1. when the *price* increases, *demand* decreases,
2. when the *price* increases, *supply* increases.

It is immediately apparent that the *prices* of these two assertions don't relate to the same copy of the *Product*. Indeed:

1. when the *price* varies, the *demand* for the *Product* varies inversely, but the requested copies of the *Product* are real, *i.e.* already built, manufactured,

2. when the *price* varies, the *offer* of the *Product* varies in the same direction but the offered copies of the *Product* are virtual, *i.e.* not yet developed, not yet manufactured. This is therefore only a possible assertion which must therefore be rejected as sometimes true and sometimes false. Indeed, no logical reasoning can be based here on uncertainty. "*Mayhap yes Mayhap no*" has absolutely no place here.

Let us make an analogy with mechanics in order to understand the influence of the "*arrow of time*" and only this influence.

Hypothesis 1

Suppose a steam locomotive running on a horizontal track at constant speed. The amount of steam existing in the boiler can be considered as the *supply* of steam and the amount used as the *demand*. From these data, it can be seen that the flow of steam (which has the dimension of a speed = quantity of steam per unit of time) injected into the cylinders by the locomotive engineer is equal to that of steam created by the driver since the speed is constant. There is therefore a balance between a certain distance travelled and an equal *supply* and *demand* of steam.

Hypothesis 2
Now suppose that the locomotive encounters a rise. As a result, the locomotive engineer will open the steam intake valve further, increasing his *demand*. In order to prevent the steam from running out, the driver introduces more coal into the boiler to create additional steam to compensate for the increase in its use. From this, the following two conclusions can be drawn:

1. when the inlet valve is opened, it's indisputable that the quantity of usable steam decreases, so that its *supply* decreases simultaneously with the increase in steam *demand*. Moreover, the distance travelled (per unit of time) will be less than that of the first hypothesis,

2. From the moment the driver introduces fuel, it's undeniable that the *supply* increases. However, there is no longer any simultaneity with the variation in demand that took place prior to the increase in *supply*. There is a chronological dissociation between the moment of the increase in *demand* and that of the increase in *supply*. Moreover, the speed has been modified with the rise, so the path travelled per unit of time is different from that of the previous hypothesis (horizontal path).

After a certain time, it will happen that the speed becomes constant again at a different value than before and at that time the *supply* and *demand* for steam will be equal again but for a different value. There is therefore a new balance between another path and another *supply* and *demand*, this balance being different from the previous one.

Some may always retort that it was enough to anticipate the rise and to heat more beforehand. Still, it would be necessary to know what is going to happen, *i.e.* to know the future, which is impossible. Here we try to situate ourselves in similarity with the Economy. However, many people try to anticipate variations in demand, which is perfectly justified. However, before the shipwrecks of the Erika and Prestige oil tankers, who could have foreseen their consequences on the *demand* for oysters from Marennes d'Oléron and on the tourist demand of the Atlantic coast ? A profusion of examples of this type could be presented, which would show that neither the moment of the variation nor its amplitude can ever be predicted exactly.

Hypothesis 3
Now suppose that the ascent is over and a descent begins. The mechanic would normally have to partially close the inlet valve. Under penalty of discharge at the valve, the driver is therefore obliged to reduce the amount of fuel introduced into the boiler. The following two conclusions can be drawn from this:

1. when the inlet valve is partially closed, it's indisputable that the quantity of usable steam increases so that its *supply* increases simultaneously with the decrease in the demand for steam. Moreover, the distance travelled (per unit of time) will be greater than that of the second hypothesis,

2. From the moment the driver stops the fuel supply, it's undeniable that the *supply* decreases. However, there is no longer any simultaneity with the variation in *demand* that took place prior to the decrease in *supply*. There is a chronological dissociation between the moment of the

decrease in *demand* and that of the decrease in *supply*. Moreover, the speed has been modified with the descent, therefore the path travelled per unit of time is different from that of the previous hypothesis (upward path).

After a certain time, it will happen that the speed becomes constant again at a different value than before and at that time the *supply* and *demand* for steam will be equal again but for a different value. There is therefore a new balance between another path and another *supply* and *demand*, this balance being different from the previous one.

In physics, and particularly in the above example of the locomotive, it's never a question of drawing one curve giving the path travelled as a function of the *supply* of steam at a given moment and another curve as a function of the *demand* for steam at another moment and under different traffic conditions, as this is of absolutely no interest. Steam *supply* and *demand* are always seen as flow rates and never as quantities.

Let us now return to an economic explanation with what has just been said in mechanics. Indeed, it's possible to consider an exchange before a variation in *demand* in which there is a balance between *price*, *supply* and *demand*, the latter two being equal. When there is an increase in *demand*, *supply* simultaneously decreases but then producers tend to produce more in order to satisfy this increase in *demand* and to sell more copies of the *Product*. However, as in mechanics, this increase in *supply* will only take place later, *i.e.* the increase in *supply* isn't synchronised, simultaneous with the increase in *demand*. It would be exactly the same if, instead of an increase in *demand*, a decrease took place.

Therefore, the following very important point can be made:

- ***a variation in demand causes a change in supply:***
  - ***a REAL CONSEQUENTIAL variation of the opposite sign,***
  - ***a DIFFERENT EVENT variation of the same sign.***

As the two *price* functions (*offer* and *demand*) don't correspond at the same time, they don't apply to the same copies of the *Product*. Consequently, it's out of the question to say that there is an equilibrium *price*, except in the case where no change (of any kind) could occur. Now, all the agents' actions are precisely aimed at improving living conditions and therefore at improving the variations in economic exchanges.

If we take the example of swimming costumes, it's certain that depending on the climatic conditions of the summer periods, demand can vary rapidly in very high proportions. The *price* may be at a certain level one year and at another the following year. It is therefore erroneous to consider a *price* given by the intersection of the curve representing the *demand* of one year and the curve representing the offer of the following year, because this would only give a virtual average *price* and without interest for the naiad who is only interested in the *price* of the swimming costume to which she is devoted and who disdains a *price* without real existence.

An analogy between the *supply* of steam in a locomotive and the *supply* of *Products* placed on the market, as well as the *demand* (consumption) of steam and the *demand* for these same *Products*, has just been exposed. This analogy has made it clear how *price*, *supply* and *demand* are linked chronologically. Indeed, since in assumption 1 above, variations in demand and *supply* are simultaneous, the *price* cannot be placed between them. On the other hand, in hypothesis 2, the variations are staggered in time due to the insertion of the *price* between *supply* and *demand.*

By posing :

° = *Finite variation of a characteristic*
p = *price*
S = *supply*
D = *demand*

the only possibility is to write :

$$\ldots \Rightarrow \overbrace{\pm\Delta S \Rightarrow \mp\Delta p \Rightarrow \pm\Delta D}^{Copy\ n} \Rightarrow \overbrace{\pm\Delta S \Rightarrow \mp\Delta p \Rightarrow \pm\Delta D}^{Copy\ n+1} \Rightarrow \ldots$$

$$\xrightarrow[\text{times}]{\qquad\qquad\qquad\qquad\qquad\qquad}$$

Thus and according to this sequence, it's imperative to take time into account. As a result, the *supply* and *demand* of a *Product* must necessarily be considered as two flows, two speeds and especially not as two quantities: the way they are usually exposed. All the diagrams and reasoning commonly presented indicate that *supply* and *demand* are quantities. For example, on one day the *supply* of cherries may be three tons and 15 days later only one ton. But in the meantime there has to be a variation, which can never be instantaneous. It is therefore obligatory, required, imposed to take into account the duration of the variation considered and consequently the time under penalty of logical heresy. Of course, the same applies to *demand.* Consequently :

- *supply* is the number of copies of a *Product* put on the market per unit of time but it's also the number of copies of this *Product* manufactured in the same time frame. We can say that the offer is 333 pairs of shoelaces manufactured per day or 8 alarm clocks manufactured per hour, *etc..*,
- *demand* is the number of copies of a *Product* sold by suppliers or acquired by consumers but always per unit of time. We can say that the demand was for 99 flea collars sold per day or 44 mops sold per hour, *etc..*,

because it's always necessary to specify the length of time during which the quantity of *Products* is offered or requested, otherwise there is a risk of misunderstanding and confusion. Therefore, the offer is a direct function of the speed with which a copy of the *Product* is made, in exactly the same way that the speed of rotation in mechanics is a direct function of the speed with which each cycle is performed. Therefore :

- ***the offer is a consequence of the speed at which the Product is made.***

It is common to hear the following assertions:

- “when demand increases, the *price* increases” (or *vice versa*),
- “when demand increases, *supply* increases” (or *vice versa*).

But :

- ***no SPONTANEOUS variation in demand is possible.***

Indeed, the evolution of *demand* is never a cause but always a consequence, either of an inverse variation of the *price*, or of a direct variation of the *Utility.*

Therefore, to say that :

- “when *demand* increases, ...”

is meaningless because, in this case, *demand* is considered as the cause of the phenomenon, which is impossible. The box below shows very simply the mistake made by referring to the law of “*supply* and *demand”*. Indeed, only the law of *Utility/Price*, which is defined later in the note in a much better way, should be taken into account. It must be considered as a rule that doesn't allow for any exceptions and derives from the Principle of Causality. Therefore :

- ***the law of “Utility/Price” always refers to a single copy of the Product,***
- ***the law of “supply and demand” always concerns two consecutive copies, therefore not simultaneous,***

as set out in the box below :

$$\ldots \Rightarrow \overbrace{\underbrace{\pm\Delta S \Rightarrow \mp\Delta p \Rightarrow \pm\Delta D}_{\text{law of } \textit{Utility/Price}}}^{\textit{Copy n}} \quad \Rightarrow \quad \overbrace{\underbrace{\pm\Delta S \Rightarrow \mp\Delta p \Rightarrow \pm\Delta D}_{\text{law of } \textit{Utility/Price}}}^{\textit{Copy n+1}} \Rightarrow \quad \ldots$$

law of *supply* and *demand(1)*

law of *supply* and *demand(2)*

times

In this context, the laws identified 1 and 2 correspond respectively to the classic dogmatic evocations, namely :

1. when the *price* increases, the *supply* increases and vice versa,
2. when *demand* increases, the *price* increases and vice versa,

and naturally show that, in both cases, *supply* and *demand* don't relate to the same copies of the *Product* under examination and their reciprocal variation cannot therefore be simultaneous. It follows that the consequences of these two hypotheses are only eventualities and it's therefore now possible to affirm that on a microeconomic scale :

- ***the law of "supply and demand"* doesn't *exist.***

It is quite clear that *supply* and *demand* are characteristics that apply to a large number of economic agents, whatever they may be. Therefore, if one of these two characteristics is considered, one shouldn't take into account a single consumer but all of them. For example, it would be absurd to consider a single consumer of a car and at the same time to take into account the total demand for these vehicles (of the order of two million per year in France), since it's all users who correspond to *demand*. Since *supply* and *demand* are macroeconomic characteristics, it's a mistake to apply them to reasoning involving a single consumer in an exchange. It is therefore essential to find a characteristic linking the *price* of a *Product* and the *Choice* of a consumer for this *Product*, which is none other than the *Utility* he attributes to it. From this, we can see that debating or polemicising about *supply* and *demand* can bring nothing, since they are only consequences of the speed of production.
It is therefore at the level of this speed and only at this level that the causes of any evolution must be sought. Indeed, to vary the speed of manufacture, anyone will agree that it's essential to exert a *Force* (positive or negative). If no *Force* is exerted, then the production speed will remain constant and therefore *supply* and *demand* will not change.

It is reiterated that :

- ***it's at the level of the speed of manufacture that it's necessary to seek the causes of the evolution of an economic system.***

As already mentioned, for a first approach to the phenomena, it's still possible to say that the speed of manufacture of the *Product* is the speed with which the manufacturing cycle made up of the 4 sequential stages, already indicated (paragraph "Natural Sciences - Human Sciences"), is covered. In physics, it's the analysis of the phenomena occurring during a single revolution (or piston stroke) which explains the creation of mechanical energy (*W work*): the speed of rotation being the number of times the Carnot and Clapeyron cycles are performed per unit of time. The perfect analogy between mechanics and Economy should therefore be noted. In fact, and as already stated, the offer is a characteristic that can be defined as a speed corresponding to a certain number of times a *Product* is manufactured, *i.e.* a certain number of times the manufacturing cycle is peformed per unit of time. Consequently, any research on the characteristics of *supply* and *demand* (as well as rarity, which is only a different vision of supply) can only lead to misunderstandings as to the explanation of the phenomena of enrichment (or impoverishment) of an *economic system*, taking them into consideration being only a conceptual illusion.

It is therefore possible to define *supply* and *demand* as the quantities of a *Product* offered and demanded, but always per unit of time, *i.e.* :

$$S = \frac{Q_S}{t} \text{ and : } D = \frac{Q_D}{t}$$

with :

Q_S = *number of copies offered (manufactured) of the Product*
Q_D = *number of requested (used) copies of the Product*

Thus, supply and demand must be defined as speeds and more precisely as flows, either analytically or as follows :

$$S = \frac{dQ_s}{dt} \text{ and : } D = \frac{dQ_D}{dt}$$

Supply – Demand Balance

It should be noted that :

1. in physics, there is only one heat flow (Q) which circulates from a hot source to a cold source, part of which is transformed into mechanical work (W),

2. in Economics, there are two flows :
   - one of *Economic Work* (T) which circulates from the supplier to the consumer, part of which is transformed into *Money* (M),
   - the other of *Money* (M) which circulates from the consumer to the supplier, part of which is transformed into *Economic Work* (T).

The first economic flow corresponds to "*supply policy*" and the second to "*demand policy*". Indeed :

1. It has been explained that the *Money* is the one that the consumer holds in addition after a fall in *price* which enriches him. This phenomenon obligatorily requires the application of a *Work* (T) with an economic purpose so that the *Product* can be produced as quickly as possible and as cheaply as possible. This therefore refers to the "*transformation Work/Money*". Until the industrial revolution, this *Work* was performed only by human or animal (except for that coming from a few very simple machines). For the last two centuries, it has been mainly motors and machines that have been performing the *Work*. It is clearly stated that *wealth* comes only from the performance of superior *Work* and not, for example, from a reduction in remuneration.

Moreover, it's well said that the *price* of *Products* must go down and thus benefit all the consumers of these *Products*, and not that this decrease serves to increase dividends.

2. However, the previously defined *Money*, *i.e.* the *Money* which a consumer owns following a reduction in the *price* of a *Product*, is normally used to acquire another *Product* or a new copy of the same *Product* at a later date (subject to the constraints, *e.g.* fiscal, to which he is exposed). However, the acquisition (consumption, use) of a *Product* generates *Work* that must be performed since a new copy of the *Product* in question must be manufactured. This has already been explained in the paragraph "Manufacture - Consumption". In fact, it's very often heard or read that "all I have to do is increase my wages and I will make the craftsmen work" or similar assertions. This therefore refers to the "*transformation Money→Work"*.

At this stage, it must be perceived that all individuals are consumers. Whatever their age, function, occupation, social position, *etc.*, they can in no way be discriminated against analytically by their consumption. Of course, some may consume more than others, which isn't disputed. But in a normal society (except for the above-mentioned individuals - recluse, hermits, ...) nobody lives with zero or negative consumption because consumption is always positive. *A contrario*, in view of what has been expressed so far, the people who perform *Economic Work* are only those who generate a difference in *Utility* by lowering the *price* of the *Product* they produce. The others may perform *mechanical work* but in no way *economic Work*. This means that they can be exhausted at the end of their mission without having in any way given birth to any *monetary wealth.* A contract worker may find herself harassed at the end of her service for having covered all the pavements in her sector at high speed, but nobody will argue that she has enriched society through her *labour*.
Thus, in today's society, some people work economically and some don't. They can be discerned analytically according to whether their action determines a positive, zero or negative evolution of *monetary wealth*, that is to say, respectively, a decrease, a constancy or an increase in the *price* of the *Product* to which they devote themselves.

The fact that certain individuals cannot be the cause of an increase in *monetary wealth* doesn't in any way indicate the vacuity of their occupations, their function or otherwise. Their *labour* can be eminently useful and serve on other than economic levels such as educational, cultural, religious, security, medical, *etc.*, thus enabling society to function better. It is therefore by no means a good thing that civil servants are useless people. They can very well perform important, profitable and even indispensable *labour* for society. Those who enrich society through their *economic work* are generally subject to very strong pressures of competitiveness, profitability, productivity, *etc.*, and their social position is often devalued, depreciated. However, it's the opposite that should happen. But it has already been specified that it's *Work* that creates the *Money* and not a fall in wages. A fall in *prices* makes all consumers rich, and of course, even those who don't perform any work. A fall in the wages of only those who "work" (only those who make *prices* fall) increases inequality. Moreover, as the wage bill is reduced, a certain amount of *Money* will be lacking to consume later after the *transformation of Money→Work*. Therefore, it's argued that the two transformations *Work→Money* and *Money→Work* must be equivalent, both in their cause (*Work* or *Money* deployed) and in their consequence (*Money* or *Work* obtained). It follows that :

- ***neither of these two policies (supply policy, demand policy) should be favoured, only the balance between them should be sought.***

In physics, the balance between the quantity of work demanded (W) and the quantity of this work to be provided is always sought, *i.e.* one seeks to equalise a quantity demanded by a quantity offered. For example, to increase the speed of a locomotive, the locomotive engineer opens the steam intake valve more, thus increasing demand. To satisfy this increase, it's imperative to increase supply, which is a perfectly commonplace occurrence. The only effective way to do this is to increase the speed with which the work cycle is completed. This cycle is made up of the following four sequences:

1. isothermal expansion ⇒ (the temperature of the gas remains constant),
2. adiabatic expansion ⇒ (the gas temperature drops),
3. isothermal compression ⇒ (the gas temperature remains constant),
4. adiabatic compression ⇒ (gas temperature increases).

The faster these four steps are performed, the more mechanical work will be available and the higher the speed of the locomotive. They thus form a cycle which is very briefly described above. The same reasoning would apply if a deceleration is required instead of an acceleration. In Economics, considering the three actors (Seller, Transformer, Buyer) defined above (paragraph “Natural Sciences - Human Sciences”), a cycle rigorously similar to that of thermodynamics can be defined as follows (with *opheleia* = *utility*) :

5. isophele Seller-Transformer tractation ⇒ (*Utility* of the *Product* remains constant),
6. adiabatic use by the Transformer ⇒ (*Utility* of the *Product* falls),
7. Isopheles Transformer-Acquirer tractation ⇒ (*Utility* of the *Product* remains),
8. adiabatic manufacture by the Seller ⇒ (*Utility* of the *Product* increases).

The name of sequence 6 (use by the Transformer) seems *a priori* absurd by maintaining that the *Utility* decreases. Nevertheless, it's necessary to take into account the position of the observer. For an observer outside the system, it's certain that the *Utility* increases when the Transformer modifies the *Product*, *i.e.* it manufactures it. For this observer, this sequence is a fabrication. However, for the Transformer, who is inside the *system*, this sequence is considered as a use. This has already been explained in the paragraph “Principle of Relativity”. The table below shows the attributes, already specified previously, relating to the two types of transformations (sequences).It is worth noting the strict similarity between the two mechanical and economic cycles that have just been outlined above.

SEQUENCES	PHYSIC	ECONOMY
with external contact	***1 and 3 (isothermal) constant Temperature***	***5 and 7 (isopheles) constant Utility***

without external contact	***2 and 4 (adiabatic) variable Temperature***	***6 and 8 (adiabatic) variable Utility***

In conclusion :

- ***In Economy, as in mechanics, only the variation of the speed (acceleration or deceleration) of the cycle execution allows the balance between the supply of a Product and its demand.***
- ***Any other consideration is inoperative.***

However, this is only valid for the transformation *Work→Money.*

Value – Utility

As already stated, some individuals refute that the *price* of a *Product* is a function of its *Utility* to an agent on the pretext that "*air is very useful and yet costs nothing*". So do they steal it when they practice their favourite sport, namely underwater fishing? Air is a *Product* like any other because it has a cost in all places where it's lacking (aircraft, submarines, mines, inhabited space stations, *etc.*) or when its quality is unsuitable for the chosen use (sterile enclosures, "Biological Safety Level" enclosures, discharges requiring filtration or decontamination, *etc.*).

Whatever the *Product*, if an agent already has it, he has absolutely no *Utility* to acquire it. If this agent owns a vehicle and a second one is profitable for him, he will buy it, but if he already owns two cars, he will not buy a third one if he has no *Utility.*

So let's see a person who is suddenly overcome with a compelling and irrepressible desire to acquire door handles. Here he is, robbing all the hardware stores and DIY shops in his district with this utensil, then entering his cosy nest, all perky, exclaiming "*Houhou Chérie, I'm giving you a surprise! To increase demand, come and see what I bought*"! And then you have to imagine Chérie's face. Why is this never happening? Obviously, because the individual already has handles. If, for whatever reason, a handle is damaged, he will only buy one and not a pallet. The individual, who has handles on every door in his flat, doesn't have to worry about the cost of this *Product.* For him, this object costs nothing. Of course, he can know its *price*, but in exactly the same way as he can be informed of the *price* of air sold in back packs for underwater excursions.

This example illustrates to the point of absurdity, but nevertheless perfectly, that if the need for a *Product* is satisfied, that is to say if it's null, its *Utility* is also null. It would then be ridiculous and even inept to acquire it. This is why it's said that "*air is very useful and yet costs nothing*". In fact, always, except for a few rare and very special cases (some examples of which are given above), everyone has air at his or her disposal and therefore has no reason to acquire it. It is obvious to notice that if an individual acquires a *Product* it's because of the existence of a single effective cause, namely :

- ***that he has Utility and therefore needs it.***

This has already been stated (paragraph "*Utility* - marginal utility") that *Utility* and *need* are linked, in the same way as in physics where temperature and mass are interdependent. If the need doesn't exist, the *Utility* of the *Product* is zero. This is why some individuals refute *Utility* as a purchasing criterion, arguing that "*air is very useful and yet costs nothing*". This is only due to the fact that in normal daily life everyone has air at their disposal, which means that there is no need for it. However, in places where air is typically absent it has a certain cost. These criteria show perfectly well that the thirsty traveller in the desert has an imperious need for water but absolutely no need for diamonds. As a result, water has a definite *Utility* and diamonds have none. He is therefore willing to acquire the precious liquid at a high *price* and will forsake diamonds which have no *Utility* for him. However, as already exhibited, he may very well know the *price* of diamonds in the same way that any reader of this note may well know the *price* of a "charpy impact machine" but who isn't going to buy a copy to exhibit it in the middle of his living room. It is the *Utility* of a *Product* for an agent that defines the *price* he is likely to pay for it. For a given agent, the higher the *Utility*, the more likely he is to pay for it. This is why when *supply* decreases, the *price* increases because the agents with the highest *Utility* will buy the *Product*, but in return the *demand* decreases.

We know that a difference in *Utility* must exist for *Money* to take place. But in daily life, air is neither transformed nor displaced (the *Utility* is therefore constant, $dU = 0$). Consequently, *Money* doesn't exist and air doesn't cost anything. All this is perfectly in line with what has already been stated, justifying the universality of natural laws from which the Economy cannot escape.

The sequential sequence already outlined, namely :

$$\ldots \Rightarrow \overbrace{\pm\Delta S \Rightarrow \mp\Delta p \Rightarrow \pm\Delta D}^{\textit{Copy } n} \Rightarrow \overbrace{\pm\Delta S \Rightarrow \mp\Delta p \Rightarrow \pm\Delta D}^{\textit{Copy } n+1} \Rightarrow \ldots$$

$$\xrightarrow[\text{times}]{\qquad\qquad\qquad\qquad\qquad\qquad}$$

shows that an *economic system* is normally self-regulating. However, this is only true when the system under consideration is in equilibrium, *i.e.* stable, corresponding, for example, to a market saturated with a *Product*, such as a renewal market. It is then possible to assimilate these variations to fluctuations, identical to the physics of operating a system in a permanent stationary state. For example, in the case of a market for the renewal of a *Product* (such as that of refrigerators) in a saturated *economic system* (such as that of Japan), the number of these manufactured objects is roughly equal to the number of those discarded (excluding imports and exports). Here it is noted that the *price* is almost constant, which leads to the writing of the relation :

$$\frac{\partial p}{\partial t} \approx 0$$

This type of relationship could apply to many other characteristics such as *Supply*, *Demand*, *Utility*, *etc.*

"Utility/Price" Law

It is common to hear or read that *price* is an inverse function of rarity, *i.e.* the rarer a *Product* is, the more expensive it's. This is an assertion that is sometimes correct, but it's far from general. However, we know that a single example calling into question the veracity of a law makes it *ipso facto* wrong and must be rejected in the limbo of history.

Everyone knows that a one-eyed horse is rare and yet inexpensive. But a blind horse is even rarer and yet even cheaper. If these animals are not expensive it's not at all because of their abundant *supply*, but only because they have no (or almost no) *Utility*, generally being acquired only out of compassion. I own a painting which, by definition, is unique and therefore extremely rare, but which is such a worst painting that I would have to give *Cash* to a potential buyer to get it. Consequently, to maintain that "it's rare, therefore it's expensive" is a fault, a serious mistake.

The consumption of "coltan" (a mixture of colombium and tantalum ores) was almost nil a few decades ago, but the strong growth of the mobile phone and laptop market (used to make capacitors) has caused a real explosion in this consumption and consequently in the *price* of this mineral. When this market reached saturation, the demand for "coltan" fell, so the supply increased and the *price* fell. However, it's quite obvious that it was rarer at that time than 10 or 20 years earlier because there was less of it. Centuries ago its *price* was zero only because it had absolutely no use. In the end, *rarity* is only a relative characteristic, evolving inversely to *supply*. In fact, *rarity* is only a relative characteristic and evolves inversely to *supply*:

- if *supply* is low, *rarity* is high,
- if *supply* is plentiful, *rarity* is low.

Therefore, the above examples impose the falsity of assertions directly linking *price* to *rarity* and consider them as a law.

When talking about *rarity*, it's implicit that *demand* is relatively large in relation to *supply*. Consequently, if there is *demand*, it's exclusively because the *Product* in question has a certain *Utility* for certain buyers. Indeed, for Aristotle, who was very fond of the law of "s*upply* and *demand*", "rare earths" were unknown and therefore had absolutely no *Utility* and, despite their *rarity*, their demand was therefore nil. Therefore, arguing and quibbling about rarity leads to no profit.

Identically, the "*allocation of rare resources*" is often referred which only means that the *supply* of these resources is low. The use of such expressions only amounts to complicating life for nothing. As in physics and as already mentioned, only one term, with a perfectly specified definition, should be used. The expressions "allocation of rare resources", "rarity", *etc.*, have no place here. Only the noun "supply" is used and is quite sufficient because it's univocal and monosemic.

Let's give the particular example below. VCRs appeared on the market in the early 1970s at a *price* of more than 10,000 French Francs at the time (*i.e.* around 1,500€, not including inflation). At that time, only consumers with a great *Utility* bought them. Personally, I acquired a copy on special offer in 2005 at a *price* of 75 € (about 500 Francs, or more than 20 times less taking inflation into account) which seemed to me to be more than enough for the use I could make of it and therefore for the *Utility* I was giving it. It was I and I alone who judged the timing or, more precisely, the maximum *price* I was offering and which I felt corresponded to its *Utility*, *i.e.* the service it could render me. Of course I waited for the *price* to go down but in any case it was the supplier and he alone who adapted to my wishes and absolutely not the other way round. This is always true and doesn't admit of any exception (except in cases of monopoly, studied later in the chapter devoted to it). It would be possible to answer that some consumers have acquired a more expensive VCR, but only because they had a greater *Utility* than me, and in case they didn't have sufficient income, they borrowed it in order to satisfy that *Utility*.

If the supplier wants to sell the *Product* he proposes it's obligatory that he does so in such a way as to satisfy the consumer as to the *price*, which is always and exclusively in correlation with the *Utility* granted to the *Product* by this consumer, even if this *Utility* is disturbed, distorted, deregulated, perverted, altered, disguised, *etc.*, by advertising, sales technique, bad advice, vanity or other causes. Contrary to the conventional doctrines of Economics, this implies that the economic agent isn't perfectly rational and informed. So :

- ***homo œconomicus can be wrong and can be abused.***
  - ***"Can be wrong" means that it's not rational,***
  - ***"may be abused" means he is misinformed.***

The myth of "*homo œconomicus*" turns into the reality of "*quidam*".

It is common to hear the dogmatic sentence (and even assert) that "if the *price* is high, it's because *demand* is high", which is a blatant error. It is because of low *supply* that the *price* is high, provided that there are individuals whose *Utility* of the *Product* in question is high, which implies a drop in d*emand*. Wrongly, it's believed that *demand* increases because these individuals seek by any means and under any conditions to acquire the *Product* they are lacking.

By taking up again the phenomenological sequence of supply, *price* and *demand*, namely :

$$\ldots \Rightarrow \overbrace{\pm\Delta S \Rightarrow \mp\Delta p \Rightarrow \pm\Delta D}^{\textit{Copy } n} \Rightarrow \overbrace{\pm\Delta S \Rightarrow \mp\Delta p \Rightarrow \pm\Delta D}^{\textit{Copy } n+1} \Rightarrow \ldots$$

$$\xrightarrow[\text{times}]{\hspace{20em}}$$

It is easy to see that *demand* cannot influence *price*, since *demand* is an inverse function of *price* and never the other way around. If the *price* is high, it can only be because of limited *supply* and conversely, if the *price* is low it's because *supply* is high.

Mention is often made of the “allocation of rare resources”. It is only the *Utility* of these resources that consumers have. Only those who have the most *Utility* will buy them, and the higher the *Utility*, the higher the *price*. It is undeniable that when a new *Product* is put on the market, its *supply* is low. The *price* is high and its demand low. Then the *supply* increases, which causes the *price* to decrease and the *demand* to increase. Finally, the supply becomes large, which means a low *price* and high *demand*. The evolutions of the three characteristics (*supply*, *price* and *demand*) are hardly questionable and indicate that if *demand* is high, it's because the *price* is low. Those who claim that when *demand* increases, the *price* rises forget to specify that this increase causes a correlative decrease in *supply*, and that it's this decrease that induces the *price* increase. This is so true that there are so many examples of voluntary restraint of *supply* in order to instigate an increase in *price* or at least its maintenance. One of the most blatant cases, valid worldwide, is that of the *price* of oil, which is generally subject in part to the restrictive production agreements of each OPEC country, and therefore to the quantity of crude hydrocarbons offered on the market. We know that, whatever the exchange, a consumer always exerts on the supplier a *Force* (more or less important) whose aim, the effect, is to reduce the *price* of the coveted *Product*. Taking the example of the video recorder, it's certain that I was exerting a considerable *Force* on the manufacturer. Indeed, because of its importance, if the manufacturer wanted to sell me a copy of its *Product*, it was obliged to adapt the *price*, by a strong decrease, to the level of *Utility* that I attributed to this device. So :

1. if the *Utility* rises, the exchange *price* increases, and *vice versa*,
2. if the *Force* exerted by the consumer decreases, the exchange *price* increases, and *vice versa*.

Now, it's perfectly logical that if any consumer has an imperative *Utility* of a *Product*, he will not produce a consequent *Force* to lower the *price*. It is therefore possible to conclude by posing that :

- **the lower the *offer*, the higher the *price*,**
- **the higher the *price*, the lower the *demand*, the fewer consumers there are.**

Therefore, to argue that when “*demand* increases, the *price* increases” is an impossibility. Indeed, as already shown, demand can never vary spontaneously, *i.e.* it can never be the cause of any variation in *price*. In conclusion, to say that “if a *Product* is expensive, it's because of high *demand*” is a mistake. The variation in demand is always only a consequence:

- either of an inverse *price* variation (at constant *Utility*),
- or a direct variation of the *Utility* (at constant *price*),

and absolutely nothing else. Moreover, this necessarily implies a relationship between these two characteristics (*price* and *Utility*). However, this relationship can only be induced by the consumer's *Choice*. Indeed, the relationship :

$$Choice = \frac{Utiliy}{price}$$

has a good grasp of the reality of daily life. The following four assertions are of course only valid, respectively, at “constant *price*” and “constant *Utility*”.

- ***AT CONSTANT PRICE : the higher the Utility, the more the consumer wants to acquire the Product, the greater the Choice,***
- ***AT CONSTANT USE: the lower the price, the more the consumer wishes to acquire the Product, the greater the Choice.***

But a consumer's *Choice* is directly related to the *Force* it exerts on the supplier. In fact, by replacing "*Choice*" by "*Force*" in the two hypotheses above, we obtain :

- ***AT CONSTANT PRICE*: the higher the *Utility*, the more the consumer wishes to acquire the *Product*, the greater the *Force*,**
- ***AT CONSTANT USE*: the lower the *price*, the more the consumer wishes to acquire the *Product*, the greater the *Force.***

Therefore, by posing :

$F = Force$
$p = price$
$U_P = Utility\ of\ the\ Product$

it's possible to write :

$$F \cdot p = U_P$$

Force (F) is an intensive characteristic and *price* (p) is an extensive characteristic. Therefore, the left-hand term (product of the *Force* by the *price*) is extensive, while the right-hand term is intensive (*Utility* is an intensive characteristic). To balance the extensiveness of the two terms, it's imperative to take into account the nature of the *Product* by introducing a coefficient (r) which is a function of an intrinsic property. This coefficient is a function of the complexity of the *Product* under examination. The relationship is therefore presented in the form :

$F \cdot p = r \cdot U_P$ either: $Force \times price = r \times Utility$

that can be compared to Boyle-Mariotte's famous experimental law in physics, namely :
$P \cdot V = r \cdot T$ either: $Pressure \times Volume = r \times Temperature$

Presenting the economic relationship as follows :

$$price = \frac{Utility\ of\ Product}{Force}$$

It also clearly shows that a low *supply* leads to higher *prices* and *vice versa.* In fact, if there are only a small number of copies of a *Product* on the market, only those consumers with a great *Utility* will be able to acquire them at a high *price*, because they will not apply a consequent *Force* to bring down the *price*: the other shoppers will consider it too high. For these latter agents, the *Utility* is lower, leading to a modification of the relationship into an inequality, such as :

$$price > \frac{Utility\ of\ Product}{Force}$$

and implying the impossibility of exchange.

Money – Value of cash

We have defined the *Money* as the one that the consumer holds in his or her pocket as a result of a decrease in the *price* of a *Product*. Consequently, the variation in the quantity of *Money* held is a function directly inverse to the variation in *price*. Indeed, if the *price* falls, the *Money* held increases and if the *price* increases, the *Money* decreases. The relationship giving the *Money* must therefore be given a negative sign. It is quite obvious that the variation in *price* is achieved only under the action of the *Force* defined in the paragraph "*Utility*/price Law" which the consumer exerts on the supplier. It is therefore possible to write :

$$Money\ created = Force\ exerted\ by\ the\ consumer \times price\, decrease$$

(*i.e.* analytically: $dM = - F \cdot dp$ to be compared with the physical relationship: $dW = - P \cdot dV$)

The two following sentences are equivalent, which again shows the perfect analogy between Economics and Physics. These two relations give respectively :

- *Money* (M) provided by decreasing the *price* (p) of a *Product* under a *Force* (F),
- *Work* (W) to be deployed to reduce the volume (V) of a gas under pressure (P).

Thus, it's indeed the evolution of the *prices* of the *Products* put on the market that allows the variation of the *monetary wealth* of an *economic system*, in accordance with possibility N°3 (paragraph "*Money - Cash*"), namely :

- if : n is constant and : u is variable ⇒ M is variable

with respectively a positive or negative evolution (increase or decrease in *wealth*), or :

- if the *price* (p) decreases ⇒ n remains constant and : u increases ⇒ M increases
- if the *price* (p) increases ⇒ n remains constant and : u decreases ⇒ M decreases

The increase in *wealth* can only be generated by a decrease in *price*s and only then.

Barter – Change – Exchange

Here, it's necessary to ask the question of why, in a barter, there is no *Money* in circulation. It is therefore necessary to relate the following anecdote on this subject.

One day an individual came to see me and after the usual greetings :

He – ***Let us suppose two individuals exchanging goods, that is, bartering.***
Me – ***Very well! But why do these individuals barter?***
– ***Take two individuals bartering.***
– ***I understand! Two people barter, but why?***
– *(He raises his voice)* ***But, I tell you, they are bartering, don't you understand?***
– ***But I do, I understand very well! I just want to know why they are bartering.***
– *(him, speaking even louder)* ***People trade goods with each other, they have the right to do so!***
– ***Certainly, but why is bartering possible, why does it happen?***
– *(he gets angry)* ***You don't understand anything! You don't know what barter is? I am telling you that an individual gives a product to another individual who gives another product to the first. Do you understand?***
– *(me, seeing the way the discussion is going)* ***Please excuse me for a few seconds.***
(me, back) Are you the owner of your home or your dwelling?
– *(him, wondering)* ***Yes!***
– ***Here's a big clothespin in a nice colour, good quality. I know the local notary well, whom I'll call to let him know that we're going to go to his office to barter your house for my clothespin.***
– *(him, standing up)* ***But, never in a million years!***
– ***I suspected as much! But why are you refusing this barter? Enlighten my lantern.***
– ***… ??? … …***
– ***This experimental demonstration obliges you to admit that certain conditions are necessary, obligatory, imperative, for a barter to take place. I know these conditions, I leave it to you to discover them. It* isn't *difficult.***

He, already standing, takes his jacket and leaves. I don't remember us exchanging customary pleasantries.

It should be noted that if I had offered him some small *Cash* corresponding to the *price* of the pin, he would have absolutely reacted in the same way. The term barter is therefore restrictive, that of exchange is general. Consequently, a barter of *Products* or an change of *Money* are identical. Whether one considers one or the other phenomenon their conditions of existence must be the same since the laws must be general and therefore the conditions of exchange. This amounts to positing, as already shown, that the *Product* and the *Money* are two different ways of apprehending the same thing.

If we consider, as Marx says, two individuals wishing to exchange wheat for iron, it's possible to write down the possibilities of this exchange as follows:

Let B be the agent with wheat and F the agent with iron. Since B wishes to dispose of wheat and possess iron, it's obligatory that he prefers iron to wheat. If this were not the case, he would keep the wheat. Identically, F prefers wheat to iron, otherwise he would retain the iron. From this, it's possible to postulate that :

- for B, the *Utility* of iron is greater than the *Utility* of wheat,
- for F, the *Utility* of wheat is higher than the *Utility* of iron.

The first general condition of an exchange is therefore that :

- ***the Utility of the Product received is greater than that of the Product given up.***

Suppose that B wants 100 kg of iron to satisfy its needs and F wants 500 kg of wheat for this. Suppose furthermore that the *prices* of the *Products* are 8 $/kg for iron and 3 $/kg for wheat. With these *prices*, B would have to pay 800$ and F would have to pay 1500$. Four possibilities can therefore arise.

1. ***Possibility 1*** ⇒ ***The Utilities of the Products are equal***

   F doesn't want to pay 1.5 times more than B for the same service rendered. To synthesize :

$$\overbrace{\text{Utility of 100kg of iron - Utility of \$800}}^{\textbf{For B}} \neq \overbrace{\text{Utility of 500kg of wheat} - \text{Utility of \$1500}}^{\textbf{For F}}$$

Or:

$$\overbrace{\text{Utility of 100kg of iron} + \text{Utility of \$700}}^{\textbf{For B}} \neq \overbrace{\text{Utility of 500kg of wheat}}^{\textbf{For F}}$$

- the balance of the total *Utilities* (*Product* + *Money*) isn't assured, the exchange cannot take place,
- the *Money* doesn't exist.

2. ***Possibility 2*** ⇒ ***The Utilities of the Products are unequal***

   The *Utilities* of the *Products* are not in the ratio of 1.5. Either one or the other doesn't want to pay more than necessary. To synthesize :

$$\overbrace{\text{Utility of 100kg of iron}}^{\textbf{For B}} \neq \overbrace{\text{Utility of 500kg of wheat}}^{\textbf{For F}}$$

- the balance of the *Utilities* isn't assured, the exchange cannot take place,
- the *Money* doesn't exist.

3. ***Possibility 3*** ⇒ ***The Utilities of the Products are unequal***

The exchange takes place. Indeed, the *Utility* of wheat for *F* is 1.5 times higher than the *Utility* of iron for *B*. *F* has an important need unlike *B*. *F* is ready to pay more for wheat because it has an indispensable *Utility*. Since the *Product Utilities* are unequal, *F* supplies the quantity of 100 kg of iron plus 400 $ and *B* gives 500 kg of wheat, so that the *Utilities* are equal. To synthesize :

$$\overbrace{\text{Utility of 100kg of iron - Utility of \$800}}^{\textbf{For B}} = \overbrace{\text{Utility of 500kg of wheat – Utility of \$1500}}^{\textbf{For F}}$$

or:

$$\overbrace{\text{Utility of 100kg of iron + Utility of \$700}}^{\textbf{For B}} = \overbrace{\text{Utility of 500kg of wheat}}^{\textbf{For F}}$$

- the balance of the total *Utilities* (*Product + Money*) is assured, the exchange takes place,
- the *Money* exists.

It should be noted that two *Products* are in circulation (wheat and iron). In the case where the *Utility* of iron for individual *B* is nil, then the exchange would come down to a classical exchange, *i.e.* :

$$\overbrace{\text{Utility of \$1500}}^{\textbf{For B}} = \overbrace{\text{Utility of 500kg of wheat}}^{\textbf{For F}}$$

4. ***Possibility 4*** ⇒ ***The Utilities of the Products are equal***

The exchange takes place. Indeed, the *Utility* of wheat for *F* is identical to that of iron for *B*. This case is the one presented in 1 above. To synthesize :

$$\overbrace{\text{Utility of 100kg of iron}}^{\textbf{For B}} = \overbrace{\text{Utility of 500kg of wheat}}^{\textbf{For F}}$$

- the balance of the *Utilities* is assured, the exchange takes place,
- the *Money* doesn't exist.

The second general condition for an exchange is therefore that :

- ***if the respective Utilities of the exchanged Products are unequal, then Money circulates to restore the balance (Possibility N°3),***

- ***if the respective Utilities of the exchanged Products are equal, then the balance is respected, the exchange exists (barter) without circulation of Money (possibility N°4).***

An identical reasoning would lead to the same conclusions if instead of different *Products* (*e.g.* wheat and iron), different *Money* (*e.g.* Yen and Rouble) had been used. Indeed, in the case of change and no longer barter, it's necessary that the respective *Utilities* of the exchanged *Money* be equal. If the *Utilities* of the *Money* are unequal, then a *Product* must be exchanged whose *Utility* restores the balance.

Consequently, barter and change are only particular cases of a classic exchange: barter and change can only be performed when the respective *Utilities* of the *Products* (barter) or of the *Cash* (change) are equal for each agent, which isn't frequent. In the usual opposite cases, *i.e.* when the *Utilities* are unequal, it's obligatory that *Products* or *Cash* circulate. When a *Utility* is null, *i.e.* when there is only one *Product* in circulation, the *Utility* of the *Money* exchanged corresponds to the *Utility* of the *Product*. This is the general case that occurs in everyday life.

It is therefore possible to maintain that :

- ***the Product and the Cash are two absolutely equivalent entities.***

All this is perfectly rational because, as already stated, natural laws must be absolutely general and apply equally to all elements. The only difference between the *Product* and the *Cash* lies in the functional, pragmatic and efficient convenience of the latter. In conclusion, Natural Law is absolutely indifferent to time and space and applies, without exception, to all the constituents of Nature.

Anyone may question this Law, but the result of such a challenge is known in advance.

Tricle-down doctrine

In order to justify the dogmatic doctrine of “trickle-down”, the analogy is presented with a river that descends from a mountain and waters the plain. The followers of this doctrine never emphasise that this watercourse must be previously fed by raindrops that come, strictly speaking, from the seas and oceans, *i.e.* from the base. Taken in this way, it's the base that previously feeds the summit, so it's the *Workers* who enrich the owners, which is perfectly logical. The image of the river watering the plain must be reversed. In fact, it's indeed the myriads of brooks that first form brooks, then rivers and finally streams. In this enumeration, it should be noted that the number of streams decreases while their flow rate increases, which is perfectly similar to the case we are concerned with, where the number of individuals with high assets decreases while their *wealth* increases.

Since *monetary wealth* can only come from *Work*, the assets of the rich can only come from workers and engines and machines. Whether they are performing *Economic Work* (as defined in the note), they lower the *price* of the *Product* produced and enrich others. However, motors and machines are obviously indifferent to all things and in particular to all *wealth*. Only a *Worker* has the right to demand reciprocity and to ask others to also provide *Work*. In fact, if an employee performs additional *Work*, he enriches other individuals, but not himself. It is therefore perfectly logical that this *Worker* should request, claim and demand reciprocity. If the latter is satisfied, there is little or no inequality, but if reciprocity doesn't take place, then inequalities appear or increase. As a result, other individuals must normally also perform *Work* in order to enrich the initial *Worker*. However, the analysis of the facts indicates that the more "evolved" (rich) a society is, the fewer individuals are engaged in *Work*, which is mainly performed by engines and machines.

Consequently, as presented in the *corpus* of the study, among all individuals, only those who make it possible to lower the *price* of what they produce are *Workers*.

The other people can work (perform mechanical work) without, however, performing *Work of an economic nature*. Obviously these other people can be useful to society in general. For example, it's possible to draw up a non-exhaustive list of these utilities of an economic nature:

- cultural, ecological, educational, humanitarian, medical, political, religious, health, scientific, security, social, *etc.*

Among all these individuals, who perform only *labour* but not *economic work*, some have very high incomes or significant assets, *i.e.* they are described as "rich" or "very rich". Eventually, they can be classified in 2 categories, namely :

1. Those who are involved in finance *stricto sensu* (bankers, traders, speculators, ...) and we now know from this study that their actions don't grant any *monetary wealth* to society. Consequently, if one of these agents wins, another loses and *vice versa*. The chapter "Value of the monetary unit" demonstrates this unambiguously and without exception. Like it or not, the *Money* is always constant as long as there is no *Economic Work* provided, which means that if the number (n) of units varies, the value of that unit changes strictly and proportionally inversely. However, it's always possible to cheat momentarily by increasing the value of the unit (u) without decreasing its number (n). In general, this is what happens when stock market indices rise during episodes of upward speculation. But, sooner or later and inexorably, the return to equilibrium, between the number of units and its value, will happen in such a way that the *Money* is constant, inevitably provoking economic crises (Black Thursday of 24 October 1929, Asian crisis of July 1997, Internet bubble of March 2000, subprime crisis of 2007, ...).

2. Those who own a part (small or large) of a company because of share ownership. However, it's certainly not these shareholders who create the *Money*, *i.e.* who carry out *Economic Work*, because it's only the engines they own that allow this creation.

Moreover, the “rich” people are subject to very few external budget constraints and can therefore spend *Cash* in abundance by consuming in abundance. Knowing that Laziness can only increase naturally in the absence of external constraints, some individuals therefore transfer the *Work* they should provide themselves to others. But this completely dodges time by omitting the procedure which has allowed their enrichment. And yet, it's a levy of *Money* as a result of the *Work*, performed by the engines they possess. In fact, we know that *Work* must serve to enrich the consumer. Consequently, if the shareholder's levy had been lower, the consumer would have had an extra *Money* and would thus have been less penalised: inequalities would have been reduced accordingly. This shows perfectly that time must be taken into account. The shareholder's deduction of *Money* is effective as soon as the *work has been done* (transformation *Work→Money*), whereas the run-off mechanism only materialises little by little and later with losses at each exchange (transformation *Money→Work*). This shows that this doctrine isn't admissible in the context of this paper.

Some, excellent rhetors, stigmatise the cost, supposedly too high, of the French (or European) manpower and advocate the reduction of *Workers'* pay, but never advocate the reduction of theirs. However, if their own remuneration were to be reduced, the number of monetary units (n) circulating in the economic system could decrease, thus implying an increase in the value of the unit (u), and incidentally the enrichment of others (as already specified).

This hypothesis would thus embody the true principle of trickle-down (from the bottom up), but this study doesn't define any policy, nor does it recommend any strategy, tactics, governance, *etc.*, for the future.

The fact that the two transformations *Work→Money* and *Money→Work* must have equal characteristics necessarily implies that the trickle-down doctrine is absolutely inoperative in economic terms.

It was made clear that the “arrow of time” should never be evaded. To evade the time factor in reasoning is the most absolute certainty of losing one's mind. It is then easy to be deceived, to make mistakes, to wander into ideological dead ends that some people can transform into dogmas. In fact, to maintain that the consumption of the possessors will allow little by little general enrichment, dodges the fact of knowing the origin of their assets, which are in no way created *ex nihilo*, their fortune coming only from the *Work* previously performed by the *Workers* and the Engines. Instead of the reduction in the cost *price* caused by additional *work* being used to reduce the selling *price*, which benefits the whole company, it only benefits the shareholders, thus increasing inequalities.

Moreover, to put an end to this doctrine, let us go back to the origin. We know that no evolution can take place if there is no difference and, in this case, no difference in *Utility*. However, this doctrine shows absolutely no variation in *Utility* and therefore doesn't produce any *wealth*.

Microeconomics – Macroeconomics

In the classical doctrines of economics, the notions of microeconomics and macroeconomics are discerned, which need not be further explained here. In Physics, a similar distinction is made between microscopic and macroscopic phenomena. However, the analogy must stop at this point because the levels to which these concepts refer are not comparable.

Indeed, the different levels can be compared according to the following table:

General level	Physics	Economy
N3 – Higher level	**P3 - ?**	**E3 - Macroeconomic**
N2 – Intermediate level	**P2 - Macroscopic**	**E2 - Microeconomic**
N1 – Lower level	**P1 - Microscopic**	**E1 – Elementary operation**

- ***Lower level N1***

  At this level (*N1*), corresponds in physics the *P1* level which is at the level of the molecule. In Economics, it's possible to characterize this level *E1* by the elementary operation, its definition being possibly identified as each movement of a robot. For example :
  - lifting the tool to a certain height,
  - displacement of so many millimetres in such and such a direction,
  - rotation along a particular axis by so many degrees,
  - held in this position for so many seconds,
  - *etc.*

  There are other techniques for determining elementary operations (G-Code, Therbligs, MTM, RULA, ...) that could be used, but this isn't the purpose of this study. Just as there are a large number of molecules (of the order of 10^{23}) in an enclosure, it's necessary to performed a large number of elementary operations for the manufacture of any *Product*.

- ***Intermediate level N2***

  At this level (*N2*), the analogies proposed in this note undoubtedly show that the **macro**scopic physical level *P2* corresponds to the **micro**economic level *E2*. The respective qualifiers “macro” and “micro” for the same general level may lead to some confusion. Undeniably, logic would dictate that there should be only one designation.

- ***Higher level N3***

  At this level (*N3*), corresponds in Economics the *E3* level designated as macroeconomic. This level is usually represented by an economic system in which the different elements are subject to the same accounting and legal rules, for example, a country such as Argentina.

By analogy, the physical level *P3* should refer to a similar system, *i.e.* all *Workers* and engines in a country such as Poland. However, physics is totally uninterested in the phenomena that can occur at this level, unlike Economics, whose great interest infers the most important research.

The table below shows the knowledge or ignorance that one has about the different levels of these two disciplines.

General level	Physics	Economy
N3 – Higher level	**P3 - Unknown**	**E3 - Hypothetical**
N2 – Intermediate level	**P2 - Known**	**E2 - Hypothetical**
N1 – Lower level	**P1 - Known**	**E1 – Unknown**

This essay, which is only interested in Economics, is situated at the microeconomic level *E2* to which the macroscopic physical level *P2* corresponds and at the general level *N2*. Consequently, it's out of question here to refer to macroeconomics. All the reasoning therefore relates only to the phenomena that occur during the manufacture, exchange and use of a single copy of a *Product*.

It has already been explained (paragraph "*Preliminary reflections*") that in physics one is never interested in what happens at the *P3* level (higher level *N3*), *i.e.* at the level of a region, a country, *etc.* It is therefore not possible to consider what happens at the *P3* level. In fact, and for example, knowledge of mechanical work spent between 12 noon and 1 p.m. in Algeria doesn't bring any intelligibility, convenience, disposition, to the understanding of the phenomena of energy transformations from heat to work ($Q \rightarrow W$). This is so because these phenomena occur only at the level of each engine (general level *N2* $\Rightarrow$ physical level *P2*). The work spent at the country level is only the sum of the work provided by each engine and is therefore only an accounting addition which provides absolutely no explanation.

In physics, mechanical work is always and exclusively generated only by engines. No one will argue that mechanical work is provided by a company or any other entity. The same applies to *wealth*, because it's always at this level (engine) that productivity can be increased. The search for the origin of *wealth* at the macroeconomic level cannot therefore yield any convincing results. This essay shows that all *wealth* is only generated at the economic level *E2* (general level *N2*). It is at this level and only at this level that :

- ***in Economy, the Money is created at the level of each copy of a Product,***
- ***in physics, work is generated at the level of each specimen of an engine.***

Systemic – Reductionism

It is out of the question here to discuss a systemic approach to society or any other sociological holism. This paragraph is only intended to present the rationale for the use of the reductionist approach in this study.

It is perfectly logical to consider Nature (the Universe) as a gigantic system with an enormous number of interacting constituents, described at the most fundamental level as “elementary particles”. Under certain conditions these particles have been able to self-organise to form atoms with new and different emergent properties from those of the original elements. Then these atoms, subjected to other external conditions, self-organised to form molecules with new and different properties. This is the case for more and more complex systems, even biological systems (prokaryotes, eukaryotes, ..., plants, animals).
While the self-organization of the simplest systems (particles, atoms, molecules) is fairly well understood, if not mastered, the same isn't at all true for more elabourate systems and in particular for biological systems. However, the latter systems are also capable of self-organising in societies, and in this case the laws governing these phenomena are even less well known.

The fact that at each stage the self-organising entities are dissimilar to the previous ones, and above all that their properties are also different, implies that the laws governing them must be singular for each of them. In spite of this multiplicity, their kind, their type, their essence, must be of a certain homogeneity.

For example, in a dissipative system such as an avalanche (snow, sand, ...) or a convection cell (basaltic organs, Bénard cells, ...), we know that heat (Q) circulates from a hot spring to a cold spring where it dissipates. For example, this circulation of heat can take place in several ways through matter:

- firstly ⇒ by conduction (without displacement work),
- then ⇒ by laminar convection (with displacement work, without phase transformation),
- finally ⇒ by turbulent convection (with displacement work, with phase transformation).

This material is defined first and foremost by its nature and state: solid in an avalanche, liquid in a convection cell, *etc.* It also possesses certain properties characterised by mass, temperature, volume, pressure, density, internal energy, speed, thermal capacity, resistivity, thermal conductivity, viscosity, *etc.*

However, in Economics, although it's possible to consider a country as a dissipative system, no one can exhibit with certainty what dissipates. Is it *Money*, *Work*, *employment*, *purchasing power*, or something else? But is the support of the dissipating entity the *Product*, the *Cash*, or something else? What are the characteristics of this possible support, which must correspond to those of physics, some of which are listed non-exhaustively above?

In the hypothesis of self-organization at levels *P3* (physics) and *E3* (Economy), the phenomena of emergence would certainly be more easily apprehended and understood by knowing respectively, beforehand, the levels *P2* and *E2*, if only by the nature and the definition of the existing entities, although the properties of the higher levels are not reducible to those of the lower levels. If elements must self-organise, it seems desirable, if not indispensable, prior to any study, to know the nature and the maximum of characteristics of the entities which must organise themselves.

The more complex a system is, the more constituents of different lower levels it contains. The intrinsic understanding of this system is therefore extremely difficult and at present almost

unknown. The phenomena of emergence of new properties are still not adequately mastered. For example, mammals are incredibly complex because they have a large number of constituents that have emerged over time, each with its own function and particular properties. Despite this complexity, it's sometimes possible to consider these vertebrates as a single entity. Indeed, their eventual fall is always and without exception according to the natural laws of kinetics. This way of operating, *i.e.* reducing a set of elements to a single one, consists of simplifying the problem as much as possible, reducing it to its simplest expression and considering this procedure as a borderline case. However, the results obtained by this hypothesis do correspond to reality.
For this study, therefore, only simple systems have been considered so that they can be examined analytically, *i.e.* their evolution can be considered linear.

The similarities, both in form and in substance, presented in this study between Physics and Economics lead us to believe in the existence, hypothetical but almost certain, of a level (*N3*) at least higher than these two disciplines. It must therefore be possible to conceive of the presence of a doctrine that could encompass them and to consider it as being systemic, but this is outside the objective of this study.

It is said that in Economics "everything acts on everything" and therefore it's impossible to consider a *closed system*, which complicates matters at leisure. But in Physics the problem is exactly the same. Indeed and for example, we know that burning fuels locally affects the climate of the whole planet, *etc.* However, in order to understand phenomena, physicists, at least initially, use the reductionist method by defining closed systems which, however, adequately reflect reality.

An engineer who designs a watch engine or an aircraft engine in no way reflects on the repercussions of the energy inputs that these engines may have, during their operation, on the stability of the methane clathrates in the Siberian permafrost or on the gestation and egg-laying conditions of the females of Euphausia superba in the Antarctic Ocean, because he considers the engines he imagines and designs as *closed* or possibly *open systems*, but locally. Of course, this isn't theoretically true, but this doesn't prevent these motors from functioning properly.

When Galileo analysed the rolling of balls on inclined planes he didn't concern himself in any way with the rolling resistances or the various frictions. It was precisely by evading these constraints that Natural Laws could first be perceived and then determined. However, the failure to take into account the disruptive effects never made it impossible to study them separately.

Nobody maintains that the thermal machine that Carnot imagined is false. It is only perfect. He sought to find out why not all the heat could be converted into work and thus determine the efficiency. To design his machine, he considered two containers, one hot and one cold, which could contain infinite amounts of heat, which is obviously impossible.

When Foucault swung his pendulum under the dome of the Pantheon, he did not take into account the Coriolis effect, which was certainly still unknown to him.

It would be possible to highlight an almost infinite list of examples. Faced with the multitude of links that are found in all physical phenomena, the method followed over the last four centuries to understand them and determine the laws that orchestrate them, was to try to isolate them from each other in order to study simple, if possible elementary systems. Faced with the theoretical impossibility of totally individualising them, the solution has always resided in minimising the side effects. For example, this is indeed what is achieved with a calorimeter where heat losses by conduction through the walls are reduced to a minimum. These effects are often referred to as "disturbances", which is a perfectly relative noun in the context we are dealing with here. For example, if friction is considered as a disturbing element in the study of the laws of motion, in their own analysis, it may be expansion problems which become disturbances.

However, no natural law is known which can explain the phenomena occurring during economic exchanges. It therefore seems normal to use the reductionist approach in Economics, which doesn't seem to have any prohibitive value in terms of its explanatory value. This is therefore what has been done subsequently throughout the note.

Ockham's Razor – *(Entia non sunt multiplicanda praeter necessitatem)*

This medieval tool, already known from antiquity, is still effective. It justifies the emancipation of many concepts, laws, notions and others, commonly used in Conventional Economics (marginal utility, law of "*supply* and *demand*", creation of money by banks, general equilibrium, Edgeworth's boxes, Pareto's optima, trickle-down effect, Veblen effect, ...) and totally useless in the genesis and constitution of this new approach to economic exchanges. Indeed, all the concepts, notions, ideas, *etc.*, some of which are listed above, which have no equivalent in physics are absolutely superfluous since this paper is only the application to economic exchanges of the formalism of thermomechanics.

- ***"entities must not be multiplied beyond what is necessary".***

It follows from this that any case study must be prohibited and condemned because, then, it must be considered as an application. Since laws must be absolutely general, no particular case must be studied, exposed, validated, except as an example of confirmation or invalidation of the theory. Therefore, in the latter hypothesis, any other situation may be presented as an alternative to the example presented.

Constraints

For any action to be performed, there are constraints which limit it and which can be in any field, such as physical, intellectual, ethical, social, religious, *etc.* Taking into account only the physical field, it's possible to argue that in the Universe any change requires the execution of work in order to overcome the constraints inherent in the system under consideration. Indeed, in the absence of constraints, everyday life and even life in the *strict sense* would be impossible. For example:

- the constraints of friction between our feet and the ground allow us to walk and stand, because without them we would slip irremediably,

- The electromagnetic constraints between atoms and molecules allow the various morphologies of minerals, plants and animals, because without their presence, we would be worse than dabs, thick with a single molecule and even an atom,
- *etc.*, and we wouldn't be here to discuss it.

But also, if there were no constraints, any change would occur without any energy expenditure. This notion, this concept would therefore no longer be useful since it would be useless.

It is quite obvious that these constraints have very different values according to the different cases of application. Thus :

- it's easier to climb Sancy than Mont-Blanc and the latter than Everest,
- the energy expenditure (work) is lower when walking than when running,
- *etc.*

In addition, depending on the application, Human is looking for :

1. reduction of constraints. For example, to connect two places located at different altitudes, first it eliminates vegetation, then makes the slope as regular as possible to eliminate abrupt breaks, then it lays a surface that promotes rolling,
2. increasing constraints. For example, to protect himself from predators or enemies he built palisades, harrows and drawbridges, ditches and moats, ramparts and fortifications, *etc.* Even mosquito nets can be considered almost impassable constraints for insects.

In general, it should be noted that the reduction of constraints applies to elements located inside a *system*, but conversely their increase is directed against those located outside the system. The system can be defined as a set of elements with common interests. Consequently, any two components may have the same focus of interest and thus be included within the same system but be located in separate systems, *i.e.* outside each other, for other benchmarks.

However, it's not said that these systems are necessarily in opposition. From this it follows that every individual has total free will and can therefore make a choice at his or her own convenience. Despite this absolute freedom, the realisation of his choice is always limited or even obliterated by constraints beyond his control. For example, any person may wish to spend a night at the Pic du Midi de Bigorre, acquire a pedigree puppy, personalise his vehicle, have lunch in a starred restaurant, visit catacombs, reserve a place for a lunar or marsian trip, *etc.* However, to achieve each of these hypotheses, the person will always be subject to constraints which may be of various kinds, as already mentioned above.

What has just been exposed for the physical field applies in a similar way in the economic field. Indeed :

- depending on the *Product*, the pecuniary constraint can be very variable. It is much lower to acquire a low-range flat than a rich villa,
- depending on the agent, the constraint also varies significantly. It is much higher for a person on minimum social benefits than for a major shareholder in a large multinational company.

Moreover, it's clear that the higher the constraints, the less choice can be made and *vice versa*. If the constraints were zero, anyone would be able to make all their choices without restriction. Thus, from an economic point of view, the more *Money* an individual has at his disposal, the more he will be able to satisfy his choice and conversely, which is perfectly banal.

In order to enrich a society, the goal is that as many of its members as possible be in a position to fill their acquisition opportunities. For this it's therefore necessary to reduce the constraints weighing on these agents. But this procedure is absolutely independent of the consumer's choice and therefore of the consumer. Whatever the consumer's desires and wishes, the only useful action is to ensure that he can satisfy them and therefore has additional financial capacity. In any economic society, individuals have more or less financial possibilities (*Money*). In order to enable as many of them as possible to acquire goods and services, it's imperative that their *prices* are as low as possible. Indeed, if *price*s decrease the financial constraint falls by as much and the individual can make his choice more easily.

This essay therefore seeks to understand by which mechanisms and phenomena it's possible to reduce the financial constraints restricting the realisation of individuals' choices. It is the procedure and methodology for reducing constraints, and therefore *prices*, that this study proposes to know and master, while abandoning that of choice in the strict sense of the term. In conclusion :

- ***the definition of the choice is a matter for the Human Sciences,***
- ***the realisation of the choice depends on the Natural Sciences.***

Physics – Economics – Analogies of premises

In physics, thermodynamics is based on three essential principles and an experimental law, namely :

1. a principle of equivalence, stipulating that a variation in heat induces the same variation in work and *vice versa*,
2. a conservation principle, known as the "first principle", stating that the sum of the variations in heat and work should always be constant (in an isolated system),
3. a principle of evolution, referred to as the "second principle", specifying that entropy naturally always increases towards a maximum, depending on external constraints,
4. an experimental law called "Boyle-Mariotte's Law", indicating that the temperature of a gas is related proportionally to its volume and pressure.

Mathematically these principles and law are defined respectively as follows:

1. $W_{work} = J_{proportionality\ coefficient} . Q_{heat}$
2. $dQ_{heat} + dW_{work} = 0$
3. $dQ_{heat} = T_{tempertature} . dS_{entropy}$

4. $P_{gas\ pressure} . V_{gas\ volume} = r_{constant} . T_{gas\ temperature}$

It has already been pointed out that any evolution only takes place if there is a difference in a certain characteristic, and it can only be the same in the case that concerns us here, that is to say in Economics. Any evolution of an economic phenomenon can only take place if there is a difference in the *Utility* of the *Product*, and this evolution always takes place if this difference exists. To corroborate this fact, the example of *Homo habilis*, who modified a stone to adapt it to the purpose he had set himself to achieve, has been presented in the “Introduction” paragraph above. He improved the *Utility* of the stone and thus made a difference by the application of a certain amount of *Work*. Nowadays, the course of events always and without exception proceed from the same aim, namely :

1. to transform the *Product* in such a way that it's as well suited as possible to the intended purpose. This step modifies the *Product* and doesn't move it,
2. move the *Product* so that it's used in the best possible way at the desired location. This step moves the *Product* and doesn't modify it.

The first sequence indicates, by definition, an intrinsic evolution of the *Utility* of the *Product* and therefore the existence of a difference in *Utility* between the initial and final moments of the transformation. The second stage also shows a difference in *Utility* between the initial and final instants of the displacement.

If we come to reconsider air, we know that it's very useful, but :

1. it doesn't have to be transformed since it's consumed as it is,
2. it doesn't have to be moved as it is normally present everywhere.

Consequently, for air, there is no difference in *Utility*, neither for its use nor for its transport. Therefore, for its use, it's met neither *Work*, nor *Money*, therefore the air doesn't cost anything. Nevertheless, in certain places where it's not available, it's imperative to transport it. This transport imposes the expense of mechanical work and infers an *economic Work* as well as a difference in *Utility*. A physical energy expenditure but also an economic expenditure are then obligatory, which induces the existence of an *Economic Work* and a *Money*, so in the case of its absence, air has a cost. This perfectly corroborates the fact that in order to create *Money* (*wealth*) it's necessary to generate a difference in *Utility* that is necessarily induced by an expenditure of *Work*. It is reiterated here that a banker doesn't create any *Money* but only *Cash*.

If water is now considered, its use doesn't require any intrinsic transformation but only a transport from the withdrawal site to the consumption site. If the water is consumed on site, there is no *Work* and no *Money*. If the water is used in another place, only a *Work* and a *Money* related to the displacement are present, as well as in the case of lack of air. This transport doesn't in any way alter the *Utility* of the water. Sometimes a *Work* and a *Money* are indispensable to transform the water or air in the case that these *Products* are unsuitable for the use envisaged and that it's then necessary to filter, purify, treat, *etc.*, the water. A few decades ago dummy mobile phone antennas were offered for sale. Even for this example, which had no technical utility, the manufacture of these *Products* created a difference in *Utility* for certain individuals whose vanity had to be satisfied. *Work* and *Money* were required for their manufacture and sale (purchase by the consumer).

Whenever there was a difference in *Utility*, an *Economic Work* was obligatorily spent. In this case all economic phenomena are *ipso facto* related to the principles and law set out above. Moreover, any *economic Work* provided necessarily requires the expenditure of mechanical work. But the reciprocal isn't true: not all mechanical work generates *economic Work*. In fact, as already stipulated, mechanical work can only generate economic *Work* if it provides a difference in *Utility*. For example, rubbish collection, ironing, cleaning, *etc.* are also dependent on these laws because their realization causes a difference in *Utility* between before and after the provision of *Work*. But if the performance of the service in question doesn't result in a difference in *Utility*, then mechanical work doesn't entail either *Economic Work* or *Money*. Thus, a policeman or a religious person doesn't bring about any change in *Utility* despite the fact that they are very useful in terms of security or otherwise and can render eminent services to society.

It was stated at the beginning of the chapter that for two million years, for any *Product* (good or service) manufactured or moved, the process has always been the same and this process isn't about to be reformed. Of course, while *Work* is very old, the *Money* has only been around for three or four millennia. But it's only indispensable in exchange and has only been invented because more and more different *Products* (goods or services) have been produced and each of them in greater numbers. Our very distant forefathers had no *Money* because they made their tools for themselves. The same is true today, where any individual doesn’t use a *Money* when growing cabbage or lettuce for his own needs. As our distant ancestors had contacts, tribal or otherwise, more and more frequent exchanges appeared and a certain and obligatory reciprocity came into being in the form of barter. As already stated above (paragraph “Exchange - Barter - change”) *Work* and *Money* are two fundamentally equivalent entities. Consequently, during an exchange, any *Product* can be considered as *Cash* and *Cash* as a *Product*, the laws must be absolutely general and apply in the same way and without exclusivity, to any component of Nature.

Also from this paragraph onwards, it should be noted that :

- in a barter, only the respective *Utilities* of the exchanged *Products* count,
- during an change, only the respective *Utilities* of the exchanged *Cash* count,
- in the event of an exchange, only the respective *Utilities* of the *Product* and the *Cash* exchanged count.

In order for an exchange to take place, whatever its type, the *Utility* of the *Product* or the *Utility* of the *Cash* exchanged must be equal. It is therefore not the quantities of *Work* or *Money* circulating that it's wise to apprehend but the respective *Utilities* of their vector-support (*Product* or *Cash*). From all these considerations, it's quite natural to present, in Economics, postulates and a law of the same kind as those explained above for thermodynamics. It is therefore possible to state :

1. a principle of equivalence, stipulating that a variation of *Work* induces the same variation of *Money* and *vice versa*. In fact, we have seen that the more the supplier spends *Work* for

economic purposes, the more *Money* the consumer has at his disposal since the *price* of the *Product* decreases. It is therefore possible to postulate that *Money* (M) and *Work* (T) are related by a coefficient of proportionality (g),

2. a principle of conservation, called the “first principle”, stating that the sum of the variations of *Work* and *Money* should always be constant (in an isolated system). Indeed, because of the preceding principle of equivalence, it's possible to postulate that a variation (positive or negative) in the *Work* performed by the supplier causes the same variation in the *Money* held (more or less) by the consumer,

3. a principle of evolution, referred to as the “second principle”, specifying that *Laziness* always increases naturally towards a maximum, depending on external constraints. Indeed, it's undeniable that every individual saves his *Work* when he acts. But this can be extended to animals as well as to motors because it's strictly and absolutely in accordance with the general principle of least action. This is therefore not only relative to Human. The minus sign (-) is justified by the fact that if *Laziness* increases, *Work* decreases and *vice versa*, these two characteristics evolving in opposite directions,

4. an experimental law similar to the “Boyle-Mariotte” law, indicating that the *Utility* of a *Product* is related proportionally to its *price* and to the *Force* (*pressure*) exerted by the consumer on the supplier to decrease it. In fact, the more *Force* (pressure) exerted by a consumer on the supplier, the lower the *price* will be and *vice versa.* In the same way, the more a consumer will have a high *Utility* of a *Product*, the more he will be inclined to pay for it, so the *price* may be high, because he will not exert a consequent *Force* on the supplier.

Mathematically these principles and law are defined respectively as follows:

1. $M_{(money)} = g_{(proportionality\ coefficient)} \cdot T_{(economic\ Work)}$
2. $dT_{(Work)} = dM_{(money)} = 0$
3. $dT_{(Work)} = -U_{(Utility\ of\ Product)} . dP_{(economy\ of\ Work)}$
4. $F_{(consumer\ Force)} \cdot p_{(Product\ price)} = r_{(constant\ Product\ function)} . U_{(Utility\ of\ Product)}$

In thermodynamics, the three principles are indifferent to the nature of the gas used, as indicated by the relations presented at the beginning of this paragraph. This simply means that whatever the gas used, the results obtained are always identical. However, in Economics, the three principles exposed above are also free and exempts of definitions concerning the nature of the *Product* and of the *Cash*. In fact, there is absolutely no mention of examples of *Product* and *Cash*. Whatever the *Product* (good or service) and whatever the *Cash*, the results are always the same.

In the paragraph “Principle of Relativity”, it has been shown that for any Transformer (state of each manufacturer) the *Utility* decreases when they develop the *Product*. In fact, during the negotiation with the Seller, the Transformer wishes to part with the *Cash* but to dispose of the non-elabourated *Product*. But, during the negotiation with the Buyer, the Transformer wishes to part with the elabourated *Product* and to dispose of the *Cash*. In this case, the following table can be presented, which is only valid for the Transformer:

Tractation	For the transformer	
	Utility of Product	**Utility of Cash**
Seller - Transformers	**High**	**Low**
Transformers - Acquirer	**Low**	**High**
Time variation	➘	➚

However, it was explained that all the actors in the manufacturing and use chain were qualified as Transformers each in turn. Therefore, this table is valid and justified regardless of the economic agent but only when it's located in the position of Transformer. This conclusion shows the perfect analogy between thermodynamics where the temperature decreases, and the Economy where the *Utility* of the *Product* drops. This leads us to conceive the economic transformations of *Work* in *Money* subject to the same formalism, the same reasoning, the same method. However, as already pointed out, in no case should the characteristics proper to physics be used.

In the same paragraph it has been explained that :

- *Work* and *Money* must be considered as two different forms of *economic Energy*, just as heat and mechanical work are considered as two different forms of physical energy. Thus, *Work* and *Money* must be able to be transformed one into the other, identically to heat and mechanical work in physics,

- The daily facts show unambiguously that the economic field is in constant evolution (positive or negative variation). However, it was specified in the "Introduction" paragraph that any change imperatively requires the presence of a characteristic (property) whose value differs between two instants or two positions. Here, it's the *Utility* of the *Product* that is proposed as the adequate characteristic. Indeed, any modification consists without exception in causing a difference in *Utility*, in order to :

    - first ⇒ to make the *Product* more suitable for the requested function,
    - then ⇒ to use the *Product* in the best conditions.

- the law of "*supply* and *demand*" is totally inoperative in this new approach to economic exchanges. Only the "*Utility/price*" law similar to Boyle-Mariotte's law in physics has a certain logical coherence and has an explanatory and predictive role. The pseudo law of "*supply* and *demand*" is only a consequence of the latter law,

- The conventional approach to the Economy, starting with the *Money* circulating from the consumer to the supplier, builds a corpus on accounting. It is always only a question of *Products* "or" of *Money*. The approach presented in this introductory note rejects this approach. By perceiving the *Money* as the one that the consumer has in addition after a drop in *price*, the conception of the Economy must be based on physics because of the

> transformation *Work→Money* and no longer on accounting. It is therefore necessary to consider simultaneously the *Product* “and” the *Money.*

Moreover, the “Second Principle” of thermodynamics, which has never been questioned until now, stipulates that any transformation is temporal (linear in time), because it marks the irreversibility, if not total, at least partial irreversibility of any change, any modification, any evolution. Thus, all actions undertaken in order to return to conditions that have previously taken place are completely inoperative. It is impossible to recover a state that has already existed. Consequently, during any given evolution, the greater the waste of material and energy, the less the possibility of getting closer to its initial state is achievable by following another evolution of any kind. We also know that these losses are all the more substantial the higher the speed of the evolution, in this case four times as much waste, at least, for a doubling of speed. Irreversibility is thus all the more notable.

It is accepted that by the end of the 21st century or the beginning of the next, the Earth will have a population of about 10 billion people. Of this number 2 billion will be considered “rich”, *i.e.* having access to technology, health, education, *etc.*, which will result in a population of 8 billion “poor”, *i.e.* 4 times as many. However, the energy consumption required for these individuals to benefit from these services would not be 4 times higher, but much more. Indeed, if they cannot access them by the means currently deployed, there is no reason why they should be able to do so in the future using the same means. It is therefore only by increasing the speed at which the *Products* are manufactured in order to reduce their *price* that this would eventually become possible. Therefore, the simple doubling of the *purchasing power* of these individuals would require a theoretical minimum consumption of energy 16 ($2^{2\times}4$) times greater with relatively as much waste. Assuming a tripling of *purchasing power*, energy consumption would be 36 ($3^{2\times}4$) times higher and 64 times ($4^{2\times}$ 4) for a quadrupling. This calculation, which is of course elementary but whose background is irrefutable, was performed assuming that the standard of living of the 2 billion “rich” remains constant.

It has been explained in the paragraph “Natural Sciences - Human Sciences” that, without exception, all inventions, artifacts and others created by Human must be subject to the Laws of Nature under penalty of malfunction. For everyone, it seems quite natural that the manufacture of tools, apparatus, machines, goods, commodities, *etc.*, should be subject to the laws of nature, but also their activity, their operation, their functioning. All this is valid in the same way as intrinsically natural changes such as structural, chemical or other modifications of the mineral, vegetable and animal worlds and therefore of Human, who is only one element of them. However, no one can dispute that the *Money* is a find of the human imagination, it must therefore be understood as a simple tool designed by Human to facilitate exchanges. So like all other tools imagined, manufactured and used by the individual, it cannot be an exception. Thus, economic exchanges and any process involving the creation, destruction or transfer of *Money* can only be subject to the Laws of Nature.

Common sense decrees that the *Money* is that which flows from the consumer to the supplier in exchange for any *Product* (good or service). However, for three or four centuries no natural law has been revealed in Economics despite countless researches. If this definition of the *Money* is ineffective in accounting for exchanges, it must consequently be excluded from reasoning.

Nevertheless, it's then imperative to specify the *Money* differently. As a consequence and by way of test, it's not forbidden to postulate that :

- ***the Money is the one that the consumer holds in addition after a price drop and no longer the one that circulates from consumer to supplier.***

It is this *Money* that the consumer can then use at his convenience (apart from the constraints to which he may be subject) for the acquisition of any *Product*. Consequently, prior to any economic exchange, it's mandatory that the consumer has the quantity of *Money* necessary to purchase the desired *Product*. Even if he doesn't have this *Money*, he can borrow it, the repayments of this loan being, of course, a quantity of available *Money*. So, before taking an interest in the exchange of *Product* for *Money*, it's imperative to ask how the consumer can dispose of this *Money*? As already specified, it comes down to understanding how we have passed:

- ***from a society of subsistence, if not of rarity, to a society of abundance, if not of waste.***

In fact, to live in an *economic system* of abundance it's obligatory that the maximum possible number of consumers be able to acquire the maximum of the different *Products* on the market. In order to do so, it's therefore necessary that consumers have a lot of *Money* at their disposal, or that the *Products* are inexpensive (these two formulations being equivalent). Thus, in order to keep *prices* low, it's mandatory that the *Products* be manufactured as quickly as possible. However, in return for the increase in speed, Nature imposes to spend more energy according to the well known relation :

$$W = \frac{1}{2} \cdot m \cdot v^2$$

with :

W = *energy (work)*
m = *mass*
v = *speed*

It should be noted that this natural law stipulates that in order to double the speed and theoretically be able to divide the *price* by 2, it's obligatory to spend, as a minimum, 4 times more energy in the form of work, thus causing 4 times more energy losses and also involving more material waste. Nature prescribes and therefore requires that :

- ***to gain little of this, it's obligatory to lose much of that. And Human wants to gain a lot.***

Conclusion

In this study, finance was never discussed because this discipline is only related to accounting, even though the calculations may be probabilistic. In fact, it only deals with monetary units, with only one characteristic, namely *Cash*, whereas here it's always a question of taking into account the two characteristics of *Work* and *Money*, that is, the transformation of one into the other and *vice versa.*

It has been shown above the similarities existing between the premises of the two disciplines of thermomechanics and Economics, such as: the second principle of evolution, the first principle of conservation, the basic experimental empirical law. We know that in physics, once exhibited analytically, these three concepts, through their mathematical developments, allow us to express the functioning of energy exchanges in a rational and practically acceptable way. Identically, the developments of the economic concepts can only induce the rationality of the explanations of the economic exchanges and in adequacy with reality. Indeed, the premises being analogous in these two disciplines, no reason can lead to reject, exclude, banish, *etc.*, the application of the formalism of physics to Economics. Only concordance with the facts is capable of invalidating or confirming the veracity of this approach, or at least its fidelity to everyday economic phenomena. All other criteria must be proscribed, in particular sociological, anthropological, *etc.* arguments.

In the paragraph “Natural Sciences - Human Sciences”, it has been clearly stated that any physical system elabourated by the Human Being must be regulated and cannot be left to be abandoned. All natural phenomena put at the service of Human must be put under certain constraints in order to ensure the correct functioning of the equipment used. Generally speaking, these constraints define a range of characteristic values in which they must evolve. These values are always limited by control and regulation devices that only allow the system to operate within a range.

However, the obvious similarities between the two disciplines of thermomechanics and economics have just been shown. Consequently, and following the example of physics, the fact that the *Money* is only a human invention implies that the functioning of any *economic system* must be limited and therefore controlled. Regulations introducing legislative, regulatory or other constraints are therefore necessary to circumscribe, restrict, quota, the actions of individuals, because any action in this field is always due only to the decision and will of an individual, and in particular in the field of finance. But this is beyond the scope of this note's explanations of economic exchanges and therefore doesn't need to be dealt with here. However, all these regulations must be subject to the Laws of Nature.

Still because of the similarities between Economics and Physics and the fact that it's necessary to regulate physical phenomena in order to put them at our disposal and to take advantage of them, economic phenomena must also and imperatively be subjected to regulations that are very probably of the same essence. These regulations, which must be applied on the scale of a system such as a country, if not the entire world, can only be defined and elabourated at the level of these entities. The control and possibly the sanctioning of their application is therefore a matter for the States.

It was well specified in the note that only *Work* produces *wealth*: a supplement of *Work* providing a supplement of *monetary wealth* to the consumer through a decrease in *price*. Until the industrial revolution, this *Work* was performed only by the individual or the animal (apart from that coming from a few machines with a simple kinematic chain). For the last two centuries, it has essentially been the engines and machines that have been performing the *Work*. So, *wealth* comes only from the execution of superior *Work* and not from a decrease in remuneration. Moreover, it's well said that the *price* of *Products* must fall and thus benefit all the consumers of these *Products*, and not that this reduction in the cost *price* serves to increase profits by maintaining the selling *price* and therefore the dividends.

Humany people argue that the cost of *manpower* is too high, particularly in France. However, it's very rare for these individuals to work in the economic sense of the term defined in this essay, *i.e.* to perform *work with an economic purpose*. As a result, they generally don't enrich the economic system of which they are a part. In doing so, they unquestionably show that they discern their own labour from that of the producers of *monetary wealth*. They never consider that the cost of their own labour can be too high. But it has already been specified that it's *Work* that creates the *Money*. So, the decrease in *prices* induces the enrichment of all consumers, and of course, even those who don't perform any *economic work*. Conversely, a fall in the remuneration of "W*orkers"* alone (only those individuals who make *prices* fall) *ipso facto* increases inequality. Moreover, as the wage bill is reduced, a certain quantity of *Money* will be lacking for subsequent consumption following the transformation *Money→Work*. Therefore, logic dictates that the two transformations *Work→Money* and *Money→Work* must be equal, both in their cause (*Work* or *Money* deployed) and in their consequence (*Money* or *Work* obtained). Therefore :

- ***neither of these two policies (supply policy, demand policy) should be privileged, only the balance between them should be sought.***

Since the beginning of the industrial revolution, the tendency has been to increase the *Work done* by the engines and to decrease the *Work done* by Human. Thus, the major shareholders can benefit and even claim to be increasingly enriched since they are the owners of these engines. They therefore seek to reduce *manpower costs* as much as possible by mechanization, relocation, layoffs, *etc.* But, as already mentioned, this is only possible because of a constant (but not regular) long-term drop in fuel *price*s. As a result, this process only results in increased inequality. On the contrary, the approximation of the costs of mechanical energy and human energy would reduce the desire of the owners to monopolize the essential part of the *Money* produced by the *work* of the engines and would make the increase in inequality obsolete. It remains to be seen whether society (individuals, associations, organizations, politicians, government, *etc.*) accepts these inequalities or rejects them, lets the process unfold as it pleases or intervenes through legislative or regulatory measures (taxation, *etc.*) to cushion or block it. However, this being unquestionably related to a human decision, it doesn't need to be dealt with in this study and is therefore totally excluded.

In the paragraph "Purpose of the Study", it was specified that strictly analytical explanations of economic phenomena, and particularly exchanges, were sought. What follows these "Prolegomena" constitute the mathematical developments of what has just been exhibited above. Knowing that mathematical analysis has never been found wanting in the explanation of natural phenomena, it's reasonable to hypothesize that the same is true for the dynamic approach set out below in this essay.

02 – VALUE OF THE MONETARY UNIT

ABSTRACT: This chapter acts as a lemma and is not directly related to the essay itself. Some readers may regard it as a truism, but it is important to have a solid foundation so that further developments cannot be misleading or open to criticism and dispute.

It refers to the value of the monetary unit according to the number of units existing in the economic system studied and for the four hypotheses already defined in the chapter "00- monetary evolutions".

General

When we say :

1. that bankers create money, it means that they increase the number (n) of monetary units circulating in the economic system of which they are a part,
2. that each country (economic *system*) has its own money, reference is made to the unit (u) of money. For example, the Yen for Japan, the Shekel for Israel, etc,
3. that the money held in the pocket of an individual in Eurosystem is 17€, in that of an Englishman 34£, *etc.*, it's considered the mathematical product ($n.u$) of the number of monetary units (n) by the unit (u).

These three sentences are *a priori* correct. But :

1. in the first case, money is defined as a number (n),
2. in the second, the money is considered as a unit (u),
3. in the third, money is fixed as a product ($n.u$).

These different meanings exhibit the confusion and logical misunderstandings caused by the lack of a precise, unambiguous and monosemic definition. As already indicated in the paragraph “Semantics” (chapter “Prolegomena”) and in order to avoid misunderstandings, mistakes, misconceptions, inconsistencies, it's imperative in Economics to follow Condorcet's precepts and consequently to determine and fix the meaning of words, especially that of *Money*, which is the subject of this chapter.

By definition (Larousse L3-1970), a *measure* is defined as :

- **“the evaluation of a quantity made according to its relationship with a quantity of the same species, taken as a unit and as a term of comparison”.**

This means that a dimension is equal to :

Dimension, Magnitude, Measurement = number of units of the characteristic × value of the unit of the characteristic

This definition is of course valid whatever the field studied and particularly in Economics for the measurement of *Money*. So :

$$Money(M) = number(n)\ of\ monetary\ units \times value\ (u)\ of\ the\ monetary\ unit$$

the relationship is written:

$$M = n \cdot u \qquad \text{‹02-01›}$$

whose differential is :

$$dM = n \cdot du + u \cdot dn \qquad \text{‹02-02›}$$

Normally, reason dictates that in order to compare two or more dimensions, it's imperative that the value of the unit (u) be invariable, *i.e.* that it remains constant in time and space. In fact and in principle, the dimension should only be a function of the number (n) of units. This is why measuring tools (balances, Pesons, scales, surveyor's chains, rulers, goniometers, ammeters, voltmeters, thermometers, barometers, ...) must be checked and punched in order to guarantee their accuracy and this from standards whose dimensions have been fixed once and for all. At all times and in all places, the use of measuring instruments falsified by altering the value of the unit has always been very severely condemned.

However, in Economy this rule, normally absolute, which decrees the fixity of the unit is not valid. Indeed, the value of the monetary unit varies according to place and time, which makes it difficult to understand economic exchanges. It is quite undeniable that the United States monetary unit is not identical to that of the European, Japan, Paraguay, Malawi or any other country.

Some will argue that in the Anglo-Saxon world, physical units of measurement are different from those of the metric system. However, the transformation coefficients between these units have been definitively fixed, unlike those of monetary units which vary daily by determination on the stock exchange.

Furthermore, it's also indisputable that the Argentine Peso has varied greatly over the last few years and that the ratio of the value of the Dollar to the Euro has evolved and still fluctuates since the creation of the latter. The value of the German monetary unit in the year 2000 had absolutely no correspondence with the one it had at the beginning of the 1920s (especially in 1923).

Consequently, when studying the value of the existing *Money* in an economic system, it's of course essential to take into account the possible variation (in time) of the value of the monetary unit circulating in that system (in space). Now, according to the differential relation set out above, namely :

$$dM = n \cdot du + u \cdot dn$$

there can only be 4 possibilities of evolution of the value of the monetary unit, listed as follows:

Hypothesis 1 $dM = 0$	**Hypothesis 2** $dM \neq 0$
$dn = 0$ **(possibility 1)**	$dn = 0$ **(possibility 3)**
$dn \neq 0$ **(possibility 2)**	$dn \neq 0$ **(possibility 4)**

that can be reviewed.

The State or any other issuer having a right to issue banknotes or coins as well as credits, there are only two cases, namely :

1. the issuer doesn't issue banknotes to compensate for the change in the monetary unit,
2. the issuer issues notes to compensate for this variation.

These two cases correspond respectively to possibilities 1 and 3 (with a constant number of units) on the one hand, and 2 and 4 (at constant unit value) on the other hand, indicated in the table above. In addition, it must always be specified whether over time the monetary unit's considered constant or current. This is conventionally and usually referred to as :

- when the unit's constant, the *Money* is referred to as ***Constant Money***,
- when the unit's variable, the *Money* is referred to as ***Current Money***.

However, one must be careful that when we speak of *Constant Money* or *Current Money*, it's only the monetary unit that has this property and not the overall quantity of *Money* that may or may not vary. This fact can be confusing and therefore requires special attention.

Hypothesis 1 $\Rightarrow$ ***The overall quantity of money is constant***

Since the overall quantity of *Money* existing in the *system* is considered constant its variation is obviously zero and the differential relationship becomes :

$$n \cdot du + u \cdot dn = 0$$

In economic reality, it often happens that the remuneration of certain categories of economic agents (individuals, households, companies, associations, administrations, communities, ...) is increased. It is quite obvious that it's not because certain remunerations are increased that the *wealth* of the economic system under consideration is automatically increased. If, for example, all the wages, salaries, paycheck, *etc.* of the inhabitants of the Principality of Andorra were doubled overnight, nobody would argue that the monetary *wealth* of this country would consequently be doubled in the same period of time because the *price*s of products would themselves double. This would only be true if *price*s remained constant despite the doubling of Andorrans' income.

The same would be true for any economic system envisaged.

1. ***Possibility 1***

In this case the number of units is constant ($dn = 0$ - no issue of monetary units), which leads to the simplification of the relationship as follows :

$$n \cdot \partial u = 0$$

and one can write :

$$\boxed{if \ : M \ , \ n = constant \ so \ : \ u = constant \ (Constant \ Money)}$$

It is possible to consider this possibility as a *system*-wide case where nothing happens. Indeed, everything being constant, there is therefore no variation. However, this is only valid if the entire *system* is considered. This expresses that the total *wealth* of the *system* is constant, but this doesn't mean that within the *system* there cannot be variations between the different parts of the *system*. In the case we are concerned with, if some agents have increases in income (salary or other) this necessarily implies a loss (decrease) of income for other agents, because it will have been necessary to take the *Money* before it's redistributed to the agents whose salaries are increased. For example, if we consider an economic *system* made up of 20 million agents, and of these 200,000 (1%) have their income increased by 5%, the average loss of other agents (19,800,000) will be 0.05%. In any case, this doesn't in any way increase the overall *wealth* of the *system*. However, in any system, physical or otherwise, gradients always have a natural (unconstrained) tendency to decrease to approach equilibrium, where in principle there are only fluctuations. In Economics, the functioning of a system should not be an exception to this rule. Increasing deviations necessarily imply a vitiated process in the system.

2. ***Possibility 2***

In this case the number of units is variable ($dn \neq 0$ - issue of monetary units by the State, banks or possibly others), which leads to the writing of the relation as follows :

$$n \cdot du = - \ u \cdot dn$$

either :

$$\frac{du}{u} = - \ \frac{dn}{n}$$

whose integration gives :

$$\ln u = - \ln n$$

and one can write :

$$\boxed{if\ : M = constant\ ,\ n \neq constant\ \ so : u = \frac{1}{n}\ \left(Constant\ Money\right)}$$

Two typical examples of this case are respectively the transition from the old to the new Francs in 1959 and, closer to us, the transition from Francs to Euros. Indeed, in the first example, the number of monetary units was divided by 100 and therefore the value of the monetary unit was multiplied by the same amount with 1 New Franc equal to 100 Old Francs. The changeover to the Single European *Money* represents the same mechanism with the same coefficient. As the number of monetary units has been divided by 6.55 957 in relation to the Franc, the value of the unit has been multiplied by this coefficient and therefore 1 Euro equals 6.55 957 Francs. No one will argue that the *wealth* of France (or any other Eurozone country) has been altered in any way by these changes in *Money*, at the risk of sounding like an oddball. Of course, this is still true even if the issuer only hits a very small quantity of notes without there having been a fall in *prices*. Of course, in this case, the fall in the value of the monetary unit will be small or may even be described as derisory. However, it will never be zero, but absolutely and fully proportional to this increase in quantity in the number of monetary units.

It is common to hear it said that it's the banks that create the most *Money* by distributing more credit either to businesses or to individuals. However, it's quite obvious that it's not because a bank grants a line of credit to any economic agent that the *wealth* of the economic system in question is increased. Indeed, any granting of a loan through a bank line of credit and not covered by deposits undoubtedly amounts to an increase in the number of monetary units. Consequently, the “creation” of *Money* by the banks is only a view of the mind because the value of the monetary unit will vary in a strictly inverse way, as has just been shown above. Indeed, historical analysis shows that when credit's increased, *price*s rise. The increase in *price*s generates inflation and correlatively the decrease in the value of the monetary unit. Many economic crises are only the result of episodes of easy and abundant credit. The so-called subprime crisis is a striking and recent example. To conclude this paragraph, it's indisputable that banks only create *Cash* (monetary units) but in no way *Money*, *i.e. wealth*.

It is said that bankers create *Money* by granting credits, so it must be admitted that the transition from Old Francs to New Francs and from Francs to Euros corresponds to a destruction of *Money*, which nobody pronounces. In fact, bankers create monetary units (n) and the above-mentioned events have destroyed them: 100 n in the first case and 6.55 957 n in the second.

Consequently, if nothing else changes, the modification of the number of monetary units by issuing *paper money* (by the State) or credits (by the banks) is pure fantasy because the value of the unit will vary in an inversely proportional way. Obviously, agents who will receive a surplus of monetary units will be favoured at the expense of those who will not have received any, because the latter will see their income decrease at the same time as the value of the unit, which, as before, increases inequality.

Of course, any economic system has a certain inertia (like any physical system), the increase in certain incomes being immediate and the increase in *price*s being delayed for a certain period of time because of this inertia, resulting in a momentary increase in *wealth*. But because of this inertia, this temporary enrichment will necessarily be followed, later on, by a decrease in the latter, *i.e.* by an impoverishment, the overall final result of the system being absolutely and rigorously zero.

This hypothesis (composed of constant money possibilities 1 and 2) shows that no monetary *wealth* is neither created nor destroyed. Whether the value of the monetary unit or the number of units is constant or variable doesn't change the result strictly and absolutely nothing, because these two characteristics evolve, in this hypothesis, in a strictly inverse way. The increase in income (wages or other) is therefore absolutely inoperative for the enrichment of the economic system considered as already stipulated above.

Since the number (n) of units and the value of the unit (u) vary proportionally in the opposite direction, no *Money* can be created. To argue that bankers create the *Money* is therefore a blatant misunderstanding due to a lack of precision in the definitions of the characteristics. Also, to call the number (n) of monetary units *Money* (M) is a clear semantic error. This confusion of meaning, between the number of units and the *Money*, leads to the confusion of ideas and irremediably to the incomprehension of phenomena (paragraph “Semantics” - chapter “Prolegomena”).

Hypothesis 2 ⇒ *The overall quantity of money is variable*

Since the overall quantity of *Money* existing in the system is considered variable, its variation is obviously non-zero and the main differential relation therefore remains :

$$dM = n \cdot du + u \cdot dn$$

Now, the creation (or destruction) of *Money* (dM) can only be due to an increase (or decrease) of the *Work performed*, either by an agent (individual *stricto sensu*, employees, slaves), or by an animal, or even by an engine (the most common case in “occidental” countries since the industrial revolution). Indeed, this additional *Work* allows the improvement of productivity and the eventual lowering of the *price* of the *Product* in question. The consequence of this *price* drop is an increase in the quantity of *Money* that remains in the possession of the Acquirer and therefore in his *purchasing power* and his enrichment.

3. ***Possibility 3***

In this case, the number of monetary units is constant ($dn = 0$ - no issue of monetary units), resulting in the simplification of the relationship as follows :

$$\partial u_n = \frac{1}{n} \cdot \partial M$$

and one can write :

$$\boxed{if\ :\ M \neq constant\ ,\ \ n = constant\ \ so:\ u\ =\ \frac{1}{n}.M\ \ (Current\ \ Money)}$$

Since the quantity of units n is constant the value of this unit's obviously a direct function of the quantity of *Money* created, and only of this, by additional *Work done*, which causes, *ipso facto*, a directly proportional enrichment of the consumer agents composing the *economic system.*

4. ***Possibility 4***

In this case the number of units is variable ($dn \neq 0$ - issue of monetary units), resulting in the relationship being written as follows :

$$\partial n_u = \frac{1}{u} \cdot \partial M$$

and one can write :

$$\boxed{if\ :\ M\ ,n\ \neq\ constant\ \ so\ :\ u\ =\ constant\ \ (Current\ \ Money)}$$

Since by an increase of the *Work performed* a proportional quantity of *Money* is created, the State (or any other issuer of *Money*) has the right to issue as many monetary units (units of account in fiduciary or scriptural form) as *Money* created in order to keep the value of the monetary unit constant. In the same way as in the previous possibility, this creation of *Money* increases the *wealth* of the system. However, it's quite obvious that the *Money* issued by the State must be equitably distributed among the agents composing the *system*, otherwise inequalities would be inevitably increased. However, the policy to be followed isn't at all the aim of this study, which focuses exclusively on the explanation of the phenomena.

Those who assert that banks create money *ex nihilo* then unquestionably refer to this possibility:

- increase of *Money* by increasing the number of monetary units, at constant units.

A little logic, reason, but above all no common sense, then shows that there would be nothing but an unlimited increase in credit to infinitely enrich any *economic system.* Poverty (not to mention misery) should have disappeared long ago. Moreover, loans should never be repaid, because each repayment would impoverish the poor. Economic crises, which are often due to excess liquidity from credit, would in this case have no purpose and therefore should never exist.

Analytical possibilities 3 and 4 above are obviously valid both when the quantity of money decreases and when it increases, *i.e.* when its variation is negative ($dM < 0$) or positive ($dM >$

0), this variation determining respectively a decrease or an increase in *purchasing power*, *i.e.* an impoverishment or an enrichment of the system under consideration. This hypothesis (composed of possibilities 3 and 4, with variable money) shows that :

- ***monetary wealth is created when the price decreases,***
- ***monetary wealth is destroyed when the price rises.***

Conclusion

It is undeniable that increasing the number of monetary units by printing banknotes or entering credit lines doesn't imply any expenditure of *Work*, apart from that just necessary for the manufacture of banknotes and/or the entry of credit lines. Such an increase in monetary units is always only due to a human decision. If some people believe and maintain that this increase can provide an increase in *wealth*, then why not give credit without limit "*urbi and orbi*"? On the other hand, lowering *price*s obligatorily imposes the execution of *Work* at least proportional to this decrease. It is quite certain that this second hypothesis is much more difficult to achieve. To summarise, it's possible to pose that :

- ***monetary evolutions which don't require the execution of Work, never create Money,***
- ***the creation of Money necessarily requires an expenditure of Work.***

The relevant, judicious interest of all research in Economics isn't to know whether or not there is a balance, but to know the process and the analytical relations that allow to enrich (or to impoverish) any *economic system*. How important is it to have mastery of one or more balances when the goal for everyone is to always improve their lot, which necessarily implies transformation, evolution?

When any individual earns any kind of income, it's possible to say that he or she receives a certain amount of monetary units, *i.e.* the number (n) of units defined above. Indeed, the value of his income can only be given by the value of the monetary unit (u), which is only determined by the *price* of the *Products* placed on the market. Let us suppose, for example, that an economic agent receives a monthly income of 1,000$ and that this amount enables him to meet just his basic needs (food, clothing, housing, health). At the end of each month, therefore, he has nothing left.

Let us now assume that :

1. the *prices* of the *Products* he acquires each month increase by 10%, it's quite certain that he will lack 100$ to satisfy his needs. Therefore, it's essential that he either reduces his “lifestyle” or that he borrows to maintain it. It is undeniable that this hypothesis corresponds to an impoverishment of this individual,

2. the *prices* of the *Products* that he acquires each month fall by 10%, it's certain that by maintaining his consumption habits, he will have 100$ at the end of the month in his purse that he can use as he pleases later on. It is obvious that this hypothesis corresponds to an enrichment of this individual.

Whatever the hypothesis envisaged (rising *price*, falling *price*, constant *price*), it's indisputable that :

- the quantity of monetary units (n) received by the economic agent is constant (1,000 units),
- the value of this quantity of monetary units (1,000 u) changes with the *price* level of the *Products* he buys each month,
- the quantity of monetary units (N) existing in the *system* is constant,
- the value of this quantity of monetary units ($N.u$) varies with the general *price* level of the *Products* placed on the market.

It is always possible to ask the following question:

- ***where does the Cash available to any consumer come from?***

Some may answer that their employer has provided it for them. Whoever the employer is, private or public entrepreneur, local authority, state, *etc.*, it's always possible to rephrase the question in these terms:

- ***where does the cash available to these employers come from?***

The answer can only be :

1. from consumers and businesses through taxes, levies, miscellaneous charges, *etc.* if the employer is a public body or an administration of some kind,
2. consumers if the employer is a private or public company.

However, the taxes, levies and various charges of companies come from consumers themselves. Thus, it's shown that *Cash* comes from consumers, and we come back to the first question, namely :

- ***Where does the Cash that any consumer has come from?***

As indicated above, the only adequate answer can only be that the value of the *Cash* only comes from *price* reductions that have taken place previously. A few centuries ago, almost all of a household's income was spent on food, clothing and housing. It is well known that, as these expenditure items declined, the income generated was transferred to other consumption items. This is exclusively the only method of increasing *purchasing power*. However, it's normal to always seek the best possible *purchasing power*, which obviously requires lowering the general *price* level. However, it's neither Merlin nor Carabosse, let alone a banker, nor a snap of the fingers that makes it possible. This decrease in *prices* can only be the result of an improvement in productivity, which in turn depends on the application of superior *Work*. It is quite certain that, in order to lower the *price* of the *Product* he produces, any supplier is obliged to provide more *Work* than before, by any means (himself, employees, slaves, animals, motors and machines). It follows unquestionably from this, that an improvement in the *purchasing power* of a consumer, that is to say an increase in the value of his income, can only come from the implementation of additional *Work* provided by the supplier. This method is the one and only recipe for the enrichment of a community. Some may retort that all that is needed is to increase the number of monetary units (n) held by the consumer. However, if this number is increased, we will find ourselves in the case indicated by possibility 2 of hypothesis 1 stipulating that if the number of monetary units is increased, then the value of the unit decreases proportionally. Now it's therefore possible to ensure and certify that :

- ***the Additional Work performed by the supplier is TRANSFORMED into Additional Money owned by the consumer,***
- ***this Work is defined here as economic Work (T) and no longer as physical Work (W).***

This definition of *Economic Work* (T) and its discrimination against mechanical work (W) is explained below. Nevertheless, it's possible to express here that *Work of an economic nature* is that which allows a reduction in the *price* of a *Product*. It should be stressed that *Economic Work* is always inferior to physical work. In fact, a zealous contract worker can be exhausted at the end of the day without having done any *Economic Work*, since no *price* reduction has taken place.

Therefore, and as already stated above:

- ***the Money should not be considered as the one circulating from a consumer to a supplier, but as the one that the consumer holds in addition after a price decrease.***

In conclusion, it can be stated that :

- the only way to increase the *wealth* of an *economic system* is to performed additional *Work* which corresponds to a gain in productivity, and absolutely no other economic measure, because this chapter shows beyond doubt that only a fall in *prices* can lead to an increase in *wealth* and/or consumption (*caeteris paribus*),
- Increases in income that are not due to an increase in *Work* done always result in economic distortions within the system and not in its overall enrichment. However, these increases are always only due to human decision and will, which implies that these measures are applications and therefore not theoretical, as they should not be taken into account. Of course, some may retort that these increases can be used to reduce inequalities through redistribution, which isn't disputed. However, they must then necessarily admit that these inequalities are precisely due to previous increases in income (wage or other) which had previously caused these distortions and which should therefore not have occurred.

Forgetting this fact would then be a blatant example of the loss of analytical reasoning and, consequently, of reason.

Moreover :

- ***these four analytical possibilities identify all possible monetary developments,***
- ***all the monetary considerations that one can imagine necessarily reside there.***
- ***NO OTHER POSSIBILITY CAN EXIST.***

In everyday reality, developments can be seen as being formed from different possibilities that have just been defined.

In an *isolated system*, if for some reason part of the population sees its income increase, it's certain that the rest of the population will see its income decrease, all other things being equal. If the heads of companies and shareholders are increased, the employees will see their *purchasing power* decrease, and conversely, if they are increased, profits, dividends, directors' fees, *etc.*, will decrease. Consequently, in the case of an increase in the *purchasing power* of a part of the population through an increase in income, only that part will become richer at the expense of the other part, which is perfectly logical.

Assuming that this increase in *purchasing power* is due to a fall in *prices*, it's quite certain that no part of the population is harmed since this fall benefits all the agents making up this population. We can see that the only normal way to increase the *wealth* of an *economic system* is to reduce the *prices* of the *products* placed on the market. However, this decrease can only be caused by an increase in the *Work done*, as formulated above.

Increasing income (wages, salaries, pensions, dividends, allowances, benefits, ...) is always only a consequence of a human decision, whereas the decrease in *prices* can only be achieved by the execution of additional *Work* leading to an improvement in productivity, which is much more difficult.

It is therefore possible to write that :

- ***the increase in income* doesn't *require any expenditure of Work***
- ***the fall in prices necessarily requires the execution of Work at least proportional to the square of it.***

Those who advocate wage increases always think that they are performed for a constant *price* level, which corresponds to a *price* decrease for a constant wage level: this is strictly specified in the box above. All of this demonstrates in the most formal way that coinage, minting money, is by no means a creation.

Every German in 1923 was a multi-billionaire and yet lived very sparsely. Some might indeed think that increasing income by holding *prices* constant is similar to lowering *prices* by holding income constant. However, this view of things is only valid within the *economic system* under consideration, *i.e.*, as a general rule, within the same country. On the other hand, compared to another system, *i.e.* another country with a different *currency*, the increase in income necessarily implies a devaluation corresponding to the decrease in the value of the *Money* (analytical possibility 2). This chapter demonstrates that it's imperative to distinguish *Money* from *Cash*. Indeed, a sum of 100 Francs in 1950 had a much higher value than the same sum in the year 2000. The *Money* is, of course, a completely intactile (but perfectly real) characteristic and therefore it must be contained, integrated, supported by something concrete, material, palpable, that is to say, tactile, which is *Cash*. It can be banknotes, coins, cheques, bank cards, bills of exchange, precious metals (gold, silver, *etc.*), *etc.*, but also nuggets of native copper, shells, salt bars, in so-called "primitive" societies, or by any object that is considered to contain an exchange value, a monetary value, of *Money*.

In conclusion it's necessary to define :

- ***Money as the value of Cash,***
- ***Cash is the vector-support of the Money.***

It is therefore possible to argue that the issuance of monetary units by the State or by banks can be summed up as an identical phenomenon. Therefore :

- ***making the banknote printing plate work creates Cash but never Money.***

Contrary to many dogmatic preconceptions, speculation and the financialisation of the economy therefore never creates *wealth*, because, to paraphrase Lucretia, we can affirm :

- ***Ex nihilo non moneta.***

This aphorism being in perfect agreement with the general one, namely:

- ***EX NIHILO NIHIL***

which has never been and never will be caught in default. Any consideration that leads one to believe or support the contrary is then a loss of reason.

03 – BASIC DEFINITIONS

As this study is based exclusively on the analogies between exchanges and energy transformations and exchanges and economic transformations, it's therefore obvious that it's necessary and indispensable to rely on definitions similar but not identical to those of the physical world. Consequently, this makes it necessary to possibly specify new definitions other than those commonly accepted in conventional microeconomics, as well as to expose new symbols that do not necessarily correspond to those of conventional economics.

General

Normally the arguments, criteria and conditions for the validity of the reasoning would have to be developed here. However and *a priori*, the application of analytical reasoning can be accepted and applied to economic phenomena on condition that the variations in the characteristics of the economic system under examination are small enough and close enough in time to be judged as continuous. For example, the evolution of the *price* of a *Product* can be considered as continuous because it doesn't generally change abruptly over a long enough period of time. Obviously, this isn't always the case in reality. For example, at the time of sales, *price*s fall by 20 to 50% (or even more) in one go. It is quite obvious that in this case, the evolution of *price*s is difficult to assimilate to a continuous and regular variation. Nevertheless, at the end of the sales, *price*s return substantially to their previous level and this period can be assimilated to a temporary anomaly which doesn't call into question this supposed continuity of evolution for a sufficiently long period.

The noun "*wealth*" refers, here and throughout this study, only to the quantity of *Money* existing in the *economic system* under consideration, *i.e.* to the only money supply in any form whatsoever, both scriptural and fiduciary. Monetary aggregates (M0, M1, ...) don't have to be used here, as their definition only comes from a human resolution. It never takes into account the assets that an economic agent (definition below) or any community may have. Indeed, for the constitution of a certain patrimony, it has always been necessary to create a *Money* beforehand. By posing :

R_m = *monetary wealth*

i = *economic agent (definition below)*

n = *number of economic agents*

The monetary *wealth* of an economic system can be defined as follows:

$$R_m = \sum_{i=1}^{n} R_{m(i)}$$

The aim of the whole paper is to find out how it's possible to have :

$\boxed{dR_m > 0}$ **‹03-01›**

which necessarily implies that individual *wealth* increases (at least statistically), *i.e.* :

$\boxed{dR_{m_{(i)}} > 0}$ **‹03-02›**

It is obvious that the analytical explanations allowing these differentials to be positive will also admit negative or possibly null results. As in mechanics, where kinetic relations indicate both acceleration and deceleration depending on their sign, the same will be true in Economics.

At the present time, it's undeniable that these two relations constitute the goal to be achieved by any *economic system* (it may be otherwise for a particular individual whose search for happiness or otherwise is paramount). The aim of this study is therefore the search for the means to enable this enrichment as well as the existing relations between these means and this enrichment, knowing that there is no space for any other consideration, and in particular any reference to the "Theory of General Equilibrium (TEG)". Consequently, the use in this study of the law of "*supply and demand*" brings absolutely no profit and therefore has no purpose.

Usually, reference is always made to the redistribution of *wealth*, but there is never any mention or allusion to how it could have been created, as if by magic or by the wave of a magic wand. If a cake is to be shared, any sane person is perfectly convinced of the need to have made it beforehand. This note is therefore the search for the ingredients and the recipe to make this cake. According to the two relationships outlined above, it's therefore at the level of the individual, of the economic agent, that one must look for the possibility or possibilities of increasing *wealth*, *i.e. purchasing power*.

Basic definitions

Below throughout the note :

- the (economic) agent represents any individual in the strict sense, but also self-employed workers and heads of enterprises (craftsmen, traders, farmers, liberal professions, *etc.*), a household, a family unit, an enterprise (of all legal types), an association, an administration, a local authority or other, *etc.*, *i.e.* both a natural person and a legal entity, capable of either acquiring, processing or selling any *Product* (definition below). The verb to transform means to elabourate, to manufacture, to build as well as to consume, to use, to destroy. The fact that the verbs acquire and sell can be condensed by the verb exchange, shows that this discrimination is relative to the position of the agent (observer) to whom one refers (consumer or supplier),
- the *Product* represents any object, merchandise, product, good or service that an economic agent (as defined above) can either acquire, transform or sell. It can be raw materials, semi-finished products, manufactured objects, agricultural products, any goods, services, *etc.*,

provided that they can be either acquired, transformed or sold. In conventional microeconomics, the *Product* can be related to the “good”. The *Product* must be considered as the vector-support of *Work*, in the same way as in thermodynamics, gas is considered as the vector-support of heat,

- *Cash* is represented by banknotes, coins, gold and silver metal, cheques, credit cards, as well as shells (cowries), salt bars, feathers, teeth, nuggets of native copper in so-called “primitive” societies, *etc.*, *i.e.* by everything that can be considered as containing an exchange value, a monetary value, of the *Money*. It should be noted that the inscription of a line of bank credit should not be considered as *Money* but only as *Cash*. In fact, the beneficiary of this line of credit will use notes, cheques, drafts, *etc.* to pay for his purchases in the same way as if he had possessed through him the quantity of *Money* corresponding to his credit. *Cash* must be considered as the vector-support of the *Money*, in the same way that in thermodynamics, gas is considered as the support vector of heat,

- *labour* (l) must be understood as the thing to be done, the task, the work to be done. It is constant for a given *Product* and manufacturing method. In fact, it's generally considered that the thing, the work, the *Product* to be made represents the *Work to be done*. However, everyone knows very well that the quicker the *Product* is made, the greater the *Work*. *Work* being a function of the speed of manufacture, it's therefore necessary and indispensable to discriminate between *Work* and *labour*. The more quickly the *labour* is performed, the greater the *Work* will be. In fact, painting a door or ploughing a field requires a certain amount of *labour* which is equal to itself but which can be done using different methods at different speeds. But in order to change this speed of execution it's necessary to vary a *Force*. More complete explanations are given in the chapter “Mechanics of Exchanges”. *Labour* in Economics is similar to space in physics,

- the *Work* (T) must be considered as included in the *Product*. The exact, analytical definition will be given later. Let us say for the moment that it's the variation in the *speed of execution of the labour* (definition above) under the effect of a *Force* that initiated it and therefore should not be confused with the *Product*. In fact, for a constant *labour*, the *Work* varies according to its *speed* of execution. This *Work* (T) must be considered with an economic vision and not a physical one (W) since it's related to a *labour* and not to a space, as will be specified later,

- the *Money* (M) is defined as the measure of the value of *Cash*, as it's quite obvious that a 100 franc note circulating in the year 2000 had absolutely no value at all as the one available a century earlier at ½. In the same way that a *Product* contains a certain amount of *Work*, it's possible to say that *Cash* contains a certain amount of *Money* that varies according to place and time. *Cash* should not be confused with *Money*, because just as it's necessary to have a support for the *Work* (which is the *Product*), it's also necessary that the *Money* be included in something (which is the *Cash*). This is so true that for any transfer of *Money* it's necessary to have banknotes, coins, credit cards, cheques, bills of exchange, drafts, action coupons, magnetic or optical supports (tapes, discs, CDs, DVDs, *etc.*) in the clearing houses, *etc.*.,

- the *complexity* (c) must be understood as the inertia that a *Product* presents at the change in *speed of execution of the labour*. In fact, as we have seen above, the *labour* required to produce a *Product* can be performed at different *speeds*. However, it's certain that some *Products* will be more easily modified and transformed than others. A piece of hardened steel is much more difficult to machine than the same piece of annealed steel, a piece of Quercy oak than a piece of Landes pine,

- the *Utility* of the *Product* (U_P) (which can be both objective and subjective, accurate and erroneous) must be considered in its most general meaning and be placed in the exclusive framework of the exchanges. Conventionally, the notion of "marginal utility" is commonly used but has absolutely no purpose in this paper for the reason developed in the chapter "Prolegomena" and is therefore not used. *Utility* should be taken, in this study, in the sense of Walras, as already explained in the chapter "Prolegomena".

  If an individual acquires any *Product*, it necessarily has a certain *Utility*, which may be higher or lower. For himself, the *Utility* of use of the *Product* may be nil, but it may be very high if he wishes to give it as a gift. The following example is in line with what has just been said. A few years ago, dummy car telephone antennas were offered for sale despite their null technical utility, but whose *Utility* for the consumer's vanity could be very high.

  Someone will buy an object for its *Utility* as a tool, such as a knife, a trowel or a pair of straps, but he may acquire another object for its Food, Gastronomic or Taste *Utility*. Someone else may purchase a *Product* for its Visual Beauty *Utility* such as a work of art. A third person may purchase a pleasure trip to the islands for its relaxing and scenic *Utility*. A company may purchase machine tools, ballpoint pens, *etc.*, for its own use. An agent may purchase a piece of clothing for sports or to fight against the cold, but he may also purchase a ceremonial garment, but in each case the object, the merchandise, the service, the *Product* will have its *Utility*. The satisfaction or extinction of a person's vanity is also a *Utility* for the latter. It is possible to enrich this enumeration ad infinitum. Every object or service has its own *Utility* and it's, in fact, this characteristic that agents are looking for.

  To refute the idea that *Utility* is an important characteristic of economic exchanges, some say that air is very useful and yet costs nothing. Yet, if they ran out of it, they would be prepared to pay a high *price* for it. A bit of logic shows that if the need for a *Product* is satisfied, it's quite certain that it would be absurd to acquire it. But in places where air is lacking, it has a cost: for example in submarines, mines, manned aircraft and satellites, and what about the air used by hunters, fishermen and scuba divers. For an agent the *Utility* can be variable over time. Indeed, during the development of a *Product*, the consumer sees its *Utility* increase but on the contrary decrease during its use. Moreover, this *Utility* is variable according to the agents considered: a scalpel is very useful for a surgeon and nil for other agents. A very high quality High Fidelity channel is very useful for an informed music lover or for musical institutions, but much less for the average person and none for the deaf. It is necessary to underline that the value of *Utility* attributed to a *Product* by a consumer can be right or wrong, correct or unfounded.

The rate at which a *Product* depreciates through use or becomes obsolete through technical evolution can vary greatly, from almost instantaneous to almost nil. For example, the use of a match causes its *Utility* to fall from its maximum to almost zero almost instantaneously. And even if the user uses it as a toothpick, the *Utility* of the match will always be zero. It is the piece of wood that will have its own *Utility*. This is also the case for Food *Products* as they are used only once. It is also the case for Services. Once the use of a ski lift in a winter sports resort its *Utility* becomes null, as well as the visit to the family doctor. This is also true for lazing around under the coconut trees. It can be moderately fast for common tools such as kitchen utensils, cars, clothes, DIY or gardening tools. In general, in this case, the obsolescence comes from the more or less rapid wear of the objects and the *Utility* of the *Product* decreases with time for the user. On the other hand, some *Products* are almost eternal, and in particular works of art (paintings, sculptures, monuments, *etc.*), provided that they are stored and maintained normally to ensure their durability. In this case, the *Utility* of the object doesn't diminish with time.

Experience, *i.e.* everyday life, shows that no one will buy a match already burnt because its utility is null and void. Nobody will buy a ticket for a rugby match that has already taken place because the service has already been performed and its *Utility* is null. On the other hand, an agent will buy a used car because it will have retained some *Utility*. And this agent will pay more or less for this opportunity, depending directly on the *Utility* it will have retained. And if it's a work of art, since its *Utility* is almost constant over time, its *price* will not decrease.

To conclude, let's say that *Utility* can be subjective as well as objective, or possibly distorted by advertising arguments, sales techniques or other, which doesn't change at all the reasoning and the method applied in this study, as well as their validity, in the same way that a *Product* has a certain *Utility* (variable in time for the same agent and in space depending on the agents), *Cash* has a certain *Utility* (U_A). Indeed, it's obligatory to have a support that serves as a vector for the *Money*. When any customer acquires a *Product*, the supplier always asks for *Cash* (as defined above: banknotes, coins, bank cards, drafts, *etc.*) containing the quantity of *Money* corresponding to the *price* of the *Product*.

This *Utility* is variable depending on the agents. Indeed, the lower an agent's income is, the higher the *Utility* of the *Cash* will be. A billionaire doesn't give much importance to a one Euro coin, but it has a certain *Utility* for a consumer agent living on social minima who can acquire a kilogram of pasta with this amount. Moreover, if *price*s increase the *Utility* of the coin decreases since this agent will not be able to buy as many *Products*. Conversely, if the *price*s decrease he will be able to acquire more *Products* and in this case he will have an extra amount of *Money* left in his pocket after the acquisition and consequently the *Utility* of the *Cash* will have been increased.

Definition of agents

The manufacturer is defined in this note as an agent producing a *Product* but also as any supplier. A manufacturer can therefore be a wholesaler, a trader, *etc.*, although it doesn't necessarily modify a *Product*. It can also be an end user who modifies the *Utility* of a *Product* through its use and who resells it second-hand. So we are faced with three possibilities that can be discriminated analytically as follows:

- manufacturer ⇒ positive *Utility* variation ⇒ (*Utility* increases for the consumer)
- merchant ⇒ zero *Utility* variation ⇒ (*Utility* is constant for the consumer)
- user ⇒ negative *Utility* variation ⇒ (*Utility* decreases for the consumer)

- the supplier and the consumer designate any two agents carrying out an exchange.

Everyday life shows that a *Product* is successively developed by a whole series of manufacturers placed chronologically one after the other. As already stated in the chapter "Prolegomena", three agents are defined as follows:

- a Seller ⇒ an agent selling a raw or partially processed *Product* to a Transformer,
- a Transformer ⇒ an agent transforming this raw *Product* and selling it to a Acquirer,
- an Acquirer ⇒ an agent continuing to develop the *Product* or an end user.

By definition :

- the Transformer is considered to be placed within the system,
- the Seller and the Acquirer are considered to be outside the system.

For any given consumer, the *Utility* of the *Product* evolves during its manufacture and use as follows:

1. during the manufacture of the *Product* by a Transformer, the Buyer sees the *Utility* increase,
2. when using this *Product* by himself, he sees the *Utility* diminish.

Like everything else, this is a function of the position of the observer, *i.e.* perfectly in accordance with the Principle of Relativity. This means that any manufacturer must always be considered as a user for the previous manufacturer. Therefore, it's absolutely necessary to admit that :

- ***the Transformer is a user for the Seller,***
- ***the Acquirer is a user for the Transformer,***

and that :

- ***the Seller is a manufacturer for the Transformer,***
- ***the Transformer is a manufacturer for the Acquirer.***

Consequently, it follows that for the Transformer (inside the *system*) :

1. ***the Utility of the Product increases during manufacture by the Seller,***
2. ***the Utility of the Product diminishes when he* elabour*ates it himself,***
3. ***the Utility of the Product increases when the Acquirer uses it.***

These inverse variations of *Utility* for the Transformer will allow the implementation of a cycle allowing the creation of *Money* (*M*) in the same way as the inverse variations of temperature in physics allow the realization of the Carnot and Clapeyron cycles defining the destruction of heat and the creation of mechanical work. It will be indicated later on how it's possible to explain the increase in *wealth* by the creation of *Money* due to the destruction of *Economic Work* (nothing can come from nothing).

By convention and by analogy with physics:

- everything that enters the system, that is to say, everything that the Transformer receives will be counted positively;
- everything that goes out of the system, or everything that the Transformer gives will be counted negatively.

As a main conclusion, we have to admit that :

- ***the Product must be considered as the vector-support of the Work,***
- ***Cash must be considered as the vector-support of the Money,***

in the same way as in thermodynamics :

- ***gas is considered to be the heat vector-support.***

It should be noted that, in everyday life, no one confuses a *Product* with the *Work* that has been necessary to elabourate it, whereas confusion is generally made between *Cash* and *Money*, so it's necessary and indispensable to differentiate between these two characteristics. Identically to the exact sciences, where they are always named by one and only one name, it's obligatory to proceed in the same way in economic science and to use only one perfectly characterised term for each thing, to the exclusion of all others, and as far as possible in a monosemic manner.

04 – MECHANICS OF EXCHANGES

ABSTRACT: In physics, we know that to get from one point to another, there are many different paths and that each of these can be travelled at different speeds. Similarly in Economics, to realize any Product, there are several manufacturing methods and each of them can be executed more or less quickly (productivity).

In economics, as in physics, there are speeds, accelerations, forces that induce them, resistances and constraints, etc. This chapter therefore attempts to define the relationships that can associate these characteristics with each other, always following the physical reasoning supported by mathematical analysis.

General

Let's take the example of manufacturing a chair (or any other *Product* as already defined). Of course, it can be made in different duration, *i.e.* more or less quickly. But for the same method, whatever the speed of manufacture, the *labour to be done* is always the same because it represents the work, the task, the thing, the chair to be made. In fact, whether the chair is made in 4, 8 or 16 hours, the *labour* is always the same, but it's the *Work* that is variable because it's obvious that it's more difficult to make it in 4 hours than in 8 and especially than in 16, *i.e.* the energy used increases when the *speed* of manufacture increases.

Let us now take the example of the construction of a wall, which can be made of bricks, rubble, dry stones, cut and cemented stones, *etc.* It is obvious that each method presents a greater or lesser degree of difficulty in construction. The use of ashlar requires more *labour* than the use of bricks or rubble stones (agglos). For a given method, the *speed* of construction can vary, as it can be faster or slower depending on whether the mason accelerates or slows down, or on the number of people employed. However, for the method used, whatever the *speed* of execution, the task to be performed, the wall, is identical, *i.e.* the *labour*, but the higher the *speed*, the more energy (*Work of an economic nature*) spent.

The previous examples are absolutely analogous to mechanics, where for a given path, the space travelled is always the same regardless of the speed of travel, the mechanical work spent being a direct function of that speed. The same is true for filling a bathtub, where the capacity is always constant but the filling speed is variable according to the opening of the tap, *i.e.* the flow rate. The logic is the same for an earthwork where the volume is constant but the speed of completion depends on the means used (basket, shovel, wheelbarrow, shovel, ...).

It should be noted that, as a general rule, work, according to common sense, is similar to *labour* as defined in this note. Indeed, when we say “there is a lot of work” it means that there is a lot of thing to do, and when we say “we've done a lot of work” it means that a lot of thing has been done. On this basis, the term *labour* should have been replaced by work, but the analogy with the physical definition would have been flouted in this case. However, as the whole study is based on physical analogies, it was preferred to consider *Work* with the same type of analytical definition as in physics and to give the thing to be done the noun of *labour* (one of the terms *task*, *drudgery, job; ...*, would have been, perhaps, more appropriate).

The table below lists some examples according to the field of application and explains their similarities:

FIELD OF APPLICATION		CHARACTERISTIC		ENERGY
		BASE	RELATION TO TIME	
physic	*Travel*	*space (e)*	*speed (v)*	*mechanical work (W)*
	Flow	*volume (V)*	*debit (v)*	*mechanical work (W)*
	Earthworks	*volume (V)*	*debit (v)*	*mechanical work (W)*
	Information	*bit (b)*	*bitrate (bps)*	
economy	*Transformation* $W \rightarrow M$	*labour (l)*	*productivity (ω)*	*Economic work(T)*
	Transformation $M \rightarrow W$	*price (p)*	*tachyaxy (ϖ)*	*Money (M)*

Speeds ⇒ Productivity – Price formation

Consequently, for the realization of a given *Product*, according to a fixed method :

- ***the labour is constant and the Work (of an economic nature) is variable according to the speed of execution of this labour.***

In physics, the mechanical Work (W) is associated with the space travelled, whereas here, in Economics, the *economic Work* (T) is combined with the *labour to be performed.* For this reason, it's essential to differentiate these two jobs by different symbols (W and T).

The *labour* as well as the *Work* referred to here can be performed by an agent, an animal, a motor or a machine, but, whatever the means used, this *labour* and/or *Work* must always be performed. In fact, during antiquity and until the 18th or 19th century, the economic agent could have the *labour* and *Work* he had to perform replaced by one or more slaves, by wage-earners or by simple machines using natural or animal energy. From the second half of the 18th century onwards, more complex machines appeared due to the development of efficient and powerful engines (steam engines, internal combustion engines, electric motors, *etc.*) which made it possible to replace *labour* and, above all, to increase the amount of *Work* that had to be done by Human.

Consequently, by posing :

t = *time*
l = *labour to be done - task – job to be done*

ω = *speed of execution of the labour to be done - productivity*

it's possible to write :

$$\boxed{\omega = -\frac{dl}{dt}} \tag{04-01}$$

The relationship is marked with a negative sign because the amount of *labour to be done* decreases with time as opposed to the amount of *labour done*, which increases. However, between these two types of *labour* (*labour to be done* and *labour done*), the important one is the *labour to be done*, because the greater the *labour*, the more personnel (employees, slaves), animals or engines are needed to do it. The *labour done* out is of no interest because once a *Product* is manufactured, there is nothing more to be done. If there is still something to be done, it can only be *labour to be done.*

In the same way, each time an elementary operation on the chair (or any other *Product*) is performed, it's possible to say that the *price* increases by a certain amount, *i.e.* the *price* is formed as the *labour* is performed, but not necessarily at the same *speed* as the *labour* itself. Consequently, by posing :

p = *price*
ϖ = *speed of price formation - tachyaxis*

it's possible to write :

$$\boxed{\varpi = \frac{dp}{dt}} \tag{04-02}$$

From these two relations (04-01 and 04-02), we see that *labour* and *price* are comparable to space (linear displacement) in physics. Moreover, they are valid whatever the case considered, *i.e.* whatever the *economic system* considered, at any time and in any place, and are therefore compatible with the Principle of Homogeneity. In fact, whether the *labour* is carried out in any country and the *price* of the *Product* is considered in any of them, the *speeds* will always be given by these relations. However, they only give a measure of these *speeds* and in no case do they stipulate for what reason (just as in mechanics the speed relationship only gives a measure of the speed). Whether *productivity* decreases or increases, *i.e.* the *speed* at which *labour* is carried out varies for any reason (too much or too little supply, faulty supply of raw materials, absence or lack of personnel, machinery or motor breakdown, new, faster manufacturing method, *etc.*) the 04-01 relationship will always give a faithful and accurate measure of the instantaneous *speed.* Whether the *speed* of execution of the *labour* is cancelled due to snacks, strikes, interruption of power supply, technical unemployment, weekends, holidays, *etc.*, this *speed* will always be equal to zero, which is what the relation 04-01 gives, validating here again its total conformity to reality. In the same way, the relation 04-02 is exact whatever the reason for the *price* to evolve in this way. Indeed, whether it's due to an increase in wages, social security charges, various taxes, *etc.*, or a decrease due to an increase in productivity or wear and tear on the *Product* during its use, the *price* always forms (increase or decrease) at a certain speed given by this relation.

These two relations (04-01 and 04-02) can be written respectively :

$dl = - \omega \cdot dt$ and : $dp = \varpi \cdot dt$

whose integrations return, for a constant speed (analogous in mechanics to the "Uniform Rectilinear Movement"):

$l = - \omega \cdot t + C$ and : $p = \varpi \cdot t + C$

By posing:

C = *labour to be carried out for purchase*	and :	C = *price at purchase*
$\omega.t$ = *task done (added)*	and :	$\varpi.t$ = *Valeur added*

we can say that:

1. the *labour to be done* (l) at any given moment is equal to the *labour to be done* (C) at the initial moment (at purchase) minus the *task* ($\omega.t$) already done at that moment;
2. the *price* (p) at any given moment is equal to the initial (for purchase) *price* (C) plus the Value Added ($\varpi.t$) at that moment,

which corresponds perfectly to the analysis of daily reality, but if :

$\omega.t$ = *task done (added)* $\Rightarrow$ $-\omega.t$ = *task to be done (to be added)*

Speed variation

However, these two *speeds* (of *labour* execution and *price* formation), which have just been defined, can obviously vary over time, *i.e.* increase (acceleration) or decrease (deceleration).

Consequently, by posing :

γ_ω = *variation in the speed of execution of the labour to be done (gain or loss of productivity)*
γ_ϖ = *change in the speed of price formation (enrichment or impoverishment, inflation or deflation)*

The analytical discrimination between the possibilities of evolution (enrichment or impoverishment, inflation or deflation) will be given later.

It is possible to write respectively :

$$\boxed{\gamma_{\omega} = \frac{d\omega}{dt} = -\frac{d^2 l}{dt^2}}$$ and : $$\boxed{\gamma_{\varpi} = \frac{d\varpi}{dt} = \frac{d^2 p}{dt^2}}$$ **‹04-03› ‹04-04›**

or :

$$d^2 l = -\ \gamma_{\omega} \cdot dt^2$$ and : $$d^2 p = \gamma_{\varpi} \cdot dt^2$$

whose integrations return, for a uniformly varied speed (analogous in mechanics to the "Rectilinear Uniformly Varied Movement", *i.e.* with γ constant) :

$$l = -\ \omega \cdot t \mp \frac{1}{2} \cdot \gamma_{\omega} \cdot t^2 + C$$ and : $$p = \varpi \cdot t \pm \frac{1}{2} \cdot \gamma_{\varpi} \cdot t^2$$

With :

$$-\gamma_{\omega} = \textit{gain of productivity}$$
$$+\gamma_{\omega} = \textit{loss of productivity}$$
and :
$$+\gamma_{\varpi} = \textit{impoverishment} \text{ or } \textit{inflation}$$
$$-\gamma_{\varpi} = \textit{enrichment} \text{ or } \textit{deflation}$$

As a general rule, the variations (increase and decrease) of these speeds don't occur continuously but in a jerky manner, which doesn't call into question the path of reasoning. Taking the example of the chair, the *speed of execution of the labour* on the seat and backrest upholstery can vary at once between two copies of the *Product* as well as the *speed of formation of the price* of these elements, but the integration of these relations taken between the beginning and the end of the complete manufacture of the chair will always give a correct average value between the considered bounds (beginning and end of execution of the chair). Moreover, it's logically for ease that a manufacturer will change the *price* all at once, but in reality this increase could be broken down into small parts, each applying to a small operation that can be called "elementary operation". By considering the elementary operation to be small enough, it's possible to consider the evolution as continuous (the phenomenon can be compared to physics where on a macroscopic scale the phenomenon is considered continuous whereas it's discontinuous, quantified on a microscopic scale).

For example, consider a roofer. For the construction of a single-storey dwelling house he can use a 3.5-meter scale and for a two-storey building he can use a 7-meter scale. The basic operation can be considered as the climbing of a ladder but also as the climbing of a single rung. In the first case, the value of the elementary operation varies with the height of the building, whereas it's constant in the second case, because here it's the number of operations that changes. In everyday life, when faced with such a case, the elementary operation is always chosen, with a view to simplification, as large as possible but still small enough to be compatible with the validity of the results obtained. For example, during the Middle Ages, an elementary operation was defined as the area ploughed in one day and named journal, working day, *etc.* In physics we know that at the microscopic level phenomena are discontinuous but they are considered continuous at the macroscopic level. It is the same in the case that interests us here.

Fundamental principles of economic dynamics

It is obvious that, in order to vary these *speeds*, it's imperative to exert *Force*. The greater the *Force* (accelerating or decelerating the *speed* at which the *labour is done* and the *price* is formed), the greater the variation in *speed* will be. In fact, no one can dispute the fact requiring :

- on the one hand, that a supplier always exerts a *Force*, whatever the means (individuals, employees, slaves, animals, engines and machines) to accelerate the *speed of execution of the labour*,
- on the other hand, that a consumer always exerts a pressure, a *Force* on the supplier to lower the *price*, thus slowing down the *speed at which that price is formed.*

In addition, these *Force*s will be a function of the inertia of the *Product* at its *speed* change. Consequently, by applying :

c_P = *complexity of the Product*
c_A = *complexity of the Cash*
F_P = *Force, due to the supplier, relating to the execution of the labour*
F_A = *Force, due to the consumer, relating to the formation of the price*

it's possible to apply for the following respective entries :

$\boxed{F_P = c_P \cdot \gamma_\omega}$ and: $\boxed{F_A = -\, c_A \cdot \gamma_\varpi}$ **‹04-05› ‹04-06›**

and to admit that these relations represent the Fundamental Principles of economic dynamics in the same way as in physics the relation :

$$F = m \cdot \gamma$$

is admitted as representing the Fundamental Principle of mechanical dynamics. As this gives unquestionably correct results in the physical domain, it's not absurd but logical that it should be the same in the case which concerns us here, *i.e.* in Economics for the explanation of exchanges.

Complexity of the Product – *Complexity of the Cash*

Throughout the study and in general, there is often no difference between the complexity of the *Product* and the complexity of the *Cash*. This simplification means that they would be equal, which isn't true. The complexity of the *Product* is relative to only one type of *Product* among many others, whereas the complexity of *Cash* is relative to the whole *economic system* in which it circulates. The complexity of *Cash* is identical wherever the transformation takes place. For example, it's identical in Strasbourg, Quimper, Arras, Rodez, *etc.* It is therefore necessary to discriminate between these complexities by posing:

c_P = *complexity of the Product*
c_A = *complexity of Cash*

However, for the sake of clarification it's generally not stipulated which of these two complexities is involved. In calculations relating to a single transformation, this doesn't change anything, except to replace the letter c by c_P or by c_A depending on the transformation considered ($T \rightarrow M$ or $M \rightarrow T$). In the simultaneous calculations relating to both transformations (association of $T \rightarrow M$ and $M \rightarrow T$ transformations), it would obviously be necessary to introduce a c_P / c_A ratio without calling into question the judgement on the relevance (good or bad) of this dynamic approach.

Work – Money

Moreover, the *Work* spent will, of course, be a function of the intensity of the *Force* that will cause the variation in the amount of *labour done.* The greater the amount of *labour* done per unit of time, *i.e.* the faster it's done, the greater the *Work* will be. As said before, this *Work* is performed by an individual as well as by an animal or even by a motor or machine. The *Work*, as defined below, represents the sum of the different *Works done* by all possible means. Therefore, the total *Work* may increase and that of Human may decrease, because that performed by machines is increased in greater proportions. This is the case that generally occurs at the present time, *i.e.* since the industrial revolution.

Consequently, by posing :

T = *Work for economic purposes*

it's possible to write :

$$dT = F_P \cdot dl$$ **‹04-07›**

It must be made clear here that the *Work* defined by this relationship must be considered as *economically useful Work* and not taken, either in its usual and vehicular sense or as in the physical science. This *Work* is that which is capable of causing a variation in the *speed* of execution of the *labour* and, consequently, a possible variation in the *speed* of *price* formation. This is why this *Work* is designated by the letter T and not by the letter W (*Work*), as these two *Works* don't have the same analytical definition (in spite of their similarity) and, above all, don't have the same value. In fact, in reality, physical Work (W) is always superior to the *economically useful Work* (T) discussed in this study (chapter “Link Heat Consumed → Money Created”).

It can be seen that if the *speed* of execution of the *labour* doesn't vary, the *Work done* (*Economic Work*) is zero, which may puzzle more than one reader not accustomed to mechanical reasoning, although the physical work can be very important. In fact, it's quite logical to say that if the *labour* is carried out at a constant *speed*, there is no additional *Work* done to accelerate this *speed*, *i.e.* to increase *productivity*. Consequently, an agent (individual in the strict sense of the word, association, administration, company, *etc.*) who doesn't accelerate the speed at which the *Product* is produced (increase in *productivity*) doesn't *work* in the economic sense of the word, since it cannot cause any reduction in the *price* of the *product* and therefore no increase in the *purchasing power* of consumers, *i.e.* it cannot generate any increase in monetary *wealth* (R_m). However, it's clear that even if the *economic Work* is nil, the *labour* as well as the physical work can be significant, substantial and consequent. Even if agents don't create monetary *wealth*, they may produce other types of *wealth*, for example cultural *wealth* or provide non-market services. The above-mentioned example of the contract worker who has been dismissed at the end of her service has clearly not enriched society in any way.

Identically, the *Money* created will, of course, be a function of the intensity of the *Force* which will cause a variation in *price*. The lower the *price*, the more *Money* available to the consumer. Consequently, by posing :

M = *Money*

it's possible to write :

$$dM = -F_A \cdot dp \qquad \textbf{‹04-08›}$$

It is quite obvious to say that if the *price* is constant, its differential is zero and this necessarily implies that no *Money* is created since the *purchasing power* of consumers will itself remain constant. In fact, if the *price* of a kilogram of noodles decreases from \$1 to \$0.9, it's possible to say that \$0.1 of *Money* has been created (for each kilogram produced) since this amount remains in the consumer's pocket. Of course there is, before and after the *price* reduction, always \$1. However, if the number of monetary units is always constant, it's the value of that unit that has increased in this case, corresponding to possibility 3 of the chapter “Value of the monetary unit”. The State (or any other issuer) could also beat a 10-cent coin and entrust it to the consumer, who would, as before, have this amount in his pocket. In this case, we can see that the value of the monetary unit remains constant but that it's the number of units that becomes variable, the latter corresponding to possibility 4 of this same chapter. In the same way as in the previous case, it's obvious that even if the *Money* created is zero, the *price* can be very high or very low.

In thermodynamics, an engine or machine generally comprises several stages all operating on the same diagram, *i.e.* each stage operates according to the same Natural Laws. In the same way, in Economics there is a whole series of manufacturers placed chronologically one after the other and it's obvious that each of them is subject to the same Natural Laws (and not legal, regulatory or juridical, which are always the result of human will). In physics, as the process of each of the stages is identical, only the phenomena occurring in one is considered and studied. In the case we are interested in here, it's necessary to have the same approach. However, *price* and *labour* are two characteristics which are relative to the whole *Product*. It is therefore necessary to consider and study only the phenomena occurring in a single Transformer. Consequently, only the *added Value* and the *task to be done* must be taken into account, *i.e.* the *Money* and the *Work* of the single Transformer considered.

During any negotiation, a Buyer (outside the system) always exerts a *Force* (F_P) on the Transformer (inside the system) so as to increase the *task done* (or decrease the *task to be done*) by the latter. As a result, the *task to be done* (B) decreases. Whatever the intensity of this *Force*, the variation of this *task* is therefore always negative. Consequently, it's possible to write :

$$dB < 0$$

Now, when the *task to be done* decreases, the Acquirer increases the amount of *Work* that is given to the Transformer, that is to say, that enters the *system*. In accordance with the sign convention, this *Work* is therefore always positive. As a result, the 04-07 relationship, namely :

$$dT = F_P \cdot dl$$

becomes:

$$\boxed{dT = -F_P \cdot dB} \qquad \text{‹04-09›}$$

Physically, this *Work* must be considered as destruction or creation depending on whether it goes in or out of the *system*, respectively, and corresponds to the increase or decrease in the supplier's *employment*. It remains to be asked what is the creation and/or destruction of *Work*? Generally speaking, and since we must always rely on experience, that is to say, on the reality of economic life, what is sought is always the increase in the supplier's *employment* and not that of the consumer. So:

- the destruction of *Work* corresponds to the reduction of the *labour to be done*,
- the creation of *Work* corresponds to the increase in *labour to be done*.

This can be represented as follows:

Labour to be done	Work
↘	***destruction***
↗	***creation***

During any negotiation, a Buyer (outside the system) always exerts a *Force* (F_A) on the Transformer (inside the system) in order to make the Transformer reduce the *Value Added* (V). Regardless of the intensity of this *Force*, the variation of this *Added Value* is therefore always negative, consequently, it's possible to write :

$$dV < 0$$

However, when the *Added Value* decreases, the Acquirer decreases the amount of *Money* that is given to the Transformer, *i.e.* that enters the *system*. According to the sign convention, this *Money* is therefore always negative. As a result, the 04-08 relationship, *i.e.* :

$$dM = -F_A \cdot dp$$

becomes :

$$\boxed{dM = F_A \cdot dV} \qquad \textbf{‹04-10›}$$

Physically, this *Money* must be considered as a destruction or a creation depending on whether it enters or leaves the *system* and corresponds to the increase or decrease of the *purchasing power* of the supplier. It remains to be asked what is the creation and/or destruction of *Money*? Generally speaking, and as we must always rely on experience, *i.e.* the reality of economic life, what is sought is always the increase in the *purchasing power* of the consumer and not that of the supplier. So :

- the creation of *Money* corresponds to the decrease in *price*,
- the destruction of *Money* corresponds to the increase in *price*.

This can be represented as follows:

Price	***Money***
➘	***creation***
➚	***destruction***

Energy

Replacing the *Force*s in the two relationships (04-09 and 04-10) above by their value (relationships 04-05 and 04-06), we obtain respectively :

$$dT = -\ c_P \cdot \gamma_\omega \cdot dB \qquad \text{and :} \qquad dM = -\ c_A \cdot \gamma_\varpi \cdot dV$$

By replacing the *speed* variations (γ_ω and γ_ϖ) in the two relations above by their value (relations 04-03 and 04-04), we obtain respectively :

$$dT = -\ c_P \cdot \frac{d\omega}{dt} \cdot dB \qquad \text{and :} \qquad dM = -\ c_A \cdot \frac{d\varpi}{dt} \cdot dV \qquad \textbf{‹04-11› ‹04-12›}$$

that it's possible to write :

$$dT = - c_P \cdot \frac{dB}{dt} \cdot d\omega$$ and : $$dM = - c_A \cdot \frac{dV}{dt} \cdot d\varpi$$

By replacing the ratios dB/dt (dl/dt) and dV/dt (dp/dt) by their values (relations 04-01 and 04-02), we obtain respectively :

$$\boxed{dT = c_P \cdot \omega \cdot d\omega}$$ and : $$\boxed{dM = - c_A \cdot \varpi \cdot d\varpi}$$ **‹04-13› ‹04-14›**

After integration, these relationships give respectively :

$$\boxed{T = \frac{1}{2} \cdot c_P \cdot \omega^2}$$ and : $$\boxed{M = - \frac{1}{2} \cdot c_A \cdot \varpi^2}$$ **‹04-15› ‹04-16›**

Considering the constant zero, these relations represent the respective kinetic energies of *Work* and *Money* (see chapter “Basic Principles”). The presence of the negative sign (-) in the relation giving the *Money* is perfectly logical. Indeed, the slower the speed (ϖ) of *price* formation, the higher the *Money* held by the consumer.

Employment – Purchasing power

By taking the above relations 04-13 and 04-14, when the speeds (ω and ϖ) are constant, by definition:

$$d\omega = 0$$ and : $$d\varpi = 0$$

which implies that :

$$dT = 0$$ and : $$dM = 0$$

Consequently, by posing:
e = *employement of the supplier* and : a = *purchasing power of the consumer*

it makes perfect sense to write :

$$\boxed{e = c_P \cdot \omega}$$ and : $$\boxed{a = - c_A \cdot \varpi}$$ **‹04-17› ‹04-18›**

If the *speed* (relation 04-01, $\omega = -\ dl/dt$) of the *labour to be done* (l) increases, it means that the *labour to be done* decreases. The faster this *labour* decreases, the more important is the job (e). Similarly, if the speed (relation 04-02, $\varpi = dp/dt$) is slow, the higher the *purchasing power* (a) is. Moreover :

- *Work* is zero (neither created nor destroyed) when the *labour is done* at a constant *speed* and therefore the supplier's *employment* obviously remains constant,
- *Money* is nil (neither created nor destroyed) when the *price* is formed at constant *speed* and therefore the consumer's *purchasing power* obviously remains constant itself.

Note

It should be noted that it's usually convenient to measure *purchasing power* by saying that it takes *x* hours of average salary to acquire such a *Product*. From this "definition" it's possible to pose :

$$purchasing\,power\ =\ \frac{time}{product}$$

So this would mean that the longer it takes to acquire the *Product*, the higher the *purchasing power* would be, which is absurd. Analytical accuracy requires reversing the ratio, *i.e.* :

$$purchasing\,power\ =\ \frac{product}{time}$$

Now, the number of hours worked (time) multiplied by the salary corresponds to the cost *price* of the *Product* under consideration. Therefore, it's possible to replace and one obtains :

$$purchasing\,power\ =\ \frac{price}{time}$$

The ratio happens to be mathematically the speed of formation of the *price* of the *Product* (relation 04-02). However, the *purchasing power* is also a function of another characteristic (to take into account the *Product*) which can only be the inertia that opposes the variation of this speed (in the same way as in physics). This inertia has been defined as the complexity of the *Product*. Consequently and finally, the relation becomes :

$$purchasing\,power\ =\ complexity \times \frac{price}{time}$$

which is nothing other than the relation 04-18 (to the nearest sign). We see that by the reasoning we find the result of the classical analytical calculation.

For a given *Product* the *complexity* (c) is obviously constant, consequently the differentials of the relations 04-17 and 04-18 give respectively :

$$de = c_p \, . \, d\omega \qquad \text{and :} \qquad da = -c_a \, . \, d\varpi \qquad \textbf{‹04-19› ‹04-20›}$$

but the relations 04-11 and 04-12 give respectively :

$$c_p \, . \, d\omega = - \, dT \, . \, \frac{dt}{dB} \qquad \text{and :} \qquad - \, c_a \, . \, d\varpi = - \, dM \, . \, \frac{dt}{dV}$$

and by replacing dT and dM by their value (relations 04-09 and 04-10), we obtain :

$$c_p \, . \, d\omega = \, F_p^{ext} \, .dB \, . \frac{dt}{dB} \qquad \text{and :} \qquad - \, c_a \, . \, d\varpi = \, F_A^{ext} \, . \, dV . \frac{dt}{dV}$$

which makes it simple:

$$\boxed{de = F_P . dt} \qquad \text{and :} \qquad \boxed{da = F_A . dt} \qquad \textbf{‹04-21› ‹04-22›}$$

or :

$$F_P = \frac{d}{dt} \cdot e \qquad \text{and :} \qquad F_A = \frac{d}{dt} . a$$

demonstrating that the use of the supplier and the *purchasing power* of the consumer are only a function of the External *Force*s applied by the (external) consumer on the (internal) supplier so that the latter increases his *task to be done* and decreases his *Added Value*. In the same way that *labour* and *Work* can be carried out, depending on the circumstances, by the individual himself, slaves, employees, animals or engines and machines, *employment* is obviously the sum of the jobs of all these actors.

Therefore, by posing the following clues :

i = *individuals, self-employed workers (craftsmen, merchants, farmers, ...), heads of enterprises,*
e = slaves
s = *employees*
a = *animals*
m = *engines, machines*

it's possible to write :

$$l = l_i + l_e + l_s + l_a + l_m$$
$$T = T_i + T_e + T_s + T_a + T_m$$
$$e = e_i + e_e + e_s + e_a + e_m$$

these characteristics being additive.

We have seen that *employment* is equal to (relation 04-17) :

$$e = c_P \ . \ \omega = -c_P \ . \ \frac{dl}{dt}$$

which undoubtedly shows that *employment* is a function only of the amount of *labour to be done* per unit of time, that is to say of the *speed* with which it's done and absolutely nothing else, for a given *Product* (at constant *complexity*). This is, of course, due to the reduction in the amount of *labour to be done* as a function of time (negative relationship). This proves that a reduction in the legal working time has absolutely no influence on the creation of *employment*, as it may only have an effect on the *unemployment* rate. In fact, if we divide the working time by two and the legal daily working time is reduced from 8 to 4 hours, it's indisputable that for the same *speed* of execution of the *labour*, it will be necessary to hire a second person in the afternoon since the first person will have finished her shift at noon. However, the latter will have seen his or her *employment* divided by 2, because until proof to the contrary: $1 \times 8\, hours = 2 \times 4\, hours$, but this obviously depends on a human decision and is therefore a matter of policy, which is outside the scope of this note's explanatory framework.

It is possible to consider the following as a real concrete example of what is put forward above. During the month of March of the year 2000, the agents of the Post Office in the Toulouse conurbation went on strike. As the mail sorting *speed* had become nil, the job was nil since no one was working. At the end of the strike, the local management of the Post Office temporarily hired about 400 people to absorb the stock of letters and parcels in backlog. These hirings corresponded to an increase in *employment* because the sorting *speed* had to be increased. Once this reduction was achieved, the sorting *speed* decreased back to the original *speed* and the people hired were made redundant, so *employment* fell. This shows that *employment* is logically and exclusively dependent only on the *speed* at which the *labour* is done and absolutely nothing else.

As already mentioned above, since *labour* can be done by any means (individuals, slaves, employees, animals, engines and machines), it's quite obvious that total *employment* (e) is itself the sum of the different partial jobs, or :

$$e = - \ c_P \cdot \frac{dl_i + dl_e + dl_s + dl_a + dl_m}{dt}$$

At present in the “developed” countries, *i.e.* essentially since the industrial revolution, it's possible to consider the *labour* performed by slaves and animals as zero. As a result, the relationship becomes simpler and becomes :

$$e = - \ c_P \cdot \frac{dl_i + dl_s + dl_m}{dt}$$

Moreover, the *labour performed* by the individual (craftsman, trader, self-employed, entrepreneur, ...) can be considered as constant. As a consequence, the relationship becomes even simpler and becomes :

$$e = - c_P \cdot \frac{dl_s + dl_m}{dt}$$

which shows that if the *labour to be performed* by an employee is replaced by that of a machine, the employee will see his *job* deteriorate and will eventually be fired, which corresponds perfectly to reality. This will, of course, depend on the respective costs of the different *labours to be done* either by the employee or by the engine or the machine (or other means).

Employment relations purchasing power

We know the relationship between *employment* (04-17) and *purchasing power* (04-18), *i.e.* :

$e = c_P \cdot \omega$ and : $a = - c_A \cdot \varpi$

The speeds of *labour* ω performance and *price* formation ϖ are vectorial characteristics, *i.e.* oriented, and each refers to a different transformation that takes place in different directions: *Product* (speed ω) and *Cash* (speed ϖ) circulating in opposite directions. In these relations, *employment* (e) is that of the supplier while *purchasing power* (a) is that of the consumer.

Relationships 04-21 and 04-22, namely :

$de = F_P \cdot dt$ and : $da = F_A \cdot dt$

can be written as :

$dt = \frac{de}{F_P}$ and : $dt = \frac{da}{F_A}$

These relationships can be equal, then:

$$\frac{de}{F_P} = \frac{da}{F_A}$$

or:

$$\frac{F_A}{F_P} = \frac{da}{de}$$

With the relations 04-19 and 04-20, we obtain :

$$\boxed{\frac{F_A}{F_P} = \frac{d_a}{d_e} = -\frac{c_a}{c_P} \cdot \frac{d\,\varpi}{d\,\omega}}$$ **‹04-23›**

Of course, it's possible to modify, as one wishes, the sign of these relationships according to whether one considers a consumer or a supplier, *i.e.* according to the meaning of the *Force*s applied, without this being an obstacle to the validity of the results, but subject to indicating it, as it will be seen that (relationships 05-06 and 05-11) :

$F_A^{ext} = - F_A^{int}$ and : $F_P^{ext} = - F_P^{int}$

exhibiting the Principles of actions and reactions relating respectively to *Avarice* and *Laziness*.

Evolution of the monetary unit

The lower the *price*, the more *Money* the consumer has at his disposal. Each time a *price* falls, the number (n) of monetary units in the economic system remains constant, but the value of the unit (u) increases. We know the differential relationship (chapter "Value of the monetary unit"):

$$dM = n \cdot du + u \cdot dn$$

However, a variation in the *price* of a *Product* doesn't lead to any variation in the number (n) of units existing in the system. Therefore, n is constant ($dn=0$), so the above relation becomes :

$$\partial M = n \cdot \partial u$$

or :

$$(\partial u)_n = \frac{\partial M}{n}$$

By replacing the *Money* by its value (relation 04-08), namely :

$$dM = - F_A \cdot dp$$

we obtain :

$$\boxed{\partial u_n = - F_A \cdot \frac{\partial p}{n}}$$ **‹04-24›**

which makes perfect sense. The change in the value of the monetary unit (u) in an *economic system* is an inverse function of the change in *price* relative to the number of units (n) existing in that *system*. If the issuer strikes a certain number of monetary units in order to keep the unit constant, then the above relationship becomes :

$$(\partial n)_u = - F_A \cdot \frac{\partial p}{u}$$

Of course, if, following an improvement in productivity for whatever reason, the *price* of mousetraps has decreased by 5%, it's certain that the *wealth* of the *economic system*, such as in France, will have hardly increased, but the increase will not be zero. However, if the *price* of cars falls from $15,000 to $14,000 through a gradual increase in productivity, then for France, where the production of these goods is about 2 million, the increase in monetary *wealth* will be about $2 billion, which is no longer negligible at all.

However, the laws of physics indicate that the energy required to increase speed varies as the square of the speed. This means that to double the speed, four times as much energy is required. However, it should be noted that this quantity is a theoretical minimum. At the time when this energy was supplied by Human (individuals, slaves, employees), by animals and possibly by a few simple machines using natural energies (wind, water), its quantity and power could only be very limited. As *productivity* was low, the result was that the *price* of the *Products* was high; the society could be described as poor.

The mastery of physical and chemical phenomena, following the invention of mathematical analysis, allowed :

- firstly, the exploitation in very large quantities of the deposits of geological resources,
- then, the control of energy transformations,
- finally, the spread of technology throughout almost the whole of society.

This has led to a hundredfold (and even more) increase in the amount of energy that can be used in the form of mechanical work, which has led to an unparalleled increase in productivity and a consequent fall in the *price* of products; the company can be described as rich.

From the Neolithic period up to the industrial revolution, it's possible to consider the standard of living of the various societies to be fairly constant; the temporal and spatial differences that existed can therefore be seen as fluctuations. Throughout this period, the amount of energy (heat and especially work) available to human has not changed. Only minor technical improvements made it possible to achieve small improvements in living conditions. It was only at the dawn of the 18th century that large quantities of technically accessible and economically affordable fuels made it possible for the standard of living of the individuals making up the societies that had these resources to increase exponentially.

It is this process, and only this process, that can change (more or less) the *wealth* of a society.

Income – Power

By bringing back, in the transformation $T \rightarrow M$, the quantity of *Money* created or destroyed per unit of time (hour, day, month, year, ...), a characteristic is obtained which is typically the Income per unit of time Γ_M (hourly, daily, monthly, annual, ...), that is to say :

$$\boxed{\Gamma_M = \frac{dM}{dt}}$$ **‹04-25›**

Identically, by bringing back, in the transformation $M \rightarrow T$, the quantity of *Work* created or destroyed per unit of time (hour, day, month, year, ...), a characteristic is obtained which is typically the *developed Power* Γ_T (hourly, daily, monthly, yearly, ...), that is to say :

$$\boxed{\Gamma_T = \frac{dT}{dt}}$$ **‹04-26›**

5 - BASIC PRINCIPLES

ABSTRACT: The Mankind being a component like any other of the Universe, it can only be enslaved to the laws that govern it. Now, the latter being determined and guided by extreme Principles, such as the Principles of "least action" and "conservation of energy", Man can only espouse Principles of the same kind and cannot in any way free himself from them. Indeed, Nature never discriminates between any of its elements and affects them all equally.

This chapter focuses on the presentation in economics of Principles similar to those of physics, namely: the Principles of equivalence, evolution, conservation, but also that of the equality of action and reaction. Indeed, when two agents (consumer and supplier) are present, they exert antagonistic forces on each other, which are necessarily equal during the transaction.

Principle of equivalence

We know that it's the realisation of additional *economic Work* that allows the creation of *Money* through an increase in *productivity* (chapter “Value of the monetary unit”). It is therefore possible to write the transformation relation :

$$\boxed{M = g_{TM} \cdot T} \qquad \textbf{‹05-01›}$$

which is similar in substance and form to the thermodynamic relationship in which heat is transformed into work ($W = J.Q$). This relation commonly represents the “Equivalence Principle”. The later chapter “Flows and Transformations” explains the presence of the transformation coefficient g .

We know that in physics the coefficient J is a constant (depending only on the units used, *i.e.* equal to 1 when they are identical), so logically, in Economics the coefficient g must also be a constant, otherwise it would cause inequalities between employees. In fact, this is very well understood by everyone, who claims :

- ***equal work, equal pay,***

but this implies the truthfulness of the reciprocal, namely :

- ***equal pay, equal work,***

which is never claimed by anyone. The first sentence relates to the $T \rightarrow M$ transformation, and the second to the $M \rightarrow T$ transformation. Then the relationship must be converted as follows:

$$\boxed{T = g_{MT} \cdot M} \qquad \textbf{‹05-02›}$$

or :

$$M = \frac{1}{g_{MT}} \cdot T$$

Accordingly:

$$g_{\mathbf{TM}} = \frac{1}{g_{\mathbf{MT}}} \qquad \textbf{‹05-03›}$$

provided that these coefficients are constant implying that the two transformations are symmetrical.

T→M Transformation ⇒ Definition

Anyone can imagine the $T \to M$ transformation in the following classical way. Everybody perfectly understands that in order to manufacture any *Product*, it's necessary to start from the beginning where there are only raw materials. At the present time, nothing more is done than our ancestor *H.habilis* who used to pick up a pebble and then hit it with a hammer in order to make splinters out of it. As it's made, the starting *Product* is increasingly transformed so that it's more and more suitable for its intended purpose. However, no one disputes the fact that this required energy to be expended in the form of mechanical work. In return for this *Product*, *Cash* flows in the opposite direction. The quantity of this *Cash* is more and more important according to the elabouration of the *Product*.

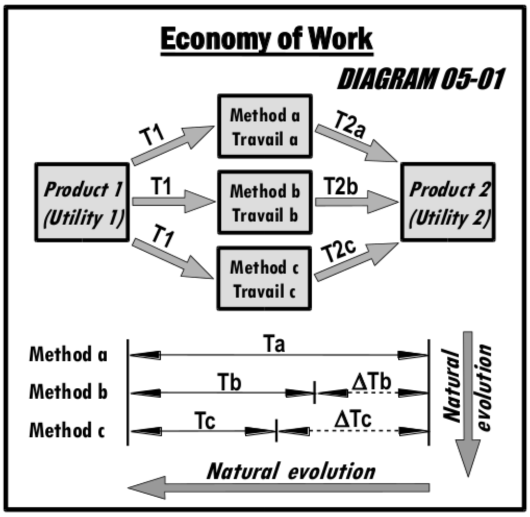
In spite of the generality of this conception of exchange, it doesn't in any case allow us to understand how an *economic system* can become richer (chapter “Value of the monetary unit”).

However, the analysis of the facts shows unambiguously that enrichment is only due to the acceleration of manufacturing operations which allow costs to be reduced. From this, it's possible to draw the consequence that it's the *Work* exercised by the supplier and necessary for this acceleration which allows this decrease in *price*s and thus the increase in the *Money* held by the consumer.

There is nothing complicated about this approach to economic exchange. It can be easily apprehended and mastered without any particular effort.

T→M Transformation ⇒ Second principle

All economists are convinced that there are no Natural Laws in their discipline. For this reason, they maintain that since the Economy is dependent on Human and that Human acts according to his needs and/or tastes, it cannot therefore have general laws applying to all the actors composing the *system* under examination.



However, as shown below, the actions falling under the above-mentioned Principles are of equal interest to each economic agent but also to each animal and each engine. These manifestations are absolutely generic, general and universal since they are subject to these Principles and are, therefore, indifferent, insensitive and foreign to Human Beings. They can thus claim to be the genesis of the Basic Principles.

In addition to the General Principles applicable whatever the field studied (Principles of Relativity, Homogeneity, Causality, ...), it's essential to establish Basic Principles that are specific to the discipline in question. These are hereafter referred to as First Principle and Second Principle by analogy with those of thermodynamics.

It is obvious that any agent, whoever he is and whatever he does, always tries to save the *labour* he has to do and therefore his *Work*, that is to say to do the minimum but always in a way compatible with the external constraints to which he is subjected. The right of every agent to save his *Work* is valid at all times and in all places, in accordance with the Principle of Homogeneity.

It should be noted, however, that this property may be extended to animals as well as to motors and machines. In fact, when Human uses animals as a substitute for his own *Work*, they obviously react in such a way as to perform the minimum amount of it, but always according to the external constraints exerted on him by Human or other causes. The same is true for the engines that replace human *Work*, because as soon as the constraints increase, the speed of the engines decreases.

This shows that they provide the energy (in the form of *work W*) strictly necessary and just sufficient for operation because otherwise it would necessarily imply the possibility of perpetual motion. In fact, a car approaching a hill slows down inexorably (all other things being equal and in particular the pressure of the driver on the accelerator pedal). If this were not the case, it would necessarily imply that energy, coming from nowhere, would have to be supplied to maintain the constant speed: this energy could therefore be used without limit.

Diagram 05-01 above, shows 3 options or methods (a, b, c) of changing the *Utility* of a *Product* from U_{P1} to U_{P2}, by carrying out a certain amount of (economic) *Work*. This quantity of *Work* (*T*) can be provided by an individual, by slaves (ancient civilizations), by animals or by engines and machines (especially since the industrial revolution), but it must always be provided by whatever means.

In this schema, we have :

$$Work\,a = Work\,2\,a - Work\,1$$

$$Work\,b = Work\,2\,b - Work\,1$$
$$Work\,c = Work\,2\,c - Work\,1$$

as well as : $T_a > T_b > T_c$

which implies: $\Delta T_b < \Delta T_c$

In time and as already said above, natural evolution, that is to say, without additional constraint, implies in a general and absolutely unquestionable manner that *Work* diminishes, either :

$$\Delta T < 0$$

This can be understood by approaching the phenomena which occur during a deceleration in mechanics where the variation of work is negative. This variation of *Work* has the consequence and the aim of bringing the *Utility* of the *Product* to a certain level, by posing :

U_P = *Utility* of the *Product*

we can write:

$$- \frac{\Delta T}{U_P}$$

which is none other than *Laziness* realised for each level of *Utility* (always in a natural evolution, *i.e.* out of constraint, as stipulated above).

Consequently, by posing :

P = *Laziness*

he comes :

$$\Delta P = - \frac{\Delta T}{U_P}$$

In fact, the smaller the amount of *Work* provided to performed any task (job, *labour*), the greater the *Laziness* will be and it's therefore normal that this report be preceded by the negative sign. This *Laziness* as well as the *Work* itself are characteristics that can evolve continuously, which allows, consequently, to write this relationship in the conventional differential form, that is to say :

$$\boxed{dT = -U_P \cdot dP} \qquad \langle 05\text{-}04 \rangle$$

This relationship is very similar (to the nearest sign), both in substance and form, to the one giving the quantity of heat according to entropy in thermodynamics, namely :

$dQ = T \cdot dS$

It represents the "Second Principle" and it's possible to write:

- ***Laziness naturally always increases, up to a maximum limited by external constraints.***

This is nothing other than the transposition into Economics of the Second Principle of thermodynamics which states that :

- ***entropy naturally always increases, up to a maximum limited by external constraints.***

T→M Transformation ⇒ ***First principle***

By definition, in a Barter Economy, there is no *Money*, but it's easy to notice that in this case, the *Utilities* of the exchanged *Product*s are equal (see chapter "Prolegomena", paragraph "Barter - Change - Exchange").

Consequently, it's possible to write that :

- ***there can be no Money without a difference in the Utility of the Product***

This is an expression of the "First Principle" and is nothing other than the transposition into Economics of the same expression of the First Principle of thermodynamics which states that :

- ***there can be no mechanical work without a difference in temperature.***

In physics, we know that it's the heat destroyed (used) that is transformed into created work, that is to say that :

- the quantity of heat available decreases while the quantity of work increases by the same amount according to the Principle of Equivalence, the sum of these two quantities being constant (in an isolated *system*), that is to say :

$$\underbrace{dQ}_{cause} + \underbrace{dW}_{effect} = 0$$

which is the classical analytical expression of the First Principle of thermodynamics. In Economics, it's strictly the same. In fact, it's possible to postulate that the *Work to be done* that is destroyed is transformed into *Money* created, that is to say that :

- the quantity of *Work to be done* decreases as the *Product* is elabourated, while the quantity of *Money* created increases by the same amount according to the Principle of Equivalence, the sum of these two quantities being therefore constant (in an isolated *system*), that is to say :

$$\boxed{\underbrace{dT}_{cause} + \underbrace{dM}_{effect} = 0} \qquad \text{‹05-05›}$$

This relationship can be seen as the analytical expression of the First Principle of Economics. The nullity of the latter (05-05) is of course only valid in an isolated *system* (autarkic *economic system* or generally when only two agents in contact are considered, *i.e.* a supplier and a consumer).

T→M Transformation ⇒ *Principle of action and reaction*

We know that the actors of an exchange, namely the supplier and the consumer, each exert two *Force*s on the other: one relating to *Work*, the other relating to *Money*. In fact, any actor always seeks to performed the minimum amount of *Work* but also to have the maximum amount of *Money*. The result is that if one exerts a *Force*, the other resists it. Now, in order to guarantee correct reasoning, it's indispensable to present arguments, which are not demonstrable but *a priori* impossible to question, attesting to the equality of these *Force*s, that is to say of the actions and reactions relating respectively to *Work* and to the *Money*.

It is undeniable that both the Seller and the Buyer act by exerting a *Force*, a Pressure on the Transformer so that the latter's *Added Value* is as small as possible. This *Force* is called “action”. However, the Transformer reacts by exerting a *Force*, a Pressure on the Seller and on the Buyer so that its *Added Value* is as high as possible. This *Force* is called “reaction” and is directed in the opposite direction of the action.

As a matter of principle, these *Force*s are equal but of opposite sign due to their opposite orientation. Indeed, if we take as an example, the negotiation between a Buyer and a Transformer, it would be a mistake to believe that these *Force*s are unequal. The Transformer having set a *price*, the Buyer will try to lower it. If the latter's *Force of Action* is low, *i.e.* if he only wants a small discount, the Transformer will relatively easily agree to lower the *price* and his own *Force of Reaction* will be low. If, on the contrary, the Buyer's *Force of Action* is very high, *i.e.* if he wishes a very large reduction in *price*, the Transformer will put up very strong resistance to this reduction and his *Force of Reaction* will be all the higher.

We can see from this example that the F_A *Force*s (in relation to the *Money*) of the two actors in contact are, in principle, equal and vary simultaneously in the same way to the nearest sign. This fact can be established as a Principle, just as in mechanics there is the Principle of Action and Reaction. It is then possible to write :

$$\boxed{F_A^{ext} = -\,F_A^{int}} \qquad \text{‹05-06›}$$

M→T Transformation ⇒ *Definition*

If the apprehension, if not the mastery, of the *Work→Money* transformation is relatively easy, it's not at all the same for the *Money→Work* transformation. It is obvious that :

- the $T \rightarrow M$ transformation is always effective during the elabouration of a *Product*, and it's relative to *Laziness* (P). Chronologically, it evolves in such a way that the *labour to be done* and the *Work to be done* decrease, while the *price* and the Money increase.

- The $M \rightarrow T$ transformation can only be conceived when acquiring a *Product*, and it's related to *Avarice* (A). Chronologically, it evolves in such a way that the *price* and the *Money* decrease, while the *labour to be done* and the *Work to be done* increase.

The table below shows these evolutions.

	Transformation $T \rightarrow M$	**Transformation** $M \rightarrow T$
Labour & Work	➘	➚
Price & *Money*	➚	➘

When a consumer acquires a *Product*, he transfers *Cash* including *Money* to the supplier, who transfers a *Product* containing *Work*. In order to sell a new copy of the *Product*, the latter supplier must obligatorily purchase a new draft from its own supplier, which it will then shape, and so on.

The table below shows, for each transformation, how the *labour* and the *Work* on the one hand and the *price* and the *Money* on the other hand evolve.

Let us assume a series of agents (from 1 to n) in the position of suppliers, *i.e.* several manufacturers placed chronologically one after the other (central part of the table).

- By their actions, these agents determine *Work→Money* transformations (left side of the table). When the first supplier agent (*1*) starts manufacturing, the *labour to be done* and the *Work to be done* are obviously maximum. For the next agent (*2*) these characteristics will be lower. And so on, for each supplying agent. When the last agent (n) has finished his work, the *labour* and the *Work* will be minimal (possibly equal to zero).

  But, during all these stages, the *price* and the *Money* will increase. Of course, some suppliers create the *Money* and others don't; this is why the signs "greater or equal ($\geq$)" and "smaller or equal ($\leq$)" are used. In fact, we know that it's the destroyed *Work* that creates the *Money* provided that the *Utility* of the *Product* varies. If the *Utility* doesn't change (wholesaler, merchant, ...) there can be no creation of *Money*. However, it's obligatory that in the whole series, certain suppliers will create *Money* and the quantity existing at the end of the manufacturing process will be greater than at the beginning.

- At the end of the production the last supplier (*n*) becomes the consumer (*n*). In fact, he is obliged to purchase from the previous supplier (*n-1*) the *Product* that he has to finish manufacturing. The same applies to all suppliers who are obliged to purchase the *Product* they have to manufacture, up to the first supplier (*1*) who provides the raw materials. By their actions, these agents determine *Money*→*Work* Transformations (right-hand side of the table).

The quantity of *Money* is gradually depleted as the *price* decreases at each stage to become minimal for the final consumer (*1*). It should be noted that in this series of transformations, the *Utility* of *Cash* decreases at each stage. In fact, each consumer opts for the purchase of the *Product* and gives up *Cash*, and not the other way round.

In this way, the cycle can begin again, but this is valid for each stage of the participants.

Transformation $T \rightarrow M$		**Agent**			**Transformation $M \rightarrow T$**	
Labour	**Work**				***Money***	**Price**
l_1 = max. $\geq l_2$	T_1 = max. $\geq T_2$	↓SUPPLIERS↓	**1**	↑CONSUMERS↑	M_1 = min. $< M_2$	p_1 = min. $< p_2$
$l_2 \leq l_1$	$T_2 \leq T_1$		**2**		$M_2 > M_1$	$p_2 > p_1$
$l_i \leq l_2$	$T_i \leq T_2$		**i**		$M_i > M_2$	$p_i > p_2$
$l_{n-1} \leq l_i$	$T_{n-1} \leq T_i$		**n-1**		$M_{n-1} > M_i$	$p_{n-1} > p_i$
l_n = min. $\leq l_{n-1}$	T_n = min. $\leq T_{n-1}$		**n**		M_n = max. $> M_{n-1}$	p_n = max. $> p_{n-1}$

To better explain how the two transformations are linked, let us assume an agent designated *i* in the table above.

Thus :

- During the $T \rightarrow M$ transformation, he is considered as a supplier in contact :
  - first with the previous agent (*2*) where he prefers the *Product* to the *Cash*,
  - then with the next agent (*n-1*) where he prefers *Cash* to the *Product.*

- During $M \rightarrow T$ transformation, he is considered as a consumer in contact :
  - first with the previous agent (*n-1*) where he prefers *Cash* to the *Product*,
  - then with the next agent (*2*) where he prefers the *Product* to *Cash.*

It then becomes possible to present the following table, which clearly shows the inverse evolutions of the respective *Utilities* of the *Product* and of the *Cash* depending on which of the two transformations is considered. This is due to the fact that the chronology of contacts is reversed in both transformations, which doesn't in any way mean going back in time; its “arrow” only moves in one direction.

	Transformation $T \to M$	Transformation $M \to T$
Utility of Product	↘	↗
Utility of Money	↗	↘

It is possible to exhibit that :

- in $T \to M$ transformation, the *Product* supplier becomes a consumer of *Cash* in $M \to T$ transformation,
- in tr $T \to M$ ansformation, the consumer of the *Product* becomes a supplier of *Cash* in t $M \to T$ ransformation,

In the whole series of participants, it's possible to consider three consecutive agents and, as already specified, to define for example :

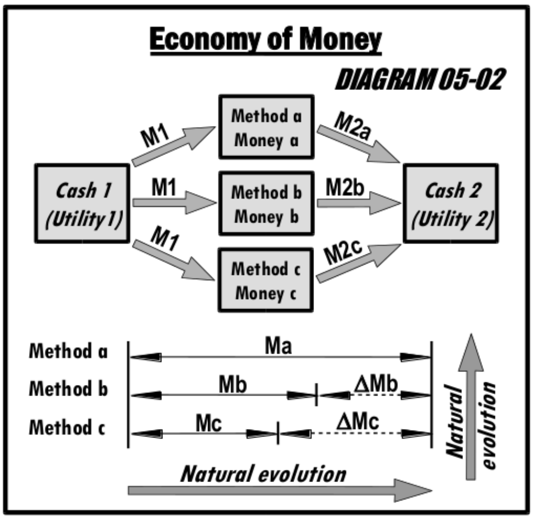
- agent *2*, as the Seller,
- agent *i*, like the Transformer,
- agent *n-1*, such as the Acquirer.

All this corresponds well to the reality of things as shown in the table below.

	Seller	Transformer	Buyer
Transformation T→*M*	**Supplier**	***Product*** →	**Consumer**
Transformation *M*→*T*	**Consumer**	← ***Cash***	**Supplier**

M→T Transformation ⇒ *Second principle*

Identical to $T \to M$ transformation, nobody can dispute the fact that all agents also have a natural tendency to always save their *Money*. Indeed, they systematically seek to acquire the coveted *Product* at the lowest possible *price*, but always in a way that is compatible with the constraints to which they are subject. By posing :



U_A = *Utility of Cash*
A = *Avarice*

If we now consider diagram 05-02 opposite, it's easy to follow the same reasoning as above. Indeed, in this diagram, we have :

$$Money\,a = Money\,2\,a - Money\,1$$
$$Money\,b = Money\,2\,b - Money\,1$$
$$Money\,c = Money\,2\,c - Money\,1$$

with :

$$M_a > M_b > M_c$$

which implies :

$$(M_a - M_b) < (M_a - M_c)$$

or else:

$$M_b > M_c$$

that is to say that over time, natural evolution (without constraints) gives in a general and unquestionable way:

$$\Delta M > 0$$

This can be understood by looking at the phenomena that occur during acceleration in mechanics where the variation in work is positive. This variation in *Money* having the consequence of bringing the *Utility* of *Cash* to a certain level, we can write:

$$\Delta A = \frac{\Delta M}{U_A}$$

Now, Avarice is a characteristic which can evolve continuously and consequently it's possible to write this relation in conventional differential form, that is to say :

$$\boxed{dM = U_A \cdot dA} \qquad \text{‹05-07›}$$

which makes it possible to write :

- ***Avarice naturally always increases, up to a maximum limited by external constraints.***

This relationship is very similar (in its substance and form) to the one giving the quantity of heat according to entropy in thermodynamics, *i.e.* :

$$dQ = T \cdot dS$$

M→T Transformation ⇒ *First Principle*

By definition, in an Change Economy, there is no *Work*, but it's easy to notice that in this case, the *Utilities of Cash* exchanged are equal (see chapter "Prolegomena", paragraph "Barter - Change - Exchange"). Consequently, it's possible to write that :

- ***there can be no economic Work without a difference in the Utility of Cash***

This is an expression of the "First Principle" and is nothing other than the transposition into Economics of the same expression of the First Principle of thermodynamics which states that :

- ***there can be no mechanical work without a difference in temperature.***

In physics, we know that it's the destroyed (used) heat that is transformed into created work, that is to say that :

- the quantity of heat available decreases while the quantity of work increases by the same amount according to the Principle of Equivalence, the sum of these two quantities being constant (in an isolated *system*), *i.e.* :

$$\underbrace{dQ}_{cause} + \underbrace{dW}_{effect} = 0$$

which is the classical analytical expression of the First Principle of thermodynamics. In Economics, it's strictly the same. In fact, it's possible to postulate that the *Money* destroyed is transformed into *Work to be done* created, that is to say that :

- the quantity of *Money spent* decreases as the *Product* is elabourated, while the quantity of *Work to be done* created increases by the same amount according to the Principle of Equivalence, the sum of these two quantities being therefore constant (in an isolated *system*), that is to say :

$$\boxed{\underbrace{dM}_{cause} + \underbrace{dT}_{effect} = 0} \qquad \textbf{‹05-08›}$$

which can be considered as the analytical expression of the First Principle of Economics. The nullity of this relationship (05-08) is of course only valid in an isolated *system* (autarkic economic system or generally when only two agents in contact are considered, *i.e.* a supplier and a consumer).

M→T Transformation ⇒ Principle of action and reaction

It is undeniable that both the Seller and the Buyer act by exerting a *Force*, a *Pressure* on the Transformer in such a way that the *task to be added* to the Transformer is the greatest possible. This *Force* is called "action". However, the Transformer reacts by exerting a *Force*, a *Pressure* on the Seller and on the Buyer in such a way that the *task to be added* is the smallest possible. This *Force* is called "reaction" and is directed in the opposite direction of the action.

As a matter of principle, these *Forces* are equal but of opposite sign due to their opposite orientation. In fact, if we take as an example the negotiation between a Buyer and a Transformer, it would be a mistake to believe that these *Forces* are unequal. If the Buyer's *Force of Action* is low, that is, if he only wants a small reduction in the *task to be added*, the Transformer will accept this measure relatively easily and his own *Force of Reaction* will be low. If, on the other hand, the Acquirer's *Force of Action* is very high, *i.e.* if he wishes a very large reduction in the additional *task to be added*, the Transformer will put up very strong resistance to this measure and his *Force of Reaction* will be all the higher. We can see from this example that the F_P *Forces* (in relation to the *Product*) of the two actors in contact are, in principle, equal and vary simultaneously in the same way to the nearest sign. This fact can be established as a Principle, just as in mechanics there is the Principle of action and reaction.

It is then possible to write :

$$\boxed{F_P^{ext} = -\,F_P^{int}} \qquad \langle\mathbf{05\text{-}09}\rangle$$

06 – INTERNAL ENERGIES

ABSTRACT: It seems quite logical to analyze work and money as two different forms of economic energy.

For example :

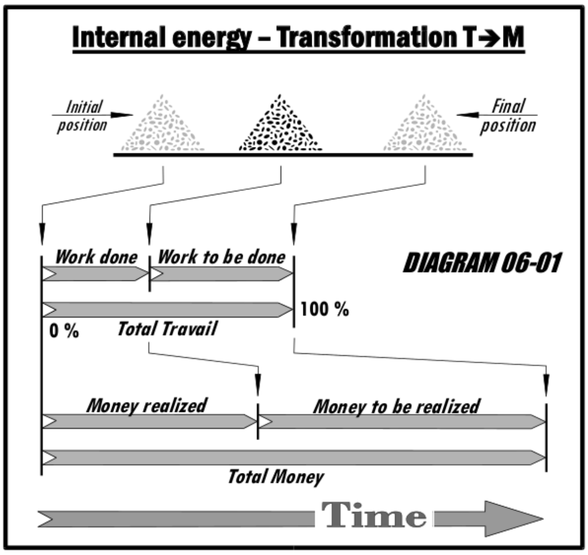
- *In a hunter-gatherer tribe, it is possible to argue that the economy was very small, i.e. its importance was insignificant. Indeed, work was almost non-existent: individuals were content to take from their environment just what they needed, and moreover, there was no or very little money, considered as a means of exchange with neighbouring tribes;*
- *In contrast, in a modern megalopolis, the amount of work is comparatively huge and the amount of money is huge, which makes it possible to emphasise the great importance of the economy.*

It has already been seen that these two characteristics, work and money, can be converted into each other and that their respective variation is due either to the economy of work (laziness) or to the economy of money (avarice). This chapter shows how work and money are articulated, how their respective natural evolution occurs, how the different roles of money can be defined as well as the discrimination of kinetic and potential energies according to whether work is to be done or carried out, and money is done or to be done.

T→M Transformation ⇒ internal energy

Figure 06-01 opposite explains the First Principle, as its analysis shows that :

Work done + Money to be done = 100%.
Work to be done + Money done = 100 %



is a constant value to the nearest transformation coefficient (g).

If this *economic system* is in contact with other *systems*, *Work* and/or *Money* can possibly be exchanged between them (always by means of the vectors-supports : *Product* and *Money*) and, consequently, the algebraic sum of these two characteristics isn't necessarily zero (relation 05-05). Therefore, by posing :

E_{TM} = *economic internal Energy of the system* it's possible to write :

$$\boxed{dE_{TM} = \underbrace{dT}_{cause} + \underbrace{dM}_{effect}} \qquad \text{‹06-01›}$$

But we know the relationships (05-04 and 04-10) giving the respective values of these characteristics, namely :

$dT = - U_P \cdot dP$ and : $dM = F_A^{ext} \cdot dV$

which allows us to replace them with these and we get:

$$\boxed{dE_{TM} = - \underbrace{U_P \cdot dP}_{cause} + \underbrace{F_A^{ext} \cdot dV}_{effect}} \qquad \text{‹06-02›}$$

It is possible to compare this relationship, in both substance and form, with the similar one in thermodynamics, namely :

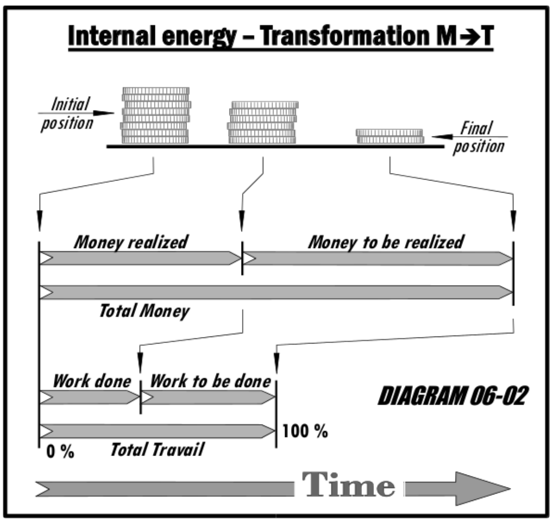
$$dU = \underbrace{T \cdot dS}_{cause} - \underbrace{P \cdot dV}_{effect}$$

which makes it possible to notice that the signs of these two relations are inverse to each other. This explains why the directions of displacement of the cycle of destruction of *Work to be done* and the cycle of creation of *Money* are contrary to those of Carnot and Clapeyron.

The essential first consequence that can be drawn immediately from the First Principle and the Principle of Equivalence is that :

- ***the failure to respect the proportionality between Work and Money irremediably provokes inequalities, distortions or economic crises,***

i.e. the transformation coefficient g isn't a constant as in physics.



M→T Transformation ⇒ internal energy

Figure 06-02 below makes the First Principle explicit, as its analysis shows that :

Money spent + Work to be done = 100%.
Money to be spent + Work done = 100%.

or a constant value to the nearest transformation coefficient (g). If this *economic system* is in contact with other *systems*, *Money* and/or *Work* can possibly be exchanged between them (always by means of the vectors-supports: *Cash* and *Product*) and, consequently, the algebraic sum of these two characteristics isn't necessarily zero (relation 05-08). Therefore, by posing :

E_{MT} = *internal economic Energy of the system*

it's possible to write :

$$\boxed{dE_{MT} = \underbrace{dM}_{cause} + \underbrace{dT}_{effect}} \qquad \text{‹06-03›}$$

But we know the relationships (05-07 and 04-09) giving the respective values of these characteristics, namely :

$dM = U_A \cdot dA$ and: $dT = - F_P^{ext} \cdot dB$

which allows us to replace them with these and we get:

$$\boxed{dE_{MT} = \underbrace{U_A \cdot dA}_{cause} - \underbrace{F_P^{ext} \cdot dB}_{effect}} \qquad \text{‹06-04›}$$

It is possible to compare this relationship, in both substance and form, with the similar one in thermodynamics, namely :

$$dU = \underbrace{T \cdot dS}_{cause} - \underbrace{P \cdot dV}_{effect}$$

which makes it possible to notice that the signs of these two relations are identical. This explains why the directions of displacement of the cycle of destruction of *Money* and the cycle of creation of *Work to be done* out are similar to those of Carnot and Clapeyron.

Note on internal energies

The similar relationships 06-02 and 06-04 should be compared, *i.e.* :

$dE_{TM} = - U_P \cdot dP + F_A^{ext} \cdot dV$ and: $dE_{MT} = U_A \cdot dA - F_P^{ext} \cdot dB$

with :

dE_{TM} = *Variation of the internal Energy on Transformation* $T \rightarrow M$
(Product flow from supplier to consumer - Work)
dE_{MT} = *Variation of Internal Energy on Transformation* $M \rightarrow T$

(flow of Money from the consumer to the supplier - Money).

In the case where these two transformations would be totally reversible, either in the perfectly theoretical hypothesis that there would be absolutely no loss or although these losses would be absolutely equal in both transformations, then it would be possible to write :

$$dE_{TM} = dE_{MT}$$

which would result in:

$$- U_P \cdot dP = F_A^{ext} \cdot dV = U_A \cdot dA = - F_P^{ext} \cdot dB$$

However, one might that for the proper functioning of the *economic system* under consideration, it's imperative to come as close as possible to these equities, as otherwise this would lead to economic distortions that could even lead to economic crises. It is therefore imperative that economic agents have sufficient *Money* to consume and, consequently, to create *Work*. However, this note doesn't aim to define an economic policy, but merely to update and clarify the phenomena occurring in economic exchanges.

Virtual characteristics – Real characteristics

According to the transformations ($T \rightarrow M$ and $M \rightarrow T$), the following should be noted :

1. the *Work to be done* is transformed into the *Money realized*,
2. the *Money realized*, made becomes the *Work to be done.*

But as a corollary, it's possible to write :

1. the *Work done* becomes the *Money to be done*,
2. the *Money to be done* becomes the *Work done.*

These transformations are respectively visualised on the diagrams 06-01 and 06-02.

Logically, if we consider the *Work done* and the *Money realized* as real and the *Work to be done* and the *Money realized* as virtual, then we can see that :

- ***the variation of one virtual characteristic causes the variation of the other real characteristic,***
- ***the variation of one real characteristic causes the variation of the other virtual characteristic.***

If you look closely, this is exactly what happens in thermodynamics.

In fact, in thermodynamics we know that internal energy is composed of the remaining heat and the work done and that it's the variation of the unused characteristic (the heat) that causes the variation of the other characteristic (the work).

Whether in thermodynamics or in Economics, it's possible to say :

- ***The change of a real characteristic in virtual causes the change of the other virtual characteristic in real and vice versa.***

$T \to M$ Transformation ⇒ *Natural displacement of work*

We know that in thermodynamics a body is more or less hot and that in Economics an agent is more or less lazy. We also know that in physics if two bodies in contact are equally hot (same temperature), there is no heat exchange and that if the two bodies are not at the same temperature, a heat exchange always takes place in the same direction, *i.e.* that the heat always flows naturally (without external constraints) from the hottest body to the least hot body. The consequence is that in order to transfer heat in the opposite direction (from the least warm body to the warmest body), it's necessary to use work, that is to say, to "consume" it, to "expend" it. This means that this expenditure of work is a constraint forcing the heat to move in the opposite direction to the natural direction.
In the $T \to M$ transformation, let us suppose an *isolated system* where a negotiation between a supplier and a consumer (indexed $_f$ and $_c$) takes place. Let us also suppose that the *price* of the *Product* is fixed and that these actors only discuss the *Work* that remains *to be done* to complete it, that is to say that they each try to do as little as possible. Knowing that the *Utility* of the *Product* received is greater than that of the *Product* given up, it's possible to write :

$$U_{P(supplier)} < U_{P(consumer)} \quad \text{‹06-05›}$$

The Second Principle allows you to write :

$$dP_{(f+c)} = dP_{(f)} + dP_{(c)} \geq 0$$

because we consider a natural displacement of *Work*. As the actors are not under constraint, *Laziness* can only increase or, at the very least, remain stable.

We have said that during the discussion between the agents, they only refer to the *Work* included in the *Product*, that is to say that only the *Laziness* of each actor is taken into account but not their *Avarice* (the *price* being fixed). Thus, in the relation (06-02) giving the variation of the internal Energy, namely :

$$dE_{TM} = - U_P \cdot dP + F_A^{ext} \cdot dp$$

we have:

$$dp = 0$$

and the relation is simplified as follows:

$$\partial E_{TM} = - U_P \cdot \partial P$$

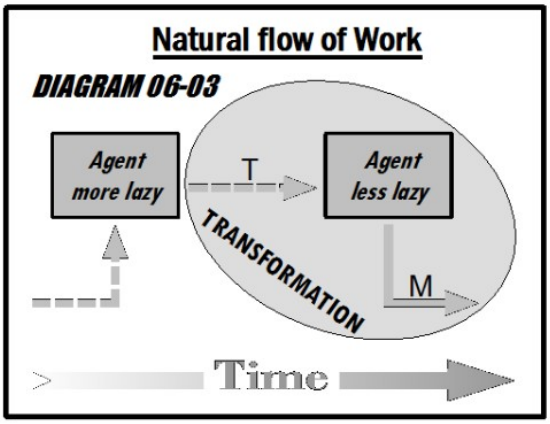
either:

$$\partial P = - \frac{1}{U_P} \cdot \partial E_{TM}$$

and we can write for each agent (supplier and consumer):

$$\partial P_{(f)} = - \frac{1}{U_{P(f)}} \cdot \partial E_{TM(f)}$$ and : $$\partial P_{(c)} = - \frac{1}{U_{P(c)}} \cdot \partial E_{TM(c)}$$

But since the *system* is isolated, the First Principle allows us to write:



$$E_{TM_{(f+c)}} = E_{TM_{(f)}} + E_{TM_{(c)}} = constant$$

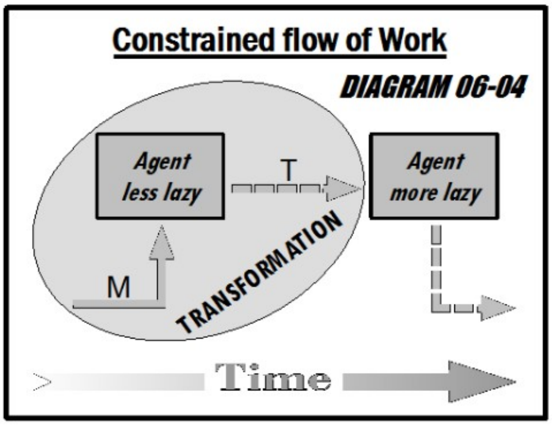
or :

$$dE_{TM(f)} = - dE_{TM(c)}$$

Thus, the *Laziness* of the consumer becomes:

$$\partial P_{(c)} = \frac{1}{U_{P(c)}} \cdot \partial E_{TM(f)}$$

and the relation giving the variation of the total *Laziness* of the *system* is written:



$$\partial P_{(f+c)} = - \frac{1}{U_{P(f)}} \cdot \partial E_{TM(f)} + \frac{1}{U_{P(c)}} \cdot \partial E_{TM(f)} \geq 0$$

or :

$$\partial P_{(f+c)} = \partial E_{TM(f)} \cdot \left(\frac{1}{U_{P(c)}} - \frac{1}{U_{P(f)}} \right) \geq 0$$

As we know that (relationship 06-05):

$$U_{P(f)} < U_{P(c)}$$

it's possible to write :

$$\frac{1}{U_{P(f)}} > \frac{1}{U_{P(c)}}$$

or again:

$$\frac{1}{U_{P(c)}} - \frac{1}{U_{P(f)}} < 0$$

This inequality implies that:

$$\partial E_{TM(f)} \leq 0$$

So, according to the sign agreement, internal Energy comes out of the supplier, this Energy being *Work to be done* T. Knowing the relation 05-04, namely:

$$dP_{(f)} = - \frac{dT}{U_{P(f)}}$$

and since:

$$\partial E_{TM(f)} = \partial T \leq 0$$

then:

$$\boxed{\partial P_{(supplier)} \geq 0} \qquad \text{‹06-06›}$$

and it's possible to write that :

- ***naturally, the Work to be done flows from the supplier to the consumer, the reverse operation, from the consumer to the supplier, is only possible if the supplier is under constraint.***

Figures 06-03 and 06-04 represent the $T \rightarrow M$ transformation occurring naturally and under stress respectively.

We now know that the flow of *Work to be done* T flows naturally from a lazier agent to a less lazy agent, as shown in figure 06-03. It is therefore the latter that transforms the *Work to be done* into *Work done* and the corresponding *price p* will decrease according to the quantity of *Work* T that has penetrated, this decrease being a creation of *Money realized* M. The rule that the variation of a virtual characteristic modifies the other real characteristic is well verified.

As from the lazier agent he leaves the *Work to be done* T, he has to enter something else and it can only be the *Money to be realized.* But this in no way corresponds to a transformation because the two characteristics in question (*Money to be realized* that enters and *Work to be done* that leaves the lazy *corps*) are virtual. Thus, the transformation of production of *Money realised* M is provided by the scheme 06-03 (natural flow) and the return (transformation of destruction) by the scheme 06-04 (constrained flow).

A priori, it would be possible to have the transformation performed by the laziest corps, which is what some people claim when they say: "All we have to do is lower the retirement age and/or reduce the working week, without any reduction in pay". This means that from the *Money realised M* enters the *system* and from the *Work to be done* T comes out, which seems possible. However, in order for there to be a cycle, there must be a return. But this return is impossible because, in fact, a lazier corps cannot receive *Work to be done* T and the *Money realised* M .

$M \to \boldsymbol{T}$ *Transformation* ⇒ *natural movement of Money*

A similar reasoning can be developed for the natural direction of movement of the Money. In the $M \to W$ transformation, let us suppose an *isolated system* where a negotiation between a supplier and a consumer (indexed $_f$ and $_c$) takes place. Let us also suppose that the *labour* (*Work*) of the *Product* is fixed and that these actors only discuss the *price* (*Money*) of it, that is to say that they each try to lose as little *Money* M as possible. We know that the *Utility* of the *Cash* received is greater than that of the *Cash* given up. Therefore it's possible to write :

$$U_{A\,(\text{supplier})} > U_{A\,(\text{consumer})} \qquad \text{‹06-07›}$$

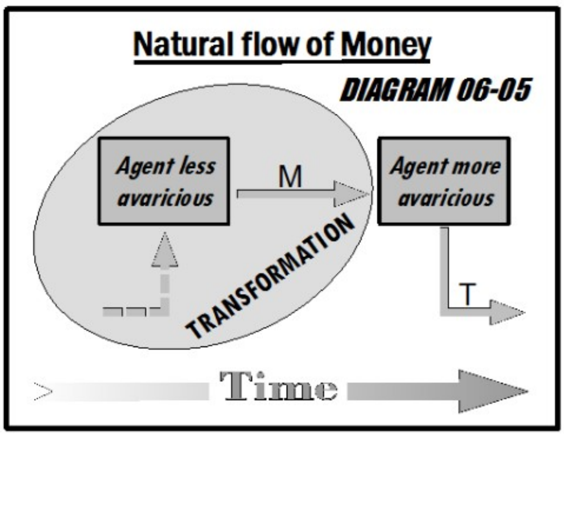
The Second Principle allows you to write :

$$dA_{(f+c)} = dA_{(f)} + dA_{(c)} \geq 0$$

because we consider a natural displacement of *Money*. Since the actors are not under constraint, *Avarice* can only increase or, if necessary, remain stable.

We have said that during the discussion between the agents, they only refer to the *Money* included in the *Cash*, *i.e.* only the *Avarice* of each actor is taken into account, but not their *Laziness* (*labour* being fixed as well as *task*), therefore, in the relation (06-04) giving the variation of the internal Energy, namely :

$$dE_{MT} = U_A \cdot dA - F_P^{ext} \cdot dl$$



we have :

$$dl = 0$$

and the relation is simplified as follows:

$$\partial E_{MT} = U_A \cdot \partial A$$

either:

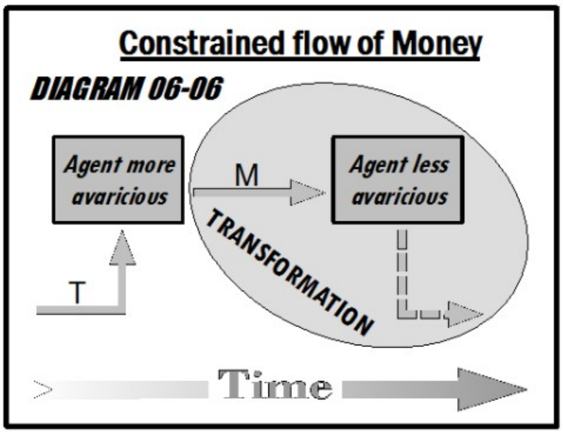
$$\partial A = \frac{1}{U_A} \cdot \partial E_{MT}$$

and we can write for each agent (supplier and consumer):

$$\partial A_{(f)} = \frac{1}{U_{A(f)}} \cdot \partial E_{MT\,(f)} \quad \text{and :} \quad \partial A_{(c)} = \frac{1}{U_{A(c)}} \cdot \partial E_{MT\,(c)}$$

But, as the *system* is isolated, the First Principle makes it possible to write:

$$E_{MT_{(f+c)}} = E_{MT_{(f)}} + E_{MT_{(c)}} = constant$$



or more :

$$dE_{MT\,(f)} = - \; dE_{MT\,(c)}$$

As a result, consumer *avarice* becomes :

$$\partial A_{(c)} = - \; \frac{1}{U_{A(c)}} \cdot \partial E_{MT\,(f)}$$

and the relation giving the total *Avarice* variation of the system is written :

$$\partial A_{(f+c)} = \frac{1}{U_{A(f)}} \cdot \partial E_{MT\,(f)} - \frac{1}{U_{A(c)}} \cdot \partial E_{MT\,(f)} \geq 0$$

or :

$$\partial A_{(f+c)} = \partial E_{MT\,(f)} \cdot \left(\frac{1}{U_{A(f)}} - \frac{1}{U_{A(c)}} \right) \geq 0$$

As we know that (relationship 06-07):

$$U_{A(f)} > U_{A(c)}$$

it's possible to write:

$$\frac{1}{U_{A(f)}} < \frac{1}{U_{A(c)}}$$

or again:

$$\frac{1}{U_{A(f)}} - \frac{1}{U_{A(c)}} < 0$$

This inequality implies that:

$$\partial E_{MT(f)} \leq 0$$

So, according to the signing convention, internal Energy comes out of the supplier, this Energy being *Money realized* M . Knowing the relation 05-07, namely:

$$dA_{(f)} = \frac{dM}{U_{A(f)}}$$

and since:

$$\partial M \leq 0$$

then:

$$\boxed{\partial A_{(supplier)} \leq 0} \qquad \text{‹06-08›}$$

and it's possible to write that :

- ***naturally, the Money realized flows from the supplier to the consumer, the reverse operation, from the consumer to the supplier, is only possible if the consumer is under constraint.***

This makes perfect sense. Indeed, in the continuation of the $M \rightarrow T$ transformations, the *Cash* that circulates decreases little by little as the *Product* is less and less elabourated. As a consequence, the *Money* increases in the other direction and thus circulates from the supplier to the consumer. This corroborates the fact that this transformation (consumption) :

- increases the *labour to be done*, *i.e.* creates *Work to be done*,
- reduces the *realised price*, *i.e.* destroys the *Money realized.*

Figures 06-05 and 06-06 represent the $M \rightarrow T$ transformation occurring in natural and constrained ways respectively.

We know that the *Flow of Money realized* M flows naturally from a less stingy agent to a more stingy agent, as shown in Figure 06-05. This transfer is only possible by injecting the *Work to be done* T into the less stingy corps. But the purpose of this transformation isn't the destruction of *Work to be done* T but its creation. Therefore, the latter will be effective in the opposite direction, *i.e.* during a constrained flow of *Money realized* M , as shown in figure 06-06. Indeed, the stingier corps wanting to give *Money realized* M but subject to receiving *Work done*. The rule that the variation of one virtual characteristic changes the other real characteristic is well verified. So, here, the production transformation of *Work to be done* T is ensured by the scheme 06-06 (constrained flow) and the return (destruction transformation) by the scheme 06-05 (natural flow).

A priori, it would be possible to have the transformation performed by the stingiest corps, which some people claim when they say: “All you have to do is increase my wages and I'll make the craftsmen work”. This means that the *Money realized* M enters the system and the W*ork to be done* T leaves it, which seems possible. However, in order for there to be a cycle, there must be a return. But this return is impossible because, in fact, a more stingy *corps* cannot receive *Work to be done* T and give *Money realized* M . In fact, daily life always shows that the exchange between the consumer and the supplier only takes place when the *Work is done* and not *to be done*, as some consumers profess by asking for wage increases or the revival of consumption.
The reason for all this is that the Time Arrow doesn't move backwards and it's strictly impossible to spend money without having done the *Work* beforehand. This can be said in the following form:

- ***The expenditure of Money can only be made after its production by a Transformation of Work to be done into Work done.***

All of this is so true that when you do not have the *Money*, you must either borrow it or steal it. Consequently, the only possible cycle for creating *Work to be done* is the one formed by the diagrams 06-05 and 06-06.

Conclusion

We have just seen, in the previous paragraphs, that :

$\partial T_{(f)} \leq 0$ and : $\partial M_{(f)} \leq 0$

Knowing that:

- the variation of the *Work done* is equal to the variation of the *Work to be done* to the nearest sign,
- the change in *Money realised* is equal to the change in *Money to be realised* to the nearest sign,

either :

$dT_{done} = - dT_{to\,be\,done}$ and : $dM_{realized} = - dM_{to\,be\,realized}$

so we can write:

$\partial T_{done} \geq 0$ and : $\partial M_{realized} \leq 0$

Consequently, these two inequalities imply that :

Work		*Money*		Purchase power	Employm ent
Done	To be done	Performed	To be performed		
➚	➘	➚	➘	➚	➘
➘	➚	➘	➚	➘	➚

As already explained, this table also shows that the variation of a real characteristic leads to the variation of a virtual characteristic and *vice versa*.

Barter – *Change* – *Exchange* ⇒ *Equality of utilities*

There are four, and only four, types of exchanges between two agents designated A and B, namely :

1. *Product* for *Product* ⇒ Barter
2. *Cash* for Cash ⇒ change
3. *Cash* for *Product* ⇒ exchange
4. *Product* for Cash ⇒ exchange

The types listed 3 and 4 are of course absolutely identical. They differ only in the name of the agents. Agent A becoming agent B and *vice versa* agent B becoming agent A.

1. ***For the exchange of Product for Product (barter)***

From the 05-04 relationship, *i.e.* :

$$dT = - U_P \cdot dP$$

for each agent A and B above, it becomes respectively :

$$dT_{(A)} = - U_{P(A)} \cdot dP_{(A)} \qquad \text{and :} \qquad dT_{(B)} = - U_{P(B)} \cdot dP_{(B)}$$

These two agents form an isolated economic *system*, since they exchange *Product*s only between themselves. The *internal Energy* variation is therefore null. Thus, we know the relation 05-05, namely :

$$dT + dM = 0$$

which becomes respectively, for these same agents:

$$dT_{(A)} + dM_{(B)} = 0 \qquad \text{and :} \qquad dT_{(B)} + dM_{(A)} = 0$$

or:

$$dT_{(A)} + dM_{(B)} = dT_{(B)} + dM_{(A)}$$

As in barter economy, there is no exchanged *Money*, the relation is simplified as follows:

$$dT_{(\mathrm{A})} = dT_{(\mathrm{B})}$$

By replacing these variations of *Works* by their respective value, we have :

$$U_{P(\mathrm{A})} \cdot dP_{(\mathrm{A})} = U_{P(\mathrm{B})} \cdot dP_{(\mathrm{B})}$$

or :

$$\frac{U_{P(\mathrm{A})}}{U_{P(\mathrm{B})}} = \frac{dP_{(\mathrm{B})}}{dP_{(\mathrm{A})}}$$

But, during a negotiation between a supplier and a consumer (isopheles transformation), we know that the *Utility* of the *Product* doesn't vary, it's therefore possible to write:

$$\frac{U_{P(A)}}{U_{P(B)}} = \frac{dP_{(B)}}{dP_{(A)}} = constant$$

Moreover, during this negotiation, the respective variations of *Laziness* decrease and therefore tend towards zero:

$dP_{(\mathrm{A})} \rightarrow 0$ and : $dP_{(\mathrm{B})} \rightarrow 0$

which implies that the ratio of *Laziness* tends towards 1, that is to say:

$$\frac{U_{P(\mathrm{A})}}{U_{P(\mathrm{B})}} = \frac{dP_{(\mathrm{B})}}{dP_{(\mathrm{A})}} \rightarrow 1$$

and consequently:

$$\boxed{U_{P(A)} = U_{P(B)} \text{ at the transaction}} \qquad \text{‹06-09›}$$

2. ***For the exchange of Cash for Cash (change)***

From the 05-07 relationship, *i.e.* :

$$dM = U_A \cdot dA$$

for each agent A and B above, it becomes respectively :

$dM_{(\mathrm{A})} = U_{A(\mathrm{A})} \cdot dA_{(\mathrm{A})}$ and : $dM_{(\mathrm{B})} = U_{A(\mathrm{B})} \cdot dA_{(\mathrm{B})}$

These two agents form an isolated economic *system*, since they exchange *Cash* only between themselves. The *internal Energy* variation is therefore null. Thus, we know the relation 05-08, namely :

$$dM + dT = 0$$

which becomes respectively, for these same agents:

$$dM_{(A)} + dT_{(B)} = 0 \qquad \text{and :} \qquad dM_{(B)} + dT_{(A)} = 0$$

Or:

$$dM_{(A)} + dT_{(B)} = dM_{(B)} + dA_{(A)}$$

As in exchange economy, there is no exchanged *Work*, the relation is simplified as follows:

$$dM_{(A)} = dM_{(B)}$$

Replacing these *Money* variations by their respective values, we have :

$$U_{A\,(A)} \cdot dA_{(A)} = U_{A\,(B)} \cdot dA_{(B)}$$

or :

$$\frac{U_{A\,(A)}}{U_{A\,(B)}} = \frac{dA_{(B)}}{dA_{(A)}}$$

But, during a negotiation between a supplier and a consumer (isopheles transformation), we know that the *Utility* of *Cash* doesn't vary, so it's possible to write:

$$\frac{U_{A\,(A)}}{U_{A\,(B)}} = \frac{\mathrm{dA}_{(B)}}{\mathrm{dA}_{(A)}} = \mathit{Constant}$$

Moreover, during this negotiation, the respective variations of *Avarice* decrease and therefore tend towards zero, that is to say:

$$dA_{(A)} \to 0 \qquad \text{and:} \qquad dA_{(B)} \to 0$$

which implies that the ratio of *Avarice* tends towards 1, that is to say:

$$\frac{U_{A\,(A)}}{U_{A\,(B)}} = \frac{dA_{(B)}}{dA_{(A)}} \to 1$$

and consequently:

$$\boxed{U_{A(A)} = U_{A(B)} \text{ at the transaction}}$$ ‹06-10›

3. ***For the exchange Product for Cash (exchange)***

From the 05-04 and 05-07 relations, namely :

$dT = - U_P \cdot dP$ and : $dM = U_A \cdot dA$

for each agent A and B above, they become respectively :

$dT_{(A)} = - U_{P(A)} \cdot dP_{(A)}$ and : $dM_{(B)} = U_{A(B)} \cdot dA_{(B)}$

These two agents form an isolated economic *system*, since they exchange a *Product* and a *Cash* only between them. The variation of *internal Energy* is therefore null. Thus, we know the relations 05-05 and 05-08, namely :

$dT + dM = 0$ and : $dM + dT = 0$

which become respectively, for these same agents:

$dT_{(A)} + dM_{(A)} = 0$ and : $dM_{(B)} + dT_{(B)} = 0$

or:

$$dT_{(A)} + dM_{(A)} = dM_{(B)} + dT_{(B)}$$

- For agent A, the exchange is similar to a barter and for agent B, it's similar to an exchange. Therefore, agent A doesn't transfer *Money* and agent B doesn't provide *Work*. Therefore :

$dM_{(A)} = 0$ and : $dT_{(B)} = 0$

The relationship is then simplified as follows:

$$dT_{(A)} = dM_{(B)}$$

By replacing these variations of *Work* and *Money* by their respective values, we have:

$$- U_{P(A)} \cdot dP_{(A)} = U_{A(B)} \cdot dA_{(B)}$$

or again:

$$\frac{U_{P(A)}}{U_{A(B)}} = - \frac{dA_{(B)}}{dP_{(A)}}$$

But, during a negotiation between a supplier and a consumer (isopheles transformations), we know that the *Utility* of the *Product* and the *Utility* of the *Cash* do not vary, so it's possible to write:

$$\frac{U_{P\,(A)}}{U_{A\,(B)}} = -\,\frac{dA_{(B)}}{dP_{(A)}} = Constant$$

Moreover, during this negotiation, the variations of *Avarice* (dA) and *Laziness* (dP) decrease and tend towards zero, *i.e.* :

$dP_{(A)} \rightarrow 0$ and : $dA_{(B)} \rightarrow 0$ $\Rightarrow \dfrac{dA_{(B)}}{dP_{(A)}} \rightarrow 1$

which implies that:

$U_{A(B)} \rightarrow U_{P(A)}$

and consequently:

$$\boxed{U_{P(A)} = U_{A(B)} \text{ at the transaction}} \qquad ‹06\text{-}11›$$

4. ***For Cash for Product exchange (exchange)***
This exchange is strictly identical to the previous exchange. Indeed, only the names of the agents are inverted: agent A becoming agent B and *vice versa* (this has already been presented at the beginning of the paragraph). Therefore, it's allowed to follow a similar reasoning and it's therefore possible to write :

$$\boxed{U_{A(A)} = U_{P(B)} \text{ at the transaction}} \qquad ‹06\text{-}12›$$

Recapitulation

For the four possibilities of exchange, one can finally write :

1. *Product* for *Product* (barter) $\Rightarrow$ $U_{P\,(A)} = U_{P\,(B)}$ *at the transaction* **‹06-09›**
2. *Cash* for *Cash* (exchange) $\Rightarrow$ $U_{A\,(A)} = U_{A\,(B)}$ *at the transaction* **‹06-10›**
3. *Cash* for *Product* (exchange) $\Rightarrow$ $U_{P\,(A)} = U_{A\,(B)}$ *at the transaction* **‹06-11›**
4. *Product* for C*ash*(exchange) $\Rightarrow$
$U_{A\,(A)} = U_{P\,(B)}$ *at the transaction* **‹06-12›**

Roles of Money

In Economics, the Money is generally considered to benefit from three main functions, namely the role of unit of account, the role of exchange mediator and the role of value reserve, *i.e.* :

1. ***Role of unit of account***

   This function is a measure of the value of any *Product*. It is obvious that to measure anything, it's essential to use a unit compatible with this measurement and taken as a term of comparison. For example, in physics, to measure :

   - a voltage ⇒ the Volt
   - one length ⇒ the metre, the yard
   - a weight ⇒ the gram, the pound
   - one time ⇒ the second
   - a temperature ⇒ the Kelvin, the degree Celsius, the degree Fahrenheit
   - *etc.*

   These units are physical units that vary according to the system of measurement (metric, Anglo-Saxon, ...) in which they are used (examples above of length, weight, temperature). In Economics, it's also compulsory to have a unit that will be used to measure the value of *Product*s placed on the market. In the same way as in physics, this unit's different according to the *economic system* under consideration. For example, the unit of measurement may be different for each economic system:

   - the United States ⇒ the Dollar
   - the Euro zone ⇒ the Euro
   - Kazakhstan ⇒ the Tenge
   - Mauritania ⇒ Ouguiya
   - *etc.*

   Therefore this point (role of unit of account) is similar in Physics and Economics.

2. ***Role of mediator of exchanges***

   This function corresponds to its use for purchasing *Product*s. In this chapter, we have considered *Work* and *Money* as two different forms of Economic Energy and no longer as physical Energy, which is quite logical. *Economic Work* is assimilated to heat and *Money* to mechanical work. The use of the *Money* in an acquisition is strictly of the same nature as the use of mechanical work to ensure the displacement of any mobile, that is to say, as kinetic energy. In this case, the *Money* is used as the result of the variation in the *price* of a *Product* and the physical work as the result of the variation in the position of a moving part. The *Money* is *economic kinetic energy* identical to the work which is mechanical kinetic energy. Indeed, we have seen, above (chapter "Mechanics of exchange"), that the relation 04-14, namely :

$$dM = - c \cdot \varpi \cdot d\varpi$$

returns, after integration, the value of the *monetary kinetic Energy*, that is to say :

$$M = - \frac{1}{2} \cdot c \cdot \varpi^2$$

which is absolutely identical (to the nearest sign) to the relation giving the monetary kinetic mechanical energy, namely :

$$W = + \frac{1}{2} \cdot m \cdot v^2$$

The presence of the negative sign for the value of the *Money* should not be interpreted as inconsistent with logic, but *a contrario*, as corroborating this approach. Indeed, the lower the *price*, the more important the *Money* (*i.e.* the *Economic Energy*) will be, and therefore the lower the speed of its formation, the slower it will be.

Therefore this point (role of exchange mediator) is similar in Physics and Economics.

3. __Value reserve role__

This function is for storing *Cash* (*Money*) for later use. In physics, potential energy is energy that is stored for later use.

This definition applies perfectly to the *Money* when it's conserved (saved money) for future purchase. When it's considered as a reserve of value, the *Money* must be assimilated to trepasse jamais les termes des lois qui lui sont imposéespotential energy. When acquiring any *Product*, this reserve of value is converted into an exchange mediator, in the same way and exactly as in mechanics where potential energy is transformed into kinetic energy during its use.

Therefore this point (role of value reserve) is similar in physics and in Economics.

The three roles of the Money, defined above, can be condensed and compared as follows:

economy		**physic**
unit of account	⇔	**Unit of mesure**
mediator of exchanges	⇔	**Kinetic energy**
Reserve of value	⇔	**Potential energy**

This table therefore sets out the strict analogies between economics and physics. These similarities are additional arguments that lead to the conclusion that both disciplines must be governed by the same Natural Laws.

Kinetic energy – Potential energy

In physics, we know that the sum of kinetic energy and potential energy is constant. However, it's possible to see that the same is true in Economics. Kinetic Energy (role of mediator of exchanges) and Potential Energy (value reserve role, money saving) can be transformed one into the other (in a lossless *system*).

1. ***Transformation Work→Money***

   For this transformation, by posing :

   E_{TM}^{cin} = *Money defined as a mediator of exchanges*
   E_{TM}^{pot} = *Money saved*

   it's permitted to write :

   $$E_{TM\ final}^{cin} - E_{TM\ initial}^{cin} = E_{TM\ initial}^{pot} - E_{TM\ final}^{pot}$$

   or else:

   $$E_{TM\ initial}^{cin} + E_{TM\ initial}^{pot} = E_{TM\ final}^{cin} + E_{TM\ final}^{pot}$$

   By posing:

   $$E_{TM\ initial}^{total} = E_{TM\ initial}^{cin} + E_{TM\ initial}^{pot} \quad \text{and :} \quad E_{TM\ final}^{total} = E_{TM\ final}^{cin} + E_{TM\ final}^{pot}$$

   then it's deducted :

   $$E_{TM}^{total} = Constant$$

2. ***Transformation Money→Work***

   But so is this transformation. Indeed, by posing :

   E_{MT}^{cin} = *Work spent*
   E_{MT}^{pot} = *Work to be spent*

   it's permitted to write :

$$E^{cin}_{MT\ final} - E^{cin}_{MT\ initial} = E^{pot}_{MT\ initial} - E^{pot}_{MT\ final}$$

or else:

$$E^{cin}_{MT\ initial} + E^{pot}_{MT\ initial} = E^{cin}_{MT\ final} + E^{pot}_{MT\ final}$$

By posing:

$$E^{total}_{MT\ initial} = E^{cin}_{MT\ initial} + E^{pot}_{MT\ initial}$$ and: $$E^{total}_{MT\ final} = E^{cin}_{MT\ final} + E^{pot}_{MT\ final}$$

then it's deducted:

$$E^{total}_{MT} = Constant$$

07 – FLOWS AND TRANSFORMATIONS

ABSTRACT: It has already been pointed out that this essay does not deal with flows of goods, services or cash at all, but only with transformations. Indeed, a flow considered as such is something constant. Its eventual evolution by its importance or its speed is always only the consequence of a previous causal transformation, because a flow can never vary spontaneously. This chapter lists the various transformations of the economic field according to the conditions under which they occur, in a manner quite analogous to those taking place in the physical domain.

General

When *Product*s and/or *Cash* circulate between two economic agents, two categories of transfers can be defined, namely :

1. gifts which are a transfer from one economic entity (agent) to another, *i.e.* without consideration. These donations can be qualified :
   - in-kind, if the transfer takes place in the form of *Product*s,
   - in cash, if the transfer is in the form of *Cash*.

2. Exchanges which are reciprocal transfers, *i.e.* with counterpart. These exchanges can be qualified :
   - Economy of barter, if the two transfers are made in the form of *Product*s,
   - Economy (only) or Economy of *Money*, if one of the transfers is made as a *Product* and the other as *Cash*,
   - Economy of change, if both transfers are made in the form of *Cash*.

By definition, donations, not being exchanges, obviously don't fall within the scope of this study since it's based on the transformations between *Work* and *Money*.

It should be noted that the Barter and Change Economies are only special cases of the Economy of Money. In fact, the only difference between the *Economy of Money* and :

- the Economy of barter lies in the fact that one of the two transfers of *Product*s is replaced by a transfer of *Cash* in the Economy of money,
- The Economy of change lies in the fact that one of the two transfers of *Cash* is replaced by a transfer of *Product* in the Economy of money.

Reciprocally, however, it's possible to argue that this difference between the Economy of money and:

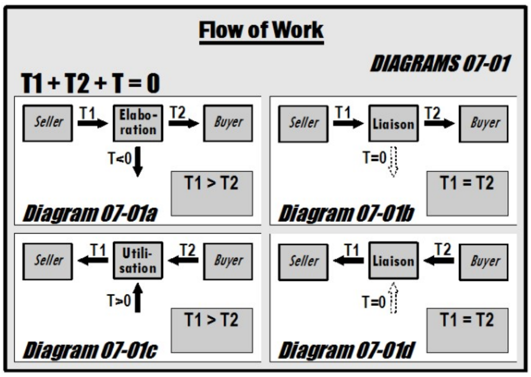
- the Economy of barter lies in the fact that the transfer of *Cash* from the Economy of money is replaced by a transfer of *Product*,
- the Economy of change lies in the fact that the transfer of the *Product* of the Economy of money is replaced by a transfer of C*ash*.

Consequently, *Cash* must be considered as an all-purpose *Product* and conversely the *Product* as *Cash*. Finally, as the rules and laws are and must be absolutely general, this shows that they must apply equally to both *Cash* and *Product*. Since the *Product* is the support of *Work* and *Cash* is the support of the *Money*, it's clear that these two characteristics are two different forms of the same thing that can be defined as *Economic energy internal* to the *system* under consideration.

Types of transfers between agents

It is possible to postulate the existence of four types of relations between the three agents already defined (Seller, Transformer, Buyer) with :

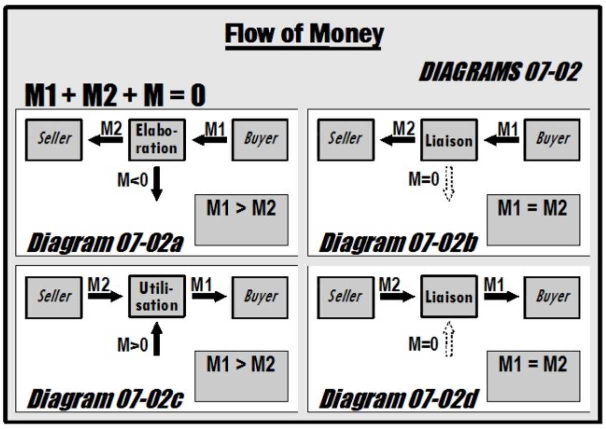
1. ***development transfers:***
   - of *Work to be done* as shown in figure 07-01a, *i.e.* the flow existing between the Seller and the Transformer (processing) is greater than that existing between the Transformer and the Buyer. In fact, during this transfer, any *Product* is modified, transformed. In this case, part of the *Work to be done* is destroyed by the Transformer and it's therefore possible to write the following arithmetic relationship:



$$\underbrace{T_1}_{input} = \underbrace{T_2 + T}_{output}$$

   - of *Money* as shown in diagram 07-02a, *i.e.* the flow existing between the Buyer and the Transformer (processing) is greater than that existing between the Transformer and the Seller. In fact, at the time of this transfer, part of the *Money* is withdrawn from the main flow by the Transformer. It is therefore possible to write the following arithmetic relation :

$$\underbrace{M_1}_{input} = \underbrace{M_2 + M}_{output}$$



2. ***direct link transfers :***
   - of Work to be carried out as shown in diagram 07-01b, *i.e.* the flow existing between the Seller and the Transformer (link) must be equal to that existing between the Transformer and the Buyer. This transfer can be assimilated to what happens when goods are transported or stored, as in this case the *Product* isn't modified in any way,

i.e. transformed. It is therefore possible to write the following arithmetic relationship:

$$\underbrace{T_1}_{input} = \underbrace{T_2}_{output}$$

- of Money as shown in diagram 07-02b, *i.e.* the flow existing between the Buyer and the Transformer (link) is equal to that existing between the Transformer and the Seller. This transfer can be assimilated to what happens, for example, when depositing *Cash* with one's banker, as in this case the *Money* isn't modified in any way, *i.e.* transformed. It is therefore possible to write the following arithmetic relation :

$$\underbrace{M_1}_{input} = \underbrace{M_2}_{output}$$

3. transfers of use :

- of *Work to be done* as shown in figure 07-01c, *i.e.* the flow circulates in the opposite direction to the first transfer. When any *Product* is used by a Transformer (use), it makes it obsolete little by little. As a result, it gives *Work to be done* to the Seller who is before it in the chain of participants and who must manufacture another copy of the *Product* to replace the one in use at the consumer's premises. It is therefore possible to write the following arithmetic relationship:

$$\underbrace{T_2 + T}_{input} = \underbrace{T_1}_{output}$$

- of *Money* as shown in diagram 07-02c, *i.e.* the flow circulates in the opposite direction to the direction of the first transfer. As above, it's possible to write the following arithmetic relation :

$$\underbrace{M_2 + M}_{input} = \underbrace{M_1}_{output}$$

4. Reverse link transfers :

- of *Work to done* out as shown in diagram 07-01d, *i.e.* the flow existing between the Buyer and the Transformer (link) is equal to that existing between the Transformer and the Seller. This link transfer is identical to that indicated in 2 above but in the opposite direction. It is therefore possible to write the following arithmetic relation :

$$\underbrace{T_2}_{input} = \underbrace{T_1}_{output}$$

- of *Money* as shown in diagram 07-02d, *i.e.* the flow existing between the Seller and the Transformer (link) is equal to that existing between the Transformer and the Buyer. This link transfer is identical to the one indicated in 2 above but in the opposite direction and can be considered no longer as a deposit but as a withdrawal. It is therefore possible to write the following arithmetic relationship:

$$\underbrace{M_2}_{input} = \underbrace{M_1}_{output}$$

It is quite obvious that the two times four equations that have just been posed only represent flows of *Work to be done* on the one hand and *Money* on the other hand. Conventional Economics is generally only interested in these flows. Indeed, conventional studies essentially only seek to modify the relative values of the different Money (M_1, M_2 and M - not to be confused with aggregates) or *Product*s manufactured, sold and consumed.

In order to increase the monetary *wealth* of any economic *system*, it's of course necessary to increase as much as possible the *Money M* which is extracted as shown in Figure 07-02a, but obviously without decreasing the *Money* M_2 accordingly. In analysing this diagram, it's impossible to define any method to increase the quantity of this *Money*. In fact, it would be possible to say that it's sufficient to increase the *Money* M_1 which penetrates, which would provoke an increase of the same amount of *Money M*. However, it would be necessary to know beforehand how this increase could have been ensured, that is to say, to know the method allowing it. This is impossible, as demonstrated in the chapter “Value of the monetary unit”. This increase *Money* M_1 could only come from a prior increase to a previous level of *Money M*, which is similar to the case where the snake bites its own tail. This clearly shows that the study of *Money* flows cannot allow any increase in the *wealth* of an economic *system*, and it's obviously this increase that is always and systematically sought. The manipulation of these flows can in no way lead to any variation (increase or decrease) in their sum, only the relative values of what enters and leaves the *system* can possibly be modified (which corresponds to a redistribution).

However, it's indisputable that the two flows of *Product* and *Cash* are linked. Indeed, the amount of *Money* (*Cash*) that flows from the consumer to the supplier is a function of the amount of *Work* (*Product*) that flows from the supplier to the consumer. It is to these relations of Transformations between the *Work done* by the supplier (not done by the consumer) to realized a *Product* and the *Money* not obtained by the supplier (obtained by the consumer) in return that this note is interested and not in their different Flows. In fact, as has already been stated, the *Money* is the *Money* remaining in the consumer's pocket after a reduction in *price* due to the *Wor*k of the manufacturer and, consequently, this *Money* isn't obtained by the latter. For this reason :

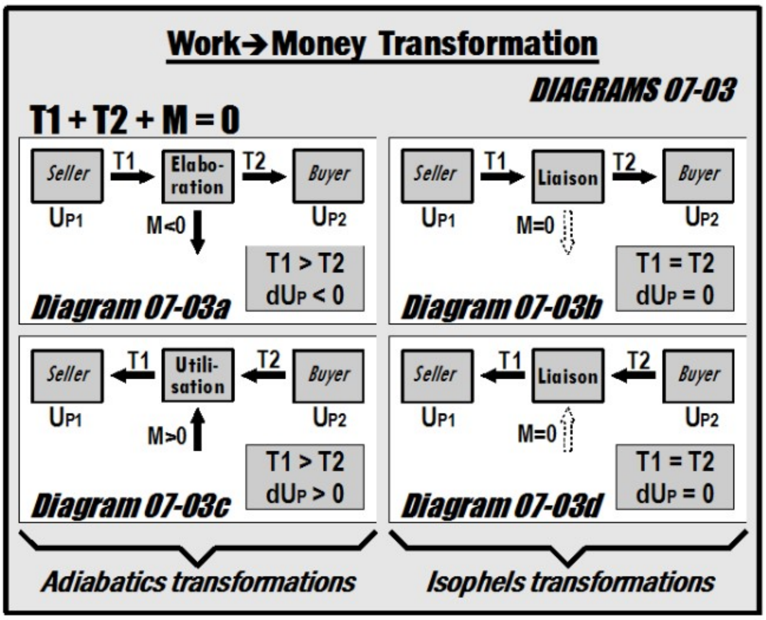
- ***this note is outside the conventional field of study of Economics, it must therefore never be attempted to link or even reconcile them.***

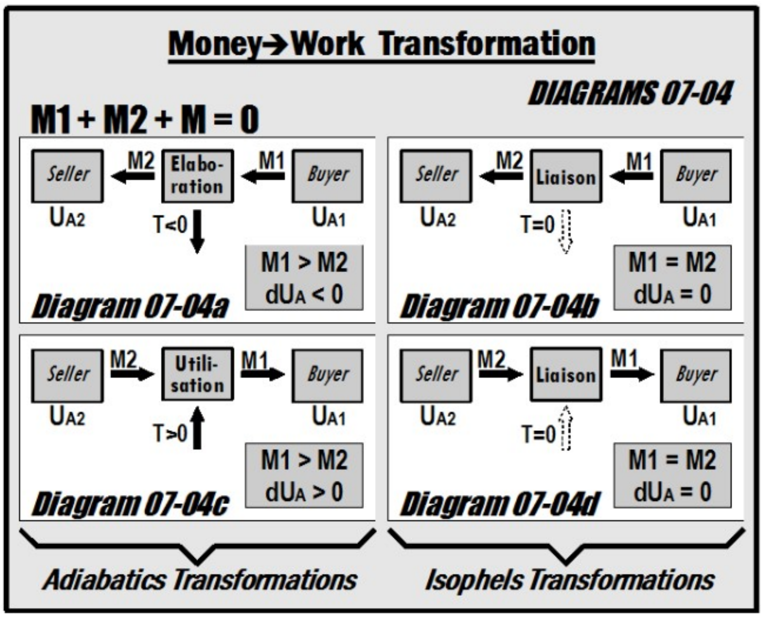
There is nothing in the two series of diagrams 07-01 and 07-02 to prohibit swapping *Work T* and *Money M* to obtain two new series of diagrams (07-03 and 07-04 respectively). In fact, whatever the case it's possible to imagine, one must be able to write :

$$T_1 - T_2 \ \textit{is the same as :} \ M_1 - M_2$$

which is a consequence of the Principle of Equivalence. This comes from the fact that :

- *the Work to be done T_1 corresponds to the Money done M_1,*
- *the Work to be done T_2 corresponds to the Money done M_2.*





Let us suppose a *Product* whose development has just begun. At this stage, the *Work to be done T_1* is still very important so the *Money M2* paid by the Transformer will be small. Suppose that :

- in a first case, the Transformer only executes a small quantity of *Work*, there will remain a consequent *T_2 Work* and therefore the *Money M_1* will be relatively small,
- in a second case, the Transformer performs a large quantity of *Work*, the *T_2 Work* will be low but in return the Acquirer will give a high quantity of Money M_1.

This shows that the difference between the *Work to be done T_1* and *T_2* out should normally be equal to the difference between the *Money M_1* and *M_2*, possibly to within a transformation coefficient. In fact, it's always possible to find a coefficient (g as already indicated in relation 05-01) that ensures the equality between the *Work T* and *Money M*, which leads to the possibility of inverting these characteristics. However, it's logical to think that this coefficient should be fixed under the consequences of economic anomalies. In fact, it would then be eminently easy to modify this coefficient at will and according to one's mood (ratio between the *Money created* and the *Work performed*). Now, it's quite certain that in this case, the agents would always modify it in the same direction so as to obtain the maximum of *Money* and to performed the minimum of *Work*, which is inscribed in human nature but which is totally contrary to experience, because it would then be enough to snap one's fingers to increase without limit the *wealth* of an economic *system* and still some would judge that the snapping of fingers was already too great an expenditure of energy.

Consequently, the interchange of *Work* and *Money* should always be considered possible. Now, these diagrams no longer represent Flows of a single characteristic but Transformations between two different ones. Now, it so happens that the explanation of energy transformations strictly identical to these, was elabourated by 19th century scientists, which formed thermodynamics. This is based on the transformation of heat Q into work W as shown in Figures 07-05 (below), which are given here for information only. Note that Figures 07-03 and 07-04 showing the economic transformations are very similar to those in physics. All the above Flow balance sheet relationships (*Work* and *Money* - series of figures 07-01 and 07-02) can be summarized by the following two algebraic relationships:

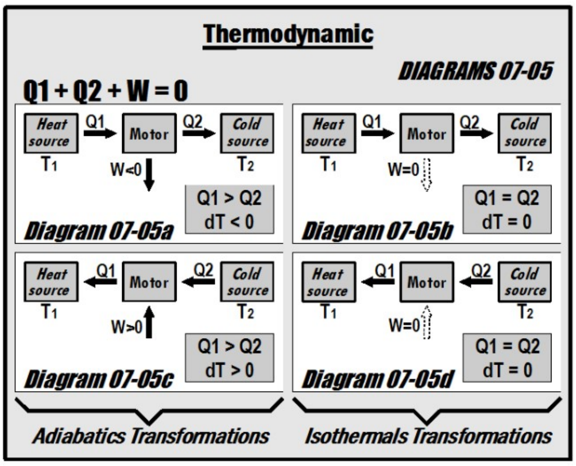
$$\underbrace{T_1 + T_2 + T = 0}_{Flow\ of\ Work} \quad \text{and :} \quad \underbrace{M_1 + M_2 + M = 0}_{Flow\ of\ Work}$$

which, after inversion (series of diagrams 07-03 and 07-04) give the following Flow balance relations :

$$\underbrace{T_1 + T_2 + M = 0}_{Transformation\ T \rightarrow M} \quad \text{and :} \quad \underbrace{M_1 + M_2 + T = 0}_{Transformation\ M \rightarrow T}$$

The first two flow equations are only accounting equations because they use only one characteristic (*Work* or *Money*), whereas the other two relations refer to two characteristics and are therefore transformations and no longer flows. Consequently, they are physical and this changes everything. This can be summarised as follows:

- ***accounting*** $\Rightarrow$ ***Work*** ***<u>or</u>*** ***Money,***
- ***physical*** $\Rightarrow$ ***Work*** ***<u>and</u>*** ***Money.***



It should be noted that in thermodynamics the direction of the work production cycle (motor) can be reversed (refrigerating machine). However, in both cases, the main flow is always formed by the heat that circulates either from the hot source to the cold source (motor) or from the cold source to the hot source (machine). In thermodynamics, these two cases differ only by the inversion of all the arrows.

In what concerns us, the series of diagrams 07-03 and 07-04 show that the two transformations $T \rightarrow M$ and $M \rightarrow T$ are not the return of each other as it has just been said for thermodynamics. In fact, in the first transformation the main flow is formed of *Work* whereas in the second transformation it's formed of *Money*.

In thermodynamics, whether in the motor cycle or in the machine cycle, the cause of the evolution is always the same, namely the variation of entropy whose sign changes according to the case. In Economics, the cause of the two transformations is different, namely :

- transformation *Work→Money* ⇒ *variation* of *Laziness*,
- transformation *Money→Work* ⇒ *variation* of *Avarice.*

Indeed, *Laziness*, is always relative to the Transformer since obviously it's during the manufacturing process that energy can be saved in the form of *Work.* However, there is another saving related to the Buyer. In fact, during any purchase the Acquirer systematically seeks to save his *Money*, that is to say, to buy the cheapest *Product* possible, as already specified. These transformation relationships are, of course, always valid whatever the case envisaged (elabouration, direct link, use, reverse link). It is only the relative values of *Works* T_1 and T_2 on the one hand and of *Money* M_1 and M_2 on the other hand, which determine respectively those of *Money M* and *Work T* and consequently one of the 3 possible values (taking into account the entry or exit of the system), namely :

1. negative : $dT < 0$ and : $dM < 0$ ⇒ elabouration,
2. null : $dT = 0$ and : $dM = 0$ ⇒ links,
3. positive : $dT > 0$ and : $dM > 0$ ⇒ use.

However, in the second hypothesis, the directions of the transfers of *Work* and *Money* (diagrams 07-03b and 07-04b) can obviously be reversed without any impact, resulting in diagrams 07-03d and 07-04d respectively. The result is that for each of these characteristics (*Work* and *Money*), four possibilities of transformation are obtained, already listed and indicated below by their value:

1. negative : $dT < 0$ and : $dM < 0$ ⇒ processing,
2. nil : $dT = 0$ and : $dM = 0$ ⇒ sales (outward link),
3. positive : $dT > 0$ and : $dM > 0$ ⇒ use,
4. null : $dT = 0$ and : $dM = 0$ ⇒ purchase (return link).

By considering either Work or *Money*, these transformations arranged chronologically, form a cycle relative to each of these characteristics.

It is clear that *Work* and *Money* can and must be considered as two different forms of *economic Energy*, whose passage from one to the other and *vice versa* are only transformations which it must be possible to assimilate to energy transformations. This Introduction is only an application of thermomechanical reasoning to the Economy without going against the economic phenomena which may occur in reality.

The cycles of *Money* creation and *Work* creation will be explained later. It is reiterated that these two transformations are not the return of each other, as one might think *a priori.*

As already shown, it should be remembered that :

- that any economic agent sequentially takes on the function of Seller, Transformer and Buyer.

- in the elabouration of any *Product* by a Transformer, the Buyer and the Seller (who are on the outside) see the *Utility* increase but the Transformer (placed on the inside) sees it decrease. However, it's obviously the internal characteristics of the *system* that need to be considered. In physics, it's the internal temperature of the cylinder (turbine or other device) that is taken into account and not the external temperature.

Function of the agents

In Economics there are several types of agents (individuals *stricto sensu*, self-employed workers, companies, associations, administrations, the State, *etc.*, as defined above) in terms of their function. In fact, all agents are consumers (infants as well as bedridden people, pensioners as well as the unemployed, enterprises as well as administrations, ...) but much less are producers (creators) of *Money*. In a company, some produce *Money* and others don't. Those, for example, who express their talents in the workshops are creators of *Money*, while an accountant or a human resources manager may help the company to operate but in no case can be considered as creators. During the day an agent may have several different functions, producer during his presence in the office, workshop, *etc.* and consumer after leaving the company. Identically, during his life, he is always a consumer, but he can possibly be a creator during his working life.

No regulatory or legislative classification should be used here, such as farmer, plumber, heating engineer, forklift operator, labourer, sailor, hostess, teacher, bailiff, elected official, prisoner, ecclesiastic, military, *etc.*, except by way of example. In Science, only the sorts that belong to mathematical analysis are to be taken into account, namely: negative, null, positive (inferior, equal, superior). Identically, in the case that interests us here, these three possibilities are given by the sign of the variation of the *Utility* (dU_P) of the *Product*.

In the same way that Figure 07-05a is the only one that creates *work* W per heat consumption Q (drop in internal temperature), here, only Figure 07-03a is the only one that creates monetary *wealth* in the form of *Money M* per consumption of *Work to be done T* (drop in *Utility* of the *Product* for the Transformer).

In the same way as in thermodynamics, where :

- it's the variation of temperature inside the system that causes the variation of space and therefore the variation of work, with :
    - a drop in temperature causing the creation of work,
    - an increase in temperature causing work destruction,

in Economics :

- it's the variation of *Utility* of the *Product* for the Transformer (inside the system), which causes the variation of *price* and consequently the variation of *Money* with :
    - a decrease in *Utility* causing the creation of *Money*,
    - an increase in *Utility* causing the destruction of *Money*.

But it's quite obvious that any consumer will only buy the *Product* if he is coveted, that is to say, if he has a certain level of *Utility* for himself; the purchase *price* being a direct function of this *Utility* as stipulated by the Core Law in the chapter that will be devoted to it. Of course, for a cycle to be possible, it's indispensable that there are at least two variations evolving in opposite directions, in order to return the system in question to its original state:

- in thermodynamics, the temperature drops then rises (inside the system) implying a variation of space in one direction and the same variation in the other direction,

- in Economics, the *Utility* of the *Product* falls then increases (within the system) implying a *price* variation in one direction and the same variation in the other direction.

However, it's no less true that only one direction creates and the other destroys, whatever the discipline studied. The whole problem is how is it possible to create more than what is destroyed? Indeed, in the hypothesis of the above cycle (limited to one outward and one return - 2 transformations), it's certain that no *Money* can be created because the quantity destroyed on the return is equal to the quantity created on the outward journey, the sum being obviously zero (since the cycle returns to its starting point). We have seen that in a complex system there are different types of agents and in the Transformers cascade it's the same. A Transformer can be a producer (creator of *Money* - diagram 07-03a), the next Transformer being only used to transport (or store) *Product*s (link - diagram 07-03b) and a third being only a consumer of *Money* (destroyer of *Money* - diagram 07-03c). Finally, the different types of agents can be listed as follows:

1. agents who are outside the “work market” (children, students, unemployed, destitute, pensioners, pensioners, sick, …),
2. agents who are in the “work market” and who can be sorted according to the 3 cases defined by the sign of the *Utility* variation, namely :
   - agents who create *Money* by increasing the *Utility* of the *Product* for the Acquirer ($dU_P>0$) but decreasing for the Transformer ($dU_P<0$) with a decrease in *price* ($dp<0$) and who are the only creators of monetary *wealth* in the strict sense,
   - agents that don’t create or destroy *Money*, leaving the *Utility* of the *Product* unchanged for the Acquirer ($dU_P=0$ for the Transformer) with no change in *price* ($dp=0$),
   - Money shredders that reduce the *Product*'s *Utility* for the Acquirer ($dU_P>0$ for the Transformer) with an increase in *price* ($dp>0$).

Extensive lists of examples can be provided. It is a matter of taking any agent (as previously defined) and determining the direction of evolution of the *Utility* of the *Product* that it develops.

1. an employee who manufactures tyres is a creator of *Money* because it's quite obvious that he increases for the motorist the *Utility* of the starting rubber mass. The same applies to a truck driver who transports tyres from the factory to a wholesaler and another truck driver who links this wholesaler to retailers. So :

$$dU_{P_{\begin{pmatrix}\text{Transformer :}\\ -\text{tyremanufacturer}\\ -\text{transporter}\end{pmatrix}}} < 0 \qquad \text{or :} \qquad dU_{P_{\begin{pmatrix}\text{Buyer :}\\ -\text{Motorist}\end{pmatrix}}} > 0$$

This example is shown in Figure 07-03a,

2. a wholesaler and a retailer, are neither creators nor destroyers of *Money*, as they don't develop the *Utility* of tyres and don't transport them. In fact, they don't spend any *Work* (energy) neither to transform the *Product* nor to move it, that is to say that :

$$dU_{P_{\begin{pmatrix}\text{Transformer}\\ -\text{tyreWholesaler}\\ -\text{retailer}\end{pmatrix}}} = 0 \qquad \text{or :} \qquad dU_{P_{\begin{pmatrix}\text{Buyer}\\ -\text{Motorist}\end{pmatrix}}} = 0$$

This example is represented by figure 07-03b,

3. a motorist is a *Money* shredder because he reduces the *Utility* of tyres for himself as they are used, *i.e.* :

$$dU_{P_{\begin{pmatrix}\text{Transformer}\\ -\text{tyremanufacturer}\\ -\text{transporter}\end{pmatrix}}} > 0 \qquad \text{or :} \qquad dU_{P_{\begin{pmatrix}\text{Buyer}\\ -\text{Motorist}\end{pmatrix}}} < 0$$

Indeed, the more kilometres the motorist drives, the greater the wear and tear and therefore the *Utility* for the consumer decreases to zero when the tyres are completely worn. However, during this period, the motorist finds himself in a situation where he is spending *Money*, since he normally has to plan the replacement of these tyres by saving a certain amount of *Cash*. However, the faster and more important the wear and tear, the faster the Transformer has to manufacture a new one, thus increasing the *Utility* of the tyre for itself.

This example is shown in figure 07-3c.

In the three possibilities described above, no account is taken of the possible variation in *price*. If the *price* is considered constant, then the explanation is as follows:

1. If two tyre manufacturers respectively put on the market at the same *price*, the first one a *Product* that can be driven 40,000 km and the other one out of service after only 20,000 km, it's certain that consumers will preferentially buy the first one, because it has a higher *Utility*. By doing so, consumers are entitled to say that after 20,000 km they will have a brand new tyre capable of covering the same distance again.

2. If two tyre manufacturers respectively put on the market at the same *price* two *Product*s of the same quality each capable of covering 40 000 km, it's certain that consumers will buy without preference one or the other, because they have the same *Utility*.

3. This third case is the opposite of the first. If the consumer acquires a tyre which is completely worn down after 20 000 km, he will be obliged to spend a quantity of Cash on a new tyre. It is possible to say that this option costs him twice as much as if he had purchased a *Product* likely to cover 40,000 km.

This explanation corroborates Principle 2, which states that there can be no *Money* without a difference in the *Product*'s *Utility*.

Of course, nothing is perfect, and in each case there are losses that modify the perfect vision of the examples that have just been given. The economic losses of *Money* can, always very easily, be explained by mechanical analogies. Only one example will be cited. In the transport of fuel it's quite certain that the quantity on arrival at the pump attendant is equal to the quantity on departure from the refinery. Nevertheless, a certain volume of fuel has been consumed by the tanker's engine, which in physical (thermodynamic) terms is considered a loss. In the same way, economically, the costs inherent to this transport (cost of diesel, driver's remuneration, investment, ...) must be integrated in the final *price* of the fuel, which increases it; these costs must be considered as losses, *i.e.* a destruction of *Money*. Indeed, an increase in *price* necessarily implies a reduction in the consumer's *purchasing power* and thus an impoverishment of the economic *system* of which he is a part.

As already mentioned, in Economics there are two causes of evolution (*Laziness* and *Avarice*) which implies two different types of transformations, but nevertheless similar, compared to thermodynamics in two main divisions defined as follows :

- transformation *Work→Money* ($T \to M$),
- transformation *Money→Work* ($M \to T$).

It is repeated again and again that these two types of transformations are not at all the opposite, the return of each other, because the variables are not the same. The cause of the transformation $T \to M$ is the *Laziness* of the Transformer while the cause of the transformation $M \to T$ is the *Avarice* of the Buyer. Moreover, in the transformation *Money→Work* it's no longer the U_P *Utility* of the *Product* that varies but the U_A *Utility* of *Cash*. In the same way that the *Utility* of a *Product* is variable according to the agents, the *Utility* of *Cash* is very different according to the agents. Indeed, a 1$ coin is much more important for an individual subject to social minima than for an "Emir of Oil". Moreover, during the manufacture of a *Product*, its *Utility* varies and it's certain that the *Utility* of *Cash* is higher when with one monetary unit it's possible to acquire more *Product*. Whether in thermodynamics or in Economics, the 3 hypotheses are defined by the direction of evolution of the temperature, the *Utility* of the *Product* and the *Utility* of *Cash*, that is to say, the increase, stability or decrease of these characteristics. But these evolutions must necessarily have a cause which is the variation of :

- entropy (S), in the heat transfer,
- *Laziness* (P), in the transfer of the *Product*,
- *Avarice* (A), in the transfer of *Cash*.

History shows that the number of working people in relation to the total population generally declines over time. Moreover, the number of creators of monetary *wealth* (*Money*) also decreases in relation to the total population but also in relation to the active population, essentially since the industrial revolution, which allowed the replacement of *labour* and *Work to be done* by human by that done by engines.

We know that the series of diagrams 07-05, concerning thermodynamics, lists all the possibilities of transformations between the heat Q consumed and the work W obtained in return. It is natural to think that diagrams 07-03 on the one hand and 07-04 on the other hand represent respectively and exhaustively all the possibilities of transformations between *Work* and *Money* and conversely between *Money* and *Work*. By analogy with physics, the various economic transformations are named :

- adiabatic ⇒ when the Utilities of the *Product* and of the *Money* evolve (figures 07-03a and 07-03c as well as figures 07-04a and 07-04c),
- isopheles ⇒ when the Utilities of the *Product* and the *Cash* remain constant (figures 07-03b and 07-03d as well as figures 07-04b and 07-04d).

The name of these transformations comes from the Greek :

- adiabatic ⇒ *a = no* and : *dia batein = to go through*
- isophele ⇒ *iso = same* and : *opheleia = utility*

Reversible transformation – Irreversible transformation

A transformation is considered to be reversible when, once completed, it's possible to cause a reverse transformation that can bring the system back to its previous state, by going through all the intermediate stages again. For a transformation to be reversible, it must be performed without any loss and without any sampling. For example, in the $T \rightarrow M$ transformation, during the manufacture of a *Product*, the tooling used will wear out and become obsolete after a certain time. It is obvious that tool wear is one of the causes of irreversibility of a transformation. There may be other causes such as manufacturing errors causing scrap. In $M \rightarrow T$ transformation, one of the essential causes of irreversibility is the drawdown of *Cash* by the State and so of *Money* (included in *Cash*).

It is logical to think that the higher the value of the losses and/or drawdown, the less reversible the transformation will be. The logical consequence of this is that the less reversible the transformation, the lower the *yield*.

Quasi-static transformation

The aim of the game is to find out the relationship between external constraints and internal characteristics. In order to apply an analytical reasoning, it's of course necessary to know the values of the external constraints at each moment. Two cases can arise, either these constraints are constant in time, or the *speed* of evolution of these constraints (external F*orces*) allows at each moment that they are balanced by the reaction forces of the system. We can then consider that the transformation is a succession of states of equilibrium very close in time. It is in this case that the transformation will be qualified as quasi-static.

In all that follows, *Work* represents the amount of the human *Work* provided by the agent and the mechanical *Work* provided by the machines (and of the other causes - slaves, animals). In the same way, the *Money* is the sum of the *Money* received or provided by manpower and the *Money* relating to the *Energy consumed* by the machines (and of the other causes - slaves, animals).

In Economics, the application of the analysis can be justified if, for example, during the manufacture of a *Product*, it's considered as a succession of elementary operations such as clamping a workpiece in the clamp vice, centering, drilling a pilot hole, boring, *etc.* (this is what a methods office defines). An external constraint being exerted on each operation one after the other, the system can be considered to be in equilibrium after each of these operations.

Isophele transformation

Isophele from the Greek *iso* = *equal* and *opheleia* = *utility*

An isopheles transformation is :

- a $T \to M$ transformation that takes place with a constant *Utility of Product*,
- a $M \to T$ transformation that is achieved with a constant *Utility of Cash*.

A merchant causes a transformation of this type because between the moment he buys a *Product* and the moment he resells it, the *price* has increased but the *Utility* of the *Product* has remained the same because he has not modified it.

This transformation is similar in physics to an isothermal transformation.

Some may say that the merchant increases the *Utility* by bringing the *Product* closer to the consumer, but this is false because in reality it's the transporter who has carried out this operation. In any case, the consumer doesn't care to know the place of production and the transport system. Generally speaking, this transformation corresponds to a variation in *labour* or *price* without variation in the *Utility* of the *Product* or the *Utility* of the *Cash* respectively.

Isoaxis transformation

Isoax from the Greek *iso* = *equal* and *axia* = *value*, *gain*

An isoaxis transformation is a transformation that takes place on a *Product* whose *price* remains constant.

A manufacturer can bring about this type of transformation by improving the *Utility* of a *Product* without increasing its *price*, for example by increasing productivity, *i.e.* by reducing manufacturing time. This transformation is similar in physics to an isochore transformation.

Isoergue transformation

Isoergue from the Greek *iso = equal* and *ergie = toil*, *work*

An isoergue transformation is a transformation that takes place on a *Cash* whose *labour* remains constant and is similar, as above, to an isochore transformation.

Isobaric transformation

Isobar from the Greek *iso = equal* and *baros = gravity, gravity, pressure.*

An isobaric transformation is a transformation that takes place on a *Product* or *Cash* where the customer's *choice* remains constant, *i.e.* where the *Force of Avarice* or the *Force of Laziness* remains constant.

A manufacturer can bring about such a transformation by increasing the *Utility* of a *Product* and proportionally increasing the *price.* This transformation is similar in physics to an isobaric transformation.

Adiabatic transformation

Adiabatic from Greek *a = without*, *dia = through* and *batein = to exchange*, to *transfer*
An adiabatic transformation is a transformation that takes place on a *Product* or on *Cash* without there being any exchange of *Work* or *Money* between the interior and exterior of the considered system.

A manufacturer causes a transformation of this type in the elabouration of a *Product* by increasing its *Utility* and its *price* and/or *labour*, which implies a decrease in the Consumer's *Choice*, that is to say, in his *Avarice* or *Laziness.* In fact, there is no exchange of *Product*s during their manufacture. This transformation is similar in physics to an adiabatic transformation.

Cyclical transformation

A cyclic transformation is a succession of any previously defined transformations which, after a certain period of time, bring the system back to its initial state but without going through all the intermediate stages again.

As the *Product* (or *Cash*) returns to its initial state, the resulting variations of the different characteristics are zero between the final and initial states, which are equal. This is of course only valid if the relationships representing the characteristics are “state equations”.

08 – CORE LAWS

ABSTRACT: As in any Science, in addition to Principles, it is essential in Economics to rely on at least one experimental law. The supply of a Product is perfectly defined as being the number of times that the cycle of manufacture of the Product is carried out per unit of time, in the same way that in physics the speed of rotation is defined as being the number of times that the cycle of manufacture of mechanical work is carried out per unit of time. In a heat→work transformation, we know that the amount of mechanical work obtained is a direct function of this speed of rotation. Consequently, in a Work→Money transformation, the quantity of Money created is a direct function of the speed with which the economic cycle is performed.

This chapter therefore sets out to highlight this experimental law in the general case, but also under certain specific conditions where these are constant.

***T**→M Transformation* ⇒ ***Core** experimental law*

In the $T \rightarrow M$ transformation, the economic cycle can be sequenced as follows, with the steps of the thermodynamic cycle in concordance:

1. purchase tractation ⇒ isopheles transformation ⇔ isothermal transformation,
2. manufacture of the *Product* ⇒ adiabatic transformation ⇔ adiabatic transformation .
3. sales contract ⇒ isopheles transformation ⇔ isothermal transformation,
4. use of the *Product* ⇒ adiabatic transformation ⇔ adiabatic transformation.

It is obvious and very important to note that for both cycles (economic and thermodynamic) :

1. ***steps 1 and 3 are performed :***
   WITH CONTACT with the outside and WITHOUT MODIFICATION of the Product and the temperature,
2. ***Steps 2 and 4 are performed :***
   WITHOUT CONTACT with the outside and WITH MODIFICATION to the Product and temperature.

Consequently and obviously, this leads to seeking explanations for economic phenomena at the level of the manufacturing cycle and not in the law of "*supply and demand*" as is customary. The paragraph "Supply - Demand" of the chapter "Prolegomena" shows that this law of a macroeconomic nature cannot serve as a basis for any explanation of microeconomic exchanges, being only a consequence (of a variation either of *price* or of *Utility*) and never the cause of the evolutions.

One of the essential rules of the Economy is the *quality/price* ratio. *Quality* in this expression is perfectly identified with *Utility* as already defined. The higher the *Utility of a Product* will be compared to that of another *Product*, and this at the same *price*, the more it will sell. This expression thus becomes the "*Utility/price*" ratio.

There are at least three characteristics that may serve as a basis for reasoning as well as for calculation, namely; the *supply* of a *Product*, its *demand* and its *price*. The chapter "Prolegomena" has already explained how these three characteristics are articulated chronologically. Some argue that supply is paramount by stating that "*supply* creates its own *demand*". Others certify that it's *demand* that acts as the driving force in the evolution of an economic system. But moreover, it's indisputable that the *Utility* of the *Product* also plays an important role in trade. Indeed, it's:

- at constant *price*, it's the variation in the *Utility* of the *Product* that directly changes *demand*,
- at constant *Product Utility*, it's the variation in *price* that inversely changes the *demand*.

From these two eventualities, it emerges that there is indeed a relationship between the *Utility* of a *Product* for a consumer and the *price* he is prepared to pay to acquire it. If the *price* displayed is too high for the *Utility* he grants to the *Product*, he will not buy it. The *Utility/price* ratio, commonly referred to as the *quality/price* ratio, is none other than the consumer's *Choice* on the desired *Product* to which he grants a certain level of *Utility*. Consequently, by posing :

$$C = \textit{Consumer's Choice}$$

it's possible to write :

$$C = \frac{U_P}{p} \qquad \textbf{‹08-01›}$$

For a given *price*, the *Choice* varies in the same way as the *Utility* of the desired *Product*. Indeed, if for any consumer, the *Utility* of the *Product* increases his *Choice* will be greater and *vice versa*. Conversely, for a given *Utility*, the lower the *price*, the greater the *Choice* and *vice versa*. The *Choice* (C) of the consumer can be replaced by the *Force* (F_A) that the consumer exerts on the supplier in order to lower the *price* (p), because these two characteristics evolve in the same way and are similar. In fact, for a given *Product* and therefore for a fixed *Utility*, if the Consumer's *Choice* is low, this means that the *price* is high and that this agent doesn't exert a significant *Force* to bring it down. Conversely, if the *price* is low, the Consumer's *Choice* is high, which means that the *Force* it exerts on the supplier is significant. Consequently, it's possible to write :

$$C = F_A = \frac{U_P}{p} \qquad \textbf{‹08-02›}$$

or :

$$F_A \cdot p = U_P$$

Indeed, we know from the Second Principle that a consumer naturally always increases his *Avarice A*. He therefore exerts an F_A *Force* on the supplier to reduce the *price* p . However, this reduction is obviously counterbalanced by the U_P *Utility* that he grants to the *Product*. From this last relationship it emerges that there are 3, and only 3, possibilities of evolution, namely :

1. ***<u>variation of the Force</u>***
   - If the consumer increases his *Force*, then :
   - for a constant *Utility*, the *price* decreases because the consumer wants to keep as much *Money* in his purse as possible,
   - for a constant *price*, the *Utility* increases proportionally, because it means that his *Laziness* has increased.

2. ***<u>price variation</u>***
   - If the *price* of the *Product* increases, then :
   - for a constant *Utility*, the *Force* decreases because the consumer buying the *Product* more expensive, therefore exerts less *Force* on the supplier,
   - for a constant *Force*, the *Utility* of the *Product* increases proportionally. Since the consumer grants a high *Utility* to the *Product* he is ready to purchase it at a high *price.*

3. ***<u>Variation of the Product's Utility</u>***
   - If the *Utility* of the *Product* for the consumer increases, then :
   - for a constant *Force*, the *price* increases, as seen in the previous case,
   - or a constant *price*, the *Force* increases proportionally. Since the consumer grants an important *Utility* to the *Product*, while keeping the *price* at the same level, he is obliged to exert a higher *Force* on the supplier.

In all three hypotheses, only one increase in each characteristic (*Force*, *price*, *Utility*) has been presented. Obviously, it would be possible to make the same comments in the case of a decrease. From all this, it's possible to draw up the following table which lists all the possibilities (positive and negative) of evolution of these three characteristics, always in a $T \rightarrow M$ transformation.

	Constant *Force*		**Constant *Price***		**Constant *Utility***	
Force	➔	➔	➚	➘	➚	➘
Price	➚	➘	➔	➔	➘	➚
Utility	➚	➘	➚	➘	➔	➔

The three Constant *Utility*, Constant *Price* and Constant *Force* assumptions are consistent with the laws of Charles, Gay-Lussac and Boyle-Mariotte, which are set out below.

However, to take into account the nature of the *Product* and its quantity (and in order to ensure the extensiveness of the two terms of the equation) it's necessary to introduce a coefficient which is a function of the *Product* and therefore of its *complexity* c_P , in the same way as in physics this coefficient (mass) is a function of the nature of the gas used. Consequently, by posing :

$r_P \quad = \quad f \quad$ (*complexity* of the *Product*, number of copies)

or :

$$r_P = f\left(c_P\right) \qquad \textbf{‹08-03›}$$

the relationship becomes :

$$\boxed{\underbrace{F_A \cdot p}_{CASH} = \underbrace{r_P \cdot U_P}_{PRODUCT}} \qquad \textbf{‹08-04›}$$

It should be noted that :

- ***this relationship doesn't in any way require economic agents to be imperatively rational.***

In fact, whatever the value of the *Utility* granted to the *Product* by the consumer, be it right or wrong, objective or subjective, the exchange *price* will always depend on it.

For a given *price* of any *Product*:

1. if the consumer judges the *Utility of the Product* to be too low for his needs, he will not buy it because he will judge its *price* to be too high. It is possible to say that the consumer prefers *Cash* to the *Product* $\left(U_A > U_P\right)$,
2. if the consumer deems the *Utility* of the *Product* too high for his needs, he will buy it as he deems its *price* to be correct. It is possible to say that the consumer prefers the *Product* to *Cash* $\left(U_P > U_A\right)$.

It is certain that these two hypotheses correspond to everyday reality. In this case, the second is the one that all advertisers are looking for. By all (legal) means, they seek to mislead the consumer as to the *Utility of the Product* (good or service) whose purchase they have the mission to incite. It isn't the intention here to discuss the means used to achieve this goal. If the consumer is fooled by advertising into believing that a particular *Product* is very useful to him, the supplier may increase the *price* of the *Product* or sell more of it. The result of this relationship is that :

- ***homo œconomicus may be mistaken and duped.***

As stated in the chapter “Prolegomena”, this expresses that he isn't necessarily rational and that he is ill-informed. This is perfectly consistent with strict reality, and therefore implies that the definition of the economic agent must be modified with respect to its supposed rationality.

It is possible to consider this relation (08-04) as an experimental Law which is similar, in its substance and form, to Boyle-Mariotte's Law in physics, namely :

$$P \cdot V = r \cdot T$$

In physics this relation isn't rigorously exact for a real gas, but only for a virtual entity called "perfect gas". Nevertheless, it's considered to be correct in current calculations and for the understanding of phenomena. In the case we are concerned with, it's necessary to have the same approach. It is possible that one or more other criteria (other than *Force* and *price*) may have to be taken into account to obtain perfect accuracy, but these must have a very small, if not insignificant or even null influence compared to the two characteristics mentioned above. For a given consumer and *Product*, *i.e.* for a constant *Utility* the *Force* (or *Choice*) and the *price* therefore evolve in opposite directions and define a hyperbole in the same way as the reciprocal evolutions of pressure and volume in physics (for an isothermal transformation).

This relationship, referred to here as "Core Law" can be renamed "Market Law". Indeed, when the *price* is too high for the *Utility* granted to the *Product* by the consumer, the economic exchange cannot take place. Indeed, at a given moment and for such a consumer, the *Utility* is fixed, therefore the right term $(r_P . U_P)$ is constant. If, for whatever reason, the *price* increases, *i.e.* is too high, then the relationship becomes an inequality and is written :

$$F_A \cdot p > r_P \cdot U_P$$

and the market doesn't exist, at least for this consumer.

The relation (08-04) defining the "Law of the market" can be written :

$$p = r_P \cdot \frac{U_P}{F_A}$$

For a given *Product* and a given consumer (*i.e.* for a fixed U_P *Utility*), the exchange *price* p_e (*i.e.* the *price* at which this consumer acquires the *Product*) is equal to :

$$p_e = r_P \cdot \underset{\Delta F_A \to 0}{\text{limit}} \frac{U_P}{\Delta F_A}$$

with :

$$\Delta F_A = \mathit{function}\left(p_D - p_S\right)$$ (since r_P and U_P are constant)

with :

p_D = asking *price* (selling *price* of the *Product*)
p_S = *price* offered (*price* at which the consumer is willing to purchase the *Product*).

In fact, the demand *price*, at constant *Utility*, can only decrease as the External *Force* exerted by the consumer increases. This relationship only means that as long as the limit's not reached (*i.e.* as long as the $\Delta F_A \neq 0$) the demand *price* is higher than the offer *price*, therefore the exchange cannot occur and the basic relationship is always an inequality. As a consequence and in a general way, for any *Product* and for any consumer (different utility for each of them), the above relationship becomes :

$$\boxed{p_e = r_P \cdot \frac{dU_P}{dF_A}} \qquad \langle 08\text{-}05 \rangle$$

So, during any kind of negotiation:

- ***the exchange price of a Product is the derivative of the Utility granted to it by the consumer in relation to the Force he deploys to obtain it.***

This relationship is very much in line with the reality of things. In fact, it's possible to sequence the chronological evolution of the *price* in the following way:

1. firstly, when a new *Product* is put on the market its *price* is relatively high, and only a few agents are likely to be able to buy it,
2. then, its *price* evolves downwards in a fairly regular way, and more and more economic agents can acquire it,
3. finally, its *price* remains stable, and almost all agents can use it.

Of course, the duration of each sequence varies greatly depending on the *Product* and the economic *system* under consideration. For example, for France, it took ¾ a century, if not more, for a car to be purchased by a majority of the population, whereas only a few years were needed for almost all agents to acquire a mobile phone.

The existence of these sequences can be explained as follows:

1. ***Sequence 1***
   When a new *Product* is put on the market, any supplier shall ensure that it's of the greatest possible *Uility* to potential Buyers. This is why market research is always performed. In an economic *system* such as that of a country, there are always a number of agents who have a great *Utility* for the *Product* in question and who, therefore, don't exert a significant *Force* on the supplier to reduce the *price*. As the dU_P/dF_A ratio is high, the exchange *price* is itself high.

2. ***Sequence 2***
   Once consumers with a high *Utility* of the *Product* are provided, *i.e.* their need is satisfied, the supplier is obliged to lower the *price* in order to satisfy consumers with a lower *Utility.* The ratio of dU_P/dF_A decreases gradually as the *Utility* decreases and the *Force* increases. In fact, the more a consumer has less need for the *Product*, the greater the *Force* exerted on the supplier to lower the *price.*

   The particular example, relating to video recorders, has already been described, which perfectly corroborates the normal evolution of *price*s. It is useful to specify here that between the first examples (around 1970) and the one acquired (2005), these devices had evolved in terms of quality, reliability, aesthetics, *etc.*, and that the *price* of the product had increased. However, the personal *Utility* that I attributed to this device had not changed one *iota*. These operations of improvement only played on the *complexity* (c_P) and consequently on the constant (r_P). Moreover, this example also shows perfectly that I was exerting a very important *Force* on the supplier to lower his selling *price*. In conclusion, for my own needs, the low *Utility* of the VCR and the high Applied *Force* imposed a low ratio (dU_P/dF_A) of these characteristics and therefore a low *price*.

3. ***Sequence 3***
   Once the market is almost saturated, the supplier no longer lowers its *price* because *Utility* is then minimal for most users. The market is then described as a "renewal market". Moreover, it cannot lower the *price* below the cost *price*. However, in order to avoid and/or slow down the *price* decrease, the supplier modifies the *Product* by improving or adding new functions. This operation doesn't have the effect of increasing the *Utility* of the *Product* for the consumer (or in very small proportions) but above all the complexity (c_P) and consequently the constant (r_P). This therefore tends to increase the *price* since the ratio $r_P.dU_P/dF_A$ either increases or decreases more slowly.

This relationship also makes explicit in an excellent way episodic *price* variations, which can be both random and predictable. In any case, these *price* variations are always due to changes in supply. A typical example is the rise in food *price*s following bad weather conditions (storm, heat wave, frost, drought, hail, ...), which causes a decrease in the supply of these products. Since there are fewer *Product*s on the market, only those consumers with a great *Utility* will obtain them because they will be willing to buy them at a high *price*. In conclusion :

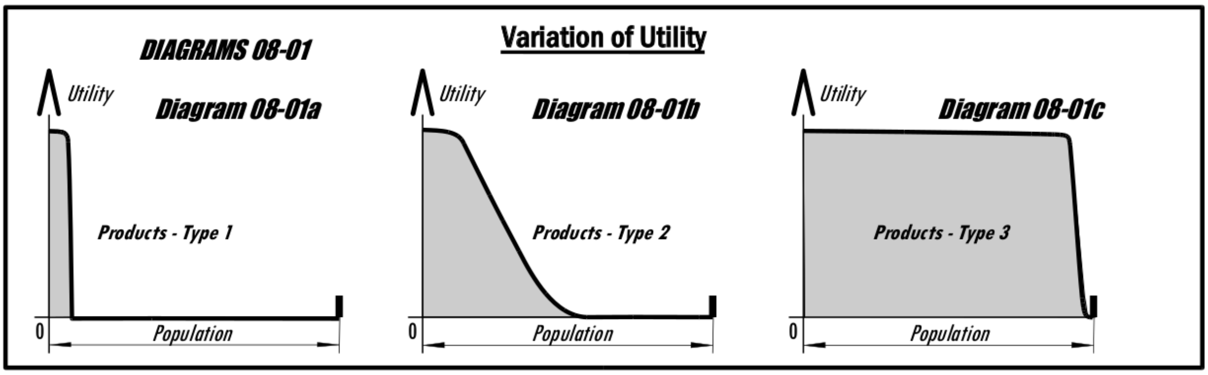
- if the *supply* decreases little, the *price* will only vary slightly upwards,
- if the *supply* decreases a lot, the *price* will increase significantly,

in accordance with the relationship where the *price* is a direct function of the *Utility* and inverse of the *Force* applied.

- The explanation of seasonal cyclical variations (*e.g.* ice cream and swimwear in summer, hot chocolate and knitwear in winter) always emerges from the analysis of the main relationships (08-04 and 08-05). During the summer periods, the *utility* of refreshments and bikinis increases a lot, so the dU_P/dF_A ratio and the *price* increases. On the other hand, hot chocolate and large knitwear have no *Utility* and therefore do not sell. On the other hand, during the frosts the respective *Utilities* of all these *Product*s are reversed and therefore see their *price*s evolve in the opposite way.

TYPES OF PRODUCTS

In the general population of any economic *system*, it's obvious that the *Utility of a Product* varies from imperative to nil or almost nil. Among all the (practically infinite) possibilities of evolution of the *Utility* according to the economic agents, it's possible to consider 3 types of *Product*s as represented below.



- ***Type 1 products***
  High *utility* for a small minority of agents and very low or no *utility* for a large majority (Figure 08-01a). Generally speaking, *Product*s intended for targeted professions fall into this category, *i.e.* each *Product* is intended for a particular profession. For example: a stethoscope is certainly indispensable for a doctor and really not very useful for the majority of individuals, a numerically controlled milling machine to process the blades of a Kaplan turbine is very useful for a very few companies but nil for almost all of them, a differential dilatometer is exclusively useful for a few solid state physics labouratories, *etc.*

- ***Type 2 products***
  High *utility* for a minority of agents, variable for the majority and low for another minority (Figure 08-01b). In general, this category should be classified as Consumer Goods. For example: vehicles (cars, motorbikes, bicycles, ...), gardening and/or DIY tools, interior decoration products, cultural products, products for a change of scenery (travel, winter sports, ...), *etc.*

- ***Type 3 products***
  High utility for a very large majority of agents and low for a small minority (08-01c). Generally speaking, this category includes so-called basic necessities. For example: Food, clothing, medicines, housing, water, energy, *etc.*, are to be classified in this category.

Obviously, depending on the level at which consumers can or cannot acquire these *Product*s, the system will be considered more or less rich. Two kinds of classification are possible, namely :

1. ***Ranking 1***

- Ranked according to the percentage of agents able to acquire substantially all of the *Product*s. For example, it's possible to write that the percentage of agents is included :
  - between 80 and 100% ⇒ the system is very rich,
  - between 60 and 80% ⇒ the system is rich,
  - between 40 and 60% ⇒ the system is moderately rich (or poor),
  - between 20 and 40% ⇒ the system is poor,
  - between 0 and 20% ⇒ the system is very poor,

2. ***Ranking 2***

- Ranking according to the percentage of *Products* that can be acquired by almost all agents. For example, it's possible to write that the percentage of Goods is included:
    - between 80 and 100% ⇒ the system is very rich,
    - between 60 and 80% ⇒ the system is rich,
    - between 40 and 60% ⇒ the system is moderately rich (or poor),
    - between 20 and 40% ⇒ the system is poor,
    - between 0 and 20% ⇒ the system is very poor,

We know that for *Products* that are acquired the relationship is equality and for *Products* that cannot be purchased the basic relationship is inequality. Therefore, the two above classifications can be modified as follows, saying that if the percentage of situations where the Core Law is verified is included :

- between 80 and 100% ⇒ the system is very rich,
- between 60 and 80% ⇒ the system is rich,
- between 40 and 60% ⇒ the system is moderately rich (or poor),
- between 20 and 40% ⇒ the system is poor,
- between 0 and 20% ⇒ the system is very poor,

Enrichment and impoverishment – Inflation and deflation

Still starting from the basic relation (08-04) and taking as variables the *price* of a *Product* and its *Utility* (*i.e.* at Constant *Force*), there are only 4 possibilities of evolution, namely :

	Price	***Utility***
Possibility 1	↘	↘
Possibility 2	↘	↗
Possibility 3	↗	↘
Possibility 4	↗	↗

It is reiterated that *Utility* here refers to the *Utility* of *Products* that cover more or less important, more or less priority needs. It is in fact understood that, for a diabetic person, the entrance ticket for an opera performance has a much lower *Utility* than that of a dose of insulin, whereas for a healthy music lover the preference (ticket or medicine) will be the opposite. When analysing the table, it's implicit that the *price* or *Utility* can remain stable, which corresponds to a borderline situation between the different possibilities.

1. ***Possibility 1*** ⇒ ***Price and Utility decrease*** ⇔ ***Enrichment***
   This hypothesis indicates that the majority of the agents under consideration see their *purchasing power* increase since they can acquire *Products* for which their need is of lower and lower priority than those they could previously purchase, since *Utility* decreases. If, for example,

they could only buy, with the income they have, 50% of the *Product*s put on the market, they are now able to acquire 51%, 52% or more of these *Product*s. Thus, this hypothesis corresponds to the enrichment of the economic *system* to which these agents belong, which is in principle the aim of any economic policy.

2. ***Possibility 2*** ⇒ ***Price decreases and Utility increases*** ⇔ ***Deflation***
   This hypothesis corresponds to the case where, despite a fall in *price*s, agents can only satisfy, with the income at their disposal, increasingly indispensable needs, which is what happens when the economic *system* is in deflation.

3. ***Possibility 3*** ⇒ ***Price increases and Utility decreases*** ⇔ ***Inflation***
   This hypothesis corresponds to the common case where agents see their *purchasing power* decrease by *price* increases. However, they can always acquire *Product*s whose *Utility* decreases. For example, if an agent already owns *Product*s with a high *Utility*, he will buy with his income those with a lower *Utility*, but with increasing difficulty.

4. ***Possibility 4*** ⇒ ***Price and Utility increase*** ⇔ ***Impoverishment***
   Conversely to case 1, a development during which the *Utility* of the *Product*s acquired as well as their *price* increases corresponds to an impoverishment of the *system*. Indeed, with the income they have, agents can only acquire increasingly expensive *Product*s that are more and more indispensable to them.

The table below shows, in another form, the four possibilities of evolution defined above, specifying their consequences:

	Utility* of *Product ⬊	***Utility* of *Product*** ⬈
Price ⬊	**1.** Enrichment	**2.** Deflation
Price ⬈	**3.** Inflation	**4.** Impoverishment

From this, still for a given, *i.e.* constant, F_A *Force*, it's possible to state that :

- **for possibilities 1 and 4 ⇒ the Core Law is verified,**
- **for possibilities 2 and 3 ⇒ the Core Law is deviated.**

Indeed, for the Core Law to be confirmed it's necessary and obligatory that the *price* and *Utility* evolve in the same direction. The various hypotheses formulated in this table are perfectly in line with reality. In fact, deflation and inflation are well considered anomalies, causing an incorrect and damaging march of the Economy, which must be fought against. Furthermore, it should be noted that :

Enrichment = − *Impoverishment*
Inflation = − *Deflation*
In order to find the truth of the law, for cases of deflation or inflation, the only solution is to change the r_P coefficient. By posing :

🡻 = *Significant downward variation* (*greater than* ⬊)

🡅 = *Significant upward variation (greater than* 🡭*)*

the table then changes as follows:

	Utility* of *Product 🡮	***Utility* of *Product*** 🡭
Price 🡮	**1.** Enrichment **:** r_P 🡒	**2.** Deflation **:** r_P 🡇
Price 🡭	**3.** Inflation **:** r_P 🡅	**4.** Impoverishment **:** r_P 🡒

We know that in periods of deflation there are few monetary units in the economic *system* under consideration and that the opposite is true in an episode of inflation. In the event of deflation, the complexity and number of *Products* tends to decrease as consumers with few monetary units look for the simplest and therefore cheapest *Products.* On the other hand, during inflationary episodes, individuals tend to acquire increasingly complex *Products* because they normally have more monetary units at their disposal.

For everyday Consumer *Product*s, essentially Type 2 *Product*s as defined above, as producers are subject to a trend *price* drop to satisfy agents as to their *Utility*, they modify the *Product*s they manufacture in order to increase complexity and thus the r_P coefficient, as indicated in the table above, in order to slow down the *price* drop; producers add many gadgets. The increase in *price* caused by these manipulations does cause inflation. It should be noted that it's necessary to decrease (box 2) or increase (box 3) in greater proportions the complexity and quantity of material (r_P) to counterbalance the variation in *Utility* in order to maintain the *Force* at its original value.

Transformation T→M ⇒ *Laws with constant characteristics*

Still on the basis of the core law or market law (relation 08-04), it's possible to present three particular cases of transformations that may occur, namely :

- an isobaric transformation (at constant F_A *Force*),
- an isoaxial transformation (at constant p *price*),
- an isopheles transformation (with constant U_P *Utility*).

corresponding in physics respectively to the laws of Charles, Gay-Lussac and Boyle-Mariotte.

1. ***Law with constant Avarice Force***

   From the core law (relation 08-04), for two different states indexed $_1$ and $_2$, it's still possible to write :

   $F_{A1} \cdot p_1 = r_P \cdot U_{P1}$ and : $F_{A2} \cdot p_2 = r_P \cdot U_{P2}$

   Or :

$$\frac{p_1}{U_{P1}} = \frac{r_P}{F_{A1}}$$ and : $$\frac{p_2}{U_{P2}} = \frac{r_P}{F_{A2}}$$

since the *Force* is constant $(F_{A1}=F_{A2})$, then :

$$\frac{p_1}{U_{p1}}=\frac{p_2}{U_{p2}}$$ through constant avarice. **‹08-06›**

2. ***Law at constant price***

From the core law (relation 08-04), for two different states indexed $_1$ and $_2$, it's still possible to write :

$$F_{A1} \cdot p_1 = r_P \cdot U_{P1}$$ and : $$F_{A2} \cdot p_2 = r_P \cdot U_{P2}$$

or :

$$\frac{F_{A1}}{U_{P1}} = \frac{r_P}{p_1}$$ and : $$\frac{F_{A2}}{U_{P2}} = \frac{r_P}{p_2}$$

since the *price* is constant ($p_1=p_2$), then :

$$\frac{F_{A1}}{U_{P1}}=\frac{F_{A2}}{U_{P2}}$$ through constant price. **‹08-07›**

3. ***Law of Constant Product Utility***

From the core law (relation 08-04), for two different states indexed $_1$ and $_2$, it's still possible to write :

$$F_{A1} \cdot p_1 = r_P \cdot U_{P1}$$ and : $$F_{A2} \cdot p_2 = r_P \cdot U_{P2}$$

since *Utility* is constant ($U_{P1} = U_{P2}$), then :

$$F_{A1} . p_1 = F_{A2} . p_2$$ at constant Product Utility **‹08-08›**

*Transformation M→**T*** ⇒ *Core experimental law*

In the $T \to M$ transformation discussed above, only the *price* has been taken into account because the consumer agent is only interested in the *Money* he owns and wants to keep as much of it as possible. In the $M \to T$ transformation that interests us now, it's the *labour* (and only him) that the consumer will have to do later that needs to be analysed.

We know from the Second Principle that a consumer naturally always increases his *Laziness P*. He therefore exerts a F_P *Force* on the supplier to reduce the *labour l* he will have to do after the purchase. However, this reduction is obviously counterbalanced by the U_A *Utility* he gives to *Cash*. Indeed, the *Utility* of *Cash* is variable according to the agents of the same economic *system*. For an agent with little income, this *Utility* is much higher than for another agent with a high income. Moreover, depending on the individual's character, *i.e.* according to his greed, this characteristic can vary in very high proportions.

Thus, the *Utility* of *Cash*, in the same way as the *Utility* of a *Product* can be considered as continuous or almost continuous, in the same *system*, depending on the agents.

In the $M \to T$ transformation, the economic cycle can be sequenced as follows, with the stages of the thermodynamic cycle in agreement:

1. purchase contract ⇒ isopheles transformation ⇔ isothermal transformation,
2. manufacture of the *Product* ⇒ adiabatic transformation ⇔ adiabatic transformation,
3. sales contract ⇒ isopheles transformation ⇔ isothermal transformation,
4. use of the *Product* ⇒ adiabatic transformation ⇔ adiabatic transformation.

It is obvious and very important to note that for both cycles (economic and thermodynamic) :

- ***steps 1 and 3 are performed :***
  WITH CONTACT with the outside and WITH MODIFICATION of the Cash,
- ***Steps 2 and 4 are performed:***
  WITHOUT CONTACT with the outside and WITHOUT MODIFICATION of the Cash.

Indeed, we must remember that we are considering $M \to T$ transformation. In this process the *Cash* is modified during the negotiations and remains constant during the manufacturing or use phases.

There are at least three characteristics that can be used as a basis for reasoning and calculation, namely; the supply of a *Cash*, its *demand* and its *labour*.

The chapter "Prolegomena" has already explained how these three characteristics are chronologically articulated. Some argue that supply is paramount by stating that "supply creates its own demand". Others certify that it's demand that acts as the driving force in the evolution of an economic *system*. But moreover, it's indisputable that the *Utility* of the *Product* also plays an important role in trade. Indeed :

- with constant *labour*, it's the variation of the *Utility* of *Cash* that directly makes *demand* evolve,
- with constant *Utility* of *Cash*, it's the variation in *labour* that inversely changes the *demand*.

From these two eventualities, it emerges that there is a relationship between the *Utility* of *Cash* for a consumer and the *labour* he is willing to do to acquire it. If the work to be done is too high for the *Utility* he gives to the *Cash*, he will not buy the *Product*.

Consequently, by asking :

$C = consumer\ Choice$

it's possible to write :

$$C = \frac{U_A}{l} \quad \text{‹08-09›}$$

For a given *price*, the *Choice* varies in the same way as the *Utility* of the desired *Product*. Indeed, if for any consumer, the *Utility* of the *Product* increases his *Choice* will be greater and *vice versa*. Conversely, for a given *Utility*, the lower the *price*, the greater the *Choice* and *vice versa*. The *Choice* (C) of the consumer can be replaced by the *Force* (F_A) that the consumer exerts on the supplier in order to lower the *price* (p), because these two characteristics evolve in the same way and are similar. In fact, for a given *Product* and therefore for a fixed *Utility*, if the consumer's *Choice* is low, this means that the *price* is high and that this agent doesn't exert a significant *Force* to bring it down. Conversely, if the *price* is low, the consumer's *Choice* is high, which means that the *Force* it exerts on the supplier is significant. Consequently, it's possible to write :

$$C = F_P = \frac{U_A}{l} \quad \text{‹08-10›}$$

or :

$$F_P \cdot l = U_A$$

From this relationship it emerges that there are 3, and only 3, possibilities of evolution, namely:

1. ***Force variation***
   If the consumer increases his *Force*, then :
   - for a constant *Utility*, then the *labour* decreases because the consumer wants to do as little as possible,
   - for a constant *labour*, the *Utility* increases proportionally, because it means that his *Avarice* has increased.

2. ***variation of labour***

If the consumer increases his *labour*, then :

- for a constant *Utility*, the *Force* decreases because the consumer increasing the amount of *labour* he has to do wishes to receive more and therefore exerts less *Force* on the other agent,
- for a constant *Force*, the *Utility* increases proportionally, because it means that his *Avarice* has increased.

3. ***Variation of the Utility of Cash***

If the consumer increases his *Utility*, then :

- for a constant *Force*, the *labour* increases because the consumer increasing the *labour* he has to perform wants to receive more and therefore exerts less *Force* on the other agent,
- for a constant *labour*, the *Force* increases proportionally, because it means that his *Avarice* has increased.

In the three hypotheses, only an increase of each characteristic (*Force*, *labour*, *Utility*) has been presented. Obviously, it would be possible to make the same comments in the case of a decrease. From all this, it's possible to draw up the following table which lists all the possibilities (positive and negative) of evolution of these three characteristics, always in a $M \to T$ transformation.

	Constant *Utility*		**Constant Labour**		**Constant *Force***	
Force	➚	➘	➚	➘	➔	➔
Labour	➘	➚	➔	➔	➚	➘
Utility	➔	➔	➚	➘	➚	➘

The three hypotheses of Constant *Utility*, Constant *Labour* and Constant *Force* are consistent with the laws of Charles, Gay-Lussac and Boyle-Mariotte, which are set out below.

However, to take into account the nature of *Cash* and its quantity (and in order to ensure the extensiveness of the two terms of the equation) it's necessary to introduce a coefficient which is a function of *Cash* and therefore of its complexity c_A, just as in physics this coefficient (mass) is a function of the nature of the gas used. Consequently, by posing :

$r_A \;=\; f$ (complexity of *Cash*, number of monetary units)

or

$$r_A = \mathrm{f}(c_A) \qquad \langle 08\text{-}11 \rangle$$

the relationship becomes :

$$\boxed{\underbrace{F_P \cdot l}_{PRODUCT} = \underbrace{r_A \cdot U_A}_{CASH}} \qquad \langle 08\text{-}12 \rangle$$

This relationship (08-12) defining the "Law of the market" can be written :

$$l = r_A \cdot \frac{U_A}{F_P}$$

For a given *Cash* and a given consumer (*i.e.* for a fixed U_A *Utility*), the *labour to be done* at the exchange l_e is equal to :

$$l_e = r_A \cdot \lim_{\Delta F_P \to 0} \frac{U_A}{\Delta F_P}$$

with :

$$\Delta F_P = \text{fonction}\left(l_D - l_S\right)$$ (since r_A and U_A are constant)

l_D = *labour required* (*labour to be done for which the consumer is willing to purchase the Product*)
l_S = *free labour* (*labour to be done upon sale of the Product*).

In fact, the *labour required*, at constant *Utility*, can only decrease as the External *Force* exerted by the consumer increases. This relationship only means that as long as the limit's not reached (*i.e.* as long as the $F_A \neq 0$) the requested *labour* is less than the *labour offered*, therefore the exchange cannot take place and the basic relationship is always an inequality. Consequently and in general, for any *Cash* and for any consumer (different *Utility* for each of them), the above relationship becomes :

$$\boxed{l_e = r_A \cdot \frac{dU_A}{dF_P}} \qquad \textbf{‹08-13›}$$

So, during any kind of negotiation:

- ***the labour to be done in exchanging Cash is the derivative of the Utility granted to it by the consumer in relation to the Force he deploys to keep it.***

Transformation M→T ⇒ Laws at constant characteristics

Still on the basis of the core law or market law (relation 08-12), it's possible to present three particular cases of transformations that may occur, namely :

- an isobaric transformation (at constant F_P *Force*),
- an isoergue transformation (at constant *labour* l),
- an isopheles transformation (at constant U_A *utility*).

corresponding in physics respectively to the laws of Charles, Gay-Lussac and Boyle.

1. ***Basic law with constant Lazy Force***

   From the core law (relation 08-12), for two different states indexed $_1$ and $_2$, it's always possible to write :

$$F_{P1} \cdot l_1 = r_A \cdot U_{A1} \quad \text{and :} \quad F_{P2} \cdot l_2 = r_A \cdot U_{A2}$$

   Or :

$$\frac{l_1}{U_{A1}} = \frac{r_A}{F_{P1}} \quad \text{and :} \quad \frac{l_2}{U_{A2}} = \frac{r_A}{F_{P2}}$$

   since the *Force* is constant ($F_{P1} = F_{P2}$), then :

$$\frac{l_1}{U_{A1}} = \frac{l_2}{U_{A2}} \quad \text{through constant laziness force.} \qquad \textbf{‹08-14›}$$

2. ***Basic law of constant labour***

   From the core law (relation 08-12), for two different states indexed $_1$ and $_2$, it's always possible to write :

$$F_{P1} \cdot l_1 = r_A \cdot U_{A1} \quad \text{and :} \quad F_{P2} \cdot l_2 = r_A \cdot U_{A2}$$

   or :

$$\frac{F_{P1}}{U_{A1}} = \frac{r_A}{l_1} \quad \text{and :} \quad \frac{F_{P2}}{U_{A2}} = \frac{r_A}{l_2}$$

   since *labour* is constant ($l_1 = l_2$), then:

$$\frac{F_{P1}}{U_{A1}} = \frac{F_{P2}}{U_{A2}} \quad \text{through constant labour.} \qquad \textbf{‹08-15›}$$

3. ***Core Law of Constant Utility of Cash***

   From the core law (relation 08-12), for two different states indexed $_1$ and $_2$, it's always possible to write :

$$F_{P1} \cdot l_1 = r_A \cdot U_{A1} \quad \text{and :} \quad F_{P2} \cdot l_2 = r_A \cdot U_{A2}$$

since the *Utility* of *Cash* is constant ($U_{A1} = U_{A2}$), then :

$$F_{P1}.l_1 = F_{P2}.l_2 \qquad \text{through constant Utility of Cash.} \qquad \textbf{‹08-16›}$$

Note

At the end of this chapter, it should of course be noted that the main relationships (08-04, 08-12) known as "Core Laws" or "Market Laws", namely :

- for $T \rightarrow M$ transformation $F_A \cdot p = r_P \cdot U_P$
- for $M \rightarrow T$ transformation $F_P \cdot l = r_A \cdot U_A$

each have an eminently empirical character. Nevertheless, without being violent, it's possible to formulate them, at least, as a simplifying hypothesis and certainly not a prohibitive one as to the validity of this approach.

09 – ADDITIONAL DEFINITIONS

ABSTRACT: This chapter shows other definitions that will be useful later. They are always similar to the corresponding ones in physics when the transformations take place under certain constant conditions.

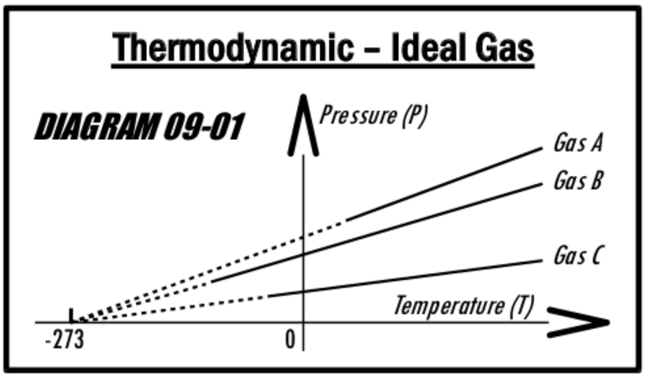
Perfect product

We know the basic relationship (08-04), namely :

$$F_A \cdot p = r_P \cdot U_P = Constant$$

which we considered to be correct, *i.e.* the consistency of these two products was always checked. However, in thermodynamics, we know experimentally that the equivalent relation (Boyle-Mariotte):

$$P \cdot V = r \cdot T = Constant$$



is strictly accurate. Experimental studies have shown that all gases behave in a way that is close to this theoretical relationship when the temperature decreases. Thus, the lower the temperature of any gas, the more the curve (P, V) showing pressure (P) versus volume (V) tends towards a perfect hyperbola. Conversely, for higher and higher temperatures, this curve is more and more distorted.

Furthermore, these experiments indicate that the curves representing the pressure of the different gases as a function of their temperature converge towards a single point (absolute zero), as shown in Figure 09-01.

It would therefore be necessary to consider how the *Force* exerted by the consumer and the *price* (*Added Value*) evolves as a function of *Utility*, *i.e.* the following functions :

$$F_A = \frac{p}{r_P} \cdot U_P = \mathrm{f}(U_P)$$

and :

$$p = \frac{F_A}{r_P} \cdot U_P = \mathrm{f}(U_P)$$

where we consider first the constant *price* and then the constant *Force*.

Previously, among the infinite number of all the existing possibilities of the *Utility* level of a *Product* for all consumers, three types of *Products* have been defined by way of examples, represented on the diagrams 08-01 (08-01a, 08-01b and 08-01c). Since no experiments similar to those performed in physics can be performed in Economics, it appears that only the analysis of phenomena occurring in daily life is likely to answer the above-mentioned questions. In the “exact” sciences there are certain fields of study, in particular astronomy, where it's impossible to performed any kind of experiment. For example, it's out of the question to cause the fusion of two black holes in order to measure the gravitational waves generated by this phenomenon. In spite of this incapacity, this doesn't prevent their detection, as does the detection of the cosmic background due to the decoupling of radiation.

With this reservation and in order to continue this dynamic study, it will be considered that there exists a perfect *Product* which allows us to verify exactly the validity of the constancy of the aforementioned ratio, that is to say that the *Avarice Force* as a function of *price* or *added Value* is geometrically represented by a hyperbola.

Elementary operation

It is obvious and logical that the *Work* required to vary the U_P *Utility* by a certain amount depends on the *Product* manufactured. Some *Products* are indeed more difficult to manufacture than others, and this to vary the *Utility* of the same quantity. If this variation in *Utility* is considered very small, *i.e.* at the limit when it tends towards zero, it's therefore possible to define a new characteristic such as :

$$Difficulty = \underset{\Delta U_P \to 0}{limit} \frac{Work}{\Delta \ Utility \ of \ Product}$$

Identically, for the *Money*, we can say that it's more or less difficult to vary the U_A *Utility* of *Cash*. Consequently, the characteristic will become :

$$Difficulty = \underset{\Delta U_A \to 0}{limit} \frac{Money}{\Delta \ Utility \ of \ Cash}$$

The *Product* Difficulty represents the effort required to perform the operation that causes an increase in *Utility* equal to U_P. By decreasing this variation until it becomes infinitesimally small, this effort will decrease to a lower limit and will therefore become a minimum effort that corresponds to a manufacturing operation that can be described as elementary.

The ideal would be to find an elementary operation that is the same for all the *Works* that can be found by experience, that is to say, in everyday life. If all elementary operations were identical, it would be possible to define *Elementary Difficulty* as the *Specific Difficulty* to each elementary operation. However, this is very rarely the case in everyday practice. However, the smaller the elementary operations are considered, the closer one gets to this case.

The example of the roofer has already been presented, where the elementary operation must be defined as climbing a single rung and not a ladder.

All this isn't new and the following example shows that it's very well understood in everyday life. Peasants in the Middle Ages considered the elementary operation to be the journal (or journau, day, wrought), an area ploughed in one day.

At all times and in all places, therefore, elementary operations had to be defined in such a way as to be able to compare the *work performed*, but it should be noted that these are always defined as small but as large as possible, for the sake of simplification, without however distorting the comparison, *i.e.* the errors generated by the increase in the operation don't make this comparison impossible.

Of course, it's more difficult to mount a pile of tiles on a roof than it's to take a paper to be signed on the top floor of an office building by taking the lift. But the same is true in thermodynamics, where we know that each gas has its own calorific capacity, and in Economics, each *Product* and each *Cash* will have its own Difficulties.

If we consider very small elementary operations, there will be a very large number of them and each of them will vary the *Utility* only very little and it will be possible to write for the Difficulties respectively related to the *Product* and the *Cash*:

$$\boxed{\Phi = \frac{dT}{dU_P}}$$ and : $$\boxed{\Phi = \frac{dM}{dU_A}}$$ **‹09-01› ‹09-02›**

These Difficulties have, *a priori*, no reason to be equal and will therefore have to be differentiated, which will be done in the chapter “Difficulties”.

We know that in order to change the *Utility* of the *Product* and of *Cash*, it's necessary to exert *Force* and this *Force* can only be provided by an agent, by an animal or by a machine (or other). However, regardless of the actor exercising the *Force*, the Difficulties are the same because they are specific to the *Product* and the *Cash* and totally independent of the actor.

In thermodynamics, the basic equation of state can be written, when it applies :

1. to the whole system: $P \cdot V = r \cdot T$
2. to the macroscopic standard unit (mole): $P \cdot V = n \cdot R \cdot T$
3. to the microscopic elementary constituent: $P \cdot V = N \cdot k \cdot T$

because the ratios between the constants are respectively :

$$R = \frac{r}{n}$$

and :

$$k = \frac{r}{N}$$

with :

n = *number of microscopic units*
N = *number of elementary constituents*

There are therefore three levels of comparison. However, the first level can only be used if the systems being compared are equal, which isn't generally the case. In practice, therefore, only the other two levels are used, the second for macroscopic comparisons and the third for microscopic comparisons. However, this is only possible because the number of microscopic constituents included in the macroscopic standard unit's always the same.
Indeed, knowing that :

$$\underbrace{r}_{level\ 1} = \underbrace{n \cdot R}_{level\ 2} = \underbrace{N \cdot k}_{level\ 3}$$

we can write:

$$\frac{R}{k} = \frac{N}{n}$$

Since R and k are constants, this implies:

$$\frac{R}{k} = \frac{N}{n} = Constant = Number\ of\ Avogadro$$

Transformation T→M ⇒ Laziness of coupled systems

Suppose a new entrepreneur of some kind wants to manufacture *Product*s that already exist on the market. The existing *Product*s obviously have a fixed and therefore constant *Utility*. It is possible to wonder how the *Laziness* of the new entrepreneur will evolve so that he can sell his own *Product*s.

By posing the following clues :

$_E$ = New Entrepreneur
$_Z$ = Other Transformers
U_{P0} = *Utility* of already existing products

Knowing that *Laziness* is an additive characteristic, it's possible to write, for a finished transformation :

$$\Delta P_{(E+Z)} = \Delta P_{(E)} + \Delta P_{(Z)}$$

The First Principle makes it possible to write:

$$\Delta E_{TM} = T + M$$

However, for *Products* already existing on the market, the *Money* is null because the *price* of these *Products* is also fixed. Consequently, this relationship is simplified as follows:

$$\Delta E_{TM} = T$$

For a finite transformation, the relation 05-04, namely:

$$dT = -U_P \cdot dP$$

is written as follows:

$$\Delta T = -U_P \cdot \Delta P$$

and replacing:

$$\Delta E_{TM_{(Z)}} = -U_{P0} \cdot \Delta P_{(Z)}$$

Since only the two systems $_E$ and $_Z$ are considered, they can be considered isolated from the outside world. Therefore, the First Principle allows us to write :

$$\Delta E_{TM_{(Z)}} + \Delta E_{TM_{(E)}} = 0$$

or:

$$\Delta E_{TM_{(Z)}} = -\Delta E_{TM_{(E)}}$$

By replacing, the above relationship is written:

$$-U_{P0} \cdot \Delta P_{(Z)} = -\Delta E_{TM_{(E)}}$$

or:

$$\Delta P_{(Z)} = \frac{\Delta E_{TM_{(E)}}}{U_{P0}}$$

Knowing that, according to the Second Principle and in an isolated system, *Laziness* can only increase (or remain constant), the relation becomes :

$$\Delta P_{(E)} + \Delta P_{(Z)} \geq 0$$

Therefore, by replacing :

$$\Delta P_{(E)} + \frac{\Delta E_{TM(E)}}{U_{P0}} \geq 0 \qquad \text{‹09-03›}$$

or :

$$\Delta P_{(E)} \leq \frac{\Delta E_{TM(E)}}{U_{P0}}$$

But we saw that:

$$\Delta E_{TM} = T$$

so, by substituting, it's possible to write:

$$\boxed{\Delta P_{Entrepreneur} \leq \frac{T}{U_{P0}}} \qquad \text{‹09-04›}$$

This relationship shows that *Laziness* must always decrease more than the useful *Work to be done* increases. In fact, the new entrepreneur is obliged to do more *Work* if he wants to sell his *Product* because its *price* must be lower if not equal to that of other manufacturers.

In the case that the losses are nil, it would obviously be possible to write:

$$\Delta P_{(E)} = \frac{T}{U_{P0}}$$

Transformation $M \rightarrow \boldsymbol{T}$ ⇒ *Avarice of coupled systems*

Suppose a new entrepreneur of some kind wants to manufacture *Product*s that already exist on the market. *Cash* in circulation obviously has a fixed and therefore constant *Utility*. It is possible to wonder how the new entrepreneur's *Avarice* will evolve so that he can manufacture his own *Product*s. By posing the following clue:

U_{A0} = *Utility* of *Cash* in circulation

Knowing that *Avarice* is an additive characteristic, it's possible to write, for a finished transformation :

$$\Delta A_{(E+Z)} = \Delta A_{(E)} + \Delta A_{(Z)}$$

The First Principle makes it possible to write:

$$\Delta E_{MT} = M + T$$

However, for the existing *Product*s already on the market, the *Work* is null because the *labour* of these *Product*s is fixed. Consequently, this relationship is simplified as follows:

$$\Delta E_{MT} = M$$

For a finite transformation, the relation 05-07, namely:

$$dM = U_A \cdot dA$$

is written :

$$\Delta M = U_{A0} \cdot \Delta A$$

and replacing:

$$\Delta E_{MT(Z)} = U_{A0} \cdot \Delta A_{(Z)}$$

Since only the two *systems* E and Z are considered, they can be considered isolated from the outside world. Therefore, the First Principle allows us to write:

$$\Delta E_{MT(Z)} + \Delta E_{MT(E)} = 0$$

or:

$$\Delta E_{MT(Z)} = - \Delta E_{MT(E)}$$

By replacing, the above relationship is written:

$$U_{A0} \cdot \Delta A_{(Z)} = - \Delta E_{MT(E)}$$

Knowing that, according to the Second Principle and in an isolated system, *Avarice* can only increase (or remain constant), the relation becomes:

$$\Delta A_{(E)} + \Delta A_{(Z)} \geq 0$$

Therefore, by replacing:

$$\Delta A_{(E)} - \frac{\Delta E_{MT(E)}}{U_{A0}} \geq 0 \qquad \textbf{‹09-05›}$$

or :

$$\Delta A_{(E)} \leq \frac{\Delta E_{MT(E)}}{U_{A0}}$$

But we saw that:

$$\Delta E_{MT} = M$$

so, by substituting, it's possible to write:

$$\boxed{\Delta A_{Entrepreneur} \leq \frac{M}{U_{A0}}} \qquad \text{‹09-06›}$$

In this $M \rightarrow T$ transformation, the entrepreneur doesn't seek to sell more *Product*s but to buy them. This relationship shows that the *Avarice* must always decrease more than the *Money*.

In case the losses would be nil it would obviously be possible to write :

$$\Delta A_{(E)} = \frac{M}{U_{A0}}$$

Transformation T→M ⇒ *Empraxing*

Empraxis of the Greek *en = in* and *praxis = to act*

If there are no losses in a $T \rightarrow M$ transformation (totally reversible transformation), we know that (relation 06-01) the variation of internal Energy is equal to the sum of the *Work to be done* and the *Money realized* that enters (or leaves) the *system*, namely :

$$\Delta E_{TM} = T + M$$

or :

$$T = \Delta E_{TM} - M$$

By definition, we have:

$$\Delta E_{TM} = E_{TM_{(final)}} - E_{TM_{(initial)}}$$

which makes it possible to write:

$$T = E_{TM(f)} - E_{TM(i)} - M$$

But we know that (relation 04-10):

$$dM = F_A \cdot dp$$

So, in a transformation taking place under constant *Avarice Force*, the *Money* will be equal, after integration, to :

$$M = F_A \cdot \left(p_{(f)} - p_{(i)} \right)$$

or again:

$$M = F_A \cdot p_{(f)} - F_A \cdot p_{(i)}$$

Consequently, the *Work to be done* under constant *Avarice Force* becomes:

$$T_{F_A} = E_{TM(f)} - E_{TM(i)} - F_A \cdot p_{(f)} + F_A \cdot p_{(i)}$$

which can be written:

$$T_{F_A} = \left(E_{TM(f)} - F_A \cdot p_{(f)} \right) - \left(E_{TM(i)} - F_A \cdot p_{(i)} \right)$$

If one poses:

$$\boxed{Empraxy = X = E_{TM} - F_A \cdot p} \qquad \text{‹09-07›}$$

the relationship giving *Work to be done* under *constant Avarice Force* becomes :

$$\boxed{T_{F_A} = X_{(f)} - X_{(i)}} \qquad \text{‹09-08›}$$

It was specified at the beginning of the paragraph that this relationship is only valid in the case of a perfectly reversible development. Otherwise, the relationship becomes :

$$X_{(f)} - X_{(i)} > T_{F_A}$$

or again, in a general way:

$$X_{(f)} - X_{(i)} \geq 0 \qquad \text{‹09-09›}$$

The differential of *Empraxia* is :

$$dX = d\left(E_{TM} - F_A \cdot p \right)$$

either:

$$dE_{TM} = - U_P \cdot dP + F_A \cdot dp$$

but (relation 06-02):

$$dX = - U_P \cdot dP + F_A \cdot dp - F_A \cdot dp - p \cdot dF_A$$

so, replacing:

$$dX = - U_P \cdot dP - p \cdot dF_A$$

and after simplification:

$$\boxed{dX = - U_P \cdot dP - p \cdot dF_A} \quad \textbf{‹09-10›}$$

Transformation M→T ⇒ Enomailia

If there are no losses in an $M \rightarrow T$ transformation (totally reversible transformation), we know that (relation 06-03) the variation of *Internal Energy* is equal to the sum of the *Money realized* and the *Work to be done* that enters (or leaves) the system, *i.e.* :

$$\Delta E_{MT} = M + T$$

or :

$$M = \Delta E_{MT} - T$$

And by definition we have:

$$\Delta E_{MT} = E_{MT(f)} - E_{MT(i)}$$

which makes it possible to write:

$$M = E_{MT(f)} - E_{MT(i)} - T$$

But we know that (relation 04-09):

$$dT = - F_P \cdot dl$$

Therefore, in a transformation taking place with constant *Force of Laziness*, the *Work to be done* will be equal, after integration, to :

$$T = - F_P \cdot \left(l_{(f)} - l_{(i)} \right)$$

or again:

$$T = - F_P \cdot l_{(f)} + F_P \cdot l_{(i)}$$

As a consequence, the *Money realized* under constant *Force of Laziness* becomes:

$$M_{F_P} = E_{MT(f)} - E_{MT(i)} + F_P \cdot l_{(f)} - F_P \cdot l_{(i)}$$

which can be written:

$$M_{F_P} = \left(E_{MT(f)} + F_P \cdot l_{(f)} \right) - \left(E_{MT(i)} + F_P \cdot l_{(i)} \right)$$

If one poses:

$$\boxed{Enomailia = L = E_{MT} + F_P \cdot l} \qquad \textbf{‹09-11›}$$

the relationship giving the *Money realised* under constant *Force of Laziness* becomes :

$$\boxed{M_{F_P} = L_{(f)} - L_{(i)}} \qquad \textbf{‹09-12›}$$

It was specified at the beginning of the paragraph that this relationship is only valid in the case of a perfectly reversible development. Otherwise, the relationship becomes :

$$L_{(f)} - L_{(i)} < M_{F_P}$$

or again, in a general way:

$$L_{(f)} - L_{(i)} \leq 0 \qquad \textbf{‹09-13›}$$

The differential of Enomailia is :

$$dL = d\left(E_{MT} + F_P \cdot l \right)$$

either:

$$dL = dE_{MT} + F_P \cdot dl + l \cdot dF_P$$

but (relation 06-04):

$$dE_{MT} = U_A \cdot dA - F_P \cdot dl$$

therefore, accordingly:

$$\boxed{dL = U_A \cdot dA + l \cdot dF_P} \qquad \textbf{‹09-14›}$$

Borderline cases of adiabatic transformations

For each $T \rightarrow M$ and $M \rightarrow T$ transformation, we know that (relations 04-10 and 04-09) :

$dM = F_A \cdot dp$ and : $dT = - F_P \cdot dl$

However, in an adiabatic transformation, the three main variables (*Utilities*, *Forces* and *price* or *labour*) vary simultaneously, which doesn't facilitate the study. To do this, it's possible to study borderline cases, *i.e.* to admit particular cases in which :

- for the transformation $T \rightarrow M$:
  - the *Force of Avarice* is constant,
  - the *price* is constant.

- for the transformation $M \rightarrow T$:
  - the *Force* of Laziness is constant,
  - the *labour* is constant.

Transformation T→M ⇒ Constant avarice Force

We determined the differential of *Empraxia* (relation 09-10), namely :

$$dX = - U_P \cdot dP - p \cdot dF_A$$

Since we admit, in this hypothesis, that the *Avarice Force* is constant, its differential dF_A is null, so the relation can be summed up as :

$$(\partial X)_{F_A} = - U_P \cdot \partial P$$

But we also know that (relation 05-04):

$dT = - U_P \cdot dP$ that is: $(\partial T)_{F_A} = - U_P \cdot \partial P$

so:

$$\boxed{(\partial T)_{F_A} = (\partial X)_{F_A}} \quad \text{‹09-15›}$$

and say that :

- ***In a $T \rightarrow M$ transformation, taking place at constant Force of Avarice, the Work received by the system is equal to the variation of Empraxia.***

Transformation T→M ⇒ Constant price

We have determined the differential of the *Internal Energy* (relation 06-02):

$$dE_{TM} = -\ U_P \cdot dP + F_A \cdot dp$$

Since we assume in this hypothesis that the *price* is constant, its differential dp is null, so the relation can be summed up as :

$$(\partial E_{TM})_p = -\ U_P \cdot \partial P$$

But we also know that (relationship 05-04) :

$dT = -\ U_P \cdot dP$ either: $(\partial T)_p = -\ U_P \cdot \partial P$

so:

$$\boxed{(\partial T)_p = (\partial E_{TM})_p} \qquad \text{‹09-16›}$$

and say that :

- ***In a $T \to M$ transformation, taking place at constant price, the Work received by the system is equal to the variation of internal Energy.***

<u>Transformation M→T</u> ⇒ <u>Force of Laziness constant</u>

We have determined the differential of Enomailia (relationship 09-14), namely :

$$dL = U_A \cdot dA + l \cdot dF_P$$

Since we admit in this hypothesis that the *Force* of Laziness is constant, its differential dF_P is null, so this relation can be summed up as :

$$(\partial L)_{F_P} = U_A \cdot \partial A$$

But we also know that (relation 05-07):

$dM = U_A \cdot dA$ that is: $(\partial M)_{F_P} = U_A \cdot \partial A$

therefore:

$$\boxed{(\partial M)_{F_P} = (\partial L)_{F_P}} \qquad \text{‹09-17›}$$

and say that :

- ***In an transformation $M \to T$, taking place at constant Lazy Force, the Money received by the system is equal to the variation of Enemailie.***

*Transformation M→**T*** ⇒ *Constant labour*

We have determined the internal *Energy differential* (relation 06-04), namely :

$$dE_{MT} = U_A \cdot dA - F_P \cdot dl$$

Since we admit in this hypothesis that the *labour* is constant, its differential *dl* is null, so this relation can be summed up as :

$$(\partial E_{MT})_l = U_A \cdot \partial A$$

But we also know that (relation 05-07):

$dM = U_A \cdot dA$ that is: $(\partial M)_l = U_A \cdot \partial A$

so :

$$\boxed{(\partial M)_l = (\partial E_{MT})_l} \qquad \textbf{‹09-17›}$$

and say that :

- ***In a*** $M \rightarrow T$ ***transformation, taking place at constant labour, the Money received by the system is equal to the variation of Internal Energy.***

10 – DIFFICULTIES

ABSTRACT: In physics, a characteristic of each body involved in a transformation is its heat capacity. Indeed, in this discipline, any mechanical work created only comes from a certain amount of heat destroyed. However, depending on the body, this amount of thermal energy is variable. For example, there is more heat in a litre of water at 20°C than in a litre of alcohol at the same temperature. This means that for the same positive temperature variation of 1°C, more or less heat is needed depending on the body considered.

In economics, it is strictly the same. The economic work necessary to carry out the same variation in Utility will be different for the different Products. It has been mentioned :

- *that a piece of hardened steel is much more difficult to process than the same piece of annealed steel;*
- *that a piece of oak from Quercy is much harder than a piece of pine from the Landes.*

This chapter therefore presents the characteristics of "Difficulty" corresponding to those of calorific capacity according to the conditions in which the different transformations are carried out.

Transformation T→M ⇒ Difficulty at constant price

By definition, *Difficulty* at constant *price* (or *constant value added*) is defined as the ratio between *Work at constant price* and the change in *Utility* obtained by this *Work*, *i.e.* :

$$\Phi_V = \lim_{\Delta U_P \to 0} \frac{T_V}{\Delta U_P}$$

or :

$$\Phi_V = \left(\frac{\partial T}{\partial U_P} \right)_V$$

From the relation (06-01) giving the *Internal Energy*, namely:

$$dE_{TM} = dT + dM$$

and the *price* being constant, there is no creation or destruction of *Money*, therefore :

$$dM = 0$$

Moreover, since we know that (relation 09-16):

$$(\partial E_{TM})_V = (\partial T)_V$$

one can therefore write :

$$\boxed{\Phi_V = \left(\frac{\partial T}{\partial U_P}\right)_V = \left(\frac{\partial E_{TM}}{\partial U_P}\right)_V}$$ **‹10-01›**

Transformation T→M ⇒ *Specific difficulty at constant price*

By dividing the *Constant Price Difficulty* or *Constant Value Added Difficulty* by the number of elementary operations, we obtain the elementary value of this characteristic, *i.e.* the *Specific Difficulty at Constant Price* or the *Specific Difficulty Constant Value Added* :

$$\varphi_V = \frac{\Phi_V}{N}$$

or :

$$\boxed{\phi_V = \frac{1}{N} \cdot \left(\frac{\partial T}{\partial U_P}\right)_V = \frac{1}{N} \cdot \left(\frac{\partial E_{TM}}{\partial U_P}\right)_V}$$ **‹10-02›**

Transformation T→M ⇒ *Difficulty at constant Force*

In the same way as above, it's possible to define the *Constant Avarice Force Difficulty* as being the ratio between the *Work with constant Avarice Force* on the variation of *Utility* obtained by this *Work*, that is to say :

$$\Phi_{F_A} = \lim_{\Delta U_P \to 0} \frac{T_{F_A}}{\Delta U_P}$$

or :

$$\Phi_{F_A} = \left(\frac{\partial T}{\partial U_P}\right)_{F_A}$$

Since the *Avarice Force* is constant, we have seen that, in this case, the *Work to be done* was equal to the variation of *Empraxia*, namely (relation 09-15) :

$$(\partial T)_{F_A} = (\partial X)_{F_A}$$

We can therefore write:

$$\boxed{\Phi_{F_A} = \left(\frac{\partial T}{\partial U_P}\right)_{F_A} = \left(\frac{\partial X}{\partial U_P}\right)_{F_A}}$$ **‹10-03›**

Transformation T→M ⇒ *Specific difficulty at constant Force*

The ratio between the *Difficulty at constant Avarice Force* and the number of elementary operations, gives the elementary value of this characteristic, that is the *Specific Difficulty at constant Avarice Force* :

$$\varphi_{F_A} = \frac{\Phi_{F_A}}{N}$$

or again:

$$\boxed{\phi_{F_A} = \frac{1}{N} \cdot \left(\frac{\partial T}{\partial U_P}\right)_{F_A} = \frac{1}{N} \cdot \left(\frac{\partial X}{\partial U_P}\right)_{F_A}}$$ **‹10-04›**

Transformation T→M ⇒ *Relationship between Difficulties*

We know that *Empraxia* is equal to (relation 09-07) :

$$X = E_{TM} - F_A \cdot p$$

and also that (relation 08-04):

$$F_A \cdot p = r_P \cdot U_P$$

therefore:

$$X = E_{TM} - r_P \cdot U_P$$

which gives by derivation with respect to U_P:

$$\frac{dX}{dU_P} = \frac{dE_{TM}}{dU_P} - r_P$$

but we have just seen above that (relations 10-03 and 10-01):

$$\left(\frac{\partial X}{\partial U_P}\right)_{F_A} = \Phi_{F_A}$$ and : $$\left(\frac{\partial E_{TM}}{\partial U_P}\right)_V = \Phi_V$$

so:

$$\boxed{r_P = \Phi_V - \Phi_{F_A}}$$ **‹10-05›**

This relationship is valid in the transformation $T \to M$, that is, considering the *Work to be done* and the *Money realized*, and shows that the *Difficulty at constant price* Φ_V is greater than that at constant *Avarice Force* F_A, which is quite logical. This implies that the curve representing the adiabatic transformation is less inclined than that representing the isopheles transformation, as we will see in the chapter "Cycles".

We know that (relation 08-04) :

$$F_A \cdot V = r_P \cdot U_P$$

which can be written in the form :

$$\ln F_A + \ln V = r_P \cdot \ln U_P$$

which gives as a derivation:

$$\frac{\partial F_A}{F_A} + \frac{\partial V}{V} = \frac{\partial U_P}{U_P} \qquad \langle 10\text{-}06\rangle$$

In an adiabatic $T \to M$ transformation, the quantity of *Work* exchanged is zero, so the *Internal Energy* is summed up in the relation:

$$dE_{TM} = dM$$

and if we consider this transformation to be quasi-static, *i.e.* the *internal force* F_A (exerted by the supplier) is equal, by reaction, to the *external Force* F_A (exerted by the consumer), we also have (relation 04-10) :

$$\partial M = F_A \cdot \partial V$$

hence :

$$\partial E_{TM} = F_A \cdot \partial V$$

But we have previously determined that (relation 10-01):

$$\Phi_V = \frac{\partial E_{TM}}{\partial U_P}$$

which gives :

$$\partial E_{TM} = \Phi_V \cdot \partial U_P$$

consequently:

$$\Phi_V \cdot \partial U_P = F_A \cdot \partial V$$

which gives:

$$\partial U_P = \frac{F_A \cdot \partial V}{\Phi_V}$$

By transferring this value into the main differential equation 10-06, we get:

$$\frac{\partial F_A}{F_A} + \frac{\partial V}{V} = \frac{1}{U_P} \cdot \frac{F_A \cdot \partial V}{\Phi_V}$$

or again:

$$\frac{\partial F_A}{F_A} + \frac{\partial V}{V} = \frac{F_A}{U_P} \cdot \partial V \cdot \frac{1}{\Phi_V}$$

If we put:

$$\boxed{\gamma_{TM} = \frac{\Phi_{F_A}}{\Phi_V}} \qquad \text{‹10-07›}$$

The 10-05 relationship implies :

$$r_P = \Phi_V - \Phi_{F_A} \quad \Rightarrow \quad \Phi_V > \Phi_{F_A}$$

therefore:

$$\boxed{\gamma_{TM} < 1} \qquad \text{‹10-08›}$$

From this inequality, it emerges that it's more difficult to make transformation evolve at constant *price* (*added value*) than at *constant Force*, which corresponds well to reality. Consequently, the adiabatic curves of the cycle (studied later) are less inclined than the isopheles curves.

Transformation T→M ⇒ *Relationship between variables*

From relationship 10-07, above, it's possible to write :

$$\Phi_{F_A} = \Phi_V \cdot \gamma_{TM}$$

which is reported in the relation 10-05 between *Difficulties*, namely:

$$r_P = \Phi_V - \Phi_{F_A}$$

we find:

$$r_P = \Phi_V - \Phi_V \cdot \gamma_{TM}$$

either:

$$\Phi_V = \frac{r_P}{1 - \gamma_{TM}}$$

which we also report in the main equation:

$$\frac{\partial F_A}{F_A} + \frac{\partial V}{V} = \frac{F_A}{U_P} \cdot \partial V \cdot \frac{1 - \gamma_{TM}}{r_P}$$

From the basic relationship 08-04:

$$F_A \cdot V = r_P \cdot U_P$$

we draw:

$$\frac{F_A}{U_P} = \frac{r_P}{V}$$

which gives:

$$\frac{\partial F_A}{F_A} + \frac{\partial V}{V} = \frac{r_P}{V} \cdot \partial V \cdot \frac{1 - \gamma_{TM}}{r_P}$$

which after simplification gives:

$$\frac{\partial F_A}{F_A} + \gamma_{TM} \cdot \frac{\partial V}{V} = 0$$

The integration of this equation gives:

$$F_A \cdot V^{\gamma_{TM}} = k_{FV} \qquad \text{‹10-09›}$$

We have just found the relationship between the variables F_A and p and the *Difficulties* γ_{TM} ratio. It is possible to determine those existing respectively between the variables V and U_P on the one hand, and F_A and U_P on the other.

During the development, we found the following equations:

$$\frac{\partial F_A}{F_A} + \frac{\partial V}{V} = \frac{\partial U_P}{U_P}$$

and :

$$\frac{\partial F_A}{F_A} + \gamma_{TM} \cdot \frac{\partial V}{V} = 0$$

The first equation gives:

$$\frac{\partial F_A}{F_A} = \frac{\partial U_P}{U_P} - \frac{\partial V}{V}$$

which is carried over into the second:

$$\frac{\partial U_P}{U_P} - \frac{\partial V}{V} + \gamma_{TM} \cdot \frac{\partial V}{V} = 0$$

which gives after simplification:

$$\frac{\partial U_P}{U_P} + \left(\gamma_{TM} - 1\right) \cdot \frac{\partial V}{V} = 0$$

and integration:

$$\boxed{U_P \cdot V^{\gamma_{TM} - 1} = k_{UV}} \qquad \text{‹10-10›}$$

Using the same reasoning, the first equation gives :

$$\frac{\partial V}{V} = \frac{\partial U_P}{U_P} - \frac{\partial F_A}{F_A}$$

which we carry over into the second:

$$\frac{\partial F_A}{F_A} + \gamma_{TM} \cdot \left(\frac{\partial U_P}{U_P} - \frac{\partial F_A}{F_A} \right) = 0$$

which gives after simplification and integration:

$$\boxed{U_P^{\gamma_{TM}} . F_A^{1-\gamma_{TM}} = k_{UF}} \qquad \text{‹10-11›}$$

*Transformation M→**T*** ⇒ *Difficulty with constant labour*

By definition, the *Difficulty at constant Labour* or c*onstant task to add* is defined as the ratio of the *Money at constant labour* to the Variation in *Utility* obtained by this *Money*, *i.e.* :

$$\Phi_B = \lim_{\Delta U_A \to 0} \frac{M_B}{\Delta U_A} \qquad \text{or :} \qquad \Phi_B = \left(\frac{\partial M}{\partial U_A} \right)_B$$

From the 06-03 relationship giving the *Internal Energy*, namely :

$$dE_{MT} = dM + dT$$

and since *labour* is constant, there is no destruction (or creation) of *Work to be done*, therefore :

$$dT \;=0$$

and since we know that (relation 09-18):

$$(\partial E_{MT})_B \;= (\partial M)_B$$

we can therefore write:

$$\boxed{\Phi_B = \left(\frac{\partial M}{\partial U_A}\right)_B = \left(\frac{\partial E_{MT}}{\partial U_A}\right)_B} \qquad \text{‹10-12›}$$

Transformation $M \rightarrow \boldsymbol{T}$ ⇒ Specific difficulties to constant labour

By dividing the *Difficulty at constant labour* by the number of elementary operations, we obtain the elementary value of this characteristic, *i.e.* the *Specific Difficulty at constant labour*:

$$\varphi_B \;= \frac{\Phi_B}{N}$$

or again:

$$\boxed{\varphi_B = \frac{1}{N}\cdot\left(\frac{\partial M}{\partial U_A}\right)_B = \frac{1}{N}\cdot\left(\frac{\partial E_{MT}}{\partial U_A}\right)_B} \qquad \text{‹10-13›}$$

Transformation $M \rightarrow \boldsymbol{T}$ ⇒ Difficulties with constant Force

In the same way as above, it's possible to define the *Difficulty at constant Lazy Force* as the ratio of the *Money at constant Lazy Force* to the change in *Utility* of the *Cash* obtained by this *Money*, *i.e.* :

$$\Phi_{F_P} \;= \underset{\Delta U_A \to 0}{limite} \frac{M_{F_P}}{\Delta U_A}$$

or :

$$\Phi_{F_P} \;= \left(\frac{\partial M}{\partial U_A}\right)_{F_P}$$

The Lazy *Force* being constant, we have seen that, in this case, the *Money realized* was equal to the variation of *Enomailie* (relation 09-17), that is to say :

$$(\partial M)_{F_P} \;= (\partial L)_{F_P}$$

we can therefore write:

$$\boxed{\Phi_{F_P} = \left(\frac{\partial M}{\partial U_A}\right)_{F_P} = \left(\frac{\partial L}{\partial U_A}\right)_{F_P}}$$ ‹10-14›

*Transformation M→**T*** ⇒ *Specific Difficulties with constant Force*

The ratio between the *Difficulty at constant Lazy Force* and the number of elementary operations gives the elementary value of this characteristic, *i.e.* the *Specific Difficulty at Constant Lazy Force*:

$$\varphi_{F_P} = \frac{\Phi_{F_P}}{N}$$

or again:

$$\boxed{\varphi_{F_P} = \frac{1}{N} \cdot \left(\frac{\partial M}{\partial U_A}\right)_{F_P} = \frac{1}{N} \cdot \left(\frac{\partial L}{\partial U_A}\right)_{F_P}}$$ ‹10-15›

*Transformation M→**T*** ⇒ *Relationship Between Difficulties*

We know that *Enomailie* is equal to (relation 09-11) :

$$L = E_{MT} + F_P \cdot B$$

and also that (relation 08-12):

$$F_P \cdot B = r_A \cdot U_A$$

therefore:

$$L = E_{MT} + r_A \cdot U_A$$

which gives by derivation from U_A :

$$\frac{dL}{dU_A} = \frac{dE_{MT}}{dU_A} + r_A$$

but we have just seen above that:

$$\left(\frac{\partial L}{\partial U_A}\right)_{F_P} = \Phi_{F_P}$$ and : $$\left(\frac{\partial E_{MT}}{\partial U_A}\right)_B = \Phi_B$$

therefore:

$$\boxed{r_A = \Phi_{F_P} - \Phi_B} \quad ‹10\text{-}16›$$

This relationship is valid in the $M \to T$ transformation, that is, considering the *Money realized* and the *Work to be done*, and shows that the *Difficulty at constant labour* is smaller than that at *constant Laziness Force*. This implies that the curve representing the adiabatic transformation is more inclined than the curve representing the isopheles transformation, as we will see in the chapter "Cycles".

Making the same type of calculations as in the previous $T \to M$ transformation.

We know that (relation 08-12) :

$$F_P \cdot B = r_A \cdot U_A$$

which can be written in the form :

$$\ln F_P + \ln B = r_A \cdot \ln U_A$$

which gives as a derivative:

$$\frac{\partial F_P}{F_P} + \frac{\partial B}{B} = \frac{\partial U_A}{U_A} \quad ‹10\text{-}17›$$

In an adiabatic $M \to T$ transformation, the variation of the exchanged *Money* is null, therefore the *Internal Energy* is summed up in the relation :

$$dE_{MT} = dT$$

and if we consider this transformation as quasi-static, *i.e.* the *internal Force* F_P (exerted by the supplier) is equal, by reaction, to the *external Force* F_P (exerted by the consumer), we also have (relation 04-09) :

$$\partial T = - F_P \cdot \partial B$$

hence :

$$\partial E_{MT} = - F_P \cdot \partial B$$

But we have previously determined that (relation 10-12):

$$\Phi_B = \frac{\partial E_{MT}}{\partial U_A}$$

which gives :

$$\partial E_{MT} = \Phi_B \cdot \partial U_A$$

consequently:

$$\Phi_B \cdot \partial U_A = - F_P \cdot \partial l$$

which gives:

$$\partial U_A = - \frac{F_P \cdot \partial B}{\Phi_B}$$

By plotting this value in the main differential equation 10-17, we have:

$$\frac{\partial F_P}{F_P} + \frac{\partial B}{B} = - \frac{1}{U_A} \cdot \frac{F_P \cdot \partial B}{\Phi_B}$$

or again:

$$\frac{\partial F_P}{F_P} + \frac{\partial B}{B} = - \frac{F_P}{U_A} \cdot \partial B \cdot \frac{1}{\Phi_B}$$

If we put:

$$\boxed{\gamma_{MT} = \frac{\Phi_{F_P}}{\Phi_B}} \qquad \text{‹10-18›}$$

The 10-16 relationship implies :

$$r_A = \Phi_{F_P} - \Phi_B \qquad \Rightarrow \qquad \Phi_{F_P} > \Phi_B$$

which entails:

$$\boxed{\gamma_{MT} > 1} \qquad \text{‹10-19›}$$

From this inequality, it emerges that it's more difficult to make the transformation evolve at *Constant Force* than at *Constant Labour* (*task to be added*), which corresponds well to reality. Consequently, the adiabatic curves of the cycle (studied later) are more inclined than the isopheles curves.

*Transformation M→**T*** ⇒ *Relationship between variables*

From relationship 10-17, above, it's possible to write :

$$\Phi_{F_P} = \Phi_B \cdot \gamma_{MT}$$

which is reported in the relation (10-16) between the Difficulties, namely :

$$r_A = \Phi_{F_P} - \Phi_B$$

we find:

$$r_A = \Phi_B \cdot \gamma_{MT} - \Phi_B$$

either:

$$\Phi_B = \frac{r_A}{\gamma_{MT} - 1}$$

which we also report in the main equation:

$$\frac{\partial F_P}{F_P} + \frac{\partial B}{B} = - \frac{F_P}{U_A} \cdot \partial B \cdot \frac{\gamma_{MT} - 1}{r_A}$$

In the basic relation (08-12):

$$F_P \cdot B = r_A \cdot U_A$$

one draws:

$$\frac{F_P}{U_A} = \frac{r_A}{B}$$

which is also transferred into the main equation, which gives:

$$\frac{\partial F_P}{F_P} + \frac{\partial B}{B} = - \frac{r_A}{B} \cdot \partial B \cdot \frac{\gamma_{MT} - 1}{r_A}$$

which after simplification gives:

$$\frac{\partial F_P}{F_P} + \gamma_{MT} \cdot \frac{\partial B}{B} = 0$$

By integrating this equation, we find:

$$\boxed{F_P \cdot B^{\gamma_{MT}} = k_{FB}}$$ **‹10-20›**

We have just found the relationship between the variables F_P and B and the ratio of γ_{MT} *Difficulties*. It is possible to determine those existing respectively between the variables B and U_A on the one hand, and F_P and U_A on the other hand.

During the development, we found the following equations:

$$\frac{\partial F_P}{F_P} + \frac{\partial B}{B} = \frac{\partial U_A}{U_A}$$

and :

$$\frac{\partial F_P}{F_P} + \gamma_{MT} \cdot \frac{\partial B}{B} = 0$$

The first equation gives :

$$\frac{\partial F_P}{F_P} = \frac{\partial U_A}{U_A} - \frac{\partial B}{B}$$

which is carried over into the second one:

$$\frac{\partial U_A}{U_A} - \frac{\partial B}{B} + \gamma_{MT} \cdot \frac{\partial B}{B} = 0$$

which gives after simplification and integration:

$$\boxed{U_A \cdot B^{\gamma_{MT} - 1} = k_{UB}}$$ **‹10-21›**

Using the same reasoning, the first equation gives :

$$\frac{\partial B}{B} = \frac{\partial U_A}{U_A} - \frac{\partial F_P}{F_P}$$

which we carry over into the second:

$$\frac{\partial F_P}{F_P} + \gamma_{MT} \cdot \left(\frac{\partial U_A}{U_A} - \frac{\partial F_P}{F_P} \right) = 0$$

which gives after simplification and integration:

$$\boxed{U_A^{\gamma_{MT}} . F_P^{1-\gamma_{MT}} = k_{UF}}$$ **‹10-22›**

11 - STRUCTURE OF EXCHANGES

ABSTRACT: This chapter analyses the phenomena that occur during the contacts between the two actors (supplier and consumer) in an economic exchange in order to understand them. It also explains how the Utility of the Product and the Utility of the Cash evolve during the manufacturing and trading process. Furthermore, as with any system, since transformations are never total or perfect and the future cannot be foreseen with certainty, it is also necessary to understand how the characteristics of Work and Money can be discerned between their useful and lost parts.

General

Both in Economy of barter and in Economy of change or Economy of money (classical), it's imperative that, in an absolutely general way, the *Utility* of the received thing is higher than that of the given thing. This is explained in each case in the table below:

TYPES OF ECONOMY	UTILITIES	VALIDITY
Economy of barter	U_P **received** $>$ U_P **sold**	**for the 2 agents**
Economy of change	U_A **received** $>$ U_A **sold**	**for the 2 agents**
Economy of money	U_P **received** $>$ U_A **sold**	**for the consumer**
Economy of money	U_A **received** $>$ U_P **sold**	**for the supplier**

Indeed, when any agent finds that a *Product* is too expensive it simply means that the *Utility* of the *Product* for that agent is less than the *Utility* of the *Cash* he possesses, which implies that the exchange doesn't take place because the agent then prefers to keep the *Cash* through him rather than to possess the *Product*. Identically when he acquires the *Product*, this implies that the *Utility* of the *Cash* is then lower than that of the *Product* because otherwise he would prefer to keep the *Cash* and not purchase the *Product* (previous hypothesis). This can be summarised as follows:

- if the consumer prefers the Cash to the *Product*, he will not buy it and *vice versa*,
- if the supplier prefers the *Product* to *Cash*, he will not sell it and *vice versa.*

Evolution of Utilities

Consequently, it's possible to analyse the exchanges as follows:

1. ***during the Seller-Transformer tractation :***

- the Seller wishes to part with the *Product* and receive *Cash*, from which it's deduced that he prefers *Cash* to the *Product.* Therefore, for the Seller, the *Utility* of the *Cash* must be greater than the *Utility* of the *Product*,
- the Transformer wishes to part with the *Cash* and receive the *Product*, from which it's inferred that he prefers the *Product* to the *Cash.* Therefore, for the Transformer, the *Utility* of the *Product* must be greater than the *Utility* of the *Cash.*

2. ***<u>during the Acquirer-Transformer negotiation:</u>***
   - the Transformer wishes to part with the *Product* and receive *Cash*, from which it can be deduced that he prefers *Cash* to the *Product.* Therefore, for the Transformer, the *Utility* of the *Cash* must be greater than the *Utility* of the *Product*,
   - the Acquirer wishes to part with the *Cash* and receive the *Product*, from which it's inferred that he prefers the *Product* to the *Cash.* Therefore, for the Acquirer the *Utility* of the *Product* must be greater than the *Utility* of the *Cash.* We note that in this negotiation, the Transformer is assimilated to the Seller in the first negotiation and that the Buyer plays the role of the Transformer.

It emerges from this analysis that it's possible to posit (by Principle) that :

1. ***<u>during the Seller-Transformer transaction:</u>***
   - the *Utility* of the C*ash* for the Seller is equal to the *Utility* of the *Product* for the Transformer. These *Utilities* have a high value;
   - the *Utility* of the *Product* for the Seller is equal to the *Utility* of the Cash for the Transformer. These *Utilities* have a low value,

2. ***<u>during the Acquirer-Processor negotiation:</u>***
   - the *Utility* of the *Cash* for the Transformer is equal to the *Utility* of the *Product* for the Buyer. These *Utilities* have a high value,
   - the *Utility* of the *Product* for the Transformer is equal to the *Utility* of the *Cash* for the Acquirer. These *Utilities* have a low value.

Moreover, it should be noted that :

1. during the manufacture (or use) of the *Product*, the *Product* is modified while the *Cash* isn't,
2. during the negotiation between a supplier and a consumer, the *Cash* is modified while the *Product* isn't.

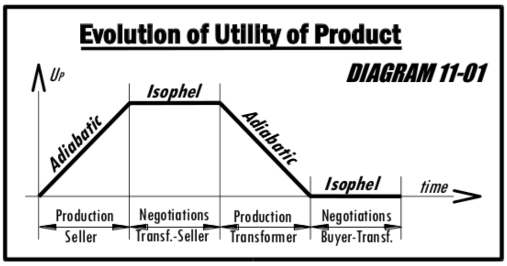
As a result :

1. when the *Utility* of the *Product* varies, the *Utility* of the *Cash* remains constant, *i.e.* :
   - the transformation of the *Product* is adiabatic,
   - the transformation of *Cash* is isopheles,

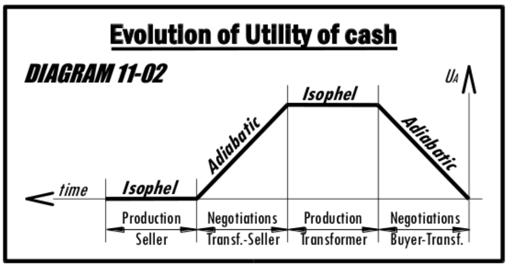
2. when the *Utility* of the *Cash* varies, the *Utility* of the *Product* remains constant, *i.e.* :
   - the transformation of *Cash* is adiabatic,

◦ the transformation of the *Product* is isopheles.

From all of this it's possible to derive diagrams 11-01 and 11-02 listing, for the Transformer, the respective variations of the *Utility of the Product* and the *Utility of the Cash.*



In fact, for the Transformer, the *Utility* of the *Product* increases during manufacture by the Seller and remains stable during the negotiation with the latter. Then, it decreases during the manufacture by itself (*i.e.* its use) and remains constant during the negotiation with the Acquirer (Figure 11-01).



In the same way, also for the Transformer, the *Utility of the Cash* increases during the negotiation with the Acquirer and remains constant during the manufacture of the *Product.* Afterwards, it decreases during the negotiation with the Seller and remains stable during manufacture by the Seller (figure 11-02).

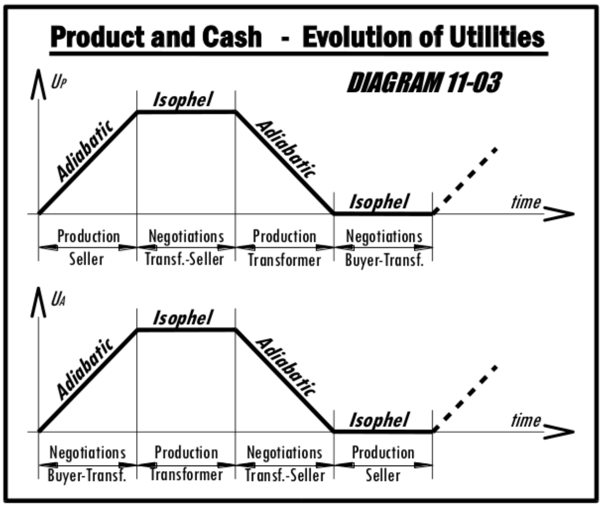
Given that *Cash* flows in the opposite direction to the *Product*, the axis of the abscissae representing time in diagram 11-02 is inverted in relation to that of diagram 11-01, which is perfectly logical.

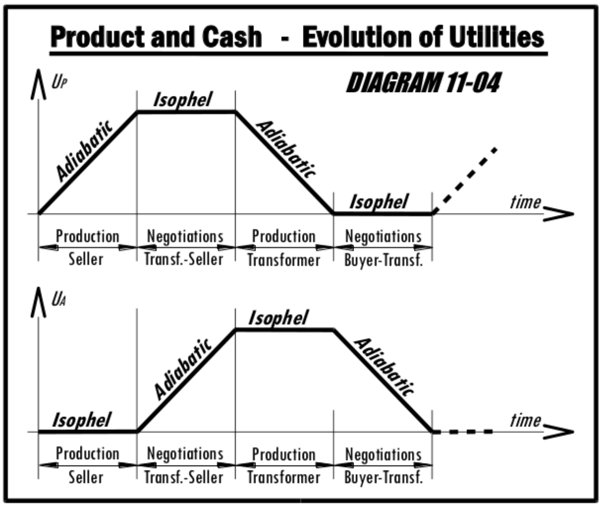
Diagram 11-03 summarises the two previous diagrams after reversing the time axis of diagram 11-02. It is obvious that the different steps no longer correspond between the two diagrams. Diagram 11-04 is identical to diagram 11-03 after matching the different sequences.

The fact that one of the two *Utilities* (of the *Product* or of the *Cash*) varies while the other (of the *Cash* or of the *Product*) remains constant necessarily imposes that, in the two cycles (diagrams 11-01 and 11-02) formed by the four transformations, the slope of the adiabatic curves in one cycle is lower than that of the isopheles curves and *vice versa* in the other cycle.

However, analytical calculations show that this is indeed the case:

- transformation *Work* → *Money* $\Rightarrow \dfrac{\textit{slop adiabatic}}{\textit{slop isophel}} < 1$ (contrary to physics),
- transformation *Money* → *Work* $\Rightarrow \dfrac{\textit{slop adiabatic}}{\textit{slop isophel}} > 1$ (similar to physics).





which corroborates the fact that these two transformations are not the return of each other. Moreover, knowing that the *Product* moves in the opposite direction to that of *Cash*, the direction of circulation of the cycle of *Work* is necessarily opposite to that of *Money.*

We know that in physics, mathematical analysis gives results that are in line with the reality of Nature and there is no reason why this should not be the case in the case we are concerned about. In fact, in the present case, we have determined that the slopes of the adiabatic curves are lower than those of the isopheles curves in the transformation *Work→Money* and higher in the other transformation. Now, the calculations give results that are very much in line with the reality of the phenomena. Consequently, these results incite us to reject the doubt about this mechanistic approach to economic exchanges, but on the contrary, if not to consider it totally correct, at least to admit that there is something true and to judge it, until proven otherwise, convincing.

Useful and Lost Work – *Useful and Lost Money*

In thermodynamics, everyone knows that it's not possible to know exactly how much heat is needed to do a certain job. In fact, if a motorist is asked to make a certain journey, he or she will fill the vehicle's tank based on the average consumption of the vehicle, but will take the precaution of providing extra fuel so as not to run out of fuel, as he or she cannot predict how the journey will go. As a corollary, if the amount of heat available is fixed *a priori*, it becomes impossible to calculate the work likely to be provided by it because the losses (never zero) cannot be known exactly. Consequently, in everyday life, any individual can never answer exactly the following two questions:

1. In order to obtain a certain amount of energy in the form of work, how much energy must be expended in the form of heat?
2. In order to possess a certain amount of energy in the form of heat, how much energy can be obtained in the form of work?

It is impossible to apprehend the future quantitatively, only the direction of evolution (*i.e.* the sign) can be known. What has just been said for thermodynamics applies rigorously in the same way in the economic field that interests us here.

In the transformation of *Work→Money*, it's impossible to know exactly what is happening:

1. the total quantity of *Work* which must be supplied to obtain a fixed quantity of *Money*. In fact, according to the Principle of Equivalence and the First Principle, we have :

$$dM_{created} = dT_{useful}$$

but, in this transformation, there are always losses of *Work*, therefore:

$$dM_{created} < \delta T_{total}$$

with :

$$\boxed{\delta T_{total} = \delta T_{lost} + dT_{useful}} \quad \text{‹11-01›}$$

2. the quantity of *Money* that can be obtained with a fixed total quantity of *Work*. In fact, according to the Principle of Equivalence and the First Principle, we have :

$$\delta M_{created} = \delta T_{useful}$$

but, in this transformation, there are always losses of Work, therefore:

$$\delta M_{created} < dT_{total}$$

with :

$$\boxed{dT_{total} = \delta T_{lost} + \delta T_{useful}} \quad \text{‹11-02›}$$

In conclusion, in the transformation *Work→Money* :

- ***if one knows the useful Work, it's not possible to know the total Work,***
- ***if one knows the total Work, it's not possible to know the useful Work.***

Identically, in the transformation *Money→Work*, it is impossible to know exactly :

- the total quantity of *Money* that must be supplied to obtain a fixed quantity of *Work*. In fact, according to the Principle of Equivalence and the First Principle, we have :

$$dT_{created} = dM_{useful}$$

but, in this transformation, there are always losses of *Money*, therefore:

$$dT_{created} < \delta M_{total}$$

with :

$$\boxed{\delta M_{total} = \delta M_{lost} + dM_{useful}} \qquad \text{‹11-03›}$$

- the amount of *Work* that can be obtained with a fixed total quantity of *Money*. In fact, according to the Principle of Equivalence and the First Principle, we have :

$$\delta T_{created} = \delta M_{useful}$$

but, in this transformation, there are always losses of *Money*, therefore:

$$\delta T_{created} < dM_{total}$$

with :

$$\boxed{dM_{total} = \delta M_{lost} + \delta M_{useful}} \qquad \text{‹11-04›}$$

In conclusion, in the transformation from *Money→Work* :

- ***if we know the useful Money, it's not possible to know the total Money,***
- ***if the total Money is known, it's not possible to know the useful Money.***

This is because the loss of *Work* and *Money*, never zero, can never be known precisely but only statistically.

In the transformation *Work→Money*, we know that *Work* is spent in order to produce *Money*. According to the First Principle, this amount of *Work* is always the same for the same amount of *Money created*. However, there are always constraints outside the will of the Transformer that limit his *Laziness*.

If the chef of a restaurant wishes to make mashed potatoes, it will be necessary for him to provide a larger quantity of vegetables than just enough for the making of the dish because he knows very well that the peelings and perhaps some tubers of doubtful quality will be discarded. If the cost of the mash is $1.50, the absence of external constraints would have allowed the cook to produce it for $1.33, for example. This is well understood by everyone.

Therefore, the *Work* spent is always higher than the theoretical *Work* and is therefore composed of two parts :

1. a constant part, regardless of the way in which one proceeds to produce the work and whose value corresponds to the minimum theoretical *Work* necessary and just sufficient for this production,

2. a part which is a function of the method used and whose value corresponds to the extra *Work* spent to overcome external constraints.

In addition to never being zero, external constraints are never perfectly measurable. The cook will spend more or less *Work* depending on the arrangement of the different utensils, their weight, capacity, morphological characteristics, the quality of the tool used for peeling, the configuration of the room, the distance from the kitchen to the customer's table, the number of customers who may force him to meander between the tables, *etc.* It is therefore impossible to know precisely these constraints and how they evolve throughout the production of the mash and its service. However, in order to determine the *price* of this dish, the cook can only estimate these constraints and for this he will rely on his experience. The external constraints can therefore only be determined (approximated) statistically and as *Laziness* is a function of these, it's itself a statistical form. This therefore boils down to an information deficit.

If an agent wishes to open a supermarket, he will not ask for authorisation to open in an almost deserted place, inaccessible or far from the clientele, which is logical, but why? Because he is trying to reduce the external constraints of the shoppers in order to minimise losses. The agent will try to get as close as possible to areas with a high population density and the largest possible catchment area. However, as the latter is vast, he will create a car park so that the customer isn't constrained by parking. Supermarket managers often set up a free shuttle service to comb the customer base to the great displeasure of small local shopkeepers in town centres, in order to reduce the constraint on those people who don’t have means of locomotion. Depending on how far away the potential customers are, the constraint on travel will be different and will depend on the customer. The “average” constraint can obviously only be estimated statistically. It is possible to list endless examples of this type.

From this, in the transformation *Work→Money*, it comes that :

- if we spend W_{spent} of *Work*, we create $M_{created}$ of *Money* and if we spend M_{spent} *Money*, we create $W_{created}$ of *Work*, with :

$$\boxed{T_{spent} > M_{created} = M_{spent} > T_{created}} \quad \text{‹11-05›}$$

From this relationship we can see that the *Work* spent is superior to the *Work* created. This isn't an impossibility, because it's always possible to execute a Work that is superior to another.

Reciprocally, in the transformation *Money→Work* :

- if one spends M_{spent} of *Money*, one creates $T_{created}$ of Work and if one spends T_{spent} of Work, one creates $M_{created}$ of *Money*, with :

$$\boxed{M_{spent} > T_{created} = T_{spent} > M_{created}} \quad \text{‹11-06›}$$

We see in this latter relationship that the *Money* spent is greater than the *Money* created, which is strictly impossible. The equality between these two *Money* will thus only be acquired :

1. either by devaluation, which causes an economic distortion,
2. or by a *Work* spent in excess of the *Work* created. For this reason, more *Work* is needed to pay the interest.

As stated in the chapter “Value of the monetary unit”, the second hypothesis (possibilities 3 and 4) is therefore the only economically valid method. Consequently, it can be said that :

- **the *Work done* is always greater than the *Work to be done*, the supplement is a function of external constraints,**
- **the *Work done* is always greater than the *minimum necessary Work* and sufficient to obtain the *Money.***

This is another expression of the Second Principle, which states that there is never a maximum *yield.*

12 – CYCLES

ABSTRACT: This chapter refers to the values of :

- *Work destroyed and Money created for the T→M transformation;*
- *of Money destroyed and Work created for the M→T transformation;*

and this for each condition under which each of these transformations takes place, namely: isopheles, adiabatic, isoaxis, isoergue, isobaric.

It also presents the corresponding diagrams in economics to those of Carnot and Clapeyron, which makes it possible to visualize what is destroyed (Work or Money) and what is created (Money or Work) according to the two types of transformations.

Transformation T→M ⇒ Isopheles Work

We know the general 05-04 relationship, namely :

$$dT = - U_P \cdot dP$$

During an isophele transformation, the *Utility* of the *Product* remains, by definition constant, so we can write :

$$T = - U_P \cdot \int_{P_{(i)}}^{P_{(f)}} dP$$

or:

$$\boxed{T = - U_P \cdot \left(P_{(f)} - P_{(i)} \right)} \qquad \textbf{‹12-01›}$$

Transformation T→M ⇒ Adiabatic Work

Always starting from the same 05-04 relationship as above, namely :

$$dT = - U_P \cdot dP$$

we know that, during an adiabatic transformation, *Utility* increases or decreases according to the direction of this transformation, but also that the variation of *Laziness* is null because, by definition, no *Work* is exchanged between the *system* and the outside, therefore :

$$\boxed{T = 0} \qquad \textbf{‹12-02›}$$

Transformation T→M ⇒ Isopheles Money

We know the 04-10 relationship, namely :

$$dM = F_A \cdot dp$$

and we know that (relationship 08-04):

$$F_A \cdot p = r_P \cdot U_P$$

By replacing the *Force* in the first relationship with its value above, it comes:

$$dM = r_P \cdot \frac{U_P}{p} \cdot dp$$

or again:

$$dM = r_P \cdot U_P \cdot \frac{dp}{p}$$

The integration of this equation will give the *Money M*. The bounds will be defined respectively by the initial and final *price*s. Knowing that the *Utility* of the *Product* is by definition constant during an isopheles transformation, it's possible to write :

$$M = r_P \cdot U_P \cdot \int_{p_{(i)}}^{p_{(f)}} \frac{dp}{p}$$

either :

$$M = r_P \cdot U_P \cdot \left(ln\ p_{(f)} - ln\ p_{(i)} \right)$$

or :

$$\boxed{M = r_P \cdot U_P \cdot ln \frac{p_{(f)}}{p_{(i)}}} \qquad \textbf{‹12-03›}$$

Transformation T→M ⇒ Adiabatic Money

During an adiabatic transformation there is, by definition, no transfer of *Work* or *Money* between the Transformer and the Buyer or Seller. During this transformation, the *Utility* of the *Product* varies from $U_{initial}$ to U_{final}.

Moreover, as already mentioned, if the evolution of this transformation is relatively slow, that is to say, in small quantities, it can be considered as quasi-static. Consequently, the relation 04-10 :

$$dM = F_A \cdot dp$$

will always be valid.

If we multiply and divide by p to the power γ_{TM}, we obtain :

$$dM = F_A \cdot p^{\gamma_{TM}} \cdot \frac{dp}{p^{\gamma_{TM}}}$$

and as we have seen (relation 10-09):

$$F_A \cdot p^{\gamma_{TM}} = k_{Fp} = Constant$$

we can write:

$$M = F_A \cdot p^{\gamma_{TM}} \cdot \int_{p(i)}^{p(f)} \frac{dp}{p^{\gamma_{TM}}}$$

or again:

$$M = F_A \cdot p^{\gamma_{TM}} \cdot \int_{p(i)}^{p(f)} p^{-\gamma_{TM}} \cdot dp$$

or:

$$M = F_A \cdot p^{\gamma_{TM}} \cdot \left(\frac{1}{-\gamma_{TM} + 1} \cdot p_{(f)}^{-\gamma_{TM}+1} - \frac{1}{-\gamma_{TM} + 1} \cdot p_{(i)}^{-\gamma_{TM}+1} \right)$$

But we have already said that (relationship 10-09) :

$$F_A \cdot p^{\gamma_{TM}} = Constant$$

So, at the beginning of the transformation, p will be equal to $p_{(i)}$ and F_A will be $F_{A(i)}$. In the same way, at the end of the transformation, p will become equal to $p_{(f)}$ and F_A to $F_{A(f)}$.

This gives :

$$M = \frac{F_{A(f)} \cdot p_{(f)} - F_{A(i)} \cdot p_{(i)}}{-\gamma_{TM} + 1}$$

but, according to the relation 08-04, namely :

$$F_A \cdot p = r_P \cdot U_P$$

we can write:

$$F_{A(i)} \cdot p_{(i)} = r_P \cdot U_{P(i)}$$ and : $$F_{A(f)} \cdot p_{(f)} = r_P \cdot U_{P(f)}$$

so:

$$M = \frac{r_P \cdot U_{P(f)} - r_P \cdot U_{P(i)}}{- \gamma_{TM} + 1}$$

or:

$$\boxed{M = \frac{r_P}{1 - \gamma_{TM}} \cdot \left(U_{P_{(f)}} - U_{P_{(i)}} \right)} \qquad \text{‹12-04›}$$

If the *Final Utility* is equal to the *Initial Utility*, there is no creation (or destruction) of *Money*. This is the case of an intermediary who increases the *price* of a *Product* without increasing its *Utility*. The *Cash* that the consumer gives to this intermediary and which corresponds to this increase is only transferred.

Transformation T→M ⇒ Isoaxial Money

Always starting from the 04-10 relationship, namely :

$$dM = F_A \cdot dp$$

we know that in an isoaxial transformation the *price* is, by definition constant, so it's possible to write:

$$dp = 0 \qquad \Rightarrow \qquad dM = 0$$

and consequently:

$$\boxed{M = 0} \qquad \text{‹12-05›}$$

Leaving aside the constant, that is to say that in this type of transformation, there is no creation of *Money realized.*

Transformation T→M ⇒ Isobaric Money

We always ask the relation 04-10, namely :

$$dM = F_A \cdot dp$$

Now, by definition, this transformation is performed under a *constant Force of Avarice*, so it's possible to sum up and write:

$$M = F_A \cdot \int_{p_{(i)}}^{p_{(f)}} dp$$

which gives by integration:

$$\boxed{M = F_A . (p_{(f)} - p_{(i)})}$$ **‹12-06›**

Transformation M→T ⇒ Isopheles Money

We know the general relationship 05-07 :

$$dM = U \cdot dA$$

During an isopheles transformation, the *Utility* of *Money* remains, by definition constant, so we can write:

$$M = U_A \cdot \int_{A_{(i)}}^{A_{(f)}} dA$$

or :

$$\boxed{M = U_A \cdot \left(A_{(f)} - A_{(i)} \right)}$$ **‹12-07›**

Transformation M→T ⇒ Adiabatic Money

Always starting from the same 05-07 relationship as above :

$$dM = U_A \cdot dA$$

we know that, during an adiabatic transformation, *Utility* increases or decreases according to the direction of this transformation, but also that the variation of *Avarice* is null because, by definition, no *Money* is exchanged between the *system* and the outside, therefore :

$$\boxed{M = 0}$$ **‹12-08›**

Transformation M→T ⇒ Isopheles Work

We know the relationship 04-09 :

$$dT = - F_P \cdot dl$$

and we know that (relationship 08-12):

$$F_P \cdot l = r_A \cdot U_A$$

By replacing the *Force* in the first relationship with its value above, it comes:

$$dT = - r_A \cdot \frac{U_A}{l} \cdot dl$$

or again:

$$dT = - r_A \cdot U_A \cdot \frac{dl}{l}$$

The integration of this equation will give the *Work T*. The bounds will be defined respectively by the initial and final labours. Knowing that the *Utility* of *Cash* is by definition constant during an isopheles transformation, it's therefore possible to write :

$$T = - r_A \cdot U_A \cdot \int_{l_{(i)}}^{l_{(f)}} \frac{dl}{l}$$

either :

$$T = - r_A \cdot U_A \cdot \left(\ln l_{(f)} - \ln l_{(i)}\right)$$

or :

$$\boxed{T = - r_A \cdot U_A \cdot ln \frac{l_{(f)}}{l_{(i)}}} \qquad \text{‹12-09›}$$

Transformation M→T ⇒ Adiabatic Work

During an adiabatic transformation there is, by definition, no transfer, neither of *Work* nor of *Money*, between the Transformer and the Buyer or Seller. During this transformation, the *Utility* of *Cash* varies from $U_{initial}$ to U_{final}. Furthermore, as has already been said, if the evolution of this transformation takes place relatively slowly, that is to say, in small quantities, it can be considered quasi-static. Consequently, the relation 04-09, namely :

$$dT = - F_P \cdot dl$$

will always be valid.
If we multiply and divide by l to the γ_{MT} power, we obtain :

$$dT = - F_P \cdot l^{\gamma_{MT}} \cdot \frac{dl}{l^{\gamma_{MT}}}$$

and as we have seen (relation 10-20):

$$F_P \cdot l^{\gamma_{MT}} = k_{Fl} = Cte$$

one can write :

$$T = - F_P \cdot l^{\gamma_{MT}} \cdot \int_{l_{(i)}}^{l_{(f)}} \frac{dl}{l^{\gamma_{MT}}}$$

or else:

$$T = - F_P \cdot l^{\gamma_{MT}} \cdot \int_{l_{(i)}}^{l_{(f)}} l^{-\gamma_{MT}} \cdot dl$$

or:

$$T = - F_P \cdot l^{\gamma_{MT}} \cdot \left(\frac{1}{-\gamma_{MT} + 1} \cdot l_{(f)}^{-\gamma_{MT}+1} - \frac{1}{-\gamma_{MT} + 1} \cdot l_{(i)}^{-\gamma_{MT}+1} \right)$$

But we've already said that (10-20 relationship):

$$F_P \cdot l^{\gamma_{MT}} = Constant$$

So, at the beginning of the transformation, l will be equal to $l_{(i)}$ and F_P will be $F_{P(i)}$. In the same way, at the end of the transformation, l will become equal to $l_{(f)}$ and F_P to $F_{P(f)}$, which gives :

$$T = - \frac{F_{P(f)} \cdot l_{(f)} - F_{P(i)} \cdot l_{(i)}}{-\gamma_{MT} + 1}$$

but, according to the relation 08-12, namely :

$$F_P \cdot l = r_A \cdot U_A$$

we can write:

$$F_{P(i)} \cdot l_{(i)} = r_A \cdot U_{A(i)} \qquad \text{and :} \qquad F_{P(f)} \cdot l_{(f)} = r_A \cdot U_{A(f)}$$

thus:

$$T = - \frac{r_A \cdot U_{A(f)} - r_A \cdot U_{A(i)}}{- \gamma_{MT} + 1}$$

or again:

$$\boxed{T = \frac{r_A}{\gamma_{MT} - 1} \cdot \left(U_{A_{(f)}} - U_{A_{(i)}} \right)} \qquad \textbf{‹12-10›}$$

Transformation M→T ⇒ Isoergue Work

Always starting from the 04-09 relationship, namely :

$$dT = - F_P \cdot dl$$

we know that in an isoergue transformation the *labour* is, by definition constant, so it's possible to write :

$$dl = 0$$

hence:

$$dT = 0$$

and consequently:

$$\boxed{T = 0} \qquad \textbf{‹12-11›}$$

Leaving aside the constant, *i.e.* that in this transformation there is no creation of *Work to be done* and therefore no influence on *employment*.

Transformation M→T ⇒ Isobaric Work

We always ask the relation 04-09, namely :

$$dT = - F_P \cdot dl$$

Now, by definition, this transformation is performed under *Force of Constant Laziness*, it's therefore possible to sum up and write :

$$T = -\ F_P \cdot \int_{l_{(i)}}^{l_{(f)}} dl$$

which gives by integration:

$$\boxed{T = -\ F_P \cdot \left(l_{(f)} - l_{(i)} \right)} \qquad ‹12\text{-}12›$$

Cycle Work→Money ⇒ Destruction of Work

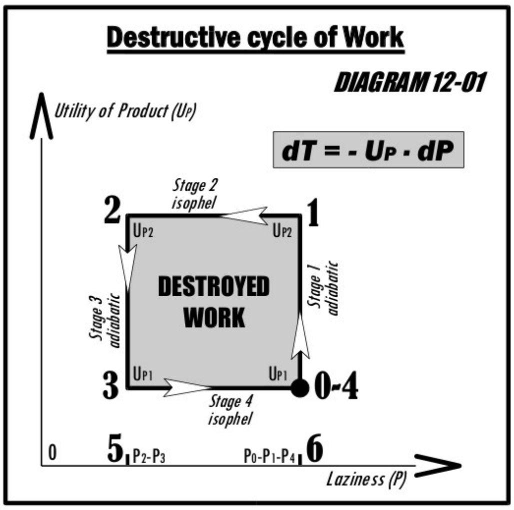
Since “Ex nihilo nihil”, in order to create *Money* it's obligatory to destroy *Work*. Therefore, it's possible to express that the destruction of *Work* causes the creation of *Money*. This cycle is represented in figure 12-01 and rotates in the normal (positive) direction. The four stages of this cycle are defined as follows:

1. ***Step 1* ⇒ *Manufacturing by the Seller***
    - During this step, the *Product* is modified. The transformation is therefore adiabatic.
    - For the Transformer, the *Utility* of the *Product* increases from U_{P1} to U_{P2}.
    - The Transformer and the Seller are not in contact (the Transformer is isolated from the Seller). Therefore, there is no transfer of *Work*. *Laziness* doesn't vary and remains equal to P_0.
    - From the relation 12-02 giving the value of this transformation, we draw :

    $$T_1 = 0$$

    - Since $P_1 = P_0$, it emerges that $T_1 = 0$. The *Work* which is executed by the Seller is destroyed since this *Work to be done* which he received from the previous manufacturer is converted into *Work done* which is no longer transferred to the Transformer.

2. ***Step 2* ⇒ *Seller-Transformer Tractation***
    - During this step, the *Product* isn't modified. The transformation is therefore isopheles.
    - For the Transformer, the *Utility* of the *Product* doesn't vary and remains equal to U_{P2}.
    - The Transformer and the Seller are in contact (the Transformer is no longer isolated from the Seller). There is therefore a transfer of *Work*. *Laziness* decreases from P_1 to P_2, since the Transformer receives *Work to be done* from the Seller and the *Utility* of this *Work* is high.



    - From the relation 12-01 giving the value of this transformation, we derive :

$$T_2 = - U_{P2} \cdot (P_2 - P_1)$$

- Since $P_2 < P_1$, it emerges that $T_2 > 0$. *Work to be done* enters the *system*, which means that it's transferred from the Seller to the Transformer who must continue manufacturing the *Product*.

3. ***Step 3*** ⇒ ***Manufacturing by the Transformer***
   - During this step, the *Product* is modified. The transformation is therefore adiabatic.
   - For the Transformer, the *Utility* of the *Product* decreases from U_{P2} to U_{P1}.
   - The Transformer and the Acquirer are not in contact (the Transformer is isolated from the Acquirer). Therefore there is no transfer of *Work*. *Laziness* doesn't vary and remains equal to P_2.
   - From the relation 12-02 giving the value of this transformation, we draw :

$$T_3 = 0$$

   - Since $P_3 = P_2$, it emerges that $T_3 = 0$. The *Work* that is done by the Transformer is destroyed since this *Work to be done* that it has received from the Seller is converted into *Work done* that is no longer transferred to the Buyer.

4. ***Step 4*** ⇒ ***Transformer-Buyer Tractation***
   - During this step, the *Product* isn't modified. The transformation is therefore isopheles.
   - For the Transformer, the *Utility* of the *Product* doesn't vary and remains equal to U_{P1}.
   - The Transformer and the Acquirer are in contact (the Transformer is no longer isolated from the Acquirer). There is therefore a transfer of *Work*. *Laziness* increases from P_3 to P_4, since the Transformer gives *Work to be done* to the Buyer and the *Utility* of this *Work* is high.
   - From the relation 12-01 giving the value of this transformation, we draw :

$$T_4 = - U_{P1} \cdot (P_4 - P_3)$$

   - Since $P_4 < P_3$, it emerges that $T_4 < 0$. *Work to be done* leaves the *system*, which means that it's transferred from the Transformer to the Buyer who must continue with the manufacture of the *Product*.

The area of the rectangle 1-2-5-6 represents the *Work to be done* which is transferred from the Seller to the Transformer. The area of rectangle 0-3-5-6 represents the *Work to be done* which is given to the Buyer by the Transformer. The difference in the areas of these two rectangles gives the *Work to be done* that has been done by the Transformer in one complete cycle. This *Work* to be performed by the Transformer is the difference between the *Work to be done* received from the Seller and the *Work to be done* given to the Buyer.

The sum of the values of the four steps is positive, in fact :

$$T_1 = T_3 = 0 \ \text{ and } \ : \ T_2 > 0 > T_4 \Rightarrow T_2 > T_4$$

The area of the rectangle 0-1-2-3 therefore represents a decrease in *employment*. This corresponds exactly to reality. In fact, the *Product* is more and more elabourated as it's manufactured, *i.e.* it contains more and more *Work done*, with the final consumer receiving the finished *Product*. In this case the *final Laziness* is equal to the *initial Laziness* ($P_4 = P_3$) since there is no more *Work to be done* transferred to the consumer, so that $T_4 = 0$.

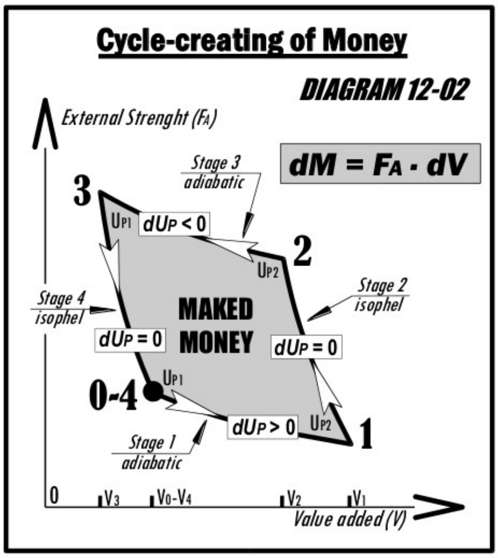
As for *employment*, it has indeed decreased because once the *Product* is finished, the Transformers no longer have any *Work to do* and are in a state of *unemployment*, unless another cycle occurs, in which case it will have been necessary to create this new *Work to be done* beforehand.

In fact, it has long been said that "*nothing comes from nothing*".

Cycle Work→Money ⇒ Creation of Money

This cycle is shown in figure 12-02 and rotates in the normal (positive) direction. The four steps of this cycle are defined as follows:

1. ***Step 1* ⇒ *Manufacturing by the Seller***
   - During this step, the *Product* is modified. The transformation is therefore adiabatic.
   - For the Transformer, the *Utility of the Product* increases from U_{P1} to U_{P2}.
   - The Transformer and the Seller are not in contact (the Seller is isolated from the Transformer). Therefore, there is no transfer of *Work*. However, the Seller is performing a *Work* which has a cost to the Seller. This cost leads to a reduction in its *Value added*.
   - This decrease in *Value added* leads to an increase in the Transformer's *Money* according to the 12-04 relationship.



$$M_1 = \frac{r_P}{1 - \gamma_{TM}} \cdot (U_{P2} - U_{P1})$$

   - Since $U_{P2} > U_{P1}$ and $\gamma_{TM} < 1$, it appears that $M_1 > 0$. *Money* enters the *system*, which means that the Transformer holds more *Money*.

2. ***Step 2* ⇒ *Seller-Transformer Tractation***
   - During this step, the *Product* isn't modified. The transformation is therefore isopheles.
   - For the Transformer, the *Utility* of the *Product* doesn't vary and remains equal to U_{P2}.

- The Seller, having completed its manufacture, increases the *added Value* of the *Product* to make a profit.
- This increase leads to a decrease in the *Money* available to the Transformer.
- From the relation 12-03 giving the value of this transformation, we draw :

$$M_2 = r_P \cdot U_{P2} \cdot \ln \frac{V_2}{V_1}$$

- Since $V_2 < V_1$, it emerges that $M_2 < 0$. *Money* goes out of the *system*, which means that it circulates from the Transformer to the Seller. In fact, if the Seller increases the *price*, the Transformer will pay more *Money*.

3. ***Step 3*** $\Rightarrow$ ***Manufacturing by the Transformer***
   - During this step, the *Product* is modified. The transformation is therefore adiabatic.
   - For the Transformer, the *Utility* of the *Product* decreases from U_{P2} to U_{P1}.
   - The Transformer and the Acquirer are not in contact (the Transformer is isolated from the Acquirer). Therefore there is no transfer of *Work*. However, the Transformer performs a *Work* that has a cost to it. This cost leads to a reduction in its own *added Value*.
   - This decrease in *Value added* leads to a decrease in the *Money* it holds according to the 12-04 relationship.

$$M_3 = \frac{r_P}{1 - \gamma_{TM}} \cdot (U_{P1} - U_{P2})$$

   - Since $U_{P1} < U_{P2}$ and $\gamma_{TM} < 1$, it follows that $M_3 < 0$. *Money* goes out of the *system*, which means that the Transformer holds less *Money*.

4. ***Step 4*** $\rightarrow$ ***Transformer-Acquirer Tractation***
   - During this step, the *Product* isn't modified. The transformation is therefore isopheles.
   - For the Transformer, the *Utility* of the *Product* doesn't vary and remains equal to U_{P1}.
   - The Transformer, having completed its manufacture, increases its own *added Value* to make a profit.
   - This increase leads to an increase in the *Money* available to the Transformer.
   - From the relation 12-03 giving the value of this transformation, we derive :

$$M_4 = r_P \cdot U_{P1} \cdot \ln \frac{V_4}{V_3}$$

   - Since $V_4 > V_3$, it emerges that $M_4 > 0$. From the *Money* enters the *system*, which means that it flows from the Acquirer to the Transformer. In fact, if the Transformer increases the *price*, the Buyer will pay more *Money*.

The 0-1-2-3 cycle area represents the *Money* that is created by the *system* during a complete cycle. The sum of the values of the four steps is negative, in fact :

$$M_1 > 0 > M_3 \quad and: \quad M_4 > 0 > M_2 \quad \Rightarrow \quad M_1 + M_4 > 0 > M_2 + M_3$$

so some *Money* come out of the *system*, which means they are created. In this cycle, the *Money* leaves the system, *i.e.* the consumer has more of it at his disposal. This cycle therefore represents an increase in the consumer's *purchasing power*. This corresponds exactly to reality.

Cycle Work→Money ⇒ Example

This paragraph shows how to deal with the making of *Money*, *i.e.* with the *price* decrease in an experimental way, *i.e.* what happens in everyday reality.

Let us consider the three agents (which represent, as already stipulated, any economic entity) as defined, namely, a Seller, a Transformer and a Buyer of any *Product*.
Whichever agent (Seller or Transformer) manufactures has only one aim, namely, to gain as much *Money* per unit of time as possible. How do agents act to achieve this goal? Agents always do more *Work*, *i.e.* they work more, in order to increase the *speed* ω of production (*productivity*). This increasing characteristic implies, *ipso facto*, a decrease in principle proportionally, *caeteris paribus*, in the cost of the *Product*. This decrease therefore allows the agent to increase the *price* by a quantity less than this decrease. An example will make this fact clearer. Let us suppose that, respectively :

- for the Seller and for the Transformer,
- for each sequence (transformation) of manufacture and negotiation,

the costs (*price* changes) are as shown in the table below.

	Fabrication	Tractation	Total
Seller	***72 $***	***30 $***	***102 $***
Transformers	***80 $***	***35 $***	***115 $***
Total	***152 $***	***65 $***	***217 $***

- the manufacturing time is, initially, one hour for both the Seller and the Transformer,
- the *price* increase for profit taking (tractation) is the same before and after the productivity improvement. If the profit was different, it would necessarily derive from a human decision, which would reject this hypothesis outside of this study.

1. ***Step 1* ⇒ *Manufacturing Vendor (Adiabatic transformation)***
   By increasing *productivity*, *i.e.* by providing superior *Work*, the Seller (the individual in the strict sense or through a machine) reduces the manufacturing time from 1 hour to 50 minutes, which causes the *price* of the *Product* to fall to :

   $$72 \times \frac{5}{6} = 60 \ \$$$

   Therefore, the Transformer's *Added Value* increases by :

$72 - 60 = 12\ \$$ ➚

2. ***Step 2*** $\Rightarrow$ ***Seller-Transformer Tractation (Isophele Transformation)***
As assumed above, when dealing with the Transformer, the Seller increases the *price* by 30 Dollars. As a result, the *price* increases to :

$$60 + 30 = 90\ \$$$

Therefore, the *added Value* of the Transformer decreases by :

$90 - 60 = 30\ \$$ ➘

3. ***Step 3*** $\Rightarrow$ ***Transformer Manufacture (Adiabatic Transformation)***
In this stage it's now the Transformer who manufactures the *Product*. The work performed by the Transformer reduces the manufacturing time from 1 hour to 48 minutes (*i.e.* 4/5 of an hour). As a result, the *price* is reduced to :

$$80 \times \frac{4}{5} = 64\ \$$$

Therefore, the Transformer's *added Value* decreases by :

$80 - 64 = 16\ \$$ ➘

4. ***Step 4*** $\rightarrow$ ***Transformer-Acquirer Tractation (Isopheles Transformation)***
As assumed above, when negotiating with the Acquirer, the Transformer increases the *price* by 24 Dollars. As a result, the *price* increases to :

$$64 + 24 = 88\ \$$$

Therefore, the *added Value* of the Transformer increases by :

$88 - 64 = 24\ \$$ ➚

It is worth noting :

1. assuming that the Seller and the Transformer make the same profit before and after the increase in *productivity*, isopheles 2 and 4 transformations don't cause any creation of *Money* and therefore don't determine absolutely any increase in the *purchasing power* of consumers. This is perfectly logical since, during these stages (2 and 4), neither the Seller nor the Transformer performs any *Work*.

   The table below lists the different transformations of the cycle. It can be seen that the Buyer's *wealth* (*purchasing power*) increases by 28 Dollars. This sum is composed of a first part due to the Seller for 12 Dollars and a second part due to the Transformer for 16 Dollars.

	Price before productivity gains	Price after productivity gains	difference
Step 1	***0 + 72 =72***	***0 + 60 =60***	***72 - 60 =12***
Step 2	***72 + 30 =102***	***60 + 30 =90***	***102 - 90 =12***
Step 3	***102 + 80 =182***	***90 + 64 =154***	***182 - 154 =28***
Step 4	***182 + 35 =217***	***154 + 35 =189***	***217 - 189 =28***

2. for the Buyer, the *price* of the *Product* changes from 217 to 189 Dollars, *i.e.* a gain of 28 Dollars without the need for him to done any *Work*.

3. the agents who performed a *Work* (Seller and Transformer) are always paid the same per unit of time, bearing in mind that the term "agent" here covers any economic entity. In fact, after an increase in *productivity*, for 1 hour of *Work* :

   - the Seller's production is ⇒ $6/5=1.20\,copies$
   - the production of the Transformer is ⇒ $5/4=1{,}25\,copies$

   or the respective hourly wages of :

   - for the Seller ⇒ $60\times 1{,}20=72\,\$$
   - for the Transformer ⇒ $64\times 1{,}25=80\,\$$

   as it was originally.

<u>Cycle Money→Work</u> ⇒ <u>Introduction</u>

Understanding the different transformations of this cycle is greatly facilitated by considering that consumers (Buyer *vis-à-vis* the Transformer and Transformer *vis-à-vis* the Seller) order the *Product* from suppliers. It is therefore necessary to observe :

- firstly, the Acquirer placing the order for a *Product* developed by the Transformer,
- then, the Transformer shall place the order for the *Product* to be manufactured with the Seller.

Consequently, the four steps can be presented schematically as follows:

1. Buyer-Transformer tractation during which the Buyer transfers *Work to be done* that the Transformer will have to done,
2. Manufacture by the Transformer during which it carries out the *Work* ordered by the Acquirer,
3. Transformer-Seller contract during which the Transformer transfers *Work to be done* that the Seller shall perform,
4. Manufacture by the Seller during which he carries out the *Work* ordered by the Transformer.

It is essential to note that :

1. the *Money* is decreasing. In fact, the *Money* received by the Transformer from the Buyer is greater than the one he transfers to the Seller,
2. the *Work to be done* increases. In fact, the *Work to be done* received from the Acquirer by the Transformer is less than that which it transfers to the Seller,

All this is perfectly similar to the $T \rightarrow M$ transformation and physics. Indeed, it's:

- The less heat Q there is to be used, the more mechanical work W is created,
- The less *Work to be done* T, the more *Money* M is created,
- The less *Money* M there is, the more *Work to be done* T created.

as symbolized in the table below :

Thermodynamics Q→W	***Q***	↘	***W***	↗
Transformation W→M	***T***	↘	***M***	↗
Transformation M→W	***M***	↘	***T***	↗

In order to have *Work to be done*, it's obvious that it must be ordered. For example: :

- a consumer C_1 orders a *Product* P_1 from his supplier F_1,
- the F_1 supplier becomes the C_2 consumer by ordering the P_2 *Product* from its own F_2 supplier,
- the F_2 supplier becomes the C_3 consumer by ordering the P_3 *Product* from its own F_3 supplier, and so on.

For an outside observer, the *Utility* of the *Product* decreases, indeed $U_{P1} > U_{P2} > U_{P3} > \cdots > U_{Pn}$, because the *Product* is less and less elabourate. It is then obvious that the *Work to be done*, that is to say, the work to be executed to complete the *Product* P_1 is increasingly higher, which becomes maximum for the *Product Pn*. Thus, each time a consumer orders (acquires) a *Product*, by spending *Money*, he increases the *Work to be done*. It is therefore possible to set that :

- ***the Money spent is transformed into Work to be done.***

This doesn't contradict similar adages:

- *“All you have to do is increase my wages and I'll make the craftsmen work"”,*
- *“All we have to do is raise wages to boost consumption”,*
- *etc.*

However, these sentences never specify where the *Money* contained in the *Cash* forming the remunerations comes from. The fact that it must be created beforehand is always overlooked. In conclusion, only the following indefinite sequence should be considered:

$\cdots \leftrightarrow$ ***Work*** $\leftrightarrow$ ***Money*** $\leftrightarrow$ ***Work*** $\leftrightarrow$ ***Money*** $\leftrightarrow \cdots$

These two characteristics can never be dissociated. An evolution of one necessarily leads to a variation of the other because they form together only one entity, namely :

- ***economic energy.***

Cycle Money→Work ⇒ Destruction of Money

Since "*Ex nihilo nihil*", in order to create *Work*, it's compulsory to destroy *Money*. Therefore, it's possible to express that the destruction of *Money* causes the creation of *Work*. This cycle is represented in figure 12-03 and turns in the opposite (negative) direction. The four stages of this cycle are defined as follows:

1. ***Step 1* ⇒ *Acquirer-Transformer Tractation***
   - During this step, the *Product* isn't modified, but the *Cash* is modified. The transformation is therefore adiabatic.
   - For the Transformer, the *Utility of the Cash* increases from U_{A1} to U_{A2}.
   - *Avarice* doesn't vary and remains equal to A_0.
   - From the relation 12-08 giving the value of this transformation, we derive :

   $$M_1 = 0$$

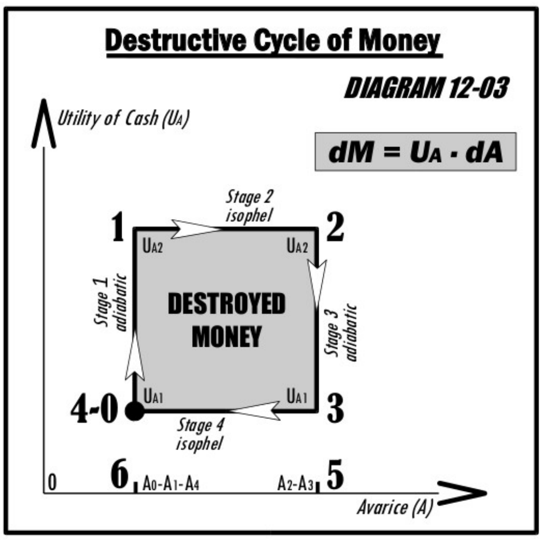
   - As $A_1 = A_0$, it emerges that $M_1 = 0$. No *Money* circulates in the system.

2. ***Step 2* ⇒ *Manufacturing by the Transformer***
   - During this step, the *Product* is modified, but the *Cash* isn't modified. The transformation is therefore isopheles.
   - For the Transformer, the *Utility of the Cash* doesn't vary and remains equal to U_{A2}.
   - The *Avarice* increases from A_1 to A_2.
   - From the relation 12-07 giving the value of this transformation, we derive :

   $$M_2 = U_{A2} \cdot (A_2 - A_1)$$

   - As $A_2 > A_1$, it emerges that $M_2 > 0$. *Money* enters the *system*. In fact, the Transformer receives from the Acquirer's *Money* in order to elabourate the *Product*.

3. ***Step 3* ⇒ *Transformer-Seller Tractation***
   - During this step, the *Product* isn't modified, but the *Cash* is modified. The transformation is therefore adiabatic.
   - For the Transformer, the *Utility* of the *Cash* decreases from U_{A2} to U_{A1}.
   - The *Avarice* doesn't vary and remains equal to A_2.
   - From the relation 12-08 giving the value of this transformation, we derive :



$$M_3 = 0$$

- As $A_3 = A_2$, it appears that $M_3 = 0$. No *Money* circulates in the system.

4. ***Step 4*** $\Rightarrow$ ***Manufacturing by the Seller***
   - During this step, the *Product* is modified, but the *Cash* isn't modified. The transformation is therefore isopheles.
   - For the Transformer, the *Utility* of the *Cash* doesn't vary and remains equal to U_{A1}.
   - The *Avarice* decreases from A_3 to A_4.
   - From the relation 12-07 giving the value of this transformation, we draw :

   $$M_4 = U_{A1} \cdot (A_4 - A_3)$$

   - As $A_4 < A_3$, it emerges that $M_4 < 0$. From the *Money* comes out of the system. In fact, the Transformer gives the *Money* to the Seller so that the Seller elabourates the *Product*.

The area of the rectangle 1-2-5-6 represents the *Money* that is given by the Buyer to the Transformer when the latter sells the *Product* elabourated to the former. The area of the rectangle 0-3-5-6 represents the *Money* which the Processor spends to purchase the raw Product proceeds from the Seller. The difference of the areas of these two rectangles gives the *Money* that enters the *system* during a complete cycle and is destroyed (executed) by the Transformer. The sum of the values of the four steps is positive, in fact :

$$M_1 = M_3 = 0 \quad \textit{and}: \quad M_2 > 0 > M_4 \quad \Rightarrow \quad M_2 > M_4$$

The area of the rectangle 0-1-2-3 represents the total value of the *Money* that enters the *system* during a complete cycle, the sum of the four values being positive means that this *Money* is destroyed. This cycle therefore represents a decrease in *purchasing power*. This is the reality, because the Transformer receives more *Money* from the Buyer of the *Product* than he himself gives to the Seller.

Cycle Money→Work ⇒ Creation of Work

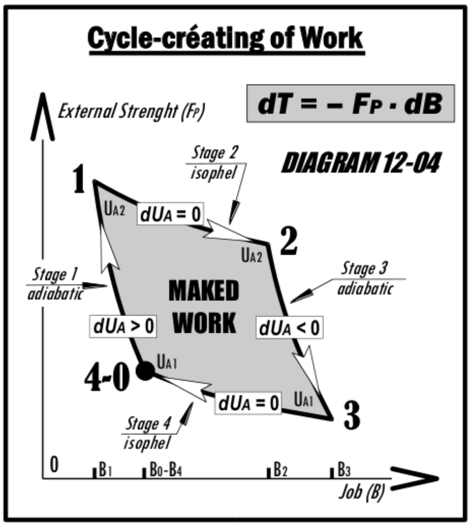
Care must be taken not to confuse this cycle with the return of the *Work→Money* cycle. In fact, this return would be caused by the variation of *Laziness* (opposite to the one defined above) whereas here the cause is the variation of *Avarice* which influences the *task to be added* and also the *Work to be done*. It is certainly for this reason that the apprehension of this cycle isn't obvious.

This cycle is represented in figure 12-04 and turns in the opposite (negative) direction. The four stages of this cycle are defined as follows:

1. ***Step 1*** $\Rightarrow$ ***Acquirer-Transformer Tractation***

- During this step, the *Product* isn't modified, but the *Cash* is modified. The transformation is therefore adiabatic.
- For the Transformer, the *Utility* of the *Cash* increases from U_{A1} to U_{A2}.
- From the relation 12-10 giving the value of this transformation, we derive :

$$T_1 = \frac{r_A}{\gamma_{MT} - 1} \cdot (U_{A2} - U_{A1})$$



- As $U_{A2} > U_{A1}$ and $\gamma_{MT} > 1$, it emerges that $T_1 > 0$. The *Work to be done* enters the *system.*

2. ***Step 2*** $\Rightarrow$ ***Manufacturing by the Transformer***
   - During this step, the *Product* is modified, but the *Cash* isn't modified. The transformation is therefore isopheles.
   - For the Transformer, the *Utility of the Cash* doesn't vary and remains equal to U_{A2}.
   - From the relation 12-09 giving the value of this transformation, we derive :

$$T_2 = - r_A \cdot U_{A2} \cdot \ln \frac{B_2}{B_1}$$

   - As $B_2 > B_1$, it emerges that $T_2 < 0$. *Work to be done* goes out of the system.

3. ***Step 3*** $\Rightarrow$ ***Transformer-Seller Tractation***
   - During this step, the *Product* isn't modified, but the *Cash* is modified. The transformation is therefore adiabatic.
   - For the Transformer, the *Utility of the Cash* decreases from U_{A2} to U_{A1}.
   - From the relation 12-10 giving the value of this transformation, we derive :

$$T_3 = \frac{r_A}{\gamma_{MT} - 1} \cdot (U_{A1} - U_{A2})$$

   - As $U_{A1} < U_{A2}$ and that $\gamma_{MT} > 1$, it emerges that $T_3 < 0$. *Work to be done* goes out of the *system.*

4. ***Step 4*** $\Rightarrow$ ***Manufacturing by the Seller***
   - During this step, the *Product* is modified, but the *Cash* isn't modified. The transformation is therefore isopheles.
   - For the Transformer, the *Utility of the Cash* doesn't vary and remains equal to U_{A1}.
   - From the relation 12-09 giving the value of this transformation, we derive :

$$T_4 = - r_A \cdot U_{A1} \cdot \ln \frac{B_4}{B_3}$$

- As $B_4 > B_3$, it emerges that $T_4 > 0$. *Work to be done* enters the system.

The area of cycle 0-1-2-3 represents the *Work to be done* that is created by the *system* during a complete cycle. The sum of the values of the four steps is negative:

$$T_1 > 0 > T_3 \quad and: \quad T_4 > 0 > T_2 \quad \Rightarrow \quad T_1 + T_4 > 0 > T_2 + T_3$$

therefore *Work to be done* leaves the *system*, which means that it's created.

13 – MONEY AND WORK – CONDITIONS OF CREATION

ABSTRACT: Following the example of thermodynamics, it is possible to elaborate the diagrams, known as "Raveau", relating to the conditions of creation of Money and creation of Work. Indeed, all the work that can be envisaged does not necessarily create Money and identically all the Money spent does not automatically create Work.

Consequently, it is these conditions determined by the first and second principles that are the subject of this chapter.

<u>T→M processing</u> ⇒ <u>Conditions for creating Money</u>

The First Principle states that :

$$T_1 + T_2 + M = 0$$

but that in order to create the *Money*, it must be negative as it must exit the system. So :

$$M < 0 \quad \Rightarrow \quad T_1 + T_2 \geq 0$$

Consequently, the First Principle prohibits the creation of *Money* if:

$$\boxed{T_1 + T_2 < 0 \quad \Rightarrow \quad \textit{prohibition}} \qquad \langle 13\text{-}01 \rangle$$

In this transformation (*Work→Money*), it's possible to determine all the cases that may arise depending on whether *Money* and *Work* enter or leave the system, *i.e.* according to the First Principle.

These hypotheses can be exhaustively inventoried as follows:

M > 0			
T1 > 0		**T1 < 0**	
T_2 > 0	**T_2 < 0**	**T_2 > 0**	**T_2 < 0**
-1- **impossible**	**-2-** **impossible**	**-3-** **impossible**	**-4-** **impossible**

M < 0			
T1 > 0		**T1 < 0**	
T_2 > 0	**T_2 < 0**	**T_2 > 0**	**T_2 < 0**
-5- **impossible**	**-6-** **possible**	**-7-** **impossible**	**-8-** **impossible**

We note that only hypothesis 6 returns an adequate answer for enrichment. Indeed, for there to be a creation of *Money*, it's necessary that :

1. *Money M* must be negative since it must leave the *system*, this necessity eliminates hypotheses 1, 2, 3 and 4,

2. the *Work to be done* T_1 is positive since it must enter the *system* during the Seller-Transformer transaction, this eliminates assumptions 7 and 8,
3. the *Work to be done* T_2 is negative (or nil for a final consumer) since it must exit the *system* during the Transformer-Acquirer transaction, this requirement eliminates assumption 5.

We are familiar with the 05-04 relationship, namely :

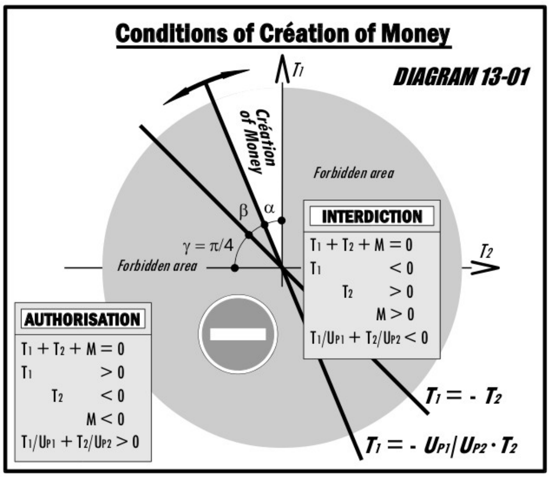
$$dP = - \frac{dT}{U_P}$$

The Second Principle specifies that *Laziness* can only increase, therefore :

$$dP \geq - \frac{dT}{U_P} \qquad \text{either:} \qquad dP \leq \frac{dT}{U_P}$$

Now, in a cycle, the variation of *Laziness* is necessarily nil, therefore:

$$\frac{dT}{U_P} \geq 0$$



For a finished transformation of *Work* between the Seller and the Transformer on the one hand and between the Transformer and the Buyer on the other hand, it's thus possible to write:

$$\frac{T_1}{U_{P1}} + \frac{T_2}{U_{P2}} \geq 0$$

Consequently, the Second Principle prohibits the creation of *Money* if :

$$\boxed{\frac{T_1}{U_{P1}} + \frac{T_2}{U_{P2}} < 0 \quad \Rightarrow \quad \textit{Prohition}} \qquad \textbf{‹13-02›}$$

Figure 13-01, above, graphically presents the different possibilities that have just been defined for this Transformation and thus shows the only area suitable for the creation of *Money*.

It should be noted that the area suitable for the creation of *Money* (relative to the angle α) isn't the same as the area suitable for the creation of Thermodynamics (relative to the angle β), but is adjacent to it. This is due to the fact that the relations giving the Second Principle of each transformation do not have the same sign.

<u>*Transformation M→**T***</u> ⇒ <u>*Conditions for the creation of Work*</u>

For this transformation, the First Principle states that :

$$M_1 + M_2 + T = 0$$

but that to create *Work*, it must be negative since it must go out of the *system*.

Therefore:

$$T < 0 \quad \Rightarrow \quad M_1 + M_2 \geq 0$$

Consequently, the First Principle prohibits the creation of *Work* if:

$$\boxed{M_1 + M_2 < 0 \quad \Rightarrow \quad Prohibition} \qquad \text{‹13-03›}$$

In this transformation (*Money→Work*), it's possible to determine all the cases that may arise depending on whether *Work* and *Money* enter or leave the system, *i.e.* according to the First Principle.

These hypotheses can be exhaustively inventoried as follows:

T > 0			
M1 > 0		**M1 < 0**	
$M_2 > 0$	**$M_2 < 0$**	**$M_2 > 0$**	**$M_2 < 0$**
-1- **impossible**	**-2-** **impossible**	**-3-** **impossible**	**-4-** **impossible**

T < 0			
M1 > 0		**M1 < 0**	
$M_2 > 0$	**$M_2 < 0$**	**$M_2 > 0$**	**$M_2 < 0$**
-5- **impossible**	**-6-** **possible**	**-7-** **impossible**	**-8-** **impossible**

It is noticeable that only hypothesis 6 returns an adequate response for the creation of *Work*. In fact, in order for there to be a creation of *Work*, it's obligatory that :

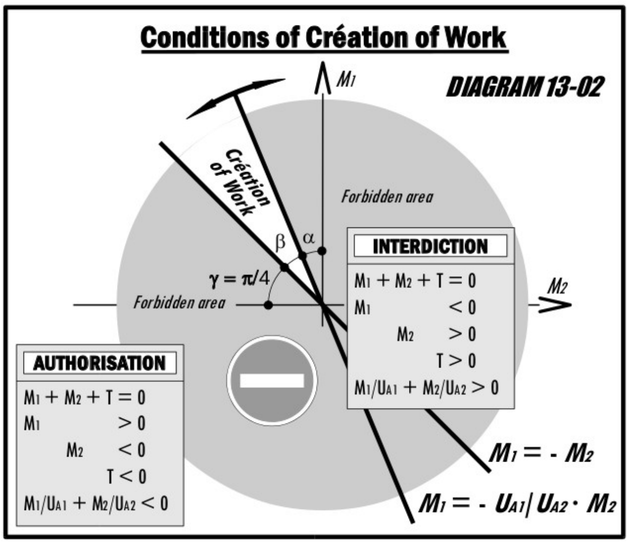
1. *Work* T must be negative, since it must leave the *system*; this necessity eliminates hypotheses 1, 2, 3 and 4,
2. the M_1 *Money* is positive since it must enter the *system* at the time of the Transformer-Acquirer transaction, this requirement eliminates assumptions 7 and 8,
3. the M_2 *Money* is negative since it must exit the *system* during the Seller-Transformer transaction, this requirement eliminates assumption 5.

We know the 05-07 relationship, namely :

$$dA = \frac{dM}{U_A}$$

The Second Principle specifies that the *Avarice* (A) can only increase, therefore :

$$dA \geq \frac{dM}{U_A}$$



Now, in a cycle, the variation of *Avarice* is obligatorily null, therefore:

$$\frac{dM}{U_A} \leq 0$$

For a finite transformation of *Money* between the Buyer and the Transformer on the one hand and the Transformer and the Seller on the other hand, it's therefore possible to write :

$$\frac{M_1}{U_{A1}} + \frac{M_2}{U_{A2}} \leq 0$$

Consequently, the Second Principle prohibits the creation of *Work* if :

$$\boxed{\frac{M_1}{U_{A1}} + \frac{M_2}{U_{A2}} > 0 \quad \Rightarrow \quad Prohibition} \qquad \text{‹13-04›}$$

Figure 13-02, above, graphically presents the different possibilities that have just been defined for this transformation and thus shows the only area suitable for the creation of *Work*.

It should be noted that the area for the creation of *Work to be done of an economic nature* (T) is the same as the physical area where work of a mechanical nature (W) is created and both are relative to the angle β .

Work and Money ⇒ Relationships

In the two diagrams 13-01 and 13-02, the sum of the angles and is always constant whatever the situation considered, *i.e.* $\pi/4$. Therefore, the only causes that can cause these angles to vary are the ratios of the *Product* and *Cash* Utilities, namely U_{P1}/U_{P2} and U_{A1}/U_{A2}. These ratios respectively define the slope of the straight lines representing the two Second Principles.

It seems perfectly logical that, for the proper functioning of the economic *system* under consideration, these slopes should be equal, *i.e.* :

$$\frac{U_{P1}}{U_{P2}} = \frac{U_{A1}}{U_{A2}}$$

but also that :

$$\alpha = \beta = \frac{\pi}{8}$$

so that neither the supplier nor the consumer is harmed, either of his *Work* or of his *Money*.

For any Transformer, we know that (chapter “Structure of Exchanges”) :

- when dealing with the Seller, the U_{P1} *Utility* of the *Product* has a high value and the U_{A2} *Utility* of the *Cash* has a low value,
- when dealing with the Acquirer, the U_{P2} *Utility* of the *Product* has a low value and the U_{A1} *Utility* of the *Cash* has a high value.

It can be deduced from this that the ratio of these *Utilities* must be equal in principle (which isn't demonstrated), therefore :

$$\frac{U_{P2}}{U_{P1}} = \frac{U_{A2}}{U_{A1}}$$ either : $$\frac{low\ value}{high\ value}$$

The equations of the functions, namely:

$$T_1 = - \frac{U_{P1}}{U_{P2}} \cdot T_2$$ and : $$M_1 = - \frac{U_{A1}}{U_{A2}} \cdot M_2$$

can be written:

$$\frac{T_2}{T_1} = - \frac{U_{P2}}{U_{P1}}$$ and : $$\frac{M_2}{M_1} = - \frac{U_{A2}}{U_{A1}}$$

As we have just seen above that:

$$\frac{U_{P2}}{U_{P1}} = \frac{U_{A2}}{U_{A1}}$$

it follows that it's possible to write:

$$\boxed{\frac{T_1}{T_2} = \frac{M_1}{M_2} = -\frac{U_{\mathbf{P1}}}{U_{\mathbf{P2}}} = -\frac{U_{\mathbf{A1}}}{U_{\mathbf{A2}}}} \qquad \textbf{‹13-05›}$$

and more:

$$\boxed{\alpha + \beta = \frac{\pi}{4}} \qquad \textbf{‹13-06›}$$

Consequently, since the sum of the angles is constant, a variation of one angle causes the opposite variation of the other angle. Since :

$$\alpha = \frac{\pi}{4} - \beta$$

then:

$$\operatorname{tg}\alpha = \operatorname{tg}\left(\frac{\pi}{4} - \beta\right)$$

The formulas of trigonometric addition transformations allow us to write:

$$\operatorname{tg}\alpha = \frac{\operatorname{tg}\frac{\pi}{4} - \operatorname{tg}\beta}{1 + \operatorname{tg}\frac{\pi}{4} \cdot \operatorname{tg}\beta}$$

and by replacing tg $\pi/4$ by its value (in this case 1), we obtain :

$$\boxed{tg\ \alpha = \frac{1 - tg\ \beta}{1 + tg\ \beta}}$$ **‹13-07›**

However, there is no indication that the two angles and must be equal. Now, for any Transformer, the Second Principle implies that :

- without constraints, the *Work to be done* which enters is minimal and that which leaves is maximal, and *vice versa* under constraints. Therefore, in the first hypothesis (without constraints):

$U_{P1} \rightarrow$ ***minimum*** and : $U_{P2} \rightarrow$ ***maximum***

Since : $U_{P1} \geq U_{P2}$ then: $\dfrac{U_{P2}}{U_{P1}} \rightarrow 1$

- without constraints, the *Money realized* which enters is maximum and the one which leaves is minimal, and conversely under constraints. So, in the first hypothesis (out of constraints) :

$U_{A1} \rightarrow$ ***maximum*** and : $U_{A2} \rightarrow$ ***minimum***

Since : $U_{A1} \geq U_{A2}$ then: $\dfrac{U_{A2}}{U_{A1}} \rightarrow 0$

Now, these two tendencies, represented by the respective slope of the curves defining the areas of *Money* creation and *Work*, are absolutely antagonistic and are contradictory because they must be equal in principle, as shown above. Consequently, the balance between these two orientations will only be achieved when the angles α and β are equal. Only then will the *Force*s of *Laziness* and *Avarice* of the different actors be equal.

Therefore, if :

$$\beta = \frac{\pi}{8}$$

it's possible to write:

$$\mathrm{tg}\,\alpha = \frac{1 - \mathrm{tg}\frac{\pi}{8}}{1 + \mathrm{tg}\frac{\pi}{8}}$$

which gives by replacing tg $\pi/8$ by its value (in this case: √2-1) and by simplifying:

$$\mathrm{tg}\,\alpha = \sqrt{2} - 1$$

Therefore:

$$\boxed{\begin{array}{c}\textit{to the balance between Work and Money economies}\\ \alpha = \beta = \frac{\pi}{8} \Rightarrow tg\ \alpha = tg\ \beta = \sqrt{2} - 1\end{array}} \qquad \text{‹13-08›}$$

This shows that it's imperative to ensure that the coefficient g linking *Money* and *Work* is equal to unity. Therefore, no economic decision should be taken without making a preliminary reference to this balance, bearing in mind that any measure favouring the employee disadvantages the consumer and *vice versa.*

- ***An economic decision acting on one actor always acts in the opposite direction on the other actor.***
- ***IT CAN NEVER BE NEUTRAL.***

However, it's possible to reflect further on the different evolutions that may occur.

In the transformation *Work→Money* we have seen that :

- for an Unconstrained Transformer, we have:

  $$\frac{U_{P2}}{U_{P1}} \to 1 \quad \Rightarrow \quad U_{P1} - U_{P2} \to 0$$

  Since the difference in *Utility of the Product* between the end and the beginning of the transformation naturally decreases, the Transformer does less Work. Consequently, the amount of *Money* created decreases as the Transformer's Laziness increases.

- for a Transformer under constraints, we have :

$$\frac{U_{P2}}{U_{P1}} \rightarrow 0 \quad \Rightarrow \quad U_{P1} - U_{P2} \rightarrow U_{P1}$$

Since the difference in *Product Utility* between the end and the beginning of the transformation increases under constraints, the Transformer performs more *Work*. As a result, the amount of Money created increases as the Transformer *Laziness* decreases.

This is quite logical. Therefore, in order to enrich an economic *system*, it's necessary that :

$$\alpha \rightarrow 0$$

In order to create *Money*, it's therefore indispensable that the Transformer goes against his natural inclination to increase his *Laziness*. It is of course, as already stated, that *Laziness* is defined here as the sum of the *economy of Work* of the different agents (individuals, employees, slaves, animals, motors) participating in the elabouration of the *Product*.

In the transformation *Money→Work*, we have seen that :

- for an Unconstrained Transformer, we have:

$$\frac{U_{A2}}{U_{A1}} \rightarrow 0 \qquad \text{so:} \qquad U_{A1} - U_{A2} \rightarrow U_{A1}$$

  Since the difference in *Utility* of *Money* between the end and the beginning of the transformation increases outside the constraints, the Transformer spends less *Money*. Consequently, the amount of *Work* created (for the Seller) decreases as the Transformer's Avarice increases.

- For a Transformer under constraint, we have :

$$\frac{U_{A2}}{U_{A1}} \rightarrow 1 \qquad \text{so:} \qquad U_{A1} - U_{A2} \rightarrow 0$$

  Since the difference in *Utility* of *Money* between the end and the beginning of the transformation decreases under constraints, the Transformer spends more *Money*. As a result, the amount of *Work* created (for the Seller) increases as the Transformer's *Avarice* decreases.

This is quite logical. Indeed, the higher the Transformer's *Avarice*, the more the Transformer acquires the *Product* from the Seller at the lowest possible *price*, in order to perform as much *Work* as possible. In fact, if the Seller offers a *Product* incorporating more *Work*, he will sell it at a higher *price*, and at a lower *price* if he doesn't. Be careful, however, not to fall into the explanation of the transformation $T \rightarrow M$ which certifies the opposite. Here, the aim isn't to create *Money* but *Work*, because the *Money* is already created since the Transformer has already received a certain quantity from the Buyer and transmits another smaller quantity to the Seller. To understand this, it's easier to consider an example. Either a Transformer, a do-it-yourselfer, wishing to fence off his vegetable garden. He can choose :

1. or to have the *labour* (and consequently the *Work*) done by a professional,
2. or to carry it out itself.

No one will dispute that the second hypothesis will be less expensive than the first, because the gardener will do more *Work* and therefore leave less (or none) to the Seller. But the choice between the two possibilities depends only on the *Avarice* of the Consumer (Transformer). If *Avarice* is high, the *price* will be low, the Transformer's *Work* will be high, the Seller's will be low.

An “infinite” list of examples can be presented.

Therefore, in order to increase the *Work to be done* (*labour to be done*), it's necessary that :

$$\beta \rightarrow \frac{\pi}{4}$$

To create *Work to be done*, it's therefore indispensable that the Transformer goes against his natural inclination to increase his *Avarice*. It is of course, as already mentioned, that *Avarice* is defined here as the sum of the savings of *Money* of the different agents (individuals, employees, slaves, animals, motors) participating in the elabouration of *Money*.

In conclusion, the creation of *Money* and/or *Work* is only possible by acting against the natural tendencies of the evolution of economies of *Money* and/or *Work*. This implies that :

- ***for any actor, it's impossible to increase simultaneously his Work and his Money, it can only be one or the other.***

Of course, this is only valid when considering a copy of the *Product* and not when focusing on the working hours. Indeed, for each copy of the *Product*, the higher the production speed, the lower the *price* (*caeteris paribus*), so the supplier receives less *Cash* per copy. However, in the same period of time, the number of copies produced is greater. Therefore, more copies can be sold, which means a higher turnover.

Note

It is worth noting the differences in the fields of interest of Man of the arts in physics and economics.

1. In the field of physics, no one deals with all the motors or machines of a system. For example, in France, there are hundreds of millions of motors of all kinds (thermal, electric, hydraulic, ...), of all sizes and powers. However, engineers, technicians and others only focus their efforts on the operation of a single engine, but never on the understanding of the whole, as this is of absolutely no interest. Indeed, what benefit would be derived from knowing the sum of the power of the engines, their average power, *etc.*? The utility of this knowledge is only of interest for each engine. It is at this level that research into understanding phenomena, improving efficiency, optimising operation, *etc.* is carried out.

2. In the economic field, it's almost the opposite. The vast majority of specialists only study macroeconomics, *i.e.* all the phenomena taking place at the level of a *system* such as a country. Few economists are concerned with microeconomics. It is at this level (like physics) that *wealth* is created, as this note makes clear. Normally, the designers of any *Product* actually act so that the operations of elabouration are carried out in the least expensive way possible.

Consequently, it's at the microeconomic level that investigations into phenomena must first be carried out as a matter of priority, even if it means looking for explanations at the macroeconomic level. Indeed, there are probably phenomena of self-organisation and/or emergence, but that is another story.

14 – PROCESSING YIELDS

ABSTRACT: Of course, we know that, whatever the discipline, a real transformation is never total; and economics, as understood in this essay, cannot escape this certainty.

The purpose of this chapter is therefore to determine the returns of the two transformations $T \rightarrow M$ *and* $M \rightarrow T$ *and also the overall return when they are considered together.*

Transformation T→M ⇒ Yield

Let's assume any t $T \rightarrow M$ ransformation. In this one, the η_{TM} yield is by definition :

$$\eta_{TM} = - \frac{M}{T_1}$$

In fact, it's equal to the *Money created* (*M*), which leaves the *system*, obtained in relation to the *Work to be done* (T_1), which enters the *system*, necessary for this obtaining.

The First Principle, implies :

$$T_1 + T_2 + M = 0 \qquad \text{either:} \qquad - M = T_1 + T_2$$

Therefore:

$$\eta_{TM} = \frac{T_1 + T_2}{T_1} \qquad \text{or:} \qquad \eta_{TM} = 1 + \frac{T_2}{T_1}$$

Now, for this transformation of any kind (reversible or not), we know from the Second Principle that:

$$\frac{T_1}{U_{P1}} + \frac{T_2}{U_{P2}} \geq 0$$

that we can write:

$$\frac{T_2}{U_{P2}} \geq - \frac{T_1}{U_{P1}} \qquad \text{or:} \qquad \frac{T_2}{T_1} \geq - \frac{U_{P2}}{U_{P1}}$$

which gives, by replacing:

$$\boxed{\eta_{TM} \geq 1 - \frac{U_{P2}}{U_{P1}}}$$ ‹14-01›

This expression seems, at first sight, to be wrong because it's given the sign "greater or equal" (≥), contrary to any usual relationship of any return. This is due to the fact that the *Work* from which this relation derives is the *Work to be done* which has not yet entered the *system* and not the *Work done* which is logically the one to be taken into account. Furthermore, it's possible to show that in this transformation the final *Utility of the Product* is lower or equal to the initial *Utility* of the Transformer, that is to say:

$$U_{P2} \leq U_{P1}$$

Therefore, for both limit cases, it follows that :

1.	if:	$U_{P2} = U_{P1}$	then:	$\frac{U_{P2}}{U_{P1}} = 1$	hence:	$\eta_{TM} = 0$
2.	if:	$U_{P2} = 0$	then:	$\frac{U_{P2}}{U_{P1}} = 0$	hence:	$\eta_{TM} = 1$

Which shows that the real efficiency is always positive (or nil) but less (or equal) than the unit, that is to say :

$$\boxed{0 \leq \eta_{TM} \leq 1}$$ ‹14-02›

like any *yield* whatsoever.

In the case where the $T \rightarrow M$ transformation of the cycle would be completely reversible (without loss), the *yield* relationship would become :

$$\eta_{TM} = 1 - \frac{U_{P2}}{U_{P1}}$$

The *yield* of the $T \rightarrow M$ transformation is totally independent of the nature of the *Product*, it's only a function of its *Utility* at the beginning and at the end of the transformation.

Transformation M→T ⇒ ***Yield***

Let's assume any $M \rightarrow T$ transformation. In this one, the $M \rightarrow T$ *yield* is by definition :

$$\eta_{MT} = -\frac{T}{M_1}$$

In fact, it's equal to the *Work to be done T* (which leaves the *system*) obtained, in relation to the M_1 *realised Money* (which enters the *system*) necessary to obtain it.

The First Principle, implies :

$M_1 + M_2 + T = 0$ either : $- T = M_1 + M_2$

Therefore:

$$\eta_{MT} = \frac{M_1 + M_2}{M_1}$$ or : $$\eta_{MT} = 1 + \frac{M_2}{M_1}$$

Now, for this transformation of any kind (reversible or not), we know from the Second Principle that:

$$\frac{M_1}{U_{A1}} + \frac{M_2}{U_{A2}} \leq 0$$

that we can write:

$$\frac{M_2}{U_{A2}} \leq - \frac{M_1}{U_{A1}}$$ or: $$\frac{M_2}{M_1} \leq - \frac{U_{A2}}{U_{A1}}$$

which gives by replacing:

$$\boxed{\eta_{MT} \leq 1 - \frac{U_{A2}}{U_{A1}}}$$ **‹14-03›**

As in this type of cycle :

$U_{A2} \leq U_{A1}$

Therefore, for the two borderline cases, the result is that :

1. if: $U_{A2} = U_{A1}$ then: $\frac{U_{A2}}{U_{A1}} = 1$ hence: $\eta_{MT} = 0$

2. if: $U_{A2} = 0$ then: $\frac{U_{A2}}{U_{A1}} = 0$ hence: $\eta_{MT} = 1$

Which shows that the real yield is always positive (or nil) but less (or equal) than the unit, that is to say:

$$\boxed{0 \leq \eta_{MT} \leq 1}$$ **‹14-04›**

If the transformation $M \to T$ of the cycle were to be fully reversible (lossless), the *yield* relationship would become :

$$\eta_{MT} = 1 - \frac{U_{A2}}{U_{A1}}$$

The yield of the $M \to T$ transformation is totally independent of the nature of *Cash*, it's only a function of its *Utility* at the beginning and at the end of the transformation.

Overall processing efficiency

First of all, it should be pointed out that the two transformations ($T \to M$ and $M \to T$) cannot be considered as independent of each other, because in this hypothesis it would be possible to envisage for each of them a return tending towards 1, which is impossible. The two transformations must always and imperatively be apprehended simultaneously. Indeed, during an exchange of *Work* (transformation $T \to M$) circulates from the supplier to the consumer, but *Money* (transformation) $M \to T$ also circulates in the opposite direction.

By definition, the global output (η_g) of the two transformations is equal to :

$$\eta_g = \eta_{TM} \cdot \eta_{MT}$$

or :

$$\eta_g = \left(1 - \frac{U_{P2}}{U_{P1}}\right) \cdot \left(1 - \frac{U_{A2}}{U_{A1}}\right)$$

but, as we have seen above (chapter “Conditions of Creation of *Money* and *Work*”) that :

$$\frac{U_{A2}}{U_{A1}} = \frac{U_{P2}}{U_{P1}}$$

which gives, by generalizing, the global yield:

$$\boxed{\eta_g = \left(1 - \frac{U_{\boldsymbol{P2}}}{U_{\boldsymbol{P1}}}\right)^2 = \left(1 - \frac{U_{\boldsymbol{A2}}}{U_{\boldsymbol{A1}}}\right)^2 = \left(1 - \frac{U_{\boldsymbol{P2}}}{U_{\boldsymbol{P1}}}\right) \cdot \left(1 - \frac{U_{\boldsymbol{A2}}}{U_{\boldsymbol{A1}}}\right)} \qquad \text{‹14-05›}$$

According to Figure 13-01, we have :

$$\frac{T_2}{T_1} = \text{cotg}\left(\frac{\pi}{2} + \alpha\right)$$

either:

$$\frac{T_2}{T_1} = - \ \mathrm{tg}\,\alpha$$

but, we know that:

$$\frac{T_2}{T_1} = - \ \frac{U_{P2}}{U_{P1}}$$

the overall efficiency, as a function of the angle, is therefore:

$$\eta_g = (1 - \ \mathrm{tg}\,\alpha)^2$$

Furthermore, knowing that:

$$\mathrm{tg}\,\alpha = \frac{1 - \ \mathrm{tg}\,\beta}{1 + \ \mathrm{tg}\,\beta}$$

the overall efficiency, as a function of the angle , becomes:

$$\eta_g = \left(1 - \ \frac{1 - \ \mathrm{tg}\,\beta}{1 + \ \mathrm{tg}\,\beta}\right)^2$$

or:

$$\eta_g = \left(\frac{2\ \mathrm{tg}\,\beta}{1 + \ \mathrm{tg}\,\beta}\right)^2$$

Therefore, in summing up:

$$\boxed{\eta_g = (1 - tg\ \alpha)^2 = \left(\frac{2\ tg\ \beta}{1 + tg\ \beta}\right)^2} \qquad \textbf{‹14-06›}$$

Since the *maximum overall efficiency* of an *economical system* ($\eta_{g\,max}$) is obtained when the angles and are equal (diagrams 13-01 and 13-02) and are therefore $\pi/8$, then the relationship is written :

$$\eta_{g\,max} = \left(1 - \ \mathrm{tg}\frac{\pi}{8}\right)^2$$

or :

$$\eta_{g\,max} = \left[1 - \left(\sqrt{2} - 1\right)\right]^2$$

which gives :

$$\boxed{\eta_{g\,max} = \left(2 - \sqrt{2}\right)^2 \approx 0{,}3431} \qquad \textbf{‹14-07›}$$

For maximum overall *yield*, the optimal *yield* (η_{opt}) of each transformation is then its square root, *i.e.* :

$$\boxed{\eta_{TM\,opt} = \eta_{MT\,opt} = \left(2 - \sqrt{2}\right) \approx 0{,}5858} \qquad \textbf{‹14-08›}$$

and :

$$\boxed{\eta_{g\,max} = \eta_{opt}{}^2}$$ ‹14-09›

the optimal *yield* of a transformation then becomes :

$$\boxed{\eta = 1 - tg\ \alpha = \frac{2\ tg\ \beta}{1 + tg\ \beta}}$$ ‹14-10›

A priori, one might think that, for the proper functioning of the economic *system* under study, it's necessary and sufficient that the *respective yield* of each transformation be 0.5. However, as we can see above, this isn't the case. Indeed, in this case, the *overall yield* would be 0.25, which represents only 73% of the *maximum yield.* This means that more *Work* has to be done and more *Money* spent than “common sense” dictates.

Note ⇒ Yield of an isopheles transformation

We know that the cycle of creation of *Money* is made up of four transformations, two of which are isopheles and two of which are adiabatic. It is possible to determine the *yields* of these two types of transformations.

- ***Transformation T→M isopheles***

  We know the general relationship (15-01) of the *yield* of a *T→M* transformation, namely :

  $$\eta_{TM} \geq 1 - \frac{U_{P2}}{U_{P1}}$$

  But, by definition, in an isopheles transformation the initial and final *Utilities* are equal so :

  $$U_{P2} = U_{P1} \quad \Rightarrow \quad \frac{U_{P2}}{U_{P1}} = 1$$

  which leads to:

  $$\boxed{\eta_{TM} = 0}$$ ‹14-11›

  These results confirm the fact that individuals who don’t increase the *Utility* of the *Product* they handle for others don’t create *Money* and therefore don’t perform any *Work* in the economic sense of the term.

- ***Transformation M→T isopheles***

  We know the general relationship (15-03) of the yield of a *M→T* transformation, namely :

$$\eta_{MT} \le 1 - \frac{U_{A2}}{U_{A1}}$$

But, by definition, in an isopheles transformation the initial and final *Utilities* are equal, therefore:

$$U_{A2} = U_{A1} \quad \Rightarrow \quad \frac{U_{A2}}{U_{A1}} = 1$$

which leads to:

$$\boxed{\eta_{MT} = 0} \qquad \langle 14\text{-}12 \rangle$$

Whatever the transformation ($T \to M$ or $M \to T$), all this shows that a difference is strictly obligatory for any change to exist and that the Economy cannot derogate from the universal laws that govern Nature.

Association of transformations ⇒ *General*

We know that, for the proper functioning of the economic *system* under consideration, the sum of the angles and (Figures 13-01 and 13-02) must be constant and equal to :

$$\alpha + \beta = \frac{\pi}{4}$$

and also that (relation 15-10):

$$\eta = 1 - \operatorname{tg}\alpha = \frac{2 \operatorname{tg}\beta}{1 + \operatorname{tg}\beta}$$

It is therefore possible to calculate the *yield* of each transformation for some values of these angles (α and β). The table below shows these *yields* for the selected angles of 5 in 5 degrees as well as for the angle of 22°30' equal to $\pi/8$.

α	η_{TM}	β	η_{MT}	η_{global}
00°	1,00	45°	0,00	0,00
05°	0,91	40°	0,16	0,15
10°	0,82	35°	0,30	0,25
15°	0,73	30°	0,42	0,31
20°	0,64	25°	0,53	0,34
22°30'	**0,5858**	**22°30'**	**0,5858**	**0,3431**

25°	0,53	20°	0,64	0,34
30°	0,42	15°	0,73	0,31
35°	0,30	10°	0,82	0,25
40°	0,16	05°	0,91	0,15
45°	0,00	00°	1,00	0,00

The last column presents the overall performance (η_g) of the economic *system* under consideration, *i.e.* by examining the two transformations simultaneously. It is evident that :

- if the *yield* of one transformation increases, the *yield* of the other transformation decreases,
- the *overall yield* is always lower than the smaller *yield* of the two conversions,
- the *yield* of one of the two transformations is always higher than the *optimal yield* ($2-\sqrt{2}$), while the other is systematically lower (unless the two *yields* are equal),
- the *overall yield* is maximum when the *yields* of both transformations are equal.

All this can be presented graphically by figures 14-01 and 14-02 below, which show how the two transformations are linked *Work→Money* and *Money→Work*.

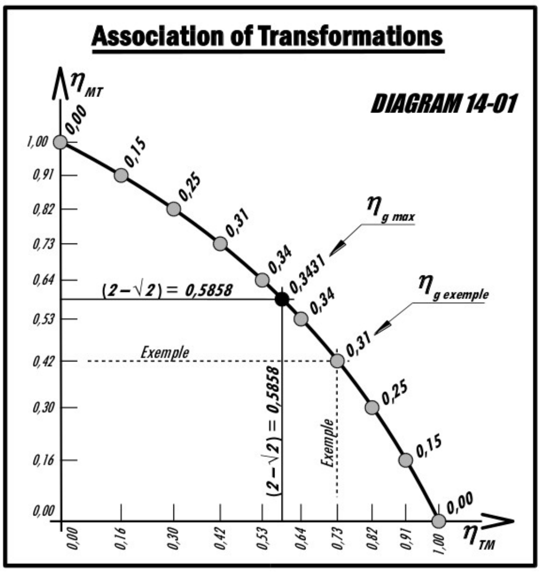


Figure 14-01 shows the results of the different contingencies in the table. It shows the example of the *maximum overall yield* that was defined previously, as well as the one analysed by figure 14-02 below.

For this example, it's proposed that the *yields* of the two transformations are respectively :

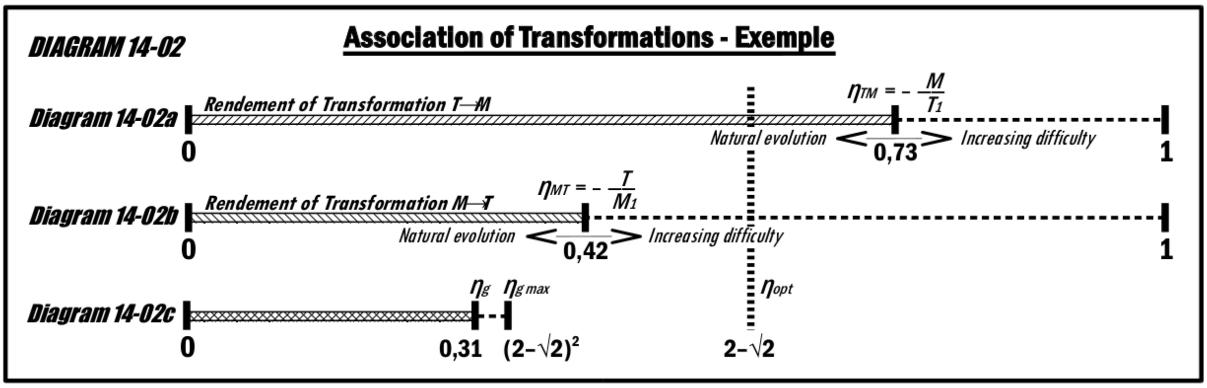
- η_{TM} = 0.73 for the angle = 15° (Figure 14-02a),
- η_{MT} = 0.42 for angle = 30° (Figure 14-02b),

in accordance with the results in the table. It follows that for this assumption the overall return is :

- η_g = 0.73 × 0.42 = 0.31 (Figure 14-02c)

It should be noted that when the *yield* of one transformation is equal to the *optimal yield* (η_{opt} = 2√2), the *yield* of the other transformation is also obligatory.

At this stage and for each transformation, it's necessary to determine the direction of evolution outside and under external constraints.



Generally speaking, *i.e.* whatever the discipline studied, we know that any *yield* is always defined as the ratio between what comes out of the *system* and what goes into it. There are therefore two possibilities for increasing efficiency, namely :

1. Decrease what enters,
2. Increase what goes out.

For the two transformations that interest us in this study, the *yields* are :

$$\eta_{TM} = - \frac{M}{T_1} \qquad \text{and :} \qquad \eta_{MT} = - \frac{T}{M_1}$$

The possibilities are listed chronologically as follows:

- For the transformation $T \rightarrow M$ $\Rightarrow$ first decrease T_1, then increase M,
- For the transformation $M \rightarrow T$ $\Rightarrow$ first decrease M_1, then increase T.

Transformation Work→Money

This transformation is represented by Figure 14-02a. By virtue of the Second Principle, we know that for the Transformer :

- *Laziness* is maximum,
- *Avarice* is minimal.

Therefore, it pursues the goal:

- to receive from the Seller the smallest possible amount of T_1 *Work to be done*. For this reason, the Transformer can only acquire a *Product* containing the minimum amount of *Work to be done*, and therefore containing the maximum amount of *Work done*. However, as the Transformer is indifferent to its *Money* it spends the maximum, as the Seller isn't bound by the Transformer's constraints with regard to the *Money*,
- to give the Acquirer as much *Work to be done* T_2 as possible (but always less than or equal to T_1).

Therefore :

$T_2 \rightarrow T_1$ then : $T_1 + T_2 \rightarrow 0$

By virtue of the First Principle, we know that:

$$- M = T_1 + T_2$$

As:

$T_1 + T_2 \rightarrow 0$ then: $- M \rightarrow 0$

Therefore, and knowing that the *yield* for this transformation is:

$$\eta_{TM} = - \frac{M}{T_1}$$

- the natural evolution goes along with the decrease of the *yield* and therefore tends towards 0,
- the evolution under constraint is suitable for increasing the *yield* and therefore tends towards 1.

*Transformation Money→**Work***

This transformation is represented by Figure 14-02b. By virtue of the Second Principle, we know that for the Transformer :

- *Avarice* is maximum,
- *Laziness* is minimal.

Therefore, it pursues the goal:

- to receive from the Buyer as much M_1 *Money* as possible,
- to give the Seller the smallest possible quantity of M_2 *Money* (but always less than or equal to M_1). For this reason, the Transformer can only acquire a *Product* containing the minimum amount of *Money realized*, therefore containing the maximum amount of *Money to be realized.* However, as the Transformer is indifferent to his *Work*, he spends the maximum, because the Seller isn't bound by the Transformer's constraints in relation to the *Work*. Consequently, the Seller receives the minimum amount of *Work to be done* T that leaves the *system.*

Therefore, the Seller receives the minimum amount of *Work to be done* T which goes out of the *system*:

$$M_2 \rightarrow 0$$

then:

$M_1 + M_2 \rightarrow M_1$

By virtue of the First Principle, we know that :

$- T = M_1 + M_2$

As:

$M_1 + M_2 \rightarrow M_1$ then: $- T \rightarrow M_1$

But however, as seen above, the Transformer tends to do the maximum amount of *Work*, to acquire the cheapest *Product* possible. Consequently, he assigns the minimum to the Seller. Therefore, the *Work* that comes out :

$- T = T_2 \rightarrow 0$

Because of this and knowing that the *yield* for this transformation is:

$$\eta_{MT} = - \frac{T}{M_1}$$

- the natural evolution agrees with the decrease of the *yield* and therefore tends towards 0,
- the evolution under constraint is suitable for increasing the *yield* and therefore tends towards 1.

<u>CONCLUSION</u>

Since one of the two *yields* is always higher and the other always lower than ($2-\sqrt{2}$), the result is that :

- ***a natural evolution of one yield causes the constrained evolution of the other and vice versa.***

Favouring the consumer to the detriment of the worker, as shown in Figures 14-02 (14-02a, 14-02b, 14-02c) therefore runs counter to the optimisation of the *economic system*. The exacerbated search for the lowest *price* provokes :

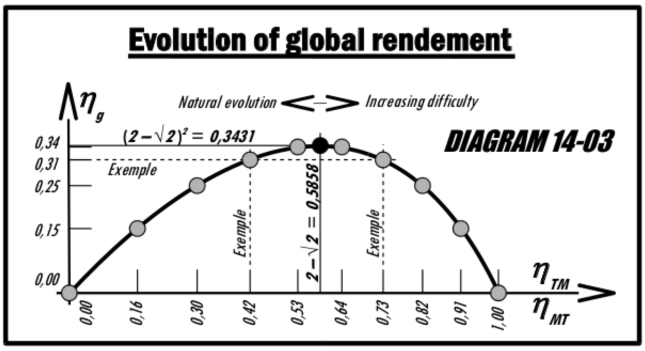
1. ***the increase in the yield of the transformation Work→Money, and thus the fall in the price of the Product related to this transformation, and the increase in purchasing power (relation 04-18),***
2. ***the concomitant decrease in the yield of processing Money→Work, and thus the decrease in labour for this processing, and the decrease in employment (relation 04-17).***

Consequently, as a corollary, this induces :

- ***the simultaneous and inexorable reduction of the overall yield.***

Moreover, it's possible to define the curve representing the global *yield* as a function of the *yields* of the two transformations, as shown in Figure 14-03. It is relevant to note that the more the respective *yields* ($T \rightarrow M$ and $M \rightarrow T$) of the two transformations deviate from the *optimal yield* ($\eta_{opt} = 2-\sqrt{2}$), the faster the *overall yield* (η_g) decreases.

Equally, it can also be said that the more the *yields* of the two transformations are different from each other, the lower the *overall yield* and the faster it decreases. This diagram clearly shows that the curve isn't as symmetrical as one might think at first sight. We know that variations in *Laziness* (*dP*) and *Avarice* (*dA*) are the causes of all economic evolutions. The relations 05-04 and 05-07, namely :



$dT = - U_P \cdot dP$ and : $dM = U_A \cdot dA$

are known (chapter “Basic principles”). But we have seen above that the returns of the two transformations are linked: if one increases, the other decreases and *vice versa*. We can therefore draw up the table below, which lists all the reciprocal effects of any variation in *Avarice* and/or *Laziness* (causes), either of the consumer or of the supplier, and how they relate to each other. It is possible to write :

1. Hypothesis 1 lists the variations of these characteristics:
   - for the consumer, if *Avarice* increases, *Laziness* also increases and *vice versa* for the supplier, *i.e.* :
   - $dA_{consumer} > 0 \Rightarrow dP_{consumer} > 0$
     $dA_{supplier} < 0 \Rightarrow dP_{supplier} < 0$

2. Hypothesis 2 lists the opposite variations of the previous hypothesis :
   - for the consumer, if *Avarice* decreases, *Laziness* also decreases and conversely for the supplier, *i.e.* :
   - $dA_{consumer} < 0 \Rightarrow dP_{consumer} < 0$
     $dA_{supplier} > 0 \Rightarrow dP_{b\,supplier} > 0$

3. Hypothesis 3 indicates, for the record, the absence of evolution when a characteristic is constant, *i.e.* :
   - $dA_{consumer} = 0 \Rightarrow dP_{consumer} = 0$
     $dA_{supplier} = 0 \Rightarrow dP_{supplier} = 0$

Hyp.	Reciprocal influences of variations in causes			
	Causes	**Consumer**		**Supplier**
1	**Economy of *Money***	➚	⇔	➘
		⇕		⇕
	Economy of Work	➚	⇔	➘
2	**Economy of *Money***	➘	⇔	➚
		⇕		⇕
	Economy of Work	➘	⇔	➚
3	**Economy of *Money***	➔	⇔	➔
		⇕		⇕
	Economy of Work	➔	⇔	➔

Instead of considering the influences of variations in the causes of the transformations (variations in *Avarice* and *Laziness*), it's possible to present the influences of variations in their consequences (variations in *Money* and *Work*), as below, which is certainly much more telling.

Hyp.	RECIPROCAL INFLUENCES OF CHANGES IN CONSEQUENCES			
	Causes	**Consumer**		**Supplier**
1	***Money***	➚	⇔	➘
		⇕		⇕
	Work	➘	⇔	➚
2	***Money***	➘	⇔	➚
		⇕		⇕
	Work	➚	⇔	➘
3	**Work**	➔	⇔	➔
		⇕		⇕
	Money	➔	⇔	➔

From the tables showing the reciprocal influences (causes and consequences), and as already mentioned several times, it can be said that if the *Avarice* (A) of the consumer increases, then the heat (Q) also increases. Indeed, if the consumer's *Avarice* (A) increases, the supplier's *Laziness* (dP) decreases, therefore his *Work* (dT) increases and, consequently, the energy needed for this increase. This corresponds well to reality. In fact, the greater the *Work done* by the supplier, the lower the *price*, which leads to a surplus of *Money* for the consumer and, therefore, allows him to acquire more and/or higher quality *Product*s.

- ***AN ECONOMIC DECISION IS NEVER NEUTRAL, NEITHER ON WORK NOR ON MONEY.***
  - ***it acts inversely for an actor,***
  - ***it acts identically for two actors.***

Moreover, for the least bad or the best (harmonious) functioning of the economic *system* under examination, it's necessary that :

- ***any economic decision or action must seek the maximum overall efficiency*** $-\eta_{g\,max} = (2 - \sqrt{2})^2$

It is reiterated here that this doesn't in any way reflect a recommended policy, but only the physical consequences of the natural mathematical laws developed in this introductory note. As a consequence of the two transformations (*Work→Money* and *Money→Work*), it's obligatory to concretely ensure social justice and equality or to converge on them as much as possible. Therefore, no arguments based on criteria of morality, probity, honesty, *etc.*, can be provided and presented here. This essay, therefore, has absolutely no aim of proposing or suggesting any kind of policy, but is limited only to uncovering and understanding the phenomena occurring in economic exchanges. Moreover, it doesn't make any value judgement on past, present or future economic policy.

15 – PRODUCT AND MONEY – SUPPLY AND DEMAND

ABSTRACT: It has already been explained how supply and demand should be understood in this study, namely that these characteristics should be defined as speeds, flows and absolutely not as quantities of things, of Products (goods and services). Indeed, by considering them as flows they are placed in a physical context whereas they are placed in an accounting situation in the opposite case, i.e. as it is usually agreed.

Although the law of supply and demand is not used in this essay, it is not forbidden to reflect on it and to make some remarks but obviously considering them as speeds.

Definition of the supply

Supply S must be considered as a *speed*, as it's necessary to clearly specify the time during which a certain number of copies of the *Product* are placed on the market. For example, it's said that the offer is 2,500 packets of radish seeds per week. This *speed* can also be called the "*manufacturing speed*" of the *Product*, *i.e.* the number of *Product*s manufactured per unit of time. This number will be indicated by "$_S$" as an index. However, as a general rule, there are several suppliers who don't manufacture the *Product* at the same *speed*, but it's always possible to determine an average *speed*.

The offer can therefore be defined as follows:

$$S = \frac{Quantity\ of\ products\ manufactured}{time} = \frac{Q_s}{t}$$

either analytically :

$$\boxed{S = \frac{dQ_S}{dt}} \qquad \langle 15\text{-}01\rangle$$

Compared to physics, this *speed*, *i.e.* the *supply*, is similar to the speed of rotation, *i.e.* the number of revolutions, cycles, piston strokes per unit of time chosen. In fact, per unit of time, we count the number of cycles of an engine that have been done and here we must count the number of copies manufactured. However, during the period of time considered for the measurement, it's possible that this speed may have varied. To go from Saint-Maximin (30700) to Saint-Maximin (60740), it's certain that the speed of a motorist, a cyclist or any other mobile isn't constant but this doesn't change the reasoning and it's still possible to determine an average speed. It is strictly the same in Economy, where the *manufacturing speed* may change, for example in one year, but it's possible to calculate an average production over this time, even if there are several suppliers manufacturing the *Product* at different speeds.

Consequently, the number of copies produced Q_S is the number of times the *labour* or the *task* has been done during the time period considered (unit of time).

Definition of the demand

In the same way as *supply*, *demand D* must be considered as *speed*, as it's necessary to specify the time during which a certain number of copies of the *Product* are sold. Indeed, it's said, for example, that demand is 888 pairs of Charentaises per day. This number will be indicated by "$_D$" as an index. However, as a general rule, there are several suppliers who do not sell the *Product* at the same *speed*, but it's always possible to determine an average *speed*.

The demand can therefore be defined as follows:

$$D = \frac{Quantity\ of\ products\ sold}{time} = \frac{Q_D}{t}$$

either analytically :

$$\boxed{D = \frac{dQ_D}{dt}} \qquad \text{‹15-02›}$$

The number of copies sold Q_D is the number of times the *price* or *Value* has been realised during the relevant period of time (unit of time).

Note on supply and demand

We have seen that *supply* and *demand* should be considered as *speeds*. Compared to mechanics, these characteristics are similar to no-load speed and laden speed respectively. Indeed :

- in mechanics, the no-load speed is a fixed speed which is determined beforehand by the manufacturer. Identically in Economy, the *supply* is a fixed *speed* which is determined beforehand by the manufacturer. He is perfectly free to set the quantity of *Product*s he manufactures per unit of time, *i.e.* the offer is only a function of the value decided by the manufacturer,
- in mechanics, the speed under load is a variable speed according to the external stresses exerted. Identically in Economy, the *demand* is a variable *speed* depending on the external constraints that apply to consumers (Buyers).

It is possible to report the relations 15-01 and 15-02 and to write :

$$\boxed{\frac{D}{S} = \frac{dQ_D}{dQ_S} \leq 1} \qquad \text{‹15-03›}$$

because the number of copies sold can never be greater than the number of copies produced, which implies that the above ratio is always less than or equal to the limit equal to *1*.

This is identical to the mechanics where the ratio of the loaded and unloaded gears is always less than *1*. It is possible to write the following sequential sequences :

- in physics : if the constraint ⬈ ⇒ the space ⬊ ⇒ the laden speed ⬊
- in Economics : if the constraint ⬈ ⇒ the *price* ⬊ ⇒ the demand ⬊

A priori, it seems that the sequence relating to the Economy is erroneous, since demand should normally increase when the *price* decreases. However, assuming that this is the case, the constraint is on consumers, as stated above, and not on the Transformer as considered throughout the note. Indeed, if consumers are under constraint, this indicates that they have less *Money*. For example :

- if, due to exceptional winter weather situations, temperatures are excessively low, energy consumption for heating will be increased. *Cash* spent in excess and containing a certain amount of *Money* will be lacking for the acquisition of another *Product*.
- if, for any reason, the State increases tax levies (taxes, charges, fines, ...) consumers will be subject to greater constraints forcing them to consume less,
- *etc.*, as it would be possible to present a large number of comparable situations.

In all the examples cited and others, the consequence is always a decrease in demand. It should be noted that if consumers have more *money* at their disposal, *e.g.* because of an increase in certain allowances, then they will no longer be “under pressure to consume less” but “under incentives to consume more”.

Product and Cash ⇒ *Macroeconomic Characteristics*

We know that there are two flows that circulate in opposite directions and that are :

- a flow of *Product*, going from the supplier to the consumer,
- a flow of *Cash*, from the consumer to the supplier.

However, every time we speak, in one way or another, of the “law of *supply* and *demand*”, there is always and exclusively an implicit reference to the *Product*. In fact, this “law” concerns the *supply* of any *Product*, its *price* and its *demand*.

However, in the same way it's possible to conceive of a similar law relating to *Cash,* indeed:

1. if we can ensure that the consumer asks for a *Product*, we can also affirm that he offers *Cash* in return,
2. if it can be ascertained that the supplier is offering a *Product*, it can also be ascertained that he is asking for *Cash* in return.

It is therefore necessary to finally take into account two "laws" that must be discerned by the object to which they apply, namely :

1. the "law of *supply* and *demand*" of *Product*,
2. the "law of *supply* and *demand*" of *Cash*.

The symbols relating to the characteristics of *supply* and *demand* shall henceforth be supplemented as follows:

S_A = *offer of Cash*,
S_P = *offer of product*,
D_A = *demand for money*,
D_P = *demand for Product*,

As a result, the following relationships can be made:

$$D_P = \frac{S_A}{p} \qquad \text{and :} \qquad D_A = S_P \cdot p \qquad \langle 15\text{-}04\rangle\ \langle 15\text{-}05\rangle$$

Indeed, it's quite certain that the number of *Product*s (D_P) that can be purchased is indeed equal to the amount of *Cash* (S_A) that consumers can spend on them divided by the *price* (p) of these *Product*s. In the same way, it's certain that the quantity of *Cash* (D_A) requested by the supplier is equal to the number of *Product*s (S_P) manufactured multiplied by their *price* (p).

These relationships can be written as follows:

$$p = \frac{S_A}{D_P} \qquad \text{and :} \qquad p = \frac{D_A}{S_P} \qquad \langle 15\text{-}06\rangle\ \langle 15\text{-}07\rangle$$

By levelling, we obtain :

$$\frac{S_A}{D_P} = \frac{D_A}{S_P}$$

either :

$$\boxed{S_A \cdot S_P = D_A \cdot D_P} \qquad \langle 15\text{-}08\rangle$$

The analysis of this relationship gives :

- If the consumer's *supply* of *Cash* decreases, then either:

  1. the consumer's *demand* for *Product*s decreases proportionally,
  2. the supplier's *demand* for *Cash* decreases proportionally,

3. the offer of *Products* by the supplier increases proportionally because the supplier decreases the *price* according to the relation 15-04 above.

and *vice versa*. All this is perfectly logical.

- If the offer of *Products* by the supplier decreases, then either :

1. the *offer* of *Cash* by the consumer increases proportionally. Some Acquirers with a great *Utility* of the *Product* will be ready to acquire it at a higher *price*,
2. the consumer demand for *Products* decreases proportionally because only Buyers with a high *Utility* of the *Product* will be willing to purchase it,
3. the supplier's demand for *Cash* decreases proportionally, because in this case this implies that the supplier is satisfied with what he has.

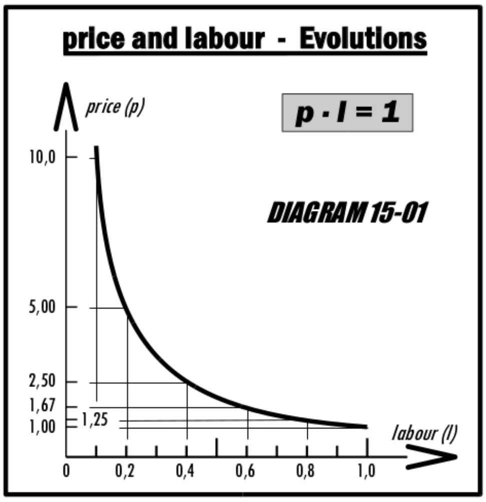
and *vice versa*. All this makes perfect sense.

Relationship 15-08 shows the interweaving of all the characteristics governing trade relations at the macroeconomic level. It shows that these characteristics of *supply* and *demand*, either of *Products* or of *Cash*, are interrelated and cannot, under any circumstances, be dissociated.

Identically to the relations 15-04 and 15-05 above, it's possible to pose the following relations:

$D_P = S_A \cdot l$ and : $D_A = \frac{S_P}{l}$ **‹15-09› ‹15-10›**

Indeed, it's quite certain that the number of *Products* (D_P) that can be purchased is indeed equal to the amount of *Cash* (S_A) that consumers can spend on them multiplied by the *labour to be done* (l). In the same way, it's certain that the quantity of *Cash* (D_A) requested by the supplier is equal to the number of *Products* (S_P) manufactured divided by the *labour to be done* (l).



The relation 15-10 above can be written as follows:

$$\frac{D_A}{S_P} = \frac{1}{l}$$

which can be equated with the relation 15-07, and gives :

$$\boxed{p \cdot l = 1}$$ **‹15-11›**

This relationship shows that the closer a *Product* is to the end of its manufacturing process, the more expensive it's, which isn't absurd. However, during this manufacturing process, as the *labour to be done* becomes smaller and smaller, the *price* evolution is faster and faster.

In reality, however, the *price* evolution is much stronger in the chronological sequence of the different participants. Indeed, in the vast majority of cases, the share of the *price* due to the manufacturer *stricto sensu* is always in the minority. The preponderant share is almost always due to the various subsequent participants such as intermediaries, wholesalers and retailers, each of whom adds a percentage to the *price* that the *Product* costs him. This percentage is generally more or less constant, resulting in an increasingly rapid increase in *price*.

Other macroeconomic relationships

Among the four characteristics (S_A, S_P, D_A, D_P) the most economically important are the supply of *Cash* (S_A) and the demand for *Products* (D_P). However, it's possible to calculate the other two characteristics (S_P and D_A).

1. ***Supply of Cash (S_A)***

Starting from the relationship 08-12, namely :

$$F_P \cdot l = r_A \cdot U_A$$

either:

$$l = r_A \cdot \frac{U_A}{F_P}$$

Replacing *labour* in the 15-09 relationship, namely:

$$D_P = S_A \cdot l \quad \Rightarrow \quad S_A = \frac{D_P}{l}$$

This gives :

$$\boxed{S_A = \frac{D_P \cdot F_P}{r_A \cdot U_A}} \qquad \text{‹15-12›}$$

where the numerator shows the characteristics relating to the *Product* and the denominator shows those relating to *Cash*. So :

- the greater the *demand* for the *Product*, the greater the *supply* of *Cash*.
- the higher the Buyer's *Laziness Force* is, the higher the *Cash supply* is, since the *labour* is all the weaker, for the same *Utility of Cash*. Indeed, the lazier an individual is, the more inclined he is to spend *Cash* in order not to perform the *labour*.
- the weaker the *Utility* of *Cash*, the stronger the *supply* of *Cash*, since *labour* is all the weaker, for the same Lazy *Force*. Indeed, if for a Buyer the *Utility* of *Cash* is low, this implies that his *Avarice* is also low and that he can therefore easily spend his *Cash*.

2. ***Product Offer (S_P)***

Starting from the relationship 08-04, namely :

$$F_A \cdot p = r_P \cdot U_P$$

either:

$$p = r_P \cdot \frac{U_P}{F_A}$$

By replacing the *price* in the 15-05 relationship, namely:

$$D_A = S_P \cdot p \quad \Rightarrow \quad S_P = \frac{D_A}{p}$$

This gives :

$$\boxed{S_P = \frac{D_A \cdot F_A}{r_P \cdot U_P}} \qquad \textbf{‹15-13›}$$

where the numerator shows the characteristics relating to the *Product* and the denominator shows those relating to C*ash, so:*

- the greater the *demand* for *Cash*, the greater the *supply* of *Product*s.
- the greater the *Avarice Force* of the Buyer, the greater the *supply* of *Product*s, since the *price* is lower for the same *Utility* of the *Product*. Indeed, the more avare a Buyer is, the less inclined he is to spend *Cash*. The Transformer is encouraged to produce more.
- the weaker the *Product Utility*, the stronger the *Product* offer, since the *price* is all the weaker, for the same *Force* of *Avarice*.

3. ***Demand for Cash (D_A)***

Starting from the relationship 08-12, namely :

$$F_P \cdot l = r_A \cdot U_A$$

either:

$$l = r_A \cdot \frac{U_A}{F_P}$$

Replacing *labour* in the 15-10 relationship, namely:

$$D_A = \frac{S_P}{l}$$

that gives:

$$\boxed{D_A = \frac{S_P \cdot F_P}{r_A \cdot U_A}} \qquad \textbf{‹15-14›}$$

where the numerator shows the characteristics relating to *Cash* and the denominator shows the characteristics relating to the *Product*. Then :

- the greater the *supply* of *Products*, the greater the *demand* for *Cash*. In fact, if the Transformer asks for a lot of *Cash*, he will produce a lot in order to sell a lot and collect as much as possible.
- the higher the Buyer's *Laziness Force* is, the higher the *demand* for *Cash*, since the *labour to be done* is all the less, for the same *Utility* of *Cash*. Indeed, if the *Lazy Power* is high, it means that the Buyer prefers to buy rather than manufacture. The Transformer will ask for more *Cash* because he will do the *labour*.
- the lower the *Utility* of *Cash* is, the higher the demand for *Cash* since the *labour* is higher for the same *Force* of *Avarice*.

4. ***Product Demand (D_P)***

We are familiar with the 08-04 relationship :

$$F_A \cdot p = r_P \cdot U_P$$

either :

$$p = r_P \cdot \frac{U_P}{F_A}$$

By replacing the *price* in the 15-04 relationship, namely:

$$D_P = \frac{S_A}{p}$$

it gives:

$$\boxed{D_P = \frac{S_A \cdot F_A}{r_P \cdot U_P}} \qquad \textbf{‹15-15›}$$

where the numerator shows the characteristics relating to *Cash* and the denominator shows the characteristics relating to the *Product*. Then :

- the greater the *supply* of *Cash*, the greater the *demand* for the *Product*.

- the higher the *Avarice Force* of the Buyer, the stronger the *demand* for the *Product*, since the *price* is lower for the same *Utility* of the *Product*.
- the lower the *Utility of the Product*, the stronger the *demand* for the *Product*, since the *price* is lower for the same *Avarice Force*.

The analyses of these four relations are perfectly logical and thus present the coherence of the Core Laws (relations 08-04 and 08-12).

Moreover, it should be noted that the relations set out in this chapter (15-01, 15-02, 15-03, 15-08, 15-11, 15-12, 15-13, 15-14, 15-15) and which have just been posed can be considered as making a link between microeconomics and macroeconomics.

16 – ECODYNAMIC POTENTIALS

ABSTRACT: This chapter defines and presents the characteristics corresponding to thermodynamic potentials, which can therefore be called "ecodynamic potentials". However, its main interest lies in the presentation of the spontaneous variations of these characteristics, i.e. how they evolve according to the constraints to which the agents are subjected.

State functions

By definition "state functions" are only a function of the final and initial values and in no way of the method and path followed between these values. Only the values at the end and at the beginning of the transformation are taken into account. However, it should be noted that these relationships are only valid in the absence of losses.

In Economics, in the two transformations $T \to M$ and $M \to T$, the functions already known (*Internal Energy* E_{TM} and *Empraxia* X on the one hand and *Internal Energy* E_{MT} and *Enomailia* L on the other hand) as well as those defined below (*Free Energy* ${E_{TM}}^L$ and *Free Empraxia* X^L on the one hand and *Free Energy* ${E_{MT}}^L$ and *Free Enomailia* L on the other hand) are state functions because they are only defined by their values at the beginning and at the end of the transformation. To conclude, depending on the transformations, the functions :

- *Internal energy* E_{TM} ⇔ *Internal energy* E_{MT}
- *Free Energy* ${E_{TM}}^L$ ⇔ *Free Energy* ${E_{MT}}^L$
- *Empraxia* X ⇔ *Enomailie* L
- *Free Empraxia* X^L ⇔ *Free Enomailie* L^L

are state functions because they only refer in all cases, *i.e.* depending on the circumstances in which the transformations take place, to :

- *Work supplied* (transmitted) and *Money created* (transmitted), in the $T \to M$ transformation,
- to the *Money provided* (transmitted) and to the *Work created* (transmitted $M \to T$), in the transformation.

They are therefore only a function of changes in the quantities of these characteristics (*Work* and *Money*). These variations are obviously equal and only equal to the difference between the final and initial values of these quantities, since it was assumed at the beginning of the paragraph that the transformations occur without losses. If there were losses (which cannot be known with certainty), they would no longer be state functions because these losses are, of course, a function of the path followed, of the method used, between the initial and final states.

Transformation T→M ⇒ *Free energy*

In the $T \rightarrow M$ transformation, the 09-03 relationship, namely :

$$\Delta P_{(E)} + \frac{\Delta E_{TM(E)}}{U_{P0}} \geq 0$$

can be written:

$$\Delta E_{TM(E)} + U_{P0} \cdot \Delta P_{(E)} \geq 0$$

By considering this relation at the end (*f*) and the beginning (*i*) of the transformation, it's possible to write :

$$\left(\Delta E_{TM_{(E)}} + U_{P0} \cdot \Delta P_{(E)}\right)_{(f)} - \left(\Delta E_{TM_{(E)}} + U_{P0} \cdot \Delta P_{(E)}\right)_{(i)} \geq 0$$

By posing :

Free energy: $\boxed{E^L_{TM} = E_{TM} + U_P \cdot P}$ **‹16-01›**

and by replacing it, you get :

$$E^L_{TM(f)} - E^L_{TM(i)} \geq 0$$ **‹16-02›**

The *Free Energy* differential is :

$$dE^L_{TM} = dE_{TM} + U_P \cdot dP + P \cdot dU_P$$

But we know that (relation 06-02):

$$dE_{TM} = - U_P \cdot dP + F_A \cdot dp$$

By replacing and simplifying, we get:

$$\boxed{dE^L_{TM} = P \cdot dU_P + F_A \cdot dp}$$ ‹16-03›

Transformation T→M ⇒ *Free Empraxia*

Let's always consider the same entrepreneur who wants to manufacture existing *Product*s already on the market and of course sell them, and let's assume that he is subject to the same *Avarice Force* as the other Transformers. The existing *Product*s obviously have a fixed and therefore constant *Utility*, however the *price* (*Value*) of these *Product*s will evolve, therefore *Money* will be created or lost but will have to be added to the *Money* of the *system*. This *Money* is equal to (relation 04-10):

$$dM = F_A \cdot dp$$

By posing : $F_{A0} =$ *Constant Avarice Force*
this relationship becomes :

$$dM = F_{A0} \cdot dp$$

which for a finite variation is written:

$$\Delta M = F_{A0} \cdot \Delta p$$

The relation 09-03, namely:

$$\Delta P_{(E)} + \frac{\Delta E_{TM(E)}}{U_{P0}} \geq 0$$

can be written:

$$\Delta E_{TM(E)} + U_{P0} \cdot \Delta P_{(E)} \geq 0$$

Now, in the case which interests us here (isopheles and isobars) and in case of equality, this relation represents the variation of the *Internal Energy* of the *global system* which is equal to the quantity of *Money* (created or destroyed) defined above. Consequently, the relation is modified as follows:

$$\Delta E_{TM(E)} + U_{P0} \cdot \Delta P_{(E)} \geq F_{A0} \cdot \Delta p$$

or :

$$\Delta E_{TM(E)} + U_{P0} \cdot \Delta P_{(E)} - F_{A0} \cdot \Delta p \geq 0$$

Considering this relation at the end (*f*) and at the beginning (*i*) of the transformation, it's possible to write :

$$\left(\Delta E_{TM(E)} + U_{P0} \cdot \Delta P_{(E)} - F_{A0} \cdot \Delta p\right)_{(f)} - \left(\Delta E_{TM(E)} + U_{P0} \cdot \Delta P_{(E)} - F_{A0} \cdot \Delta p\right)_{(i)} \geq 0$$

By posing :

Free Empraxia: $$\boxed{X^L = E_{TM} + U_P \cdot P - F_A \cdot p}$$ **‹16-04›**

it's possible to write :

$$X^L{}_{(f)} - X^L{}_{(i)} \geq 0$$ ‹16-05›

With relationship 16-01, relationship 16-04 becomes :

$$\boxed{X^L = E^L_{TM} - F_A \cdot p}$$ ‹16-06›

and with the relationship 09-07, we get :

$$\boxed{X^L = X + U_P \cdot P}$$ ‹16-07›

The differential of *Free Empraxia* is :

$$dX^L = dE_{TM} + U_P \cdot dP + P \cdot dU_P - F_{A0} \cdot dp - p \cdot dF_{A0}$$

But we know that (relation 06-02):

$$dE_{TM} = - U_P \cdot dP + F_{A0} \cdot dp$$

By replacing and simplifying, we obtain:

$$\boxed{dX^L = P \cdot dU_P - p \cdot dF_A}$$ ‹16-08›

*Transformation M→**T*** ⇒ *Free energy*

In the $M \rightarrow T$ transformation, the 09-05 relationship, namely :

$$\Delta A_{(E)} - \frac{\Delta E_{MT(E)}}{U_{A0}} \geq 0$$

can be written :

$$\Delta E_{MT(E)} - U_{A0} \cdot \Delta A_{(E)} \leq 0$$

Considering this relation at the end (*f*) and the beginning (*i*) of the transformation, it's possible to write :

$$\left(\Delta E_{MT_{(E)}} - U_{A0} \cdot \Delta A_{(E)} \right)_{(f)} - \left(\Delta E_{MT_{(E)}} + U_{A0} \cdot \Delta A_{(E)} \right)_{(i)} \leq 0$$

By posing :

Free energy: $$\boxed{E^L_{MT} = E_{MT} - U_A \cdot A}$$ ‹16-09› and by replacing it, you get :

$$E^L_{MT(f)} - E^L_{MT(i)} \leq 0 \qquad \langle 16\text{-}10 \rangle$$

The *Free Energy* differential is :

$$dE^L_{MT} = dE_{MT} - U_A \cdot dA - A \cdot dU_A$$

But we know that (relation 06-04):

$$dE_{MT} = U_A \cdot dA - F_P \cdot dl$$

By replacing and simplifying, we get:

$$\boxed{dE^L_{MT} = -A \cdot dU_A - F_P \cdot dl} \qquad \langle 16\text{-}11 \rangle$$

*Transformation M→**T*** ⇒ *Free enomailia*

Using the same reasoning for the $M \rightarrow T$ transformation. Existing *Product*s obviously have a fixed and therefore constant *Utility*, however the *labour* (*task*) to elabourate these *Product*s will evolve, since the Lazy *Force* is also considered to be constant.

As a result, *Work* will be created or lost and will have to be added to the *system*.

This *Work* is equal to (relation 04-09):

$$dT = - F_P \cdot dl$$

By posing : $F_{P0} = Constant\ Lazy\ Force$

this relationship becomes :

$$dT = - F_{P0} \cdot dl$$

which for a finite variation is written:

$$\Delta T = - F_P \cdot \Delta l$$

The relationship 09-05, namely:

$$\Delta A_{(E)} - \frac{\Delta E_{MT(E)}}{U_{A0}} \geq 0$$

can be written:

$$\Delta E_{MT_{(E)}} - U_{A0} \cdot \Delta A_{(E)} \leq 0$$

Now, in the case which interests us here (isopheles and isobars) and in case of equality, this relation represents the variation of the *Internal Energy* of the *global system* which is equal to the quantity of *Work* (created or destroyed) defined above.

Consequently, the relation is modified as follows:

$$\Delta E_{MT_{(E)}} - U_{A0} \cdot \Delta A_{(E)} \leq - F_P \cdot \Delta l$$

or :

$$\Delta E_{MT_{(E)}} - U_{A0} \cdot \Delta A_{(E)} + F_P \cdot \Delta l \leq 0$$

Considering this relation at the end (*f*) and the beginning (*i*) of the transformation, it's possible to write :

$$\left(\Delta E_{MT_{(E)}} - U_{A0} \cdot \Delta A_{(E)} + F_P \cdot \Delta l \right)_{(f)} - \left(\Delta E_{MT_{(E)}} - U_{A0} \cdot \Delta A_{(E)} + F_P \cdot \Delta l \right)_{(i)} \leq 0$$

By posing :

Free enomaillie: $$\boxed{L^L = E_{MT} - U_A \cdot A + F_P \cdot l}$$ **‹16-12›**

and by replacing it, you get :

$$L^L{}_{(f)} - L^L{}_{(i)} \leq 0$$ **‹16-13›**

With relationship 16-09, relationship 16-12 becomes :

$$\boxed{L^L = E^L_{MT} + F_P \cdot l}$$ **‹16-14›**

and with the relationship 09-11 we get :

$$\boxed{L^L = L - U_A \cdot A}$$ **‹16-15›**

The differential of *Free Enomaillie* is :

$$dL^L = dE_{M-T} - U_A \cdot dA - A \cdot dU_A + F_P \cdot dl + l \cdot dF_P$$

But we know that (relation 06-04):

$$dE_{MT} = U_A \cdot dA - F_P \cdot dl$$

By replacing and simplifying, we obtain:

$$\boxed{dL^L = - A \cdot dU_A + l \cdot dF_P}$$ **‹16-12›**

Ecodynamic potentials ⇒ Summary

Throughout this summary, the *price* symbol p has been replaced by the *Value Added* symbol V, and the *labour* symbol l has been replaced by the *task to be added* symbol B, which doesn't change the reasoning.

Four functions have been defined in each of the two Transformations ($T \rightarrow M$ and $M \rightarrow T$), the differentials of which can be summarised as follows:

1. ***Transformation T→M*** ⇒ ***Potential***

- *Free energy* ⇒ $E^L_{TM} = E_{TM} + U_P \cdot P$ **‹16-01›**
- *Empraxia* ⇒ $X = E_{TM} - F_A \cdot V$ **‹09-07›**
- *Free Empraxia* ⇒ $X^L = E^L_{TM} - F_A \cdot V$ **‹16-06›**
- *Free Empraxia* ⇒ $X^L = X + U_P \cdot P$ **‹16-07›**

2. ***Transformation M→T*** ⇒ ***Potential***

- *Free energy* ⇒ $E^L_{MT} = E_{MT} - U_A \cdot A$ **‹16-09›**
- *Enomaillia* ⇒ $L = E_{MT} + F_P \cdot B$ **‹09-11›**
- *Free Enomailia* ⇒ $L^L = E^L_{MT} + F_P \cdot B$ **‹16-14›**
- *Free Enomailia* ⇒ $L^L = L - U_A \cdot A$ **‹16-15›**

Whose differentials are :

1. ***T→M transformation*** ⇒ ***Potential differentials***

- *Internal energy* ⇒ $dE_{TM} = - U_P \cdot dP + F_A \cdot dV$ **‹06-02›**
- *Free energy* ⇒ $dE^L_{TM} = + P \cdot dU_P + F_A \cdot dV$ **‹16-03›**
- *Empraxia* ⇒ $dX = - U_P \cdot dP - V \cdot dF_A$ **‹09-10›**
- *Free Empraxia* ⇒ $dX^L = + P \cdot dU_P - V \cdot dF_A$ **‹16-08›**

2. ***M→T transformation*** ⇒ ***Differentials of potentials***

- *Internal energy* ⇒ $dE_{MT} = + U_A \cdot dA - F_P \cdot dB$ **‹06-04›**
- *Free energy* ⇒ $dE^L_{MT} = - A \cdot dU_A - F_P \cdot dB$ ***‹16-11›***
- *Enomailia* ⇒ $dL = + U_A \cdot dA + B \cdot dF_P$ ***‹09-14›***
- *Free Enomailia* ⇒ $dL^L = - A \cdot dU_A + B \cdot dF_P$ ***‹16-16›***

From the functions that have just been summarised and for each transformation, it's possible to derive the relationships indicated below:

1. ***Transformation T→M*** ⇒ ***Partial Differentials of Variables***

- $$F_A = + \left(\frac{\partial E_{TM}}{\partial V}\right)_P = + \left(\frac{\partial E_{TM}^L}{\partial V}\right)_{U_P} \quad \text{‹16-17›}$$
- $$V = - \left(\frac{\partial X}{\partial F_A}\right)_P = - \left(\frac{\partial X^L}{\partial F_A}\right)_{U_P} \quad \text{‹16-18›}$$
- $$U_P = - \left(\frac{\partial E_{TM}}{\partial P}\right)_V = - \left(\frac{\partial X}{\partial P}\right)_{F_A} \quad \text{‹16-19›}$$
- $$P = + \left(\frac{\partial E_{TM}^L}{\partial U_P}\right)_V = + \left(\frac{\partial X^L}{\partial U_P}\right)_{F_A} \quad \text{‹16-20›}$$

2. ***Transformation M→T*** ⇒ ***Partial Differentials of Variables***

- $$F_P = - \left(\frac{\partial E_{MT}}{\partial B}\right)_A = - \left(\frac{\partial E_{MT}^L}{\partial B}\right)_{U_A} \quad \text{‹16-21›}$$
- $$B = + \left(\frac{\partial L}{\partial F_P}\right)_A = + \left(\frac{\partial L^L}{\partial F_P}\right)_{U_A} \quad \text{‹16-22›}$$
- $$U_A = + \left(\frac{\partial E_{MT}}{\partial A}\right)_B = + \left(\frac{\partial L}{\partial A}\right)_{F_P} \quad \text{‹16-23›}$$
- $$A = - \left(\frac{\partial E_{MT}^L}{\partial U_A}\right)_B = - \left(\frac{\partial L^L}{\partial U_A}\right)_{F_P} \quad \text{‹16-24›}$$

as well as :

1. ***Transformation T→M*** ⇒ ***Maxwell Relationships***

- $$- \left(\frac{\partial U_P}{\partial V}\right)_P = + \left(\frac{\partial F_A}{\partial P}\right)_V \quad \text{‹16-25›}$$
- $$+ \left(\frac{\partial P}{\partial V}\right)_{U_P} = + \left(\frac{\partial F_A}{\partial U_P}\right)_V \quad \text{‹16-26›}$$
- $$- \left(\frac{\partial U_P}{\partial F_A}\right)_P = - \left(\frac{\partial V}{\partial P}\right)_{F_A} \quad \text{‹16-27›}$$
- $$+ \left(\frac{\partial P}{\partial F_A}\right)_{U_P} = - \left(\frac{\partial V}{\partial U_P}\right)_{F_A} \quad \text{‹16-28›}$$

2. ***Transformation M→T*** ⇒ ***Maxwell Relationships***

- $$+ \left(\frac{\partial U_A}{\partial B}\right)_A = - \left(\frac{\partial F_P}{\partial A}\right)_B \quad \text{‹16-29›}$$

- $-\left(\frac{\partial A}{\partial B}\right)_{U_A} = -\left(\frac{\partial F_P}{\partial U_A}\right)_B$ **‹16-30›**
- $+\left(\frac{\partial U_A}{\partial F_P}\right)_A = +\left(\frac{\partial B}{\partial A}\right)_{F_P}$ **‹16-31›**
- $-\left(\frac{\partial A}{\partial F_P}\right)_{U_A} = +\left(\frac{\partial B}{\partial U_A}\right)_{F_P}$ **‹16-32›**

Transformation T→M ⇒ *Spontaneous evolution*

By definition, if an evolution occurs spontaneously it means that the *system* is out of constraint, or at least that the constraint is decreasing. The relationship 09-03, namely :

$$\Delta P_{(E)} + \frac{\Delta E_{TM(E)}}{U_{P0}} \geq 0$$

can be written:

$$\Delta E_{TM(E)} \geq U_{P0} \cdot \Delta P_{(E)}$$

During a transformation to *Constant Laziness*, this equation becomes :

$$\Delta E_{TM} \geq 0$$

can be written:

Internal energy : $E_{TM(f)} - E_{TM(i)} \geq 0$ **‹16-33›**

We know the definitions of potentials:

Free energy ⇒ $E^L_{TM(f)} - E^L_{TM(i)} \geq 0$ **‹16-02›**

Empraxia ⇒ $X_{(f)} - X_{(i)} \geq 0$ **‹09-09›**

Free Empraxia ⇒ $X^L{}_{(f)} - X^L{}_{(i)} \geq 0$ **‹16-05›**

These four relationships indicate that for a spontaneous evolution :

- *with constant added Value and Laziness, the Internal Energy always increases,*
- *with constant added Value and Product Utility, the Free Energy always increases,*
- *with constant Avarice and Laziness, Empraxia is always increasing,*
- *with constant Avarice Force and Product Utility, the Free Empraxia always increases,*

up to a maximum, depending on external constraints.

Transformation M→T ⇒ *Spontaneous evolution*

The 09-05 relationship, namely :

$$\Delta A_{(E)} - \frac{\Delta E_{MT(E)}}{U_{A0}} \geq 0$$

can be written :

$$\Delta E_{MT(E)} \leq U_{A0} \cdot \Delta A_{(E)}$$

During a transformation to *Constant Avarice*, this equation becomes :

$$\Delta E_{MT} \leq 0$$

can be written:

Internal energy : ⇒ $E_{MT(f)} - E_{MT(i)} \leq 0$ **‹16-34›**

We know the definitions of potentials:

Free energy ⇒ $E^L_{MT(f)} - E^L_{MT(i)} \leq 0$ **‹16-10›**

Enomaillia ⇒ $L_{(f)} - L_{(i)} \leq 0$ **‹09-13›**

Free Enomaillia ⇒ $L^L{}_{(f)} - L^L{}_{(i)} \leq 0$ **‹16-13›**

These four relationships indicate that for a spontaneous evolution :

- ***with constant Task to be added and constant Avarice, the Internal Energy always decreases,***
- ***with constant Task to be Added and Constant Cash Utility, the Free Energy always decreases,***
- ***with constant Force of Laziness and Avarice, the Enemaillia always decreases,***
- ***with constant Force of Laziness and Utility of Cash, Free Enemaillia always decreases,***

to a minimum, depending on external constraints.

Spontaneous development of potentials ⇒ *Summary*

The three tables below summarise and explain the spontaneous inverse potential changes between the two transformations and $T \rightarrow M$, and $M \rightarrow T$ compare them with those of thermodynamics.

Economy – Transformation *Work→Money*				
	Differential	**Constant Char.**	**Diff.**	**Potentials**
Internal Energy	$dE_{TM} = - U_P \cdot dP + F_A \cdot dV$	$dV = 0$ and $dP = 0$	$dE_{TM} \geq 0$	$\boldsymbol{E_{TM}} \nearrow$
Free energy	$dE_{TM}^L = - P \cdot dU_P + F_A \cdot dV$	$dV = 0$ and $dU_P = 0$	$dE_{TM}^L \geq 0$	$\boldsymbol{E_{TM}^L} \nearrow$
Empraxy	$dX = - U_P \cdot dP - V \cdot dF_A$	$dF_A = 0$ and $dP = 0$	$dX \geq 0$	$\boldsymbol{X} \nearrow$
Free empraxy	$dX^L = - P \cdot dU_P - V \cdot dF_A$	$dF_A = 0$ and $dU_P = 0$	$dX^L \geq 0$	$\boldsymbol{X^L} \nearrow$

Economy – Transformation *Money→Work*				
	Differential	**Constant Char.**	**Diff.**	**Potentials**
Internal Energy	$dE_{MT} = + U_A \cdot dA - F_P \cdot dB$	$dB = 0$ and $dA = 0$	$dE_{MT} \leq 0$	$\boldsymbol{E_{MT}} \searrow$
Free energy	$dE_{MT}^L = - A \cdot dU_A - F_P \cdot dB$	$dB = 0$ and $dU_A = 0$	$dE_{MT}^L \leq 0$	$\boldsymbol{E_{MT}^L} \searrow$
Enemaillie	$dL = + U_A \cdot dA + B \cdot dF_P$	$dF_P = 0$ and $dA = 0$	$dL \leq 0$	$\boldsymbol{L} \searrow$
Free Enemaillie	$dL^L = - A \cdot dU_A + B \cdot dF_P$	$dF_P = 0$ and $dU_A = 0$	$dL^L \leq 0$	$\boldsymbol{L^L} \searrow$

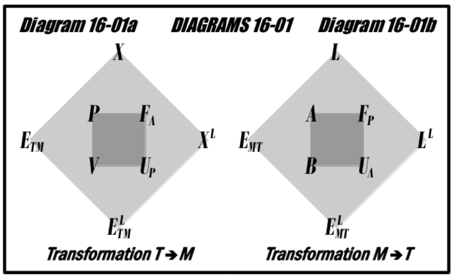
Thermodynamic – Transformation *Heat→Work*				
	Differential	**Constant Char.**	**Diff.**	**Potentials**
Internal Energy	$dU = + T \cdot dS - P \cdot dV$	$dV = 0$ and $dS = 0$	$dU \leq 0$	$\boldsymbol{U} \searrow$
Free energy	$dF = - S \cdot dT - P \cdot dV$	$dV = 0$ and $dT = 0$	$dF \leq 0$	$\boldsymbol{F} \searrow$
Enthalpy	$dH = + T \cdot dS + V \cdot dP$	$dP = 0$ and $dS = 0$	$dH \leq 0$	$\boldsymbol{H} \searrow$
Free Enthalpy	$dG = - S \cdot dT + V \cdot dP$	$dP = 0$ and $dT = 0$	$dG \leq 0$	$\boldsymbol{G} \searrow$

Note ⇒ *Mnemonics*

In thermodynamics there are 16 important relationships which can be classified as follows:

1. the relations of the definitions of potentials,
2. the relations of the differentials of the potentials,
3. the differential relationships of system variables,
4. the so-called Maxwell relationships.

Difficult to memorise, a mnemonic process was developed by Born and modified by Ji-Cheng Zhao. In this case, the number of relations is multiplied by 2, due to the presence of 2 transformations ($T \rightarrow M$ and $M \rightarrow T$), *i.e.* 32 relations.



In relation to the Zhao square (modified Born), the corresponding characteristics are placed, in an analogous way, as shown in the diagrams 16-01a and 16-01b, according to the two transformations. Therefore, the mnemonic rules must be similar, if not perfectly identical. In principle, these (mnemonic) paragraphs have no real justification in this test.

Despite this remark, since the relations relating to the $T \rightarrow M$ transformation always have signs opposite to those of the $M \rightarrow T$ transformation, it was sensible to ensure that the rules remained unchanged provided that this change of sign was taken into account.

For each set of relationships, only one example is presented and not every case that might exist.

The only examples given are :

- in the transformation $T \rightarrow M$ $\Rightarrow$ 09-07, 16-03, 16-18, 16-28
- in the transformation $M \rightarrow T$ $\Rightarrow$ 09-11, 16-11, 16-22, 16-32

Transformation T→M ⇒ *Examples*

Figures 16-02 (16-02a, 16-02b, 16-02c, 16-02d) will be valid taking into account the direction of the arrows, as in thermodynamics, but by inverting the sign in relation to the direction of the arrows, *i.e.* :

- **if the arrows go up ⇒ sign - (negative)**
- **if the arrows go down ⇒ sign + (positive)**

1. ***Potential (Figure 16-02a)***

   The example shown in Figure 16-02a gives :

   $$X = + E_{TM} - V \cdot F_A \qquad \langle 09\text{-}07 \rangle$$

   The other relationships are presented above under the references: 16-01, 16-06 and 16-07.

2. ***Potential differential (Figure 16-02b)***

   The example shown in Figure 16-02b gives :

   $$dE_{TM}^{L} = + P \cdot dU_P + F_A \cdot dV \qquad \langle 16\text{-}03 \rangle$$

The other relationships are presented above under the references: 06-02, 09-10 and 16-08.

3. ***Partial differential of potential and conjugated variables (Figure 16-02c)***
   The example shown in Figure 16-02c gives :

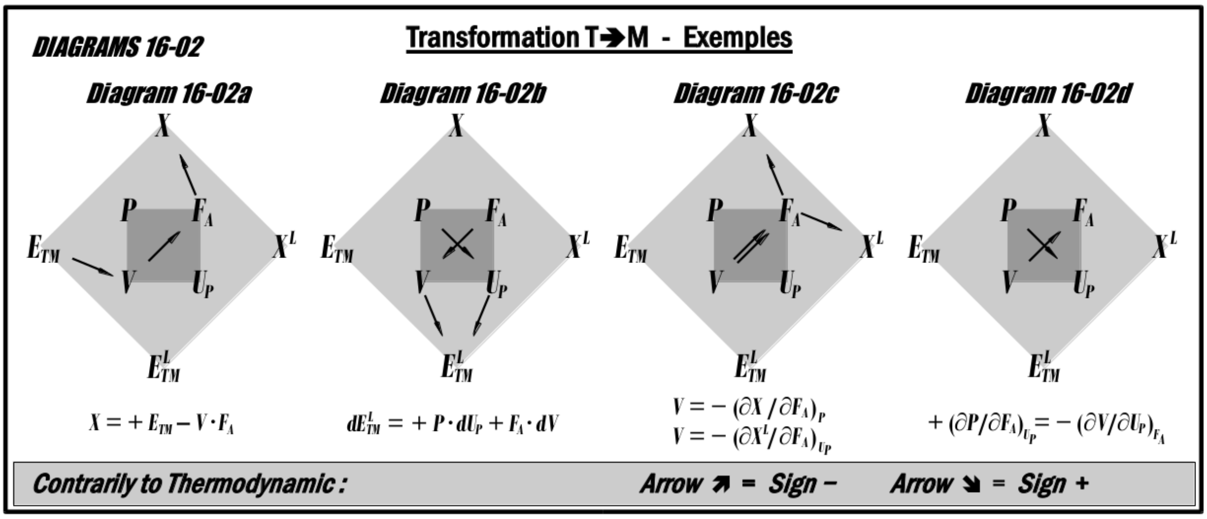
$$p \quad = - \left(\frac{\partial X}{\partial F_A} \right)_P \quad = - \left(\frac{\partial X^L}{\partial F_A} \right)_{U_P} \qquad \text{‹16-18›}$$

The other relationships are presented above under the references: 16-17, 16-19 and 16-20.

4. ***Maxwell relationship (Figure 16-02d)***
   The example shown in figure 16-02d gives :

$$+ \left(\frac{\partial P}{\partial F_A} \right)_{U_P} \quad = - \left(\frac{\partial p}{\partial U_P} \right)_{F_A} \qquad \text{‹16-28›}$$

The other relationships are presented above under the references: 16-25, 16-26 and 16-27.



*Transformation M→**T*** ⇒ *Examples*

Figures 16-03 (16-03a, 16-03b, 16-03c, 16-03d) are valid, taking into account the direction of the arrows, as in thermodynamics, *i.e.* :

- **if the arrows go up ⇒ sign + (positive)**
- **if the arrows go down ⇒ sign - (negative)**

1. ***Potential (Figure 16-03a)***
   The example shown in Figure 16-03a gives :

$$L = + E_{MT} + B \cdot F_P \qquad \langle 09\text{-}11 \rangle$$

The other relationships are presented above under the references: 16-09, 16-14 and 16-15.

2. ***Potential differential (Figure 16-03b)***
The example shown in Figure 16-03b gives :

$$dE^L_{MT} = - A \cdot dU_A - F_P \cdot dB \qquad \langle 16\text{-}11 \rangle$$

The other relationships are presented above under the references: 06-04, 09-14 and 16-16.

3. ***Partial differential of potential and conjugated variables (Figure 16-03c)***
The example shown in Figure 16-03c gives :

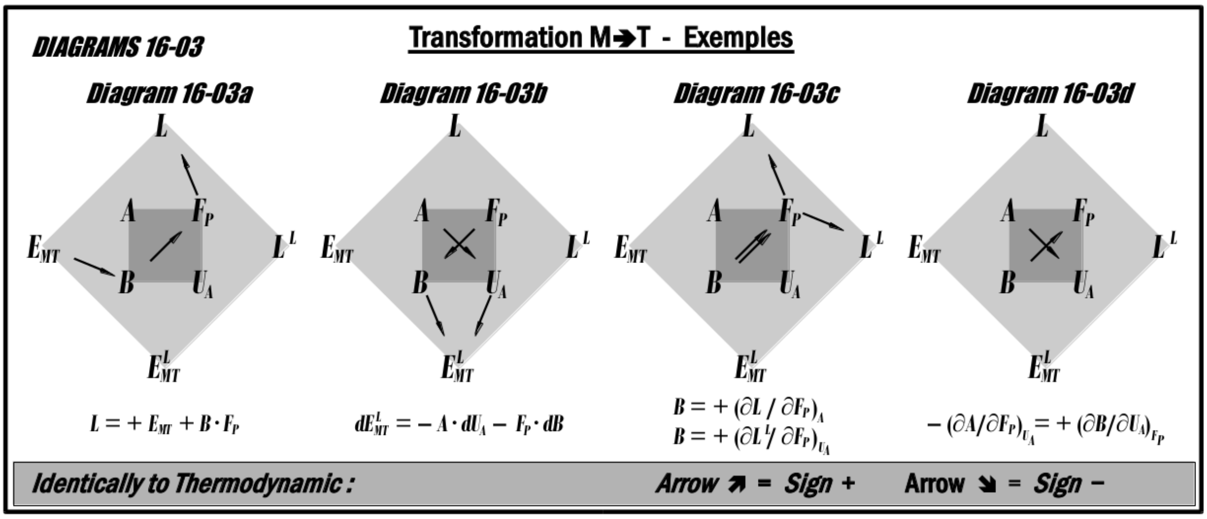
$$B = + \left(\frac{\partial L}{\partial F_P} \right)_A = + \left(\frac{\partial L^L}{\partial F_P} \right)_{U_A} \qquad \langle 16\text{-}22 \rangle$$

The other relationships are presented above under the references: 16-21, 16-23 and 16-24.

4. ***Maxwell relationship (Figure 16-03d)***
The example shown in Figure 16-03d gives :

$$- \left(\frac{\partial A}{\partial F_P} \right)_{U_A} = + \left(\frac{\partial B}{\partial U_A} \right)_{F_P} \qquad \langle 16\text{-}32 \rangle$$

The other relationships are presented above under the references: 16-29, 16-30 and 16-31.



17 – ECOELASTIC COEFFICIENTS

ABSTRACT: Identical to the previous chapter, this one exposes the eco-elastic coefficients which correspond to those of thermodynamics.

Transformation T→M ⇒ ***Coefficients***

In the $T \rightarrow M$ transformation, we know the general state function having the form :

$$r_P = \mathrm{f}\left(F_A, V, \frac{1}{U_P} \right)$$

Consequently, it's possible to pose three eco-elastic coefficients such as :

1. $$\boxed{\alpha_{TM} = -\frac{1}{V} \cdot \left(\frac{\partial V}{\partial U_P} \right)_{F_A}}$$ **‹17-01›**

which corresponds to a variation, at a *constant Avarice Force*, of the unit of a*dded Value* (monetary unit) under the influence of a variation in the *Utility* of the *Product.*

2. $$\boxed{\beta_{TM} = -\frac{1}{F_A} \cdot \left(\frac{\partial F_A}{\partial U_P} \right)_{V}}$$ **‹17-02›**

which corresponds to a variation, with *constant added Value*, of the unit of the consumer's *Avarice Force* under the influence of a variation in the *Utility* of the *Product.*

3. $$\boxed{\chi_{TM} = \frac{1}{V} \cdot \left(\frac{\partial V}{\partial F_A} \right)_{U_P}}$$ **‹17-03›**

which corresponds to a variation, at constant *Product Utility*, of the unit of a*dded Value* (monetary unit) under the influence of a variation in the Consumer's *Avarice Force.*

or, respectively :

$$\left(\frac{\partial V}{\partial U_P} \right)_{F_A} = - \ \alpha_{TM} \cdot V$$

$$\left(\frac{\partial F_A}{\partial U_P} \right)_{V} = - \ \beta_{TM} \cdot F_A$$

$$\left(\frac{\partial V}{\partial F_A}\right)_{U_p} = +\ \chi_{TM} \cdot V$$

However, we know that in mathematics:

$$\left(\frac{\partial x}{\partial y}\right)_z \cdot \left(\frac{\partial y}{\partial z}\right)_x \cdot \left(\frac{\partial z}{\partial x}\right)_y = -\ 1$$

Therefore, by posing:

$$x = V$$
$$y = U_P$$
$$z = F_A$$

this allows us to write:

$$\left(\frac{\partial V}{\partial U_P}\right)_{F_A} \cdot \left(\frac{\partial U_P}{\partial F_A}\right)_V \cdot \left(\frac{\partial F_A}{\partial V}\right)_{U_P} = -\ 1$$

and by replacing:

$$(-\ \alpha_{TM} \cdot V) \cdot \left(-\ \frac{1}{\beta_{TM} \cdot F_A}\right) \cdot \left(\frac{1}{\chi_{TM} \cdot V}\right) = -\ 1$$

which, after simplification, gives:

$$\boxed{F_A = -\frac{\alpha_{TM}}{\beta_{TM} \cdot \chi_{TM}}} \quad \textbf{‹17-04›}$$

This relationship shows that :

1. for the same variation in the *Utility* of the *Product*, the lower the a*dded Value*, the greater the Consumer *Choice*,
2. for the same variation in *Consumer Avarice*, the higher the *Utility* of the *Product*, the greater the Consumer's *Choice*,
3. for the same variation in *added Value*, the lower the consumer's *Avarice Force*, the greater his *Choice*.

It follows that, in order to satisfy the consumer, it's necessary to :

1. decrease the a*dded Value*,
2. to increase the *Utility* of the *Product*,
3. to decrease the consumer's *Avarice Force*.

This is perfectly logical and is well corroborated by daily experience.

Transformation T→M ⇒ *Case of the perfect product*

Throughout the study, it was always considered that the *Product*s strictly followed the Core Law 08-04 relationship, namely :

$$F_A \cdot V = r_P \cdot U_P = cte$$

From this relationship it's possible to draw :

$$V = \frac{r_P \cdot U_P}{F_A}$$

Relationship 17-01, namely:

$$V = \frac{r_P \cdot U_P}{F_A}$$

can be written as follows:

$$\alpha_{TM} = - \frac{1}{V} \cdot \left(\frac{\partial}{\partial U_P} \cdot V \right)_{F_A}$$

By replacing V by its above value (*Constant Force*), it comes:

$$\alpha_{TM} = - \frac{F_A}{r_P \cdot U_P} \cdot \frac{\partial}{\partial U_P} \cdot \left(\frac{r_P \cdot U_P}{F_A} \right)$$

which gives after simplification:

$$\alpha_{TM} = - \frac{\partial}{\partial U_P}$$

that is to say:

$$\boxed{\alpha_{TM} = - \frac{1}{U_P}} \qquad \textbf{‹17-05›}$$

In the same way, still from the Core Law, it's possible to shoot:

$$F_A = \frac{r_P \cdot U_P}{V}$$

The relation 17-02, namely:

$$\beta_{TM} = - \frac{1}{F_A} \cdot \left(\frac{\partial F_A}{\partial U_P} \right)_V$$

can be written:

$$\beta_{TM} = - \frac{1}{F_A} \cdot \left(\frac{\partial}{\partial U_P} \cdot F_A \right)_V$$

Replacing F_A by its above value (*constant added Value*), it comes :

$$\beta_{TM} = - \frac{r_P \cdot U_P}{V} \cdot \frac{\partial}{\partial U_P} \cdot \left(\frac{V}{r_P \cdot U_P} \right)$$

which gives after simplification :

$$\beta_{TM} = - \frac{r_P \cdot U_P}{V} \cdot \frac{\partial}{\partial U_P} \cdot \left(\frac{V}{r_P \cdot U_P} \right)$$

or :

$$\boxed{\beta_{TM} = - \frac{1}{U_P}} \qquad \text{‹17-06›}$$

The relations 17-05 and 17-06 show that the coefficients α_{TM} β_{TM} and are equal (case of the perfect *Product*). In this case, the relation 17-04 can be simplified and it comes then :

$$\boxed{\chi_{TM} = - \frac{1}{F_A}} \qquad \text{‹17-07›}$$

It would have been possible to find the latter result (χ_{TM}) by carrying out the same type of calculation as for the coefficients and .

*Transformation M→**T*** ⇒ *Coefficients*

Identically, in the transformation $M \rightarrow T$, we know the general state function having the form :

$$r_A = \mathrm{f}\left(F_P, B, \frac{1}{U_A} \right)$$

Consequently, it's possible to pose three ecoelastic coefficients such as :

1. $$\boxed{\alpha_{MT} = \frac{1}{B} \cdot \left(\frac{\partial B}{\partial U_A} \right)_{F_P}}$$ 17-08

which corresponds to a variation, under *constant Consumer Laziness Force*, of the unit of *Task to be added* under the influence of a variation in the *Utility* of *Cash*.

2. $$\boxed{\beta_{MT} = \frac{1}{F_P} \cdot \left(\frac{\partial F_P}{\partial U_A} \right)_{B}}$$ **‹17-09›**

which corresponds to a variation, in *Task to be added* constant, of the unit of the Lazy *Force* of the consumer under the influence of a variation of the *Utility* of *Cash*.

3. $$\boxed{\chi_{TM} = \frac{1}{V} \cdot \left(\frac{\partial V}{\partial F_A} \right)_{U_P}}$$ **‹17-10›**

which corresponds to a variation, at a constant *Utility* of *Cash*, of the unit of *Task to be added* under the influence of a variation in the *Lazy Force* of the consumer.

or, respectively :

$$\left(\frac{\partial B}{\partial U_A} \right)_{F_P} = \alpha_{MT} \cdot B$$

$$\left(\frac{\partial F_P}{\partial U_A} \right)_{B} = \beta_{MT} \cdot F_P$$

$$\left(\frac{\partial B}{\partial F_P} \right)_{U_A} = - \chi_{MT} \cdot B$$

However, we know that in mathematics:

$$\left(\frac{\partial x}{\partial y} \right)_{z} \cdot \left(\frac{\partial y}{\partial z} \right)_{x} \cdot \left(\frac{\partial z}{\partial x} \right)_{y} = - 1$$

Therefore, by posing:

$$x = B$$
$$y = U_A$$
$$z = F_P$$

this enables us to write:

$$\left(\frac{\partial B}{\partial U_A}\right)_{F_P} \cdot \left(\frac{\partial U_A}{\partial F_P}\right)_B \cdot \left(\frac{\partial F_P}{\partial B}\right)_{U_A} = -\ 1$$

and by replacing:

$$(\alpha_{MT} \cdot B) \cdot \left(\frac{1}{\beta_{MT} \cdot F_P}\right) \cdot \left(-\ \frac{1}{\chi_{MT} \cdot B}\right) = -\ 1$$

which, after simplification, gives:

$$\boxed{F_P = \frac{\alpha_{MT}}{\beta_{MT} \cdot \chi_{MT}}} \qquad \textbf{‹17-11›}$$

This relationship shows that :

1. for the same variation in the *Utility* of *Cash*, the lower the *Task to be added*, the greater the *Choice* of Supplier,

2. for the same variation in Consumer’s *Force of Laziness*, the higher the *Utility* of *Cash*, the greater the Supplier *Choice*,

3. for the same variation of the *Task to be added*, the lower the *Force of Laziness* of the consumer, the greater the Supplier's *Choice*.

The result is that, to satisfy the supplier, it's necessary :

1. decrease the *Task to be added*,
2. increase the *Utility* of *Cash*,
3. decrease the *Force of Laziness* of the consumer.

This is perfectly logical and is well corroborated by daily experience.

*Transformation M→**T*** ⇒ *Case of Perfect Cash*

Throughout the study, it was always considered that *Cash* strictly followed the Core Law 08-12 relationship, namely :

$$F_P \cdot B = r_A \cdot U_A = constant$$

From this relationship it's possible to draw:

$$B = \frac{r_A \cdot U_A}{F_P}$$

Relationship 17-08, namely:

$$\alpha_{MT} = \frac{1}{B} \cdot \left(\frac{\partial B}{\partial U_A} \right)_{F_P}$$

can be written:

$$\alpha_{MT} = \frac{1}{B} \cdot \left(\frac{\partial}{\partial U_A} \cdot B \right)_{F_P}$$

By replacing B with its above value (*Constant Force*), it comes:

$$\alpha_{MT} = \frac{F_P}{r_A \cdot U_A} \cdot \frac{\partial}{\partial U_A} \cdot \left(\frac{r_A \cdot U_A}{F_P} \right)$$

which gives after simplification:

$$\alpha_{MT} = \frac{\partial}{\partial U_A}$$

that is to say:

$$\boxed{\alpha_{MT} = \frac{1}{U_A}} \qquad \textbf{‹17-12›}$$

In the same way, still from the Core Law, it's possible to shoot:

$$F_P = \frac{r_A \cdot U_A}{B}$$

The relation 17-09, namely:

$$\beta_{MT} = \frac{1}{F_P} \cdot \left(\frac{\partial F_P}{\partial U_A} \right)_B$$

can be written:

$$\beta_{MT} = \frac{1}{F_P} \cdot \left(\frac{\partial}{\partial U_A} \cdot F_P \right)_B$$

Replacing F_P by its above value (constant *task to be added*), it comes :

$$\beta_{MT} = \frac{r_A \cdot U_A}{B} \cdot \frac{\partial}{\partial U_A} \cdot \left(\frac{B}{r_A \cdot U_A} \right)$$

which gives after simplification :

$$\beta_{MT} = \frac{\partial}{\partial U_A}$$

or :

$$\boxed{\beta_{MT} = \frac{1}{U_A}} \qquad \text{‹17-13›}$$

Relationships 17-12 and 17-13 show that the coefficients and are equal (the case of Perfect *Cash*). In this case, the relation 17-11 can be simplified and it then comes :

$$\boxed{\chi_{MT} = \frac{1}{F_P}} \qquad \text{‹17-14›}$$

It would have been possible to find the latter result (χ_{MT}) by carrying out the same type of calculation as for the coefficients and .

Forces and Coefficients

We have just determined the relations 17-04 and 17-11, namely :

$$F_A = -\frac{\alpha_{TM}}{\beta_{TM} \cdot \chi_{TM}} \qquad \text{and :} \qquad F_P = \frac{\alpha_{MT}}{\beta_{MT} \cdot \chi_{MT}}$$

which can be reported as follows:

$$\frac{F_A}{F_P} = -\frac{\dfrac{\alpha_{TM}}{\beta_{TM} \cdot \chi_{TM}}}{\dfrac{\alpha_{MT}}{\beta_{MT} \cdot \chi_{MT}}}$$

which gives, after simplification :

$$\boxed{\frac{F_A}{F_P} = -\frac{\alpha_{TM}}{\alpha_{MT}} \cdot \frac{\beta_{MT}}{\beta_{TM}} \cdot \frac{\chi_{MT}}{\chi_{TM}}} \qquad \text{‹17-15›}$$

In the cases of Perfect *Product* and Perfect *Cash* that we have considered above, this relationship is simplified as follows:

$$\boxed{\frac{F_A}{F_P} = -\frac{\chi_{MT}}{\chi_{TM}}} \qquad \text{‹17-16›}$$

18 – ECOMETRIC COEFFICIENT

ABSTRACT: Identical to the previous chapter, this one exposes the ecometric coefficients which correspond to those of thermodynamics.

Transformation T→M ⇒ ***Introduction***

We know that the evolution of an economic system in the transformation $T \rightarrow M$ is a function of the following 3 independent variables:

$$F_A, V, U_P$$

linked together by the Core Law (08-04), namely :

$$F_A \cdot V = r_P \cdot U_P$$

By choosing any 2 variables among them and since r_P is a constant, there are therefore three possibilities, namely :

1. *Utility* and *Added Value* ⇒ U_P and V
2. *Utility* and *Force* ⇒ U_P and F_A
3. Force and *Added Value* ⇒ F_A and V

Relationships giving the variation of Internal Energy (06-02) and *Empraxia* (09-10), namely :

$$dE_{TM} = dT + F_A \cdot dV \qquad \text{and :} \qquad dX = dT - V \cdot dF_A$$

it's possible to write respectively :

$$dT = dE_{TM} - F_A \cdot dV \qquad \text{and :} \qquad dT = dX + V \cdot dF_A \qquad \textbf{‹18-01› ‹18-02›}$$

Transformation T→M ⇒ *Utility of the product and added value*

Depending on the variables U_P and V , it's possible, by definition, to write the *Internal Energy* as follows:

$$dE_{TM} = \left(\frac{\partial E_{TM}}{\partial U_P}\right)_V \cdot dU_P + \left(\frac{\partial E_{TM}}{\partial V}\right)_{U_P} \cdot dV$$

Replacing the *Internal Energy* in relation 18-01 with this value gives :

$$dT = \left(\frac{\partial E_{TM}}{\partial U_P}\right)_V \cdot dU_P + \left(\frac{\partial E_{TM}}{\partial V}\right)_{U_P} \cdot dV - F_A \cdot dV$$

that it's possible to write :

$$dT = \left(\frac{\partial E_{TM}}{\partial U_P}\right)_V \cdot dU_P + \left[\left(\frac{\partial E_{TM}}{\partial V}\right)_{U_P} - F_A\right] \cdot dV$$

Now we know that (relation 10-01):

$$\left(\frac{\partial E_{TM}}{\partial U_P}\right)_V = \Phi_V$$

therefore:

$$dT = \Phi_V \cdot dU_P + \left[\left(\frac{\partial E_{TM}}{\partial V}\right)_{U_P} - F_A\right] \cdot dV$$

By posing :

$$\left(\frac{\partial E_{TM}}{\partial V}\right)_{U_P} - F_A = l_{TM}$$

the relationship 18-01 giving *Work* finally becomes:

$$\boxed{dT = \Phi_V \cdot dU_P + l_{TM} \cdot dV} \qquad \textbf{‹18-03›}$$

Transformation T→M ⇒ *Utility of the product and Force of Avarice*

Depending on the U_P and F_A variables, it's possible, by definition, to write *Empraxia* as follows:

$$dX = \left(\frac{\partial X}{\partial U_P}\right)_{F_A} \cdot dU_P + \left(\frac{\partial X}{\partial F_A}\right)_{U_P} \cdot dF_A$$

Replacing *Empraxia* in relation 18-02 with this value gives :

$$dT = \left(\frac{\partial X}{\partial U_P}\right)_{F_A} \cdot dU_P + \left(\frac{\partial X}{\partial F_A}\right)_{U_P} \cdot dF_A + V \cdot dF_A$$

that it's possible to write :

$$dT = \left(\frac{\partial X}{\partial U_P} \right)_{F_A} \cdot dU_P + \left[\left(\frac{\partial X}{\partial F_A} \right)_{U_P} + V \right] \cdot dF_A$$

Now we know that (relation 10-03):

$$\left(\frac{\partial X}{\partial U_P} \right)_{F_A} = \Phi_{F_A}$$

therefore:

$$dT = \Phi_{F_A} \cdot dU_P + \left[\left(\frac{\partial X}{\partial F_A} \right)_{U_P} + V \right] \cdot dF_A$$

By posing:

$$\left(\frac{\partial X}{\partial F_A} \right)_{U_P} + V = h_{TM}$$

the relation 18-02 giving *Work* finally becomes:

$$\boxed{dT = \Phi_{F_A} \cdot dU_P + h_{TM} \cdot dF_A} \qquad \langle 18\text{-}04 \rangle$$

Transformation T→M ⇒ *Force of Avarice and added value*

Starting from the basic relationship, namely :

$$F_A \cdot V = r_P \cdot U_P$$

it's possible to write:

$$dU_P = \left(\frac{\partial U_P}{\partial F_A} \right)_V \cdot dF_A + \left(\frac{\partial U_P}{\partial V} \right)_{F_A} \cdot dV \qquad \langle 18\text{-}05 \rangle$$

By transferring this dU_p value to the *Work* relationship (18-03), we obtain :

$$dT = \Phi_V \cdot \left[\left(\frac{\partial U_P}{\partial F_A} \right)_V \cdot dF_A + \left(\frac{\partial U_P}{\partial V} \right)_{F_A} \cdot dV \right] + l_{TM} \cdot dV$$

either :

$$dT = \Phi_V \cdot \left(\frac{\partial U_P}{\partial F_A} \right)_V \cdot dF_A + \left[\Phi_V \cdot \left(\frac{\partial U_P}{\partial V} \right)_{F_A} + l_{TM} \right] \cdot dV$$

By posing:

$$\Phi_V \cdot \left(\frac{\partial U_P}{\partial F_A} \right)_V = \lambda_{TM} \tag{18-06}$$

the relationship becomes :

$$dT = \lambda_{TM} \cdot dF_A + \left[\Phi_V \cdot \left(\frac{\partial U_P}{\partial V} \right)_{F_A} + l_{TM} \right] \cdot dV \tag{18-07}$$

If we always refer to the value of dU_P (relation 18-05) in the *Work* relation (18-04), we obtain :

$$dT = \Phi_{F_A} \cdot \left[\left(\frac{\partial U_P}{\partial F_A} \right)_V \cdot dF_A + \left(\frac{\partial U_P}{\partial V} \right)_{F_A} \cdot dV \right] + h_{TM} \cdot dF_A$$

either :

$$dT = \Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial F_A} \right)_V \cdot dF_A + \Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial V} \right)_{F_A} \cdot dV + h_{TM} \cdot dF_A$$

or :

$$dT = \left[\Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial F_A} \right)_V + h_{TM} \right] \cdot dF_A + \Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial V} \right)_{F_A} \cdot dV$$

By posing:

$$\Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial V} \right)_{F_A} = \mu_{TM} \tag{18-08}$$

The relationship becomes :

$$dT = \left[\Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial F_A} \right)_V + h_{TM} \right] \cdot dF_A + \mu_{TM} \cdot dV \tag{18-09}$$

From relations 18-07 and 18-09 it's possible to write :

$$\boxed{dT = \lambda_{TM} \cdot dF_A + \mu_{TM} \cdot dV} \tag{18-10}$$

We now know a triplet of relationships giving *Work* according to the different pairs of variables chosen and listed below:

$$dT = \Phi_V \cdot dU_P + l_{TM} \cdot dV \qquad \textbf{‹18-03›}$$

$$dT = \Phi_{F_A} \cdot dU_P + h_{TM} \cdot dF_A \qquad \textbf{‹18-04›}$$

$$dT = \lambda_{TM} \cdot dF_A + \mu_{TM} \cdot dV \qquad \textbf{‹18-10›}$$

Transformation T→M ⇒ *Relationship between the coefficients*

We have determined the values of λ_{TM} and μ_{TM} , (relations 18-06 and 18-08), namely :

$$\Phi_V \cdot \left(\frac{\partial U_P}{\partial F_A} \right)_V = \lambda_{TM}$$

and :

$$\Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial V} \right)_{F_A} = \mu_{TM}$$

Comparing relations 18-07 and 18-09, it's possible to write :

$$\tau_3 \cdot dF_A = \left[\Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial F_A} \right)_V + \tau_2 \right] \cdot dF_A$$

and :

$$\tau_4 \cdot dV = \left[\Phi_V \cdot \left(\frac{\partial U_P}{\partial V} \right)_{F_A} + \tau_1 \right] \cdot dV$$

These two relations give respectively after calculation:

$$\tau_2 = \left(\Phi_V - \Phi_{F_A} \right) \cdot \left(\frac{\partial U_P}{\partial F_A} \right)_V$$

and :

$$\tau_1 = \left(C_{F_A} - C_V \right) \cdot \left(\frac{\partial U_P}{\partial V} \right)_{F_A}$$

These coefficients can be listed as follows:

$$\boxed{\tau_1 = \left(\Phi_{F_A} - \Phi_V \right) \cdot \left(\frac{\partial U_P}{\partial V} \right)_{F_A}} \qquad \textbf{‹18-11›}$$

$$\boxed{\tau_2 = \left(\Phi_V - \Phi_{F_A}\right) \cdot \left(\frac{\partial U_P}{\partial F_A}\right)_V}$$ **‹18-12›**

$$\boxed{\tau_3 = \Phi_V \cdot \left(\frac{\partial U_P}{\partial F_A}\right)_V}$$ **‹18-13›**

$$\boxed{\tau_4 = \Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial V}\right)_{F_A}}$$ **‹18-14›**

*Transformation M→**T*** ⇒ *Introduction*

We know that the evolution of an *economic system* in the transformation $M \rightarrow T$ is a function of the following 3 independent variables:

$$F_P, B, U_A$$

linked together by the Core Law, namely :

$$F_P \cdot B = r_A \cdot U_A$$

By choosing any 2 variables among them and since r_A is a constant, there are therefore three possibilities, namely :

1. *Utility* and *Task to be added* ⇒ U_A and B
2. *Utility* and *Force* ⇒ U_A and F_P
3. *Force* and *task to be added* ⇒ F_P and B

Relationships giving the variation of *Internal Energy* (06-04) and *Enomaillie* (09-14), namely :

$dE_{MT} = dM - F_P \cdot dB$ and : $dL = dM + B \cdot dF_P$

it's possible to write respectively :

$dM = dE_{MT} + F_P \cdot dB$ and : $dM = dL - B \cdot dF_P$ **‹18-15› ‹18-16›**

*Transformation M→**T*** ⇒ *Utility of Cash and Task to be added*

Depending on the variables U_A and B , it's possible, by definition, to write the *Internal Energy* as follows:

$$dE_{MT} = \left(\frac{\partial E_{MT}}{\partial U_A}\right)_B \cdot dU_A + \left(\frac{\partial E_{MT}}{\partial B}\right)_{U_A} \cdot dB$$

Replacing the *Internal Energy* in the relation 18-15 with this value gives :

$$dM = \left(\frac{\partial E_{MT}}{\partial U_A}\right)_B \cdot dU_A + \left(\frac{\partial E_{MT}}{\partial B}\right)_{U_A} \cdot dB + F_P \cdot dB$$

it's possible to write :

$$dM = \left(\frac{\partial E_{MT}}{\partial U_A}\right)_B \cdot dU_A + \left[\left(\frac{\partial E_{MT}}{\partial B}\right)_{U_A} + F_P\right] \cdot dB$$

Now we know that (relation 10-12):

$$\left(\frac{\partial E_{M-T}}{\partial U_A}\right)_B = \Phi_B$$

therefore:

$$dM = \Phi_B \cdot dU_A + \left[\left(\frac{\partial E_{MT}}{\partial B}\right)_{U_A} + F_P\right] \cdot dB$$

By posing:

$$\left(\frac{\partial E_{MT}}{\partial B}\right)_{U_A} + F_P = l_{MT}$$

the relation 18-15 giving the *Money* finally becomes:

$$\boxed{dM = \Phi_B \cdot dU_A + l_{MT} \cdot dB} \qquad \text{‹18-17›}$$

*Transformation M→**T*** ⇒ *Utility of Money and Force of Laziness*

Depending on the variables U_A and F_P, it's possible, by definition, to write *Enomailie* as follows:

$$dL = \left(\frac{\partial L}{\partial U_A}\right)_{F_P} \cdot dU_A + \left(\frac{\partial L}{\partial F_P}\right)_{U_A} \cdot dF_P$$

Replacing the *Enomailie* in the relation 18-16 by this value gives :

$$dM = \left(\frac{\partial L}{\partial U_A}\right)_{F_P} \cdot dU_A + \left(\frac{\partial L}{\partial F_P}\right)_{U_A} \cdot dF_P - B \cdot dF_P$$

that it's possible to write :

$$dM = \left(\frac{\partial L}{\partial U_A}\right)_{F_P} \cdot dU_A + \left[\left(\frac{\partial L}{\partial F_P}\right)_{U_A} - B\right] \cdot dF_P$$

Now we know that (relation 10-14):

$$\left(\frac{\partial L}{\partial U_A}\right)_{F_P} = \Phi_{F_P}$$

therefore:

$$dM = \Phi_{F_P} \cdot dU_A + \left[\left(\frac{\partial L}{\partial F_P}\right)_{U_A} - B\right] \cdot dF_P$$

By posing:

$$\left(\frac{\partial L}{\partial F_P}\right)_{U_A} - B = h_{MT}$$

the relation 18-16 giving the *Money* finally becomes:

$$\boxed{dM = \Phi_{F_P} \cdot dU_A + h_{MT} \cdot dF_P} \qquad \langle 18\text{-}18 \rangle$$

Transformation $M \rightarrow \boldsymbol{T}$ $\Rightarrow$ *Force of Laziness and Task to be added*

Starting from the basic relationship, namely :

$$F_P \cdot B = r_A \cdot U_A$$

it's possible to write:

$$dU_A = \left(\frac{\partial U_A}{\partial F_P}\right)_B \cdot dF_P + \left(\frac{\partial U_A}{\partial B}\right)_{F_P} \cdot dB \qquad \langle 18\text{-}19 \rangle$$

By transferring this dU_A value (relation 18-19) into the relation of the *Money* (18-15), we obtain :

$$dM = \Phi_B \cdot \left[\left(\frac{\partial U_A}{\partial F_P} \right)_B \cdot dF_P + \left(\frac{\partial U_A}{\partial B} \right)_{F_P} \cdot dB \right] + l_{MT} \cdot dB$$

either :

$$dM = \Phi_B \cdot \left(\frac{\partial U_A}{\partial F_P} \right)_B \cdot dF_P + \left[\Phi_B \cdot \left(\frac{\partial U_A}{\partial B} \right)_{F_P} + l_{MT} \right] \cdot dB$$

By posing:

$$\Phi_B \cdot \left(\frac{\partial U_A}{\partial F_P} \right)_B = \lambda_{MT} \qquad \text{‹18-20›}$$

the relationship becomes :

$$dM = \lambda_{MT} \cdot dF_P + \left[\Phi_B \cdot \left(\frac{\partial U_A}{\partial B} \right)_{F_P} + l_{MT} \right] \cdot dB \qquad \text{‹18-21›}$$

If we always refer to the value of dU_A (relation 18-19) in the relation of the *Money* (18-18), we obtain :

$$dM = \Phi_{F_P} \cdot \left[\left(\frac{\partial U_A}{\partial F_P} \right)_B \cdot dF_P + \left(\frac{\partial U_A}{\partial B} \right)_{F_P} \cdot dB \right] + h_{MT} \cdot dF_P$$

either :

$$dM = \Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial F_P} \right)_B \cdot dF_P + \Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial B} \right)_{F_P} \cdot dB + h_{MT} \cdot dF_P$$

or again:

$$dM = \left[\Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial F_P} \right)_B + h_{MT} \right] \cdot dF_P + \Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial B} \right)_{F_P} \cdot dB$$

By posing:

$$\Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial B} \right)_{F_P} = \mu_{MT} \qquad \text{‹18-22›}$$

The relationship becomes :

$$dM = \left[\Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial F_P} \right)_B + h_{MT} \right] \cdot dF_P + \mu_{MT} \cdot dB \qquad \langle 18\text{-}23 \rangle$$

From relations 18-21 and 18-23, it's possible to write :

$$\boxed{dM = \lambda_{MT} \cdot dF_P + \mu_{MT} \cdot dB} \qquad \langle 18\text{-}24 \rangle$$

We now know a trio of relationships giving *Work* according to the different pairs of variables chosen and listed below:

$$dM = \Phi_B \cdot dU_A + l_{MT} \cdot dB \qquad \langle 18\text{-}17 \rangle$$

$$dM = \Phi_{F_P} \cdot dU_A + h_{MT} \cdot dF_P \qquad \langle 18\text{-}18 \rangle$$

$$dM = \lambda_{MT} \cdot dF_P + \mu_{MT} \cdot dB \qquad \langle 18\text{-}24 \rangle$$

*Transformation M→**T*** ⇒ *Relationship between the coefficients*

We have already determined the values of λ_{MT} and μ_{MT}, (relations 18-20 and 18-22), namely:

$$\Phi_B \cdot \left(\frac{\partial U_A}{\partial F_P} \right)_B = \lambda_{MT} \qquad \text{and :} \qquad \Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial B} \right)_{F_P} = \mu_{MT}$$

Comparing relations 18-21 and 18-23, it's possible to write:

$$\sigma_3 \cdot dF_P = \left[\Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial F_P} \right)_B + \sigma_2 \right] \cdot dF_P$$

and:

$$\sigma_4 \cdot dB = \left[\Phi_B \cdot \left(\frac{\partial U_A}{\partial B} \right)_{F_P} + \sigma_1 \right] \cdot dB$$

These two relations give respectively after calculation:

$$\sigma_2 = \left(\Phi_B - \Phi_{F_P} \right) \cdot \left(\frac{\partial U_A}{\partial F_P} \right)_B$$

and :

$$\sigma_1 = \left(\Phi_{F_P} - \Phi_B\right) \cdot \left(\frac{\partial U_A}{\partial B}\right)_{F_P}$$

These coefficients can be listed as follows:

$$\boxed{\sigma_1 = \left(\Phi_{F_P} - \Phi_B\right) \cdot \left(\frac{\partial U_A}{\partial B}\right)_{F_P}} \quad \langle 18\text{-}25\rangle$$

$$\boxed{\sigma_2 = \left(\Phi_B - \Phi_{F_P}\right) \cdot \left(\frac{\partial U_A}{\partial F_P}\right)_B} \quad \langle 18\text{-}26\rangle$$

$$\boxed{\sigma_3 = \Phi_B \cdot \left(\frac{\partial U_A}{\partial F_P}\right)_B} \quad \langle 18\text{-}27\rangle$$

$$\boxed{\sigma_4 = \Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial B}\right)_{F_P}} \quad \langle 18\text{-}28\rangle$$

19 – LINK HEAT CONSUMPTION TO MONEY CREATED

ABSTRACT: This chapter presents a link between the wealth produced (money created) and the energy consumed for this production. The relation exposed shows well, in accordance with reality, that these two characteristics are proportionally linked, naturally subject to the respective yields of all physical and economic transformations. It confirms the fact that the "developed" countries require a very important consumption of energy, in particular fossil fuels, and thus contribute strongly to the current environmental degradations.

In conclusion, all economic policies focused on the continuity of development and growth can only lead to harmful consequences. Of course, these policies carried out rationally and under certain conditions by the use of "renewable energies", are able to reduce or limit these effects but without eliminating them.

General

It was pointed out (chapter "Prolegomena", paragraph "Reductionism") that in Economics, just like in Physics, it was possible to use the technique of reductionism in order to facilitate the understanding of phenomena and in particular economic exchanges. Therefore, what follows is subject to this approach, but without being redhibitory as to its sincerity and rigour.

When any consumer goes to fetch his morning croissant, it's not forbidden, for the sake of simplification, to consider the baker and this consumer as an *isolated system*, without contact with the outside world, since the exchange (*Product* for *Cash* - *Work* for *Money*) only takes place between these two people. It is the same when the baker acquires his flour from his miller and similarly between the miller and the agricultural cooperative supplying him with grain, *etc.* The same can be said for an exchange between a merchant and an importer of toys both located in the same country. But it's also possible to extend the concept of a *closed system* between this importer and a manufacturer outside that country, since only the exchange, which has absolutely no geographical character, is considered and is always limited to two economic agents. On the other hand, by looking at all of France's imports and exports, coming and going everywhere, it's no longer possible to treat France and, for example, Argentina as a *closed system.*

Consequently, if we consider *isolated systems*, both physical and economic, the respective variations in their *internal Energy* are nil, namely :

- for thermodynamics $\Rightarrow$ $dU = dQ + dW = 0$
- for the Economy $\Rightarrow$ $dE = dT + dM = 0$

Transformation Work→Money

By definition, we know that in Economics, for the transformation Work→Money($T \rightarrow M$) the return is given by the relation :

$$\eta_{TM} = -\frac{M_{created}}{T_{used}}$$ or: $$T_{used} = -\frac{M_{created}}{\eta_{TM}}$$

and that in Physics, for the transformation chaleur→travail ($Q \rightarrow W$), it's given by the relation:

$$\eta_{QW} = -\frac{W_{created}}{Q_{consumed}}$$

But:

$$T_{used} = -W_{created}$$

Indeed, the mechanical work created ($W_{created}$) (negative since it leaves the physical system) corresponds well to the *useful economic Work* ($T_{utilized}$) (positive since it enters the *economic system*) which is going to be used by an individual, an employee, a slave, an animal, a motor or a machine to increase productivity (ω).

However, it must be kept in mind that this mechanical work ($W_{created}$) is only economically useful if it allows the *Utility* of a *Product* to evolve. If this condition isn't fulfilled, the *Economic Work spent* ($T_{utilized}$) is absolutely nil and therefore the *Money created* ($M_{created}$) too. This is why the contract worker, mentioned above in the chapter "Mechanics of Exchange", can spend a lot of mechanical work (W) and therefore be exhausted at the end of her service without having carried out any *Economic Work* (T).

Therefore :

$$\eta_{QW} = \frac{T_{used}}{Q_{consumed}}$$

hence :

$$\eta_{QW} = -\frac{M_{created}}{Q_{consumed} \cdot \eta_{TM}}$$

or :

$$Q_{consumed} = -\frac{M_{created}}{\eta_{QW} \cdot \eta_{TM}}$$

By generalizing this relationship to a compound system:

- of an energy chain, for example, with thermal, mechanical, electrical, chemical, *etc.* elements,

- various economic components,

and taking into account the returns of each constituent, the relationship can be written :

$$\boxed{Q_{consumed} = -\, M_{created} \cdot \underbrace{\frac{1}{\prod \eta_{i_{(QW)}}}}_{PHYSICS} \cdot \underbrace{\frac{1}{\prod \eta_{i_{(TM)}}}}_{ECONOMY}} \qquad \text{‹19-01›}$$

We know that the *Money* created leaves the economic *system* under study, and therefore is negative. Consequently, this relation demonstrates that the more *Money* is created, the more thermal energy is spent for this production, or :

- **the richer the Buyer, the more energy the Transformer has used.**

This is perfectly logical and seems to correspond well to reality.

However, this relationship only expresses the energy in the form of heat needed to create *Money*. Therefore, the heat destroyed may be higher, but this supplement is economically useless since it doesn't create *Money*, although it may be useful for other purposes (as previously mentioned).

The relation 04-10, namely :

$$dM = F_A \cdot dV$$

returns after integration :

$$M = F_A \cdot V + C$$

Consequently, considering the constant (C) null, the relation 19-01 becomes :

$$Q_{consumed} = -\frac{F_A \cdot V}{\prod \eta_{i\,(QW)} \cdot \prod \eta_{i\,(TM)}}$$

By using the *price* (p) instead of the *Value added* (V), it's written as :

$$\boxed{Q_{consumed} = -\frac{F_A \cdot p}{\prod \eta_{i_{(QW)}} \cdot \prod \eta_{i_{(TM)}}}} \qquad \text{‹19-02›}$$

The 04-14 relationship, namely :

$$dM = -\, c_A \cdot \varpi \cdot d\varpi$$

gives after integration :

$$M = - \frac{1}{2} \cdot c_A \cdot \varpi^2 + C$$

whose constant (C) can be considered as null. According to the *speed* of formation of the *price* (ϖ) the relation 19-01 is then written as follows:

$$\boxed{Q_{consumed} = \frac{1}{2} \cdot c_A \cdot \varpi^2 \cdot \frac{1}{\prod \eta_{i(QW)} \cdot \prod \eta_{i(TM)}}} \qquad \text{‹19-03›}$$

This last relation is to be compared with that of mechanics giving kinetic energy as a function of speed, namely :

$$W = \frac{1}{2} \cdot m \cdot v^2$$

which returns a completely theoretical minimum value because it doesn't take into account the yields. Taking into account the yields, these two relations are absolutely identical. Economy, like mechanics, therefore follows the same Natural Laws. Indeed, in Economy, as in physics, energy is a function of the square of the speed, *i.e.* :

- of the speed (v) of movement of the mobile in physics,
- the speed (ϖ) of *price* formation in Economics.

With the relation 04-18, namely :

$$a = - c_A \cdot \varpi$$

either :

$$\varpi = - \frac{a}{c_A}$$

hence:

$$\varpi^2 = \frac{a^2}{c_A^{\ 2}}$$

According to the *purchasing power* (a), the above relation becomes :

$$\boxed{Q_{consumed} = \frac{1}{2\, c_A} \cdot \frac{a^2}{\prod \eta_{i\,(QW)} \cdot \prod \eta_{i\,(TM)}}} \qquad \text{‹19-04›}$$

The latter relations clearly show that :

- the lower the *price* (p) is (relation 19-02),

- the faster the *price* (p) formed (relationship 19-03),
- the higher the *purchasing power* (a) is (relation 19-04),

the greater the energy consumption in the form of heat (Q). Indeed, in this low *price* hypothesis, productivity (ω) is necessarily high, which requires a significant amount of heat used. If productivity is high, this implies that the time taken to form the *price* is short. In fact, the time taken to change the *price* from the purchase *price* to the selling *price* is obviously equal to the manufacturing time.

Therefore, the greater the speed (ω) of manufacture, the greater the speed (ϖ) of *price* formation (always *caeteris paribus*).

Note 1

We know from experience that the average efficiency of a common internal combustion engine is about 0.30 . We have seen earlier that the overall efficiency of any economic *system* cannot exceed 0.34 . It is therefore possible to admit that the latter efficiency is, in practice, less than or equal to 0.30 . Consequently, in daily reality, the final yield between the enrichment of a *system* represented by the *Money* created (M) and the thermal energy (Q) necessary for this creation must be, except in very special cases, at most 10% . The actual yield must in the majority of cases be well below this value, *i.e.* around a few percent, if not less. Knowing now the relation (19-01) connecting Economy to Physics, it's therefore possible to make a comparison between the energy *price* of a litre of fuel and that of human energy.

We know that a litre of petroleum fuel gives off thermal energy during its combustion that is approximately equal to $10 kW/h$. Knowing also that an individual develops in everyday life a mechanical energy of less than $0.2 kW/h$, we can therefore write :

Energy of a litre of fuel ≈ 50 Mechanical energy of a Human

Taking into account the final yield between the *Money* created and the total energy spent (relation 19-01), which can reasonably be assumed to be equal to 0.05 (which is relatively high), we can ask :

Energy 1 litre of fuel ≈ 50 Human energy / 0.05

either :

Energy 1 litre of fuel ≈ 1 000 Human energy

This calculation, taking into account the *maximum overall yield* (0.34), could have been carried out with the optimal yield (0.58), which would have changed absolutely nothing in the reasoning and very little in terms of the final result. It is this quasi-gratuity of mechanical energy that explains the development of mobility in general. It isn't the purpose of this note to detail the impact of the very low cost of energy. However, it's possible to show that it promotes and catalyses :

- long-distance transport of goods (maritime, air, road, *etc.*),
- the movement of people (distance from the suburbs, weekends, holidays, *etc.*),
- *etc.*

If the unit *price*s of fuel and human energy were equal, then for every 1 Dollar of extra *Money* (*wealth*) created, 1,000 times more would have to be spent on fossil fuel. This calculation shows in the most obvious and explicit way the reason why the standard of living has risen sharply over the last two centuries, *i.e.* since the industrial revolution. However, it also shows the underlying certainty that this development will come to a halt in the longer or shorter term. Consequently, an inverse, *i.e.* regressive, variation will inevitably occur, which can only take one of two forms:

- ***either, a slow and progressive deceleration,***
- ***or, a rapid and violent slowdown.***

However, the first hypothesis can be programmed and controlled to avoid economic, social, health, *etc.* clashes, while the second doesn't. Knowing that losses increase faster than productivity, the final output of an *economic system* increases more slowly than productivity itself. This remark therefore highlights the increasing consumption of fuels induced by the acceleration of manufacturing processes, and consequently its inevitable increasingly intense impact on the environment.

Note 2

Historical analysis shows that, in general, the more “advanced” a society is, the more the ratio between the number of productive people (performing *economic work*) and the number of unproductive people (performing only *labour*) tends to decrease. The reason for this is the increasing divergence between the *price* of energy and the *price* of manpower. Indeed, by posing :

p_R = *cost price of the Product*
p_Q = *cost of thermal energy expended (heat = Q)*
p_S = *cost of manpower used (remuneration + charges = S)*
$_C$ = *China*
$_F$ = *France*

At time t_1, suppose that :

- the *price* of manpower is x times the *price* of energy,
- the energy used is x times that spent by the manpower,
- the cost of French labour, *i.e.* 5 times that of Chinese manpower.

At time t_2, suppose that :

- only the *price* of energy has been multiplied by 10 (*caeteris paribus*) compared to the previous hypothesis.

Then it's possible to write :

$$p_{F(t_1)} = 0{,}50\ p_Q + 0{,}50\ p_S = 1{,}00\ p_R \quad \text{and:} \quad p_{C(t_1)} = 0{,}50\ p_Q + 0{,}10\ p_S = 0{,}60\ p_R$$
$$p_{F(t_2)} = 5{,}00\ p_Q + 0{,}50\ p_S = 5{,}50\ p_R \quad \text{and:} \quad p_{C(t_2)} = 5{,}00\ p_Q + 0{,}10\ p_S = 5{,}10\ p_R$$

By making the ratio of the Chinese and French (China/France) cost *price*s (p_R), it comes respectively to the two times t_1 and t_2 :

at the time t_1 $\Rightarrow$ $\dfrac{\textit{Chinese cost price}}{\textit{French cost price}} = \dfrac{p_{C(t_1)}}{p_{F(t_1)}} = \dfrac{0{,}60}{1{,}00}$ either : 60 %.

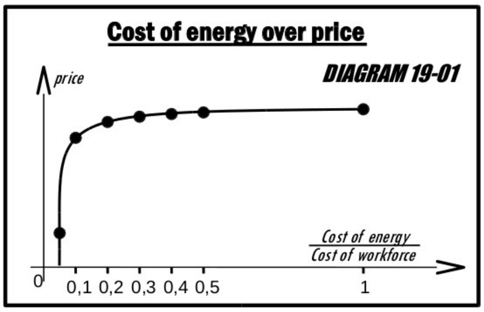
at time t_2 $\Rightarrow$ $\dfrac{\textit{Chinese cost price}}{\textit{French cost price}} = \dfrac{p_{C(t_2)}}{p_{F(t_2)}} = \dfrac{5{,}10}{5{,}50}$ either : 93%.

This calculation, whose validity is limited only to its demonstrative and not numerical expression, unambiguously attests to the primordial influence of the *price* of energy; if it were paid at a *price* more in line with the cost of manpower, the latter's share in the *price*s of the *Product*s would not be essential, as shown in the table below.

Energy Price $\times$	**Chinese Price** (p_C)	**French Price** (p_F)	**Ratio** (p_C/p_F)
1	***0,60***	***1,00***	***0,60***
2	***1,10***	***1,50***	***0,73***
3	***1,60***	***2,00***	***0,80***
4	***2,10***	***2,50***	***0,84***
5	***2,60***	***3,00***	***0,87***
⋮	⋮	⋮	⋮
10	***5,10***	***5,50***	***0,93***
⋮	⋮	⋮	⋮
25	***12,6***	***13,0***	***0,97***
⋮	⋮	⋮	⋮
100	***50,1***	***50,5***	***0,99***

It also expresses that the ratio curve (low manpower cost countries/high manpower cost countries) is asymptotically shaped. An increasingly strong increase in the *price* of energy induces an increasingly weak effect. Conversely, any decrease in the *price* of energy leads to an increasingly large effect, thus favouring *unemployment* through relocation or other measures.

On the basis of the above hypotheses, it's possible to present Figure 19-01 opposite, which clearly shows how the cost *price* of a product can change as a function of the relationship between the respective costs of energy and manpower.



Thus, offshoring to low labour cost countries is mainly due to the current quasi-free energy and very little due to the wage differential. In a few decades' time, the assured scarcity of fossil fuels can only lead to an increase in their *price* according to the core law (08-04).

As a result, the wage cost differential between countries is likely to continue to exist, but its influence on final product *price*s will only diminish as energy *price*s rise.

Entropy

This paragraph isn't of particular interest and is presented for information purposes only.

Previously, the 19-01 relationship linking heat to the *Money* and the respective physical and economic efficiencies has been determined above, namely :

$$Q = - \frac{M}{\prod \eta_{i\,(QW)} \cdot \prod \eta_{i\,(TM)}}$$

By posing:

η_g = *global yield of all transformations (physical and economic)*

the relationship 19-01 can be written :

$$Q = - \frac{M}{\eta_g}$$

which obviously corresponds to the definition of output (ratio of what comes out to what goes in).

The differential of this relation is :

$$dQ = - d\left(\frac{M}{\eta_g}\right)$$

either:

$$dQ = \frac{M \cdot d\eta_g - \eta_g \cdot dM}{\eta_g^{\,2}}$$

Then, knowing the physical relation giving entropy, namely:

$$dS = \frac{dQ}{T}$$

it's possible to write, for a real *system*, not totally reversible since one takes into account the yields:

$$dS = \frac{1}{T} \cdot \frac{M \cdot d\eta_g - \eta_g \cdot dM}{\eta_g^{\,2}}$$

At the beginning of this chapter, we admitted that the economic *system* could be considered as isolated since the exchange only takes place between a supplier and a consumer. In such a *system*, the variation in entropy is therefore directly proportional to the quantity of *Money* created (for the consumer) and, consequently, to the quantity of *Work* that had to be spent (by the supplier) for this creation (First Principle $dT + dM = 0$).

For a given output :

$$d\eta_g = 0$$

Then the relationship simplifies and gives:

$$\partial S_{\eta_g} = -\frac{1}{T_{(temperature)}} \cdot \frac{\partial M_{created}}{\eta_g} = \frac{1}{T_{(temperature)}} \cdot \frac{\partial T_{provided}}{\eta_g} \qquad \text{‹19-05›}$$

20 – CONSERVATION LAWS

ABSTRACT: This chapter shows the submission of this essay to Noether's theorem, which confirms that the laws governing economic exchanges are, like all things, subject to the laws governing the workings of the universe.

Thus, the purchasing power and the total money for the T→M transformation on the one hand, as well as the employment and the total work for the M→T transformation on the other hand, must be constant in space as well as in time. This is, of course, considered under the express condition that nothing else changes.

General

Noether's theorem indicates that :

1. space is homogeneous, *i.e.* it's the same everywhere and therefore there is no zero point,
2. time is uniform, *i.e.* it flows regularly and therefore there is no such thing as zero time.

The isotropic property of space doesn't need to be considered here.

These two properties (homogeneity of space and uniformity of time) impose that any event, any evolution, any change, can only be apprehended by any observer in relation to a spatial and a temporal reference frame respectively. It follows that the situation of a phenomenon is always due to a choice by Human of these spatial (zero point) and temporal (zero time) reference points. *Caeteris paribus*, the course of a phenomenon, both in space and in time, must be identical here, there and elsewhere, as well as before, now and after. It should be noted that the presence of markers is only obligatory in the case of a variation. For example, if an observer in rectilinear and uniform motion (MRU) refers to a reference mark that moves identically to him, has the illusion of being at rest. Then, in this hypothesis, the eventualities, rest and movement, are analogous and cannot be individualized, differentiated.

This same theorem has the consequence of implying the conservation of :

1. the quantity of movement during a translation in space,
2. the total amount of energy during a translation in time.

In this note, which is outside the realm of physics, there is neither quantity of movement nor energy in the mechanical sense. Here, similar characteristics have been determined as follows (chapter “Mechanics of Exchanges”):

- in the transformation Work→Money :
  - quantity of motion ⇔ *purchasing power*

- total energy ⇔ total *Money*

- in the transformation Money→Work :
  - amount of movement ⇔ *employment*
  - total energy ⇔ *total Work*

Purchasing power and *employment* on the one hand, total *Money* and *total Work* on the other, must remain constant in space and time respectively, *i.e.* in any place and at any time, obviously if nothing else changes.

Transformation Work→Money

1. ***Preservation of purchasing power***

It has been defined, by Principle, the 04-06 relation linking the *Force* (F_A) to the acceleration (γ_ϖ) of the speed (ϖ) of *price formation* (p), namely :

$$F_A = - c_A \cdot \gamma_\varpi \qquad \text{or :} \qquad F_A = - c_A \cdot \frac{d\varpi}{dt}$$

that it's possible to write:

$$F_A \cdot dt = - c_A \cdot d\varpi$$

By integrating between two considered instants, that is to say at the initial time t_1 and at the final time t_2, it comes :

$$F_A \cdot (t_2 - t_1) = - c_A \cdot (\varpi_{t2} - \varpi_{t1})$$

or :

$$F_A \cdot (t_2 - t_1) = - c_A \cdot \varpi_{t2} + c_A \cdot \varpi_{t1}$$

But we know the relation 04-18 giving the *purchasing power* (a), namely:

$$a = - c_A \cdot \varpi$$

then:

$$F_A \cdot (t_2 - t_1) = a_{t2} - a_{t1}$$

If no *additional force* is exerted by the consumer on the supplier to bring down the *price*, then the *purchasing power* cannot vary and remains constant. Therefore, if :

$$F_A = Constant \quad \Rightarrow \quad \boxed{a_{t2} = a_{t1}} \qquad \text{‹20-01›}$$

which shows the preservation of *purchasing power*, because the speed of *price* formation (ϖ) has no reason to change if nothing else changes.

2. ***Conservation of the total Money***

The *total Money* is considered here as the sum of kinetic energy (exchange mediator) and potential energy (savings).

Again starting from the relation 04-06, namely :

$$F_A = - c_A \cdot \gamma_\varpi \qquad \text{or :} \qquad F_A = - c_A \cdot \frac{d\varpi}{dt}$$

We also know the relation 04-02 giving the speed of formation (ϖ) of *price* formation, namely :

$$dp = \varpi \cdot dt$$

By replacing the *Force* and the *price* in the relation 04-10 giving the *Money*, namely:

$$dM = F_A \cdot dp$$

it becomes :

$$dM = - c_A \cdot \frac{d\varpi}{dt} \cdot \varpi \cdot dt \qquad \text{either :} \qquad dM = - c_A \cdot \varpi \cdot d\varpi$$

By integrating between two considered instants, either at the initial time t_1 and at the final time t_2, it comes:

$$M = - \left(\frac{1}{2} \cdot c_A \cdot \varpi_{t2}^2 - \frac{1}{2} \cdot c_A \cdot \varpi_{t1}^2 \right)$$

By posing:

E^{cin} = *Kinetic energy* either : $E^{cin} = \frac{1}{2} \cdot c_A \cdot \varpi^2$

then it comes :

$$M = - \left(E_{t2}^{cin} - E_{t1}^{cin} \right)$$

But this difference of *Kinetic Energy* between the instants t_2 and t_1 corresponds to the difference of transformed *Potential Energy* between the instants t_1 and t_2. By posing :

E^{pot} = *Potential energy*

then :

$$M = -\left(E_{t1}^{pot} - E_{t2}^{pot}\right)$$

The presence of the minus sign (-) is quite logical, because all this is related to the transformation *Work→Money*. Indeed, the slower the speed (ϖ) of *price* formation, the higher the *Money*, *i.e.* the *Kinetic Energy*, held by the consumer. As a result, the consumer can keep in his wallet this sum, which can now be considered as *Potential Energy*, and which can be used for any future use (acquisition of a *Product*, payment of a debt, payment of taxes, ...).

Consequently, the greater the *Work done* by the supplier, the more *Potential Energy* (*Money saved*) is available to the consumer. So, this *Energy* is normally higher at time t_2 than at time t_1. These last two relations can therefore be written as follows:

$$M = E_{t1}^{cin} - E_{t2}^{cin} \qquad \text{and :} \qquad M = E_{t2}^{pot} - E_{t1}^{pot}$$

It is therefore possible to equalize these two *Money* and write:

$$E_{t1}^{cin} - E_{t2}^{cin} = E_{t2}^{pot} - E_{t1}^{pot}$$

or again:

$$E_{t2}^{pot} + E_{t2}^{cin} = E_{t1}^{pot} + E_{t1}^{cin}$$

Therefore, it comes:

$$\boxed{E_{t2}^{tot} = E_{t1}^{tot}} \qquad \textbf{‹20-02›}$$

which shows the preservation, over time, of the *total Money* (*Money created* + *Money saved*).

It has just been considered the *Money created* but it would have been possible to consider the *Money* used, *i.e.* that which the consumer spends to acquire any *Product*s. Then, the *Kinetic Energy* (*Money*) at time t_2 is higher than that at time t_1 and the *Potential Energy* at time t_2 is lower than that existing at time t_1. In this case the calculations would be identical except for the sign and would obviously return the same result.

Transformation Money→Work

1. ***Employment conservation***

It has been defined, by Principle, the relation 04-05 linking the *Force* (F_P) to the *acceleration* (γ_ω) of the *speed* (ω) of *execution of the labour* (l), that is to say :

$F_P = c_P \cdot \gamma_\omega$ or again : $F_P = c_P \cdot \dfrac{d\omega}{dt}$

that it's possible to write :

$$F_P \cdot dt = c_P \cdot d\omega$$

By integrating between two considered instants, that is to say at the initial time t_1 and at the final time t_2, it comes :

$$F_P \cdot (t_2 - t_1) = c_P \cdot (\omega_{t2} - \omega_{t1})$$

or :

$$F_P \cdot (t_2 - t_1) = c_P \cdot \omega_{t2} - c_P \cdot \omega_{t1}$$

But we know the relation 04-17 giving the job (e), namely:

$$e = c_P \cdot \omega$$

then:

$$F_P \cdot (t_2 - t_1) = e_{t2} - e_{t1}$$

If no additional *Force* is exerted by the consumer on the supplier to increase the *labour*, then the *employment* cannot vary and remains constant. Therefore, if :

$$F_P = Constant \quad \Rightarrow \quad \boxed{e_{t2} = e_{t1}} \qquad \text{‹20-03›}$$

which shows the conservation of the *employment*, because the *speed of the labour* (ω) has no reason to change if nothing else changes.

2. ***Conservation of Total Work***

Total Work is considered here as the sum of *Work done* and *Work to be done.*

Still starting from the relation 04-05, *i.e.* :

$F_P = c_P \cdot \gamma_\omega$ or : $F_P = c_P \cdot \dfrac{d\omega}{dt}$

We also know the relation 04-01 giving the speed of execution (ω) of the *Work*, namely:

$$dl = - \omega \cdot dt$$

Replacing *Force* and *labour* in the relation 04-09 giving the *Work*, namely:

$$dT = - F_P \cdot dl$$

it becomes:

$$dT = c_P \cdot \frac{d\omega}{dt} \cdot \omega \cdot dt \qquad \text{or:} \qquad dT = c_P \cdot \omega \cdot d\omega$$

By integrating between two considered instants, either to the initial time t_1 and to the final time t_2, it comes:

$$T = \frac{1}{2} \cdot c_P \cdot \omega_{t2}^2 - \frac{1}{2} \cdot c_P \cdot \omega_{t1}^2$$

By posing:

E^{cin} = *Kinetic energy* and : $$E^{cin} = \frac{1}{2} \cdot c_P \cdot \omega^2$$

then:

$$T = E_{t2}^{cin} - E_{t1}^{cin}$$

But this difference in *Kinetic Energy* between the instants t_2 and t_1 corresponds to the difference in transformed *Potential Energy* between the instants t_1 and t_2. By posing :

E^{pot} = *Potential energy*

then :

$$T = E_{t1}^{pot} - E_{t2}^{pot}$$

It is thus possible to equalize these two *Works* and to write :

$$E_{t2}^{cin} - E_{t1}^{cin} = E_{t1}^{pot} - E_{t2}^{pot}$$

or again:

$$E_{t2}^{pot} + E_{t2}^{cin} = E_{t1}^{pot} + E_{t1}^{cin}$$

Accordingly, it comes:

$$\boxed{E_{t2}^{tot} = E_{t1}^{tot}} \qquad \textbf{‹20-04›}$$

which shows the conservation, over time, of the *total Work* (*Work created* + *Work to be done*).

21 – DISCRIMINATION OF ECONOMIC AGENTS

ABSTRACT: We have seen that among all the agents composing an economic system some were producers of wealth by creating Money, others were only doing useful labor for the society but without performing any Work, etc.

We also know that all the elements forming an economic system are consumers but only some are producers. Therefore, it is necessary, if not obligatory, to be able to discern these different agents in order to categorize them by the simplest possible univocal selective criteria. This is what this chapter proposes.

Categories of agents ⇒ ***General***

In this chapter the terms work and cash are to be understood in their usual sense and are written without capital letters and not in italics. From everything that has just been written, it's clear that in order to enrich any Society, it's obligatory and indispensable to bring about a reduction in the *price* of the *Product*s placed on the market through an improvement in *productivity*. Of all the economic agents that make up this Society (consumers, users, producers, suppliers), it would be good to know which ones actually increase *wealth* and which do not.

Conventionally, experience shows that in any society there are several types of agents that can be classified in different categories according to certain criteria, such as their occupation, age, type of remuneration, place of exercise of their profession, *etc.* All these ways of classification have no purpose or use in this note.

Only the categories defined by the two discrimination criteria of work performed and income obtained in return will be considered here, which implies only four and only four types of agents, namely :

1. agents who do not work and have no income,
2. agents who do not work and have income,
3. agents who work and have no income,
4. agents who work and have income.

The table below lists these categories with some examples of agents.

Cat.	Work	Income	Examples
1	**no**	**no**	**Children, schools, students, unpaid unemployed, homeless people**
2	**no**	**yes**	**Pensioners (distributive system), paid unemployed, annuitant,**
3	**yes**	**no**	**Slaves**
4	**yes**	**yes**	**Employees, managers, pensioners (capitalization system)**

We are entitled to ask ourselves the questions:

1. what do people who have no income live on,
2. where the income of those who have it comes from.

Answers will be given by analysing each category, the essential point being to be able to know unambiguously the agents who produce and create *Money* and if possible to discriminate against the other categories.

Category 1

By definition, agents in this category don’t work and have no income and can therefore only live on remittances.

Young people who are not yet self-sufficient can only live on a transfer of cash, usually from their parents who feed, clothe, house, *etc.*, and who are not yet self-sufficient. Eventually, they may receive cash from the state in the form of family allowances or education grants, which is always a transfer. The same applies to the unemployed who don’t receive benefits, who may receive certain benefits such as jobseeker’s allowance, welfare, *etc.*, which are also an income transfer. The “tramps” can only live on the generosity of others, which by definition is still a transfer. Thieves also live only by transferring cash, although this is illegal. One could add the prisoners who are fed, housed and laundered by transferring cash from the community to them. Many more examples could be found.

At first glance, some might say that schoolchildren or students are workers, but in reality they are consumers of education and Knowledge and this consumption must be paid for. It is only paid for by transferring cash, firstly from the community to the State and secondly from the State to teachers, technical and service staff, investments (buildings, equipment, *etc.*) and operating costs (heating, lighting, *etc.*).

It is quite clear that, whatever the case considered, the agents making up this group can only live by transferring cash.

Category 2

By definition, the agents in this category don’t work and have an income.

Retired persons subject to the distributuve system receive their pensions only by transferring cash from the contributions of those who work (employees, self-employed persons, heads of enterprises, *etc.*). The same applies to the unemployed receiving benefits, at least for those in a distributive system, which is particularly the case in France. For annuitants, it's obvious that they can only live by transferring cash. It is possible to add to this list heirs who only receive cash by transfer.

Some may object that for pensioners or the unemployed, they had previously contributed. This is perfectly correct, but these contributions were obviously a transfer of cash for the benefit of pensioners and the unemployed existing at the time they were contributing.
As with the first category, the latter can only live by cash transfer.

Category 3

By definition, the agents in this category work and have no income.

The agents in this category have very low incomes that just allow them to survive in spite of their work. The *wealth*, *i.e.* cash, produced by these people is taken from them under duress.

Slavery has, in principle, only been banned worldwide under the aegis of the United Nations for a few decades, and for one or two centuries in European countries and the United States. But this study must be applied without limits of time and space (Principle of Homogeneity). Therefore, *a priori*, this group of agents should no longer exist in a so-called modern society. However, it's common knowledge that in some countries child exploitation is practised on a large scale. Moreover, cases of modern slavery, in the so-called “developed” countries, of young girls used for all kinds of domestic work, are fairly regularly reported in the media and in the courts.

Some individuals such as farmers, craftsmen, merchant, self-employed workers can be defined as included in this category. In fact, a certain number of these people, despite a considerable workload, only have an income well below the minimum wage, which, let's not forget, is an hourly wage. It is indeed relatively easy to find entrepreneurial agents who only have a survival income. Let's take the following example by considering a baker working 60 hours a week (which is by no means exceptional) and his wife working the same amount, which is roughly equivalent to 500 hours/month. If this household's income is roughly in the range of the monthly minimum wage (which is also by no means exceptional), this corresponds to an hourly wage more than three times lower than this minimum threshold. Knowing that this wage is by definition a minimum, it's therefore normal to consider the remuneration for the work of these two people as just sufficient for their survival. Bearing in mind also that the number of entrepreneurs in France is in the order of 2,500,000, it's normal to estimate the number of economic agents in this case at several tens of thousands, which is far from negligible. It is well known that almost half of French farmers have incomes of less than or equal to $420/month (2016 figures), despite a substantial “workload” requiring well over 169 hours of *labour* per month; 169 hours per month corresponds to 39 hours per week.

Category 4

By definition, the agents in this category work and have an income.

Pensioners with a funded pension may be included in this category. In fact, their income is formed by their previous savings and can be considered as part of their salary, *i.e.* their work, which enables them to live in a deferred manner over time. The same can be said of a worker who saves a certain amount of cash every month to buy a vehicle after a few years. For salaried employees (civil servants, military personnel, employees of private or public companies, politicians, *etc.*) and company managers (shopkeepers, craftsmen, liberal professions, *etc.*) it seems *a priori* normal that their income comes from their work. However, and this is very important, it's questionable from a strictly economic point of view whether all these agents actually create monetary *wealth* (*Money* in the sense defined above in the note). By taking a few examples, it's easy to see that some of these agents also live only by transferring cash.

A priest does some work, but it's obvious that he lives only by transferring cash from his flock. The same can be said of a prostitute of her clients. A contract worker who also wanders on the pavements does some work but produces absolutely nothing that could enrich the Society in monetary terms.

All the agents taken as an example are of course socially, culturally, intellectually or otherwise useful. The economic utility of the work done for the writing of this study contributes absolutely nothing to the monetary *wealth* of the country, but it's possible to subsume that it's useful in terms of knowledge.

Conclusion

We have just seen that there are four categories of agents, two of which are made up of people who work, *i.e.* perform work but don't necessarily carry out *Economic Work* as defined above in the note. In fact, some agents do indeed perform some labour and even some labour, but in no case Work, in the sense indicated in the dynamic vision of economic exchanges.

Consequently, the number of categories is now limited to three and the agents composing them will be designated as follows:

1. the "Unemployed", who don't perform any *labour*,
2. the "Makers" who done a job, a task, a *labour*, without creating *Money*,
3. "Workers" who create *Money.*

whose more explicit definition is given below :

- The Unemployed are all those agents who don't perform any *labour* such as children, students, pensioners, the sick, annuitants, the unemployed, housewives or househusbands, *etc.*
- The "Makers" are the people who done *labour* at a constant *speed*, *i.e.* without exerting *Force* and therefore without varying the *Utility* of the *Product.* No *Money* is created.
- The Workers are the agents (individuals, slaves, employees, animals, motors) who exert a *Force* that transforms the *Work to be done* into *Work done* by causing a variation in the *Utility* of the *Product. Money* is created by carrying out *labour* at an *accelerated speed.*

Therefore, it's necessary to find two criteria of discrimination:

1. one separating the Unemployed from the Workers (categories 1 and 2),

2. the other one discerning the Makers from Workers (categories 2 and 3).

The term “Unemployed” is taken here in its most general sense, the common meaning being very restrictive. Indeed, in everyday life, a newborn baby, like a hospitalised person, is indeed unemployed, *i.e.* without *job*. The same is true for pensioners, schoolchildren, students, annuitants, *etc.*, and of course for the unemployed. Let us say that the Unemployed form categories N°. 1 and 2, *i.e.* they don’t work.

In order to specify the agents who done *labour* at a constant *speed*, that is, who don’t cause a variation in the *Utility* of what they elabourate, the term Workers isn't appropriate since they don’t provide any *Work for economic purposes*. Consequently, the term “Makers” was created as a neologism for the purposes of this study.

Discrimination of agents ⇒ *General*

We have seen that it was the variation in the *Utility* of the *Product* between the beginning and the end of a Transformation that allowed the creation or destruction of *Money*. We also know that any *Product* can only be purchased if it has a certain *Utility* for the consumer (agent) of any kind (individual, household, association, company, administration, *etc.*). Consequently, it's this characteristic which must be taken as the core of the discrimination criteria as we have seen in the chapter “Value of the monetary unit”.

Let us return to thermodynamics and differentiate between the following cases:

1. there may exist a system creating work by an acceleration of speed due to a drop in temperature, and it's always sought its maximum,

2. there may be a system that doesn't create work because the speed is kept constant because there is no variation in temperature,

3. there may be a system where work is destroyed by a deceleration in speed due to an increase in temperature, the cause of which is useful losses such as friction from tyres on the road or tyres on the rails. These losses are useful because if this friction were too low or zero, it would be impossible to move. The optimum of this friction is always sought, *i.e.* the function must be just ensured but without additional losses. Although this friction is useful, it's still only a destruction of work,

4. there may be a system where work is destroyed by a deceleration of speed due to a rise in temperature, the cause of which is unnecessary losses such as friction in the bearings or the piston in a cylinder. These losses are useless and their minimum is always sought.

We can see that there are four hypotheses which become the following in Economics:

1. there may exist agents creating *Money* by a deceleration of the *speed of price formation* due to a fall in *Utility* for themselves and it's always sought its maximum,

2. there may be agents that don’t create *Money* because the *speed of price formation* is kept constant because there is no variation in *Utility*, but the latter isn't zero,

3. there may be agents destroying the *Money* by an acceleration in the *speed of price formation* due to an increase in *Utility* for themselves, the cause of which are losses useful to the Society, such as State levies of *Money* for the construction of roads, bridges, hospitals, educational institutions, *etc.* State agents are therefore necessary and indispensable to done these levies and their remuneration are useful losses and their optimum must always be sought, *i.e.* the function must be justly ensured but without additional losses. Despite the fact that these agents are useful, their remuneration is always only a destruction of *Money*,

4. there may be agents destroying the *Money* by an acceleration in the *speed of price formation* due to a decrease in *Utility* for themselves, the cause of which is unnecessary losses to the Society such as those who consume without doing anything in return.

The following paragraphs will enable agents to be classified in one of these four new categories according to what they do by means of discrimination tests.

Discriminant 1

We know that the agents in this category must modify a *Product* by varying its *Utility* (an increase for the Acquirer or a decrease for the Transformer, *i.e.* for themselves). The modification of this *Utility* is due to the exercise of a *Force* involving the slowing down of the *speed of price formation.* The discrimination criterion can be defined as follows:

- ***Can a Product made by an agent in this category be desired by itself of its own free will?***

The analysis of this discriminant shows that :

1. the fact of specifying “by itself” necessarily implies that this agent varies the *Utility* of the *Product* and that it's not null,
2. specifying “of his own free will” implies that the agent isn't under constraint.

It follows that :

- only those agents who respond positively to this discrimination can be qualified as “Workers”,
- employees responding negatively to this discrimination must be defined as not working, in the economic, monetary sense of the term, as has already been stated.

It is quite obvious that the term “Worker” must be taken in the strictly economic sense, *i.e.* the only one with the capacity to create *Money*, as already specified.

It is easy to find examples of the application of this discriminatory provision, among others:

- An employee who manufactures tyres will answer positively because he elabourates well a *Product* that may have a certain *Utility* for himself and the more he Works (himself or machines) the lower the *price* will be and therefore the more *Money* will be created.

- A market gardener producing carrots will respond positively because he elabourates a *Product* that he may very well need and the more he Works the lower the *price* will be and therefore more *Money* will be created.

- A craftsman making vine stakes will respond positively because he produces a *Product* that may have a certain *Utility* for himself and the more he Works the lower the *price* will be and therefore more *Money* will be created.

Discriminant 2

We are aware that the agents in this category must not modify a *Product*, *i.e.* the *Utility of the Product* remains constant between the time the agent acquires it and the time it's resold. The criterion of discrimination can be defined as follows:

- ***Can a Product coming from an agent in this category be desired by others of their own free will?***

The analysis of this discriminant shows that :

1. the fact of specifying “by others” necessarily implies that this agent doesn't vary the *Utility of the Product*, because otherwise, he himself could desire or acquire the *Product* and one would find oneself in the previous hypothesis. However, the *Utility* isn't null and void,
2. specifying “of his own free will” implies that the agent isn't under constraint.

We know that people in this category don’t work, but they do handle a *Product* (object or service) with a *Utility* and vary its *price*.

The following example responds positively to this discrimination:

- A merchant, selling anything, will answer positively because he doesn't elabourate anything at all and cannot in any case reduce the *price* at which he acquired the *Product* and therefore cannot create any *Money*. However, the *Product* always has a *Utility* for others and the Acquirer can buy it of his own free will.

The following shows the difference between the two categories that have just been defined by these criteria. Either a tailor, not necessarily *wealth*y, and a shirt retailer. The former may want the shirt he makes, while the latter will only buy it from the tailor. The tailor changes the *Utility* of the fabric while the second doesn't change the *Utility* of the shirt.

Only consumers other than the merchant will buy shirts from him, but he himself will only buy them from the tailor.

Discriminant 3

We know that the agents in this category are necessary for the proper functioning of the Society. They don't produce any *Money* and only destroy it, *i.e.* consume it, spend it. The criteria for discrimination in this category can be defined as follows:

- ***a Product coming from an agent in this category is never desired by anyone. It is always taken under duress.***

The analysis of this discriminant shows that :

1. specifying "by anyone" implies that the Acquirer can be as much someone else as the agent himself.

2. the fact of specifying "taken under constraint" necessarily implies that the *Utility of the Product* is null and void for anyone, *i.e.* for all agents.

The following examples respond positively to this discrimination:

- the mayor of any commune will answer negatively because he doesn't elabourate anything at all and therefore cannot create any *Money*. However, it's within his or her power to spend the *Money* in an optimal way so as to ensure the proper functioning of the Society he or she is in charge of and therefore useful to it. Such *Money* may only be derived from levies made under constraint.

- A tax collector is also in this case. Indeed, everyone is happy that the State has the financial means to build educational establishments, hospitals, roads or bridges, *etc.* In order to do so, it pays an agent to collect the necessary taxes. It is therefore useful to the Society but it never creates a *Money*, as this remuneration is only an expense, a destruction, and it only comes from levies made under duress. It follows that it's quite logical to think that if a collector is useful, where only one is needed, there is no need for two.

- Some people make vignettes (differential tax on motor vehicles) but they will only be acquired under constraint by anyone.

Generally speaking, civil servants in the strict sense of the term belong to this category.

Discriminant 4

The agents in this category are consumers, *i.e. Money* destroyers and produce nothing. The criterion for discrimination in this category can be defined as follows:

- ***no Product comes from an agent in this category.***

It is possible to designate them as Unemployed in the most general sense. In fact, we can classify here people commonly looking for a *job*, but also those who are not employed such as children, schoolchildren and students, housewives, annuitants, sick people, thieves, prisoners, *etc.*

Conclusion

From all that is said in the note, it emerges that for an agent to create *Money*, it's necessary and indispensable that he provokes, for himself, a fall in *Utility of the Product* between the moment he acquires it and the moment he resells it.

Consequently, it's possible to say :

- ***Only those agents who answer affirmatively to criterion N°1, are Workers (in the sense of monetary creation).***
- ***All the other agents don't produce any Money.***

As already stated, it's absolutely not said that the agents answering negatively to the first discriminating criterion are useless for the proper functioning of the Society to which they belong or for the happiness of its members, but only that they are not producers of *wealth* in the strict sense of *Money* abundance. These agents are in fact useful in other ways such as socially, culturally, medically, *etc.* Experience shows that the more a Society evolves, the more the ratio of productive to unproductive people decreases. The characteristics of *Utility* as well as of the *speed* of execution of *labour* and *price* formation can be defined analytically for each of the four categories of agents.

Indeed :

1. if the agent answers positively to discriminant N°1 it means that the *Utility* is positive and its negative variation (for the Transformer, *i.e.* for the agent in question), the *speed* of *price* formation decreases. Therefore :

$$U_P > 0 \qquad \text{and :} \qquad dU_P < 0$$
$$\varpi > 0 \qquad\qquad\qquad d\varpi < 0$$

2. if the agent answers positively to discriminant N°2 it means that the *Utility* is positive and its variation is zero, the *speed* of *price* formation increases. Therefore :

$$U_P > 0 \qquad \text{and :} \qquad dU_P = 0$$
$$\varpi > 0 \qquad\qquad\qquad d\varpi < 0$$

3. if the agent answers positively to discriminant N°3 it means that the *Utility* and its variation are null, the *speed* of *price* formation increases. Therefore:

$$U_P = 0 \qquad \text{and :} \qquad dU_P = 0$$
$$\varpi > 0 \qquad\qquad\qquad d\varpi < 0$$

4. if the agent doesn't respond to any of the 3 discriminant mentioned, it means that the *Utility* is null as well as the *speed* of *price* formation. Moreover, these two characteristics do not vary. So :

$$U_P = 0 \qquad \text{and :} \qquad dU_P = 0$$
$$\varpi = 0 \qquad\qquad\qquad d\varpi = 0$$

The table below summarizes these analytical data.

DISCRIMINATION CRITERIA					
***Utility* and Price**					**Agent**
$U_P > 0$	$dU_P < 0$	$\varpi > 0$	$d\varpi < 0$	**Monetary Utility**	**Worker**
$U_P > 0$	$dU_P = 0$	$\varpi > 0$	$d\varpi < 0$	**Monetary inutility**	**Labourer**
$U_P = 0$	$dU_P = 0$	$\varpi > 0$	$d\varpi < 0$	**Monetary inutility**	**Public official**
$U_P = 0$	$dU_P = 0$	$\varpi = 0$	$d\varpi = 0$	**Monetary inutility**	**Unemployed**

To differentiate between the agents in the first two categories, it's still possible to write :

- if an agent of floor n can acquire without constraint the *Product* at the exit of this floor n, he belongs to the first category and he is a Worker,
- if an agent of floor n can acquire without constraint the *Product* at the exit of floor *n-1*, he belongs to the second category and he is a “Maker”.

22 - MONOPOLES

ABSTRACT: We know that any theory must explain a set of real examples as large as possible. Consequently, this study must give a consistent if not perfect explanation of economic exchanges under monopolistic conditions. This is what this chapter proposes to do, by reporting the evolution of prices and labor under these conditions without contradiction with reality and always similar to the physical evolution under constraints. Indeed, a monopolistic situation is situated, without ambiguity, in an environment forcing an individual to limit his freedom of consumption to a single supplier: the latter is no longer subject to certain constraints.

Monopolies ⇒ Definition and Ranking

The term "monopoly" comes from the Greek: *monos = alone* and: *polein = to sell*

Hence the definition of Larousse L3 dictionary :

- ***Exclusive privilege to manufacture or sell certain things, to operate certain services, to occupy certain offices.***

The definition contains the word "privilege", the definition of which is :

- ***Personal law of exception, of favour.***

Hence the definition of Cambridge dictionary :

- ***(An organization or group that has) complete control of something, especially an area of business, so that others have no share.***

Consequently, a privilege is always restrictive and therefore a monopoly. Agents who are not part of the monopoly are therefore subject to constraints to which those who are part of the monopoly are not subject.

It is usual to classify monopolies into two broad categories, in this case "legal" and "de facto" monopolies. The first includes monopolies established in the fiscal interest, in the interest of public order, in the public interest or for the encouragement and advancement of progress. All these classifications have absolutely no justification from a physical point of view. From this point of view, there is only one category and monopolies can only be classified according to the extent to which the privilege grants them a reduction in the constraints that the privilege grants them, *i.e.* the rate of competition to which the monopoly is subject. The classical appellations of monopoly *stricto sensu*, duopoly, oligopoly, *etc.* have no object in the case which concerns us in this study, since the Laws being general they must explain to any situation which may arise.

Monopolies ⇒ *Price variation*

In accordance with the Second Principle, which states that *Avarice* (A) can only increase in the absence of external constraints, it's possible to ask what happens when the *price*, or *added Value*, increases in a monopoly situation. In this case, the *Force* (F_A) exerted by the consumer on the supplier cannot be expressed. Therefore, the supplier's Reaction *Force* will no longer be equal to that of the consumer since the latter is nil on the monopoly. The evolution of the *price* plays on the consumer, but we know that, normally, it's the consumer who acts on the supplier to make him decrease. For example, if a consumer goes to a post office counter to buy a stamp and thinks it's too expensive, the charming sales assistant will remain totally indifferent to his complaints.

In the $T \rightarrow M$ transformation, we know that the *Internal Energy* of the *system* is (relation 06-01):

$$dE_{TM} = dT + dM$$

or (relation 06-02):

$$dE_{TM} = -\underbrace{U_P \cdot dP}_{cause} + \underbrace{F_A^{ext} \cdot dV}_{effect}$$

The *Force* of the consumer being null, the variation of *Money* due to this *Force* is also null therefore:

$$dM = 0$$

and the variation of the *internal Energy* is summed up to :

$$dE_{TM} = dT$$

However, experience shows unambiguously that whatever the *price*, *Work* doesn't vary. In fact, to take the above example of the postmistress for postal items and parcels, if the *price* of the item increases or decreases, the service provided will always be the same. The workload of the counter staff, postmen, mailmen, *etc.*, will not decrease or increase due to the increase in the *price* of stamps. Therefore, it's possible to write :

$$\boxed{dE_{TM} = dT = 0} \qquad \textbf{‹22-01›}$$

This relationship shows perfectly that, in the case of a monopoly, if the *price* of a *Product* increases, the variation in monetary *wealth* of the *system* is zero. Consequently, the *Cash* covering this *price* increase will necessarily come from others, *i.e.* the Buyers. It will therefore only be a transfer of *Cash*. If the monopoly gets richer, consumers get poorer.

Furthermore, we have ensured that the absence of a difference in the *Utility of the Product* implies that the *Money* created is null and void. Because in the case of a monopoly, the *price* variation has absolutely no influence on the *Utility*, the *Money* is also null.

Monopolies ⇒ *Variation in labour*

We have just seen, in the previous paragraph, the influence that a *price* increase, *i.e.* an increase in *Avarice*, can have in the case of a monopoly, therefore in the absence of external constraints. We may ask ourselves what could happen when *Laziness* increases under the same conditions, since this characteristic can only increase according to the Second Principle.

We know that in the $M \rightarrow T$ transformation, the *internal Energy* is equal to (relation 06-04):

$$dE_{MT} = U_A \cdot dA - F_P \cdot dB$$

The *Force* due to the *Laziness* of the consumer has, by definition, absolutely no influence on that of the supplier, since it's a monopoly not subject to the constraint of the consumer, consequently:

$$dT = 0$$

and the variation of the *internal Energy* is summed up to :

$$dE_{MT} = dM$$

Now, experience shows without ambiguity that whatever the *labour*, the *Money* doesn't vary. Indeed, to take the example of the Post Office, if the labour required to transport and sort a letter decreases or increases, the *price* of the service rendered will always be the same. For example, in the event of severe weather conditions (floods, snow, fog, *etc.*), the postman's labour will be higher but the *price* of delivering the mail will not have changed.

Consequently, it's possible to write :

$$\boxed{dE_{MT} = dM = 0} \qquad \text{‹22-02›}$$

This relationship shows perfectly that, in the case of a monopoly, if the *labour* of a *Product* decreases, the variation in *wealth* of the *system* is zero. It will therefore only be a transfer of *Work*. If the monopoly doesn't carry out extra *Work*, it's the consumers who do.

Conclusion

Whatever transformation a monopoly carries out, we have just seen that the *internal Energy*, which can be considered as *wealth*, either of *Money* or of *Work to be done*, always remains constant. So :

- ***A monopoly never creates, neither Money realized, nor Work to be done.***

This in no way means that monopolies are useless for the good functioning of a Society, but only that the agents composing them can only live by the transfer of *Money* from other people.

In a competitive *system*, the *Utility of the Product* elabourated by the Transformers always increases for the Buyers, otherwise the *Product* would not be sold, and the *price* increases according to this *Utility* but also decreases according to the *Work provided.* The ratio (*i.e.* g) between the *Money created* and the *Work provided* is equal to 1 considering these characteristics measured with the same unit (First Principle).

For a monopoly that increases the *Utility of a Product* it produces, the *price* increases according to the *Utility* but also decreases according to the *Work provided* but less than previously or not at all. A typical example of this monopoly *system* is an agent or company that holds a patent and exploits it. It provides some *Work* in order to increase the *Utility of the Product* and it increases the *price.* But because of his monopoly position, he raises the *price* even more without having done any extra *labour.* Consequently, the *Cash* that he will receive in addition will necessarily be a transfer. It will necessarily have been created previously in another transformation and this because of the “time arrow”. The coefficient g , being always equal to 1 , the additional *Money* that the consumer gives up can only come from a previous transformation.

A monopoly that doesn't increase the *Utility of the Product* it “manufactures” doesn't perform any Work, but only *labour* doesn't create *Money.* The *Cash* that this agent receives is entirely transferred *Cash.*

In daily reality all monopolistic systems can exist. It is therefore possible to differentiate between competitive *systems* whose transformation coefficient (g) is equal to 1 , and monopolies whose coefficient (g) seems greater than unity. It is possible to posit that the higher the transformation coefficient g seems to be, the more monopolistic the *system* is. The *Work* provided by the agent belonging to the monopoly is smaller and smaller and the *Money* included in the *Money* is more and more important.

It is easy to see that the higher the coefficient g seems to be, the more there is a disconnection between the *Work* performed and the wage. This is so true that if one asks a person how much he or she is paid, one can know, without making too many mistakes, whether he or she is part of a competitive or monopolistic system only by his or her answer.

- If the average citizen answers: “I'm a turner, a digger, a computer specialist, an accountant and I earn so much”, he is most certainly an agent who is part of a competitive *system.*
- If the average citizen answers: “I have 10, 20 or 30 years of seniority and I earn so much”, the certainty of dealing with an agent who is part of a monopoly is almost total.

For a single transformation, whether in the competitive sector or in the monopoly sector, *labour* decreases in time, that is to say, as the manufacture of the *Product* develops, but if we take several successive transformations, experience shows that in the first *system* (competitive) *labour* tends to be carried out more and more rapidly so as to increase *productivity*, contrary to what generally happens in a monopoly.

The acceleration of the *speed* of *labour* causes a decrease in *price*s, which leads to an increase in consumer choice and consequently to an increase of *Money*, *i.e.* creation, all this due to the relations already defined above.

In a succession of monopolistic transformations, *labour* doesn't tend to accelerate because there is a dissociation between *price* and *labour* as mentioned above. As there is no obligation to decrease the *price*, due to the non-competitive position, the agent has no obligation to accelerate *labour*, *i.e.* to perform *Work*. However, since the *laziness* of the latter can only increase, he constantly demands a shortening of his "working" time and the hiring of additional staff, experience showing that this is indeed the case.

It is quite obvious that in the competitive sector, the increase in *productivity* is often due to the replacement of the *Work* of the agent by the *Work* of a machine as already stipulated. This rule obviously applies in a monopoly, but in a much less imperative way.

Thermodynamic analogy

The table below summarises the evolution of the different characteristics in the case of a monopoly.

In thermodynamics, the increase in volume causes						
$S = ↗$	$P = 0$	$P = ↘$	$\Delta W = 0$	$\Delta Q = 0$	$\Delta T = 0$	$\Delta U = 0$

In Economics, the *price* increase causes						
$A = ↗$	$F_A = 0$	$F_A = ↘$	$\Delta M = 0$	$\Delta T = 0$	$\Delta U_A = 0$	$\Delta E_{MT} = 0$

In Economics, the reduction in *labour* causes						
$P = ↗$	$F_P = 0$	$F_P = ↘$	$\Delta T = 0$	$\Delta M = 0$	$\Delta U_P = 0$	$\Delta E_{TM} = 0$

The analogy between thermodynamics and economics is perfect.

Note

In thermodynamics, the measurement of the temperature during expansion in a vacuum shows that there is a slight drop in temperature during expansion and that it stabilises as soon as the expansion is complete. This slight drop in temperature increases with the increase in volume, *i.e.* with the drop in pressure.

It should be noted that the same is true in Economy. In fact, when the *price* of a *Product* from a monopoly increases, there are always agents who refuse this *Product* because of this increase in *price*, and the higher this increase, the greater the number of these agents will be. However, this number will always remain small compared to the number of consumers.

This can be seen as a further confirmation of the submission of the economy to physics.

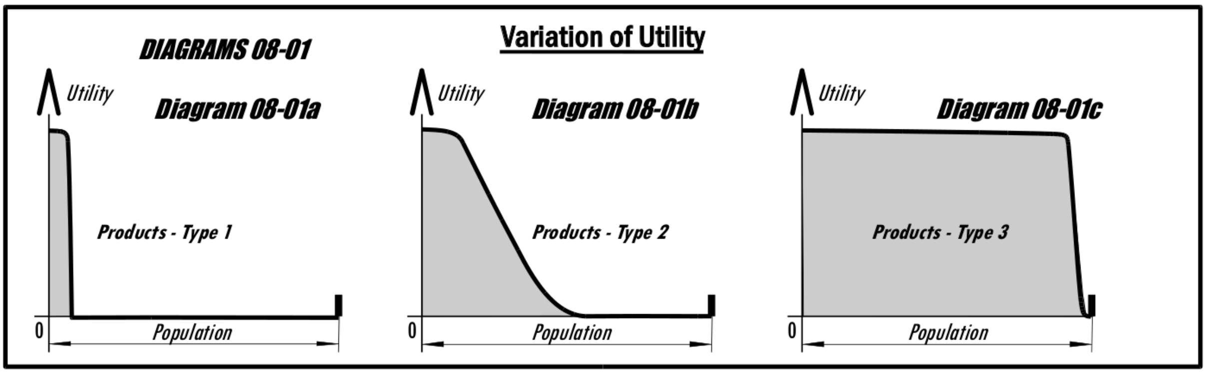
Competition

It is very often argued that competition is the cause of the fall in the *price*s of the *Product*s placed on the market, which remains to be explained.

In the paragraph "Types of *Products*" of the chapter "Core Laws", some categories (3) of *Product*s have been defined according to their *Utility* for the population (consumers) as shown in the following diagram previously explained in the paragraph and chapter indicated above.

Whatever the type envisaged (1, 2, 3) there are, in almost all cases, several manufacturers for the same *Product*. Even for type 1 *Product*s, several companies are competing to sell theirs. However, it's undeniable that these *Product*s are generally very expensive.

In reality, it's not competition that directly affects *price*s but the level of *Utility*. Whether there are 1 or 10 producers, if one of them wants to sell its *Product*, it's obliged that the *price* is in conformity with the *Utility* that the consumer grants it, any manufacturer having satisfied the *Utility* of a consumer .As to the *price*, he is obliged to lower the *price* if he wants to sell a new copy to another consumer with a lower *Utility*. All this has already been presented and explained several times.



As far as competition is concerned, the only thing that can be said is that it may only be a weak accelerator of *price* reduction.

Indeed, if one producer lowers the *price* of the *Product* under consideration, another competing manufacturer will tend to lower its own more significantly. However, this could not prevent the gradual reduction in *price* in order to satisfy more and more consumers as to their respective *Utility* of the *Product*.

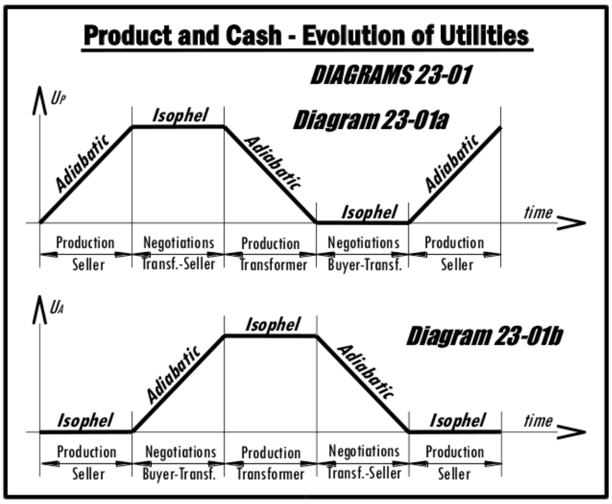
23 - CYCLES - POLAR INTERPRETATION

ABSTRACT: The sole purpose of this chapter is to corroborate the analogies between economics and mechanics. The Cartesian presentation of the cycles of creation of money and work, so far used, can be represented in a polar way. This method of expression shows in a striking way that economy as well as mechanics can only come out of phenomena of common nature, substance and principle.

General

This chapter doesn't present any particular importance but allows a better appreciation of the cyclical character of the transformations and especially the perfect similarity with (mechanical) physics.

It has been determined that the *Money* (in the $T \rightarrow M$ cycle transformations) and the *Work* (in the $M \rightarrow T$ cycle transformations) are a function of the *Utility of the Product* and the *Utility of Cash*, respectively. It is therefore possible to plot the graphs of the value of these *Utilities* as a function of time, but using polar coordinates where time is the argument and *Utility* is the module.



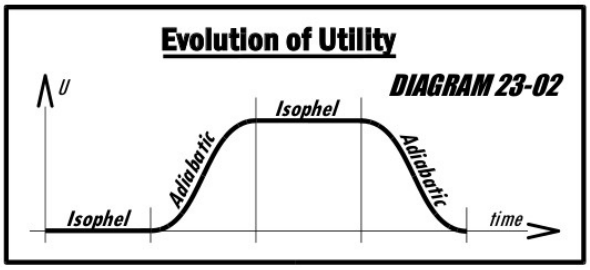
So it comes that the angle 2π radians represents any cycle. As a result, this representation makes it possible to free oneself from time.

Diagram 23-01a shows the evolution of the *Utility of the Product* and diagram 23-02b shows the evolution of the *Utility of Cash* during a cycle. These diagrams are identical to diagrams 11-03a and 11-04b (chapter "Structure of exchanges").

It has been seen that :

- in the $T \rightarrow M$ transformation, the two cycles (destruction of *Work* and creation of *Money*) turn in a positive direction,

- in the $M \rightarrow T$ transformation, the two cycles (destruction of *Money* and creation of *Work*) turn in the negative direction.



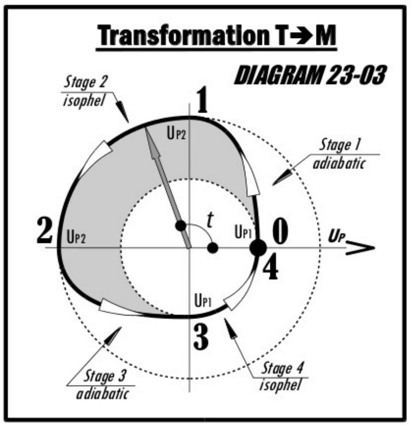
Therefore, the cycles of destruction of *Work* and *Money* rotate in the opposite direction as well as the cycles of creation of *Money* and *Work*. However, in time, it's certain that whatever the transformations are, they all evolve in the same direction; the direction of the flow of time is always the same, none of them being able to go backwards.

Therefore, the polar representation of each cycle, with time as an argument, will always be analogous because it evolves positively, as shown in the linear diagrams (23-01) above. Moreover, in each transformation ($T \rightarrow M$ and $M \rightarrow T$) the cycles of destruction of *Work* and creation of *Money* on the one hand, and of destruction of *Money* and creation of *Work* on the other hand will be identical.

In reality, the curve representing the evolution of *Utility* over time is of the type indicated in figure 23-02 above.

Transformation T→M ⇒ *Polar cycle*

The different stages of this cycle are shown in Figure 23-03 below.
To simplify the presentation of the cycle, the four steps have been considered to be of equal duration.



1. ***Step 1* - Manufacturing *by the Seller***
   - During this step, the *Utility of the Product* increases from U_{P1} to U_{P2} . It is therefore an adiabatic transformation.
   - Consequently, the end of the U_P vector describes a curve between points 0 and 1.

2. ***Step 2 - Seller-Transformer Tractation***
   - During this stage, the U_{P2} *Utility of the Product* remains constant as it doesn't change. It is therefore an isopheles transformation.
   - Consequently, the end of the U_P vector describes a curve which is an arc of a circle between points 1 and 2.

3. ***Step 3 - Manufacturing by the Transformer***
   - During this step, the *Utility of the Product* decreases U_{P2} to U_{P1} . It is therefore an adiabatic transformation.
   - Consequently, the end of the U_P vector describes a curve between points 2 and 3.

4. ***Step 4 - Transformer-Acquirer Tractation***
   - During this step, the U_{P1} *Utility of the Product* remains constant. It is therefore an isopheles transformation.

- Consequently, the end of the U_P vector describes a curve which must be an arc between points 3 and 4.

A priori, as already mentioned above, nothing says that the four transformations forming the $T \rightarrow M$ cycle have the same duration, *i.e.* that each is represented by an angle of $\pi/2$ radian.

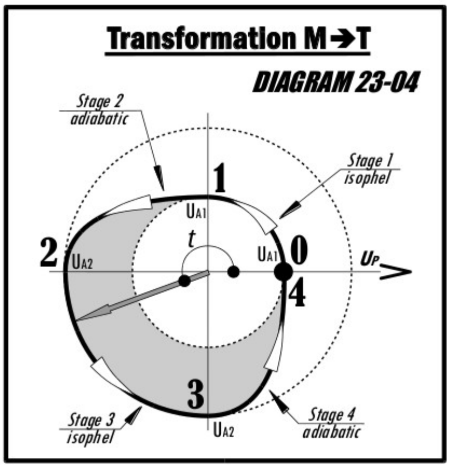
For example, a car is built (manufactured by the Transformer) in a few days and its obsolescence (use by the Acquirer) is generally between 4 and 10 years. But once the vehicle is finished, the Transformer is unemployed until the motorist orders a new vehicle.

In reality, as there is a very large number of Buyers, we see that the supply is more or less equal to the demand (we have seen that these two characteristics are *speeds* and *flow rates*). In fact, all the Transformers are constantly trying to adjust the quantity of *Product*s they offer to the quantity requested by the Buyers (just-in-time technique for example).

What has just been said for the manufacture and use of the *Product* can be extended to the negotiations between the Transformer and the Seller on the one hand and between the Buyer and the Transformer on the other hand, because these two negotiations must have the same duration.

*Transformation M→**T*** ⇒ *Polar cycle*

The different stages of this cycle are shown in figure 23-04 below, which is derived from linear diagram 23-01b. and with the adiabatic transformations taking place in a completely regular manner.



1. ***Step 1 - Acquirer-Transformer Tractation***
   - During this step, the *Utility* of *Cash* increases from U_{A1} to U_{A2}. It is therefore an adiabatic transformation.
   - Consequently, the end of the U_A vector describes a curve between points 1 and 2.

2. ***Step 2 - Manufacturing by the Transformer***
   - During this stage, the U_{A2} *Utility of Cash* remains constant as there is no negotiation. It is therefore an isopheles transformation.
   - Consequently, the end of the U_A vector describes a curve which is an arc of a circle between points 2 and 3.

3. ***Step 3 - Tractation Transformer-Vender***
   - During this step, the *Utility of Cash* decreases from U_{A2} to U_{A1}. It is therefore an adiabatic transformation.
   - Consequently, the end of the U_A vector describes a curve between points 3 and 4.

4. ***Step 4 - Manufacturing by the Seller***
    - During this stage, the U_{A1} *Utility* of *Cash* remains constant as there is no negotiation. It is therefore an isopheles transformation.
    - Consequently, the end of the U_A vector describes a curve which is an arc of a circle between points 0 (or 4) and 1.

For the same reasons as above ($T \rightarrow M$ transformation), the adiabatic steps must be equal and of the same duration. This is only valid for the replacement of *Product*s.

In addition :

- the isopheles steps 2 and 4 correspond respectively to the same adiabatic steps of the previous cycle which are equal, therefore these steps last the same time.
- adiabatic steps 1 and 3 correspond respectively to the same isopheles steps of the previous cycle which are equal, therefore these steps last the same time.

Conclusion

The two diagrams (23-03 and 23-04) are very similar to the valve control cams of a conventional single-cylinder internal combustion engine.

In fact, we see that the 2 cycles are offset by $\pi/2$ (90°) very exactly like the cams of an engine. This is an additional argument that invites us to accept the absolute generality of Natural Laws in the economic field.

24 - MISCELLANEOUS OBSERVATIONS

ABSTRACT: This chapter contains some applications of this new approach to exchanges to real, ordinary and banal situations.

Composition of the prize

Hourly Cost C_h can be defined as follows:

$$C_h = \frac{p}{t}$$

which is similar to the relationship 24-02, namely :

$$\varpi = \frac{dp}{dt}$$

It is therefore possible to write :

$$t = \frac{p}{C_h} \qquad \langle 24\text{-}01 \rangle$$

We also know the 04-15 relationship, namely :

$$T = \frac{1}{2} \cdot c \cdot \omega^2$$

as well as the 04-17 relationship, namely:

$$e = c \cdot \omega$$

By replacing, the relationship giving *Work* becomes:

$$T = \frac{1}{2} \cdot e \cdot \omega$$

But we also know that:

$$\omega = - \frac{l}{t}$$

Therefore:

$$T = - \frac{1}{2} \cdot e \cdot \frac{l}{t}$$

which can be written:

$$t = - \frac{1}{2} \cdot e \cdot l \cdot \frac{1}{T}$$ **‹24-02›**

By equating the 2 relationships 24-01 and 24-02, this gives :

$$\frac{p}{C_h} = - \frac{1}{2} \cdot e \cdot l \cdot \frac{1}{T}$$

Since the *labour to be done* l decreases during manufacture while the *price* p increases, it's normal for the relation to have a negative sign (-). However, since it's much easier to reason here with the *labour done* (l) rather than the *labour to be done* ($-l$), it's possible to disregard this sign. Then the relationship becomes :

$$\boxed{p = \frac{1}{2} \cdot \underbrace{\left(e \cdot C_h\right)}_{PART\ 1} \cdot \underbrace{\left(l \cdot T^{-1}\right)}_{PART\ 2}}$$ **‹24-03›**

This relationship can be broken down into two parts:

1. one (Part 1 ⇒ $e.C_h$), relating to the various participants during manufacture (production factors),
2. the other (Part 2 ⇒ l/T), relating to the *Product* being manufactured.

Part 1

- *price* (p) is a direct function of *employment* (e). Indeed, the more individuals, slaves, animals, employees, motors and machines are involved in the manufacture of the *Product*, the higher its *price* and *vice versa*,
- the *price* (p) is a direct function of the Hourly Cost (C_h). Indeed, the higher the cost of the factors of production, the higher the *price* of the *Product* and *vice versa*.

Part 2

- the *price* (p) is a direct function of the *labour done* (l). Indeed, the more important the work, the more elabourate the thing is, the higher its *price* and *vice versa*. It is quite clear that the stamping of a series of 5 pans is more expensive than the stamping of a single one.
- the *price* (p) is an inverse function of the *Work* (T). In fact, the greater the amount of *Work*, the faster the product is made, the lower the *price* of the product and *vice versa*.

A priori, it seems that in this relation the temporal variable (t) is missing. However, this *time* variable is taken into account in the *time* variable of *Work* (through the F_P *Force* and *acceleration* γ_ω), since *time* is an inverse function of the *Work* exercised:

- if *Work* increases, *time* decreases and so does the *price*,

- if *Work* decreases, *time* increases and so does the *price*.

All this seems perfectly logical and in line with the facts.

Creation of Money – Cinematics

If we consider the *price* of two copies of a *Product* and knowing that the *price* is a direct function of time, it's possible to ask, all other things being equal, that :

1. if the production speed decreases, the production time of the second copy increases and therefore its *price* as well. Thus, whatever the reduction in speed, the quantity of *Money* available to the consumer always decreases.

2. if the production speed doesn't vary, the production time of two consecutive copies is constant and therefore the *price* is constant as well. Thus, whatever the speed, the quantity of *Money* available to the consumer never changes.

3. if the production speed increases, the production time of the second copy decreases and therefore the *price* as well. Thus, whatever the increase in speed, the quantity of *Money* available to the consumer always increases.

In conclusion, the quantity of *Money* available to any consumer is a direct function of the *price* of the purchased *Product* and therefore of its production speed. This is perfectly in line with the daily reality of what happens in all companies.

The process described by the example below sets out the hypotheses of constant manufacturing speed (hypothesis N° 2) and its increase (hypothesis N° 3). An example setting out hypothesis N° 1 could have been presented in the same way.

Always *caeteris paribus*, considering the three agents Seller, Transformer, Buyer, and analysing the *Money* accessible by the Transformer, then, always reasoning as a physicist :

1. Manufacture by the Seller
For any manufacturer, the development of a *Product* is always a cost that he tries to reduce as much as possible by reducing the manufacturing time. As mentioned above, the *price* is decreasing. As a result, the quantity of *Money* held by the Transformer increases.

2. Seller-Transformer Dealing
The Seller wishes to make the same profit as before, which implies an increase in *price*. Therefore the quantity of *Money* held by the Transformer decreases.

3. Manufacturing by the Transformer
For any manufacturer, the development of a *Product* is always a cost that he tries to reduce as much as possible by reducing the manufacturing time. As a consequence the quantity of *Money* held by itself decreases.

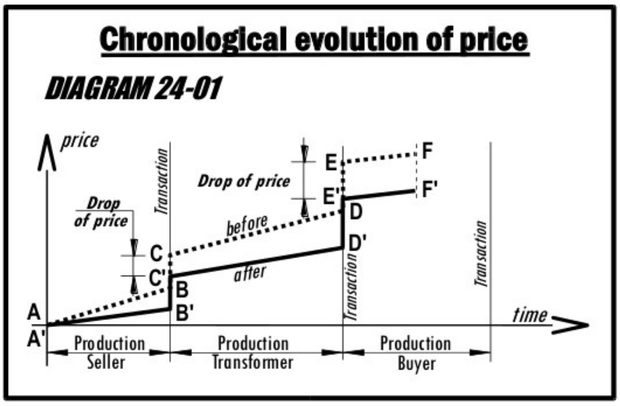
4. ***Transformer-Acquirer Tractation***

The Transformer wishes to make the same profit as before, which implies an increase in *price*. As a result, the amount of *Money* held by the Transformer increases.

The two diagrams below represent what has just been described. In all cases :

- the *price* is presumed to evolve in a regular way, which is generally not the case,
- the trading sequences, as defined above, are condensed into the transaction sequences.

These two assumptions have no bearing on the validity of the reasoning.



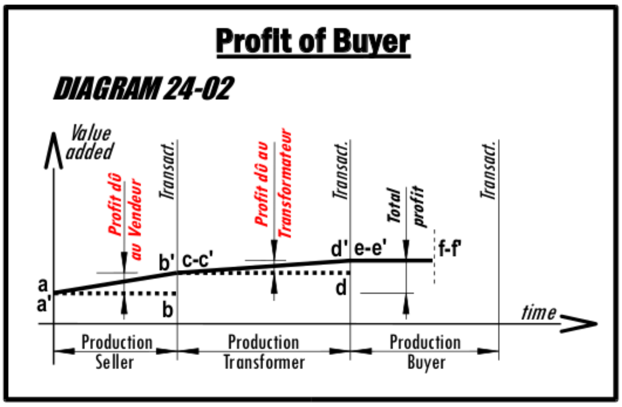


Figure 24-01 expresses the evolution of the *price* over time, *i.e.* :

- segments **AB** and **A'B'** ⇒ points **A** and **A'** are obviously confused since they serve as the origin. The **A'B'** segment has a lower slope than the **AB** segment since the manufacturing *speed* has increased which implies that the *price* evolves less quickly during this operation.

- segments **BC** and **B'C'** ⇒ these segments have the same length which means that the profit before and after speed increase is always the same. As a result, point **C'** perceived as the selling *price* of the *Raw Proceeds* is now lower than the previous selling *price* **C**. The Transformer has in addition the quantity of *Money* translated by **CC'**.

- segments **CD** and **C'D'** ⇒ this stage of manufacture by the Transformer is similar to that representing manufacture by the Seller. The **C'D'** segment has a lower slope than the **CD** segment since the manufacturing *speed* has increased, which means that the *price* changes less quickly during this operation.

- segments **DE** and **E'** ⇒ these segments have the same length which means that the profit before and after *speed* increase is always the same. As a consequence, the point **E'** perceived as the selling *price* of the elabourated *Product* is now lower than the previous selling *price* **E**. The Acquirer has in addition the quantity of *Money* translated by **EE'**.

- segments **EF** and **E'F'** ⇒ these segments have an identical slope since the Acquirer doesn't seek to accelerate the *speed* of manufacture. The distances **EE'** and **FF'** are therefore equal.

The distance *EE'* expresses the decrease in *price* as a result of the increase in manufacturing *speed* due to the Seller and the Transformer. This distance therefore represents the increase in the Acquirer's *purchasing power* (*Wealth*).

From diagram 24-01 representing the chronological evolution of the *price*, it's possible to draw diagram 24-02 showing the variation of the Buyer's profit.

- segments **ab** and **a 'b'** ⇒ points **a** and **a'** are obviously confused since they serve as the origin and segment **ab** has a zero slope. It is therefore horizontal. Since the manufacturing *speed* has increased, the *price* increases less quickly implying that the slope of the **a'b'** segment is positive.

- segments **bc** and **b'c'** ⇒ since profits are the same before and after the increase in manufacturing *speed*, points **c** and **c'** are obviously confused with point **b'**. The Transformer is enriched with a quantity of *Money* represented by the segment **bb'**. This enrichment is due to the Seller having performed a higher *Work*. So, geometrically :

  $bb' = BB'$ and : $b'c' = 0$

- segments **cd** and **c'd'** ⇒ the segment **cd** has a zero slope and is therefore horizontal. The **c'd'** segment has a greater slope than the **cd** segment since the *speed* of manufacture has increased, implying that the Transformer spends less *Money* during the manufacture of the *Product* that he elabourates. Its slope is therefore positive.

- segments **de** and **d'e'** ⇒ because profits are the same before and after the *acceleration* of the manufacturing *speed*, the points **e** and **e'** are obviously confused with the point **d'**. The Transformer is enriched with a quantity of *Money* represented by the segment **dd'**. This enrichment is due to the Transformer having performed a higher *Work*. Then, geometrically :

  $dd' = DD' - BB'$ and : $d'e' = 0$

- segments **ef** and **e'f'** ⇒ these segments both have a zero slope which means that the Acquirer always manufactures the *Product* at the same speed. The distances **ee'** and **ff'** are therefore zero.

The increase in the Acquirer's *purchasing power* is :

$$Gain\ total = \text{bb'} + \text{dd'}$$

with :

bb' = *Gain due to the extra Work done by the Seller*
dd' = *Gain due to the extra Work done by the Transformer*

In the above example, it was assumed that the profits before and after variation of the manufacturing *speed* were the same, respectively for the Seller and the Transformer, *i.e.* :

$$\underbrace{BC}_{before} = \underbrace{B'C'}_{after}\ \textit{for the Seller} \qquad \text{and :} \qquad \underbrace{DE}_{before} = \underbrace{D'E'}_{after}\ \textit{for the Transformer}$$

In reality, however, this equality isn't assured. Profits before and after a variation in *productivity* (*speed* of manufacture) are absolutely not always the same. However :

1. ***a variation in productivity is always due to the execution of extra Work,***
2. ***a variation in profits is always due to human will and decision.***

However, it has already been stated many times that any phenomenon relating to the Human Being must be rejected. Consequently, the second possibility doesn't have to be studied here because it's a matter of applications and not of theory in the strict sense. In fact, it's quite obvious that this hypothesis comes from sociology, philosophy, *etc.*, whereas the first concerns physics. It is for this reason that the profits are considered identical in order to avoid considerations relating to the social sciences and thus be confined to the field of the physical sciences. In spite of this comment, it's nevertheless useful to specify that if the manufacturer decides to increase its profit as a result of an increase in productivity, then this excess *price* can be considered as a capital loss for the consumer and a capital gain for the supplier, which marks the perfect relativity of these denominations since they are addressed to the same quantity of *Money*. Identically, it's also possible to posit that this surplus can either increase or decrease inequalities according to the income gap between the supplier and the consumer. In any case, this displacement of *Money* should only be interpreted as a transfer between non-communicating vessels; if one wins, the other loses and *vice versa*. As a consequence, it's obvious that all this is reflected in the accounts since only one flow (*Money*) is perceived and there is no evolution of the *Wealth* of the *system*.

This *price* surplus can be :

- totally retained by the supplier,
- totally granted to the employee,
- partially distributed (equally or unequally) between the supplier and the employee.

Whatever the case considered, it's only the result of a human decision and has no property of enrichment for all the agents involved (supplier, consumer, employee). The outcome is only a variation in the respective incomes of the agents with a corollary increase or decrease in inequalities.

To stipulate that this leads to a worsening or improvement of inequalities would be to make an ethical value judgment, which must be systematically excluded from any study of a physical nature. These different distributions are always only relevant to accounting and thus to the sociological and philosophical fields. However, this distribution is always only a loss for the consumer. In conclusion, the exclusive study of economic flows, either of *Cash* or of *Product*s (goods or services), cannot lead to an understanding of their variations.

To state that it's “factors of production” which allow the elabouration, the manufacture of *Product*s doesn't lead to anything. If these factors are at a standstill, for whatever reason (strikes, holidays, illness, machine maintenance, disruption of energy supply, *etc.*), they still exist but produce absolutely nothing. If they work slowly or very quickly, they are always the same and yet do not provide the same productivity at all. It isn't the factors of production that have to be taken into account but the *Work* (energy) they perform. The example of mechanics perfectly illustrates this observation. In order to move any mobile from one point to another, it's possible to use different means (man, animal, car, truck, plane, ship, ...). However, the laws of kinetics or dynamics that deal with the phenomena of displacement are totally indifferent to the nature of these means. The same is true in economics:

- ***whatever the factor of production, only Work must be taken into consideration.***

Consequently, knowing that it's *Work* that creates *wealth*, the study of the flows of *Product*s and *Cash* is completely inoperative. The doctrine of trickle-down being relative only to one flow is therefore strictly useless to vary the *wealth* of a society. It can therefore only be the transformation of *Work* into *Money* that is likely to make the basic economic phenomena explicit.

Self-regulation and Chronological price amortisation

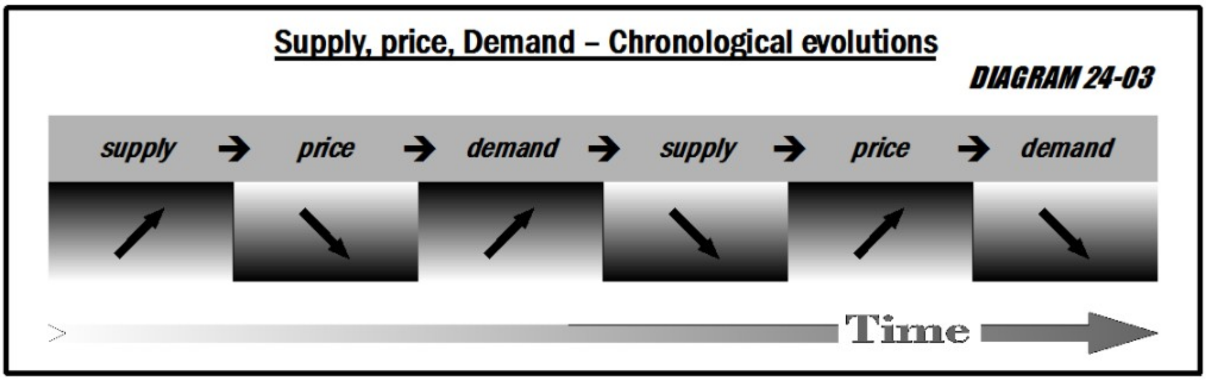
It has been shown, in particular in the paragraph “Supply-Demand” of the chapter “Prolegomena”, that the only sequence that can exist between the *price* of a *Product*, its supply and its demand is the following:

$$\ldots \Rightarrow \overbrace{\pm\Delta S \Rightarrow \mp\Delta p \Rightarrow \pm\Delta D}^{\textit{Copy } n} \Rightarrow \overbrace{\pm\Delta S \Rightarrow \mp\Delta p \Rightarrow \pm\Delta D}^{\textit{Copy } n+1} \Rightarrow \ldots$$

Thus when :

- *supply* increases, the *price* decreases and *vice versa*,
- *price* decreases, *demand* increases and *vice versa*,
- *demand* increases, *supply* decreases and *vice versa*.

These different influences and variations are shown in Figure 24-03. In reality, the step (frequency - wavelength) of the fluctuations as well as their amplitude are not necessarily regular as shown in this diagram.



Indeed, there may be regular chronological variations, but also irregular variations that occur quite randomly.

It is possible to consider :

1. ***regular fluctuations - systematic variations in prices :***
   - according to the annual arrivals of early fruit and vegetables and when these *Product*s are fully ripe,
   - at the end of the year celebrations, mothers celebrations, *etc.*.,
   - clothing after the winter and summer seasons (sales),
   - *etc.*

2. ***irregular fluctuations - random price changes :***
   - during armed conflicts,
   - due to acts of terrorism,
   - due to the creation of customs duties or their abolition,
   - widespread plant diseases or pest outbreaks,
   - *etc.*

The term "Depreciation" should not be taken here in its financial or accounting definition but in its physical meaning, *i.e.* as the decrease in time of the amplitude of a vibration (wave).

We have seen that the *price* evolves upwards or downwards according to the *supply* but not at all in direct function of the *demand* for the *Product*. However, the *demand* influences the *supply* and acts indirectly on the *price*. Therefore, it should be possible to consider these *price* evolutions as a vibration that should normally be dampened over time. In thermodynamics, the equilibrium temperature is never reached perfectly at any point in the *system* under consideration. Indeed, in a *system* composed of many molecules, there are always some with higher than average energy (equilibrium temperature) and others with less. In Economics, it's exactly the same. Indeed, for a given *Product*, in a *complex system* such as a country, there are always geographical areas (more or less large) where the *Utility* is different from that of another region. As a result, *price*s will be higher or lower than elsewhere. For example, the climatic heterogeneities of Patagonia and the Atacama lead individuals to totally different behaviours and thus to the use (manufacture and consumption) of distinct, if not dissimilar, *Products* whose *Utility* varies profoundly. The same is true of heterogeneities, no longer climatic, but geological, such as the “ségalas” (acidic earth) and the “causses” (basic earth), which generate different architectures or singular cultivation methods (tools). An endless list of exemplary situations could be presented.

It should be noted that, quite generally speaking, when there is a shortage or at least a decrease in *supply*, everyone says that the *price* increases because demand increases. However, there is no objective reason, no logical criteria to say that if *supply* decreases, *demand* increases. Indeed, it has been said that *demand* cannot be higher than *supply* according to the relation 15-03 (chapter “*Product* and Money - Supply and Demand”). What is certain is that certain economic agents with a pressing need for the *Product* in question are ready to pay a high *price* in order to acquire it: this *price* being obviously a direct function of the *Utility* that these agents grant them. As these agents insist on the delivery of the *Product*, it seems, but wrongly so, that demand is increasing. In reality, the number of agents likely to have a great *Utility of the Product* decreases with the level of this *Utility*, which implies that demand decreases with the increase of the *Utility of the Product* for the agents.

Competition ⇒ *Maximum price*

If we consider two *Products* 1 and 2, the latter replacing the former, and apply the basic relationship (08-04) to each of them, we find :

$$F_{A1} = r_{P1} \cdot \frac{U_{P1}}{p_1} \qquad \text{and :} \qquad F_{A2} = r_{P2} \cdot \frac{U_{P2}}{p_2}$$

Product P_2 will replace *Product* P_1 when the *Choice* of *Product* P_2 is equal to or greater than that of *Product* P_1 . But the *Choices* being analogous to the *Forces* of *Avarice*, we can therefore write :

$$r_{P1} \cdot \frac{U_{P1}}{p_1} \leq r_{P2} \cdot \frac{U_{P2}}{p_2}$$

from which one draws:

$$\boxed{p_2 \leq p_1 \cdot \frac{r_{P2}}{r_{P1}} \cdot \frac{U_{P2}}{U_{P1}}} \qquad \text{‹24-04›}$$

No particular hypothesis has been formulated, *a priori*, to determine this relationship, it can therefore be considered :

1. as applying to all cases,
2. as at least one relationship governing competition.

For the same *Product* (or two equivalent *Products*), the relationship is simplified as follows:

$$\boxed{p_2 \leq p_1 \cdot \frac{U_{P2}}{U_{P1}}}$$ **‹24-05›**

We can see that for the consumer the essential criteria are :

- the *price* of the coveted P_2 *Product*, which must be minimal, in accordance with the Second Principle,
- the ratio of the *Utilities of the Products* on the market, which is perfectly in line with logic and daily experience. The example of the replacement of stagecoaches by the railway can be presented, which perfectly corroborates this fact.

The relationship becomes :

- to equal *Utilities* ⇒ $\boxed{p_2 \leq p_1}$ **‹24-06›**
- to equal *prices* ⇒ $\boxed{U_{P2} \geq U_{P1}}$ **‹24-07›**

Of course, in a complex economic *system* such as France, some agents find the *Utility* of *Product* P_1 stronger or weaker than other consumers and the same is true for *Product* P_2 . As a result, the *Product* under consideration and the substitute *Product* will be sold simultaneously in the *system* under consideration for a certain period of time. This is illustrated by the example of the novelty of the introduction of compact discs on the market. The new music carriers did not dethrone LPs overnight, but for a few years they were sold concurrently. Despite this remark, in any case, for every consumer the above relationship is exactly valid and it's possible to posit that:

- ***in a competitive system, the Product Choice acquired is always superior to the Product Choice forsaken.***

The competitive relationship has just been defined in relation to the *price* and the *Utility of the Product*. In fact, it's generally these characteristics that are taken into account by a consumer subject to the *Choice* between two copies of different *price* and *Utility* of the same *Product* (or two equivalent *Products*) or not. Experience and reality show that any consumer will always choose :

- ***at constant Product Utility, the copy with the lowest price,***
- ***at constant Product price, the copy with the highest Utility.***

Competition ⇒ *Maximum labour*

If we consider two *Cash* A_1 and A_2 , the latter can replace the former and apply the basic relationship (08-12) to each of them, we find :

$$F_{P1} = r_{A1} \cdot \frac{U_{A1}}{l_1}$$ and : $$F_{P2} = r_{A2} \cdot \frac{U_{A2}}{l_2}$$

Cash A_2 will replace *Cash* A_1 when the *Choice* of *Cash* A_2 is equal to or greater than that of *Cash* A_1. But the *Choices* being analogous to the *Forces of Laziness*, we can therefore write :

$$r_{A1} \cdot \frac{U_{A1}}{l_1} \leq r_{A2} \cdot \frac{U_{A2}}{l_2}$$

from which one shoots :

$$\boxed{l_2 \leq l_1 \cdot \frac{r_{A2}}{r_{A1}} \cdot \frac{U_{A2}}{U_{A1}}} \qquad \text{‹24-08›}$$

No particular hypothesis has been formulated, *a priori*, to determine this relationship, it can therefore be considered :

1. as applying to all cases,
2. as at least one relationship governing competition.

For the same *Cash* (or two equivalent *Cash*), the relationship is simplified as follows :

$$\boxed{l_2 \leq l_1 \cdot \frac{U_{A2}}{U_{A1}}} \qquad \text{‹24-09›}$$

We can see that for the consumer the essential criteria are :

- the *labour to be done* on the coveted P_2 *Product*, which must be minimal, in accordance with the Second Principle,
- the ratio of the *Utilities of the Cash* on the market, which is perfectly in line with logic and daily experience. In fact, the higher the *Utility of Cash* for a consumer, the more inclined he will be to acquire the *Product*.

The relationship becomes :

- at equal *Utilities* $\Rightarrow$ $\boxed{l_2 \leq l_1}$ **‹24-10›**
- at equal *labour* $\Rightarrow$ $\boxed{U_{A2} \geq U_{A1}}$ **‹24-11›**

It has just been defined the relationship of a competitive nature, in relation to *labour* and the *Utility* of *Cash*. Experience and reality show that any consumer will always choose :

- ***to constant Utility of Cash, the copy with the least amount of labour to do,***
- ***to constant labour to be done, the copy with the highest Utility of Cash.***

Utility/Price Law – Examples

- ***Example 1***

  A few years ago, there was a severe drought in the spring which resulted in a very poor forage harvest. The hot, dry summer did not allow the cattle to eat properly. The *price* of fodder rose substantially as *supply* had decreased. The question is why the *price* increased. Some will answer:

  "because demand has increased".

  which is totally wrong. Indeed, the drought caused a shortage of fodder, so there was less fodder on the market, *i.e. supply* had decreased. As a result of this decline, only those consumers for whom the *Utility* of the fodder was high sought to acquire it. The higher the *Utility*, the more the consumer was inclined to buy it at a higher *price*. As the *price* increased, *demand* fell as the number of farmers with a high fodder *need* decreased with the increase in this "*need*".

  Many farmers drew on their winter reserves to feed their cattle and/or gave them other feed, usually of lower quality, *i.e.* they used substitute *Product*s (a farmer neighbour felled downy oaks to feed his cattle first, and the leftovers that they had not consumed were fed to the sheep).

  In the end, only those who had a sufficient financial base or who could not otherwise proceed bought fodder on the market, *i.e.* there were fewer of them than usual. As the *price* rose, *demand* could only fall. All this supports what has been said above, namely that a change in *supply* changes the *price* that changes the *demand* and never the other way around.

- ***Example 2***

  During the same heatwave period, many people rushed to buy fans and other air conditioners because the *Utility* of these *Products* had become higher. Merchants who displayed a *price* for these materials remained constant during the hot period.

  Finally, in this example, as the *Utility* increased and the *price* remained stable, *Choice* increased and consequently *demand*, according to the basic relationship (*Choice* being identical to *Force*):

  $$C_A = r_P \cdot \frac{U_P}{p}$$

  We see here that the *supply* is constant (the merchants had a certain quantity of appliances at their disposal) and therefore the *price* also remains constant. As *Utility* increases, *demand* increases.

  This example shows perfectly well that there is no direct relationship between *supply* and *demand* because we know that in the only possible sequence, the *price* fits chronologically between these two characteristics.

- ***Example 3***

  At the beginning of the 1980s, a computer, whose capabilities would make today's kids smile, cost a fortune and only a few thousand were sold to companies, administrations or computer enthusiasts. Today, a much more powerful machine costs much less and sales are far lower than in the past.

  In this example, both *Utility* and *price* have decreased, but the latter much faster than the former. *Choice* has increased and consequently *demand*, according to the basic relationship.

  Indeed, it was shown in the previous sub-chapter that in a group of users, the *Utility* of a *Product* decreases with the number of potential users. This is why suppliers are gradually reducing *price*s in order to satisfy an increasingly large customer base.

- ***Example 4***

  It is well known that private individuals sometimes travel hundreds of kilometres to get to the good city of Troyes to stock up on hosiery items. Why do these people spend *Cash* and time for this. Quite simply because the savings made by buying in the prefecture of Aube will be greater than the extra expense. But if they save *Cash*, it means that the *Product*s are cheaper in Troyes, at a constant *Utility*. Therefore, the *Utility/price* ratio is better, therefore the *Choice* and consequently the *demand*. Now, according to the pseudo "law of supply and demand" the *price*s of knitwear should soar, since the *demand* is very high in this city. However, this isn't at all the case, they would even tend to decrease. So why aren't *price*s going up? Everyone will answer "because of competition". This is well said, and this example shows that *demand* has absolutely no effect on *price*s. As there is competition, *supply* is therefore important and the *price* decreases.

- ***Example 5***

  Of course, sometimes *price*s rise, but this is never due to increased *demand*, but only if and only if we get close to the case of a monopolistic market. The less competition there is for a *Product*, the higher the *price* of that *Product* will be. But in this case, as has already been said, the conditions of transformation are no longer the same and, as in physics, one cannot compare two experiments which do not take place under the same conditions. In the same way that physicists free themselves from external constraints when relaxing in a vacuum, people or companies in a monopoly situation are not subject to the constraints of the market.

  The case of France Télécom can be cited as an example. For some years now, this company has been competing on mobile communications and these were the only communications whose *price*s fell. Then, the opening to competition of communications between fixed stations also caused the *price* of these communications to fall. But France Télécom having kept the monopoly of subscriptions, this company increased them, perhaps rightly so, but the fact is there. Anyone who is perfectly convinced that if competition was playing on subscriptions and the public company had kept the monopoly of communications, subscriptions would have fallen and communications would have increased with equally convincing arguments. This example shows the indifference of the *price* of a *Product* to its *demand* but its direct correlation with the level of competition, *i.e.* with the *supply*.

- ***Example 6***

  Everyone knows the story of the one-eyed horse, which is rare and cheap, which seems paradoxical at first sight, because according to the “law of supply and demand”, something rare is expensive. But it's quite obvious that a one-eyed horse isn't very valuable. One is therefore entitled to ask the question why this is so?

  The answer follows, in an obvious way, from the level of *Utility* of the horse. The *price* of a *Product* is absolutely not correlated to its *demand* (contrary to what is believed) but to its *Utility* (all things being equal).

- ***Example 7***

  If one presents sardines in oil, for a “bite of bread”, to a quidam of the Mediterranean shores after succulent agapes, he will pout, despite the modest *price*. On the other hand, if this same individual has not eaten for three days, anyone who is likely to bet that he will enjoy the allaches and be prepared to pay a high *price* for it. Yet the *Product*, in this case the fish, has not changed. In the first case, the *price* may be nil because the *Utility* itself is nil, but in the second case, the *price* may be high because the *Utility* itself is important.

Furniture rental

Consider the rental of tools, small equipment, cars or commercial vehicles, *etc.*, which are usually found in specialised agencies or shops. For a consumer (any economic agent), it's possible to consider that this type of rental consists of :

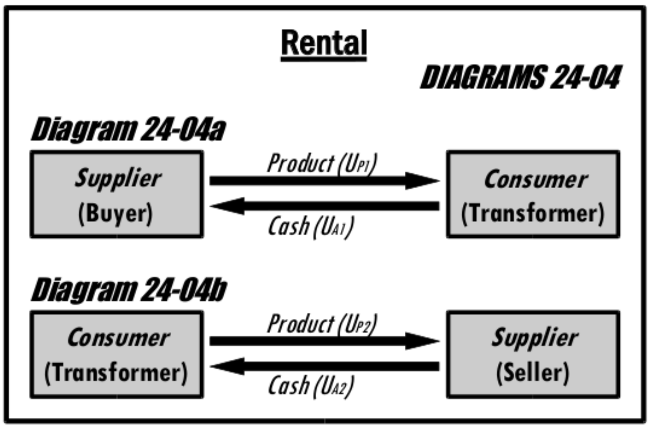
1. buying the *Product* (equipment, tools, *etc.*) from a supplier, at a given purchase *price* p_a ,
2. to resell, after use, the *Product* to the supplier who thus becomes a consumer, at a resale *price* p_v lower than p_a .

The difference between the *purchase price* p_a and the *resale price* p_v corresponds, of course, to the cost of renting the *Product*. By posing :

p_l = *rental price*

it's therefore possible to write :

$$p_l = p_a - p_v$$



This is therefore similar to the case of buying a *Product* and reselling it after use. Indeed, it doesn't matter the economic agent to whom the consumer resells the *Product* because, the laws being general, only the phenomenon counts. It is therefore possible to consider a hire of equipment or other as a sequence of Transformations as already defined, namely :

1. exchange of a *Product* for *Cash* between a supplier (Seller) and a consumer (Transformer) (diagram 24-04a), *i.e.* when the rented *Product* is rented,
2. exchange of *Cash* for a *Product* between a consumer (Transformer) and a supplier (Acquirer) (Diagram 24-04b), *i.e.* when the rented *Product* is rented.

It is possible to apply the Core Law to each exchange (acquisition and resale).

With the indices :

$_c$ *: consumer,*
$_f$ *: supplier*

1. at the time of acquisition (Figure 24-04a), the Core Law is written :

$$F_{A_{(c)}} \cdot p_a = r_P \cdot U_{P1_{(c)}}$$

which can be written:

$$p_a = \frac{r_P}{F_{A_{(c)}}} \cdot U_{P1_{(c)}}$$

2. on resale (figure 24-04b), the Core Law is written as follows:

$$F_{A_{(f)}} \cdot p_v = r_P \cdot U_{P2_{(f)}}$$

which can be written:

$$p_v = \frac{r_P}{F_{A_{(f)}}} \cdot U_{P2_{(f)}}$$

Consequently, it's therefore possible to write :

$$p_l = \frac{r_P}{F_{A_{(c)}}} \cdot U_{P1_{(c)}} - \frac{r_P}{F_{A_{(f)}}} \cdot U_{P2_{(f)}} \qquad \text{‹24-12›}$$

But, according to the Principle of Action and Reaction :

$$F_{A_{(c)}} = F_{A_{(f)}}$$

Furthermore, according to the First Principle, we know that:

$$U_{P1_{(c)}} = U_{A1_{(f)}}$$

as well as:

$U_{A2_{(c)}} = U_{P2_{(f)}}$

Therefore, the relation 24-12 can be written:

- For the consumer : $$p_l = \frac{r_P}{F_A} \cdot \left(U_{\mathrm{P1}_{(c)}} - U_{\mathrm{A2}_{(c)}} \right)$$ **‹24-13›**
- For the supplier : $$p_l = \frac{r_P}{F_A} \cdot \left(U_{\mathrm{A1}_{(f)}} - U_{\mathrm{P2}_{(f)}} \right)$$ **‹24-14›**

Therefore, for any consumer, the rental *price* of a *Product* is a direct function of the difference between the *Utility* of the *Product* when it's taken away (purchase) and the *Utility* of the *Cash* when it's returned (sale), which is perfectly logical. It is absolutely identical in the case of a second-hand sale, and it's clear that if the use of the *Product* is brought to the point of total obsolescence, we obviously find the Core Law, because the *Utility* of *Cash* is then necessarily nil.
For the supplier, the rental *price* of a *Product* is a direct function of the difference between the *Utility* of the *Cash* when it's taken away (sale) and the *Utility* of the *Product* when it's postponed (purchase). It is possible to equalize these 2 relations, which gives :

$U_{P1_{(c)}} - U_{A2_{(c)}} = U_{A1_{(f)}} - U_{P2_{(f)}}$

or :

$U_{P1_{(c)}} + U_{P2_{(f)}} = U_{A1_{(f)}} + U_{A2_{(c)}}$

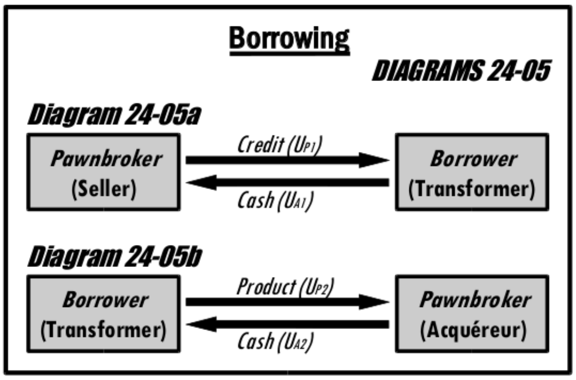
Property rental

It should be noted that what has just been shown applies equally and identically to rented accommodation (flats, residential houses, *etc.*). Indeed, it's possible to consider that the acquisition of the dwelling by the tenant is carried out at the beginning of each month and that the resale to the owner is carried out at the end of each month. In principle, the rental *price* (rent) p_l should decrease at each monthly payment due to the increase in the age of the dwelling.
However, this decrease is very small, so for the sake of simplification it's preferable to keep the rent constant for a sufficiently long time (lease term). Leases are generally updated every 3 years. Reality shows that obsolescence isn't (or hardly) taken into account when it comes to the usefulness of the dwelling for the tenant. If the *Utility* is very high, the tenant will be willing to pay a substantial rent and if the *Utility* is low, the tenant may choose another hypothesis such as for example looking for another dwelling or building his own dwelling.

All this paragraph shows that the rules laid down herein and the results obtained in no way deviate from what has been developed previously but, on the contrary, comply with them in every detail. It should be noted that if the *Utility* of the *Cash* U_{A2} for the consumer is greater than the *Utility* of the *Product* U_{P1} , the rental will not be possible since the consumer will prefer to keep the *Cash* inside him. Furthermore, it should be noted that no mention has ever been made of the “law of supply and demand” in determining the *price* of any rental. As already stated in chapter “01 - Prolegomena” this law doesn't exist and therefore cannot be used to explain any phenomenon, especially at the microeconomic level.

Borrowing

Let's now consider borrowing money from a banker, notary or other credit organization.



It has been shown that *Cash* and *Product* represent the same characteristic (of *Economic Energy*) and therefore can be switched, *i.e.* replaced by each other without any impact. As a result, the *Product* in rental exchanges is replaced by *Cash* in the case of loans and their repayment, which doesn't alter the reasoning followed so far for rentals.

This is so true that bankers offer and sell so-called “financial” *Product*s to consumers. Figures 24-04a and 24-04b (renting) are, therefore, transformed as shown in Figures 24-05a and 24-05b. The interest paid by the borrower therefore corresponds to the cost of renting a *Product* as indicated in the paragraph “Rental of movable property”.

However, it should also be noted that if any economic agent borrows *Cash* it's always for the purpose of acquiring a *Product* (with the exception of finance for speculative purposes). Consequently, for the borrower, the *Utility* of the *Cash* is equal to the *Utility* of the *Product* he covets.

Of all this, schemes 24-05a and 24-05b can be assimilated to schemes 24-04a and 24-04b in an absolutely rigorous manner. Consequently, the relations 24-15 and 24-16 are therefore valid for the calculation of the interests, namely :

- For the borrower : $$p_l = \frac{r_P}{F_A} \cdot \left(U_{\mathrm{P1}} - U_{\mathrm{A2}} \right) \qquad ‹24\text{-}15›$$
- For the lender : $$p_l = \frac{r_P}{F_A} \cdot \left(U_{\mathrm{A1}} - U_{\mathrm{P2}} \right) \qquad ‹24\text{-}16›$$

Conclusion

To conclude these last three paragraphs (Lease of movable property, Lease of immovable property, Loans) and by simplifying the writing, it's therefore possible to ask :

- **For the borrower :** $$\boxed{p_l = \frac{r}{F_A} \cdot \left(U_P - U_A \right)} \qquad ‹24\text{-}17›$$

- **For the lender :** $$\boxed{p_l = \frac{r}{F_A} \cdot \left(U_A - U_P\right)}$$ **‹24-18›**

which is true for any case considered, *i.e.* for a rental, a second-hand resale, a loan, a consumer credit, *etc.*

25 - TRANSFORMATION COEFFICIENTS

ABSTRACT: The entire study was conducted considering the transformation coefficients (g_{tm} , g_{mt}) as constant, i.e. we assumed that a certain amount of Work provided would always result in the same amount of Money and vice versa. But, a priori, nothing allows us to affirm this, because it does not seem to be systematically true.

This chapter therefore attempts to show that to ensure a correct, regular, unvaried functioning of an economic system, it is imperative that the constancy of the coefficients be guaranteed. In this case, the different possibilities of evolution are coherent and incoherent in the opposite case (chapter 00 - monetary evolutions).

Money and Work – Creation and expenditure

We know the relations (05-01, 05-02) of the equivalence principles for each $T \rightarrow M$ and $M \rightarrow T$ transformation respectively, namely :

$M = g_{TM} \cdot T$ and : $T = g_{MT} \cdot M$

Taking into account the cause (index $_d$ for spent) and the effect (index $_c$ for created), these relations are respectively written :

$M_c = g_{TM} \cdot T_d$ and : $T_c = g_{MT} \cdot M_d$ $\Rightarrow M_d = \dfrac{T_c}{g_{MT}}$

However, the M_d spent *Money* was necessarily created prior to its use. However, the created *Money* M_c can be hoarded, so :

$M_c \geq M_d$

or :

$$g_{TM} \cdot T_d \geq \frac{T_c}{g_{MT}} :$$

hence:

$$\frac{T_{created}}{T_{spent}} \leq g_{\mathrm{TM}} \cdot g_{MT}$$

Considering both transformations, we still have:

$$\frac{M_{\mathrm{created}}}{M_{\mathrm{spent}}} \geq 1$$

and:

$$\frac{T_{created}}{T_{spent}} \leq g_{\mathrm{TM}} \cdot g_{MT}$$

In the case where *Money* and *Work* would be defined in the same unit, these relations would be written:

$$\boxed{\frac{M_{created}}{M_{spent}} \geq 1} \qquad \text{‹25-01›}$$

and :

$$\boxed{\frac{T_{created}}{T_{spent}} \leq 1} \qquad \text{‹25-02›}$$

This corroborates what has already been said in the paragraph "Useful and Lost Work - Useful and Lost Money" in the chapter "11 - Structure of exchanges" of Development, *i.e.* :

- ***Money spent can never exceed the Money created,***
- ***Work spent is always more important than Work created.***

Reflections on the principles of equivalence

In order to clearly discern the characteristics of *Money* and *Work* according to whether they are the causes or consequences of the transformations, indices $_d$ (for disbursement - cause) and $_c$ (for creation - consequence) are used, as specified above.

In addition, to facilitate the intellectual process, the following are some relationships drawn from Development that will be useful later on:

$$dT_c = - F_P \cdot dl \qquad \text{‹04-09›}$$
$$dM_c = + F_A \cdot dp \qquad \text{‹04-10›}$$
$$dT_d = - U_P \cdot dP \qquad \text{‹05-04›}$$
$$dM_d = + U_A \cdot dA \qquad \text{‹05-07›}$$

$$F_A \cdot p = r_P \cdot U_P \qquad \text{‹08-04›}$$
$$F_P \cdot l = r_A \cdot U_A \qquad \text{‹08-12›}$$

$M_c = g_{TM} \cdot T_d$ **‹05-01›**

$T_c = g_{MT} \cdot M_d$ **‹05-02›**

According to the principles of equivalence, it is possible to ask (relations 05-01, 05-02) :

$M_c = g_{TM} \cdot T_d$ and : $T_c = g_{MT} \cdot M_d$

According to the relations 04-10 and 05-04 on the one hand, and 04-09 and 05-07 on the other hand, we can write :

$F_A \cdot dp = - g_{TM} \cdot U_P \cdot dP$ and : $F_P \cdot dl = - g_{MT} \cdot U_A \cdot dA$

or :

$$dP = - \frac{1}{g_{TM}} \cdot \frac{F_A}{U_P} \cdot dp \quad \text{and :} \quad dA = - \frac{1}{g_{MT}} \cdot \frac{F_P}{U_A} \cdot dl$$

However, according to the relations 08-04 and 08-12, we can write :

$$\frac{F_A}{U_P} = \frac{r_P}{p} \quad \text{and:} \quad \frac{F_P}{U_A} = \frac{r_A}{l}$$

Then:

$$dP = - \frac{1}{g_{TM}} \cdot r_P \cdot \frac{dp}{p} \quad \text{and:} \quad dA = - \frac{1}{g_{MT}} \cdot r_A \cdot \frac{dl}{l}$$

which give after integration (by measuring the characteristics with the same unit):

$$\boxed{P = \frac{r_P}{\ln\ p}} \qquad \text{‹25-03›}$$

and :

$$\boxed{A = \frac{r_A}{\ln\ l}} \qquad \text{‹25-04›}$$

Therefore in the $T \rightarrow M$ transformation, a variation in *Laziness* should normally generate a *price* variation and in the $M \rightarrow T$ transformation, a variation in *Avarice* should generate a *labour* variation, with the transformation coefficients remaining constant. This is in line with the coherent evolutions (1, 2a and 2b, 3a and 3b, 4a and 4b) because :

- the *Money created* M_c is always proportional to the *Work spent* T_d ,
- the *Work created* T_c is always proportional to the *Money spent* M_d .

However, it is possible to envisage other processes that correspond to the incoherent developments (2a1 and 2a2, 2b1 and 2b2). In these hypotheses, the transformation coefficients are therefore no longer constant and vary according to the *laziness* and *avarice* of the agents. However, it is of course understood that these transformations must normally be prohibited. It is therefore the coherent procedure which has been used throughout the trial since it is the only one which is rational.

Egoism

Let us assume any economic agent (individual, family, company, administration, ...) that we know, by principle, to be stingy when he acquires and lazy when he acts. He therefore has a certain *Avarice A* and *Laziness P* which have been defined in the study.

So it is possible to pose a certain function G in the following way:

$$\boxed{G = A + P} \qquad \text{‹25-05›}$$

So :

$$\boxed{G = \frac{r_A}{\ln l} + \frac{r_P}{\ln p}} \qquad \text{‹25-06›}$$

It is possible to name this function G as the *Egoism* of the economic agent under consideration. It is understood that this term (*Egoism*) is to be understood without any reference to a moral or other sense as already stipulated for *Laziness* and *Avarice.*

In this paragraph the transformation coefficients g_{TM} and g_{MT} have been assumed constant in accordance with the whole study.

It is therefore possible to state that :

- ***when the labour of the Product that the economic agent realizes increases, his Egoism decreases,***
- ***when the price of the Product that the economic agent buys increases, his Egoism decreases,***
- ***and vice versa,***

which makes perfect sense.

Transformation coefficients

For each transformation, we know the 05-01 and 05-02 relationships that define the Principles of Equivalence, namely :

$$M_c = g_{TM} \cdot T_d \qquad \text{and :} \qquad T_c = g_{MT} \cdot M_d \Rightarrow M_d = \frac{T_c}{g_{MT}}$$

The differentials of these equations are :

$$dM_c = g_{TM} \cdot dT_d + T_d \cdot dg_{TM} \tag{25-07}$$

and :

$$dM_d = \frac{g_{MT} \cdot dT_c - T_c \cdot dg_{MT}}{g_{MT^2}} \tag{25-08}$$

Knowing that the *Money created* is always greater than or equal to the *Money spent*, it is possible to write:

$$g_{TM} \cdot dT_d + T_d \cdot dg_{TM} \geq \frac{g_{MT} \cdot dT_c - T_c \cdot dg_{MT}}{g_{MT}^{2}} \tag{25-09}$$

Two cases may arise depending on whether monetary developments are coherent or incoherent.

Coherent developments

In this hypothesis the coefficients are necessarily constant. Consequently their differential is zero.

The relation 25-09 becomes :

$$g_{TM} \cdot dT_d = \frac{g_{MT} \cdot dT_c}{g_{MT}^{2}}$$

or by simplifying:

$$g_{TM} \cdot dT_d = \frac{dT_c}{g_{MT}}$$

or by simplifying:

$$\boxed{g_{TM} \cdot g_{MT} = \frac{dT_c}{dT_d}} \tag{25-10}$$

Incoherent developments

In this hypothesis the coefficients are necessarily variable, but the Works are constant. Consequently their differential is zero.

The relation 25-09 becomes :

$$T_d \cdot dg_{TM} = - T_c \cdot \frac{dg_{MT}}{g_{MT}^{\;2}}$$

or :

$$\boxed{\frac{T_c}{T_d} = - g_{MT^2} \cdot \frac{dg_{TM}}{dg_{MT}}} \qquad \text{‹25-11›}$$

or :

$$\boxed{\frac{T_c}{T_d} = \frac{dg_{TM}}{d\left(\frac{1}{g_{MT}}\right)}} \qquad \text{‹25-12›}$$

Wealth - GDP

It is essential to provide here some clarifications regarding the definition of *wealth* considered in this essay and the definition of GDP.

It is generally accepted that a nation's GDP reflects its *wealth*, although it is well known that this index is far from representing reality, but “In want of thrushes, one eats blackbirds!”. In fact, in the study *wealth* always and only emanates from the fall in *prices* during the elaboration of the *Products*, which implies a fall in the GDP, which is incompatible with its definition. For this reason, GDP has never been considered in the essay and should not be.

In the context of this study, when it comes to wealth, reference should never be made, implicitly or explicitly, to this index, but only to the meaning derived from it.

As a reminder, the example cited in the study is given below only if the percentage of situations where the Core Law (Law of the market) is verified is included :

- between 80 and 100% ⇒ the system is very rich,
- between 60 and 80% ⇒ the system is rich,
- between 40 and 60% ⇒ the system is moderately rich (or poor),
- between 20 and 40% ⇒ the system is poor,
- between 0 and 20% ⇒ the system is very poor,

Conclusion

The two tables below show all the possible evolutions of Money and Work in both $T \rightarrow M$ and $M \rightarrow T$ transformation.

Their analysis unquestionably shows that the functioning of any economic system is governed by the value of the variation of the transformation coefficients g_{TM} and g_{MT} , namely that :

- if both coefficients are constant, the *system* operates rationally,
- if one (or both) coefficients vary, the *system* works irrationally.

Individuals have understood this for a long time through the sentence, corresponding to the $T \rightarrow M$ transformation:

- ***"equal work for equal pay".***

Despite its logic, the $T \rightarrow M$ transformation implies its reciprocal, *i.e.* :

- ***"equal pay for equal work".***

Moreover, it is well accepted by both general opinion and experts that possibilities 2a1 and 2a2 correlating respectively to inflation and devaluation as well as possibilities 2b1 and 2b2 representing respectively deflation and revaluation are detrimental to the proper functioning of a society.

T→M Transformation								
Type	**Rep.**	**Number** n	**Value** u	**Work** T_{spent}	**Coeffic.** g_{TM}	**Money** M_{Create}	**Laziness** P	**Designation**
Coherent Evolutions	1	→	→	→	→	→	→	Constant Money
	2a	↗	↘	→	→	→	→	Constant Money
	2b	↘	↗	→	→	→	→	Constant Money
	3a	→	↗	↗	→	↗	↘	Created Money
	3b	→	↘	↘	→	↘	↗	Destructed Money
	4a	↗	→	↗	→	↗	↘	Created Money
	4b	↘	→	↘	→	↘	↗	Destructed Money
Incoherent Evolutions	2a1	↗	↘	→	↗	↗	→	Created Money
	2a2	↗	↘	↗	↘	↘	→	Destructed Money
	2b1	↘	↗	↘	↗	→	↗	Constant Money

	2b2	↘	↗	↗	↘	→	↘	Constant Money

M→T Transformation								
Type	**Rep.**	**Number** n	**Value** u	**Money** M_{spent}	**Coeffic.** g_{MT}	**Work** $T_{created}$	**Avarice** A	**Designation**
Coherent Evolutions	**1**	→	→	→	→	→	→	Constant Work
	2a	↗	↘	→	→	→	→	Constant Work
	2b	↘	↗	→	→	→	→	Constant Work
	3a	→	↗	↗	→	↗	↘	Created Work
	3b	→	↘	↘	→	↘	↘	Destructed Work
	4a	↗	→	↗	→	↗	↘	Created Work
	4b	↘	→	↘	→	↘	↗	Destructed Work
Incoherent Evolutions	**2a1**	↗	↘	→	↗	↗	→	Created Work
	2a2	↗	↘	→	↘	↘	→	Destructed Work
	2b1	↘	↗	↘	↗	→	↗	Constant Work
	2b2	↘	↗	↗	↘	→	↘	Constant Work

It is very clear from these two tables that all coherent evolutions have a fixed transformation coefficient, whereas incoherent evolutions systematically have a variable coefficient.

The chapter "00- Preamble - Monetary developments" provides information and explains the four incoherent developments of inflation and devaluation on the one hand, and deflation and revaluation on the other.

So to highlight the different possibilities, they can be presented as follows:

Designation	**Rep.**	**Transformation** $T \to M$			**Transformation** $M \to T$		
		Work T_D	**Coef.** g_{TM}	**Money** M_C	**Money** M_d	**Coef.** g_{MT}	**Work** T_C
coherent evolution	2a	→	→	→	→	→	→
inflation	2a1	→	↗	↗	→	↗	↗
devaluation	2a2	→	↘	↘	→	↘	↘
coherent evolution	2b	→	→	→	→	→	→
deflation	2b1	↘	↗	→	↘	↗	→
revaluation	2b2	↗	↘	→	↗	↘	→

In a properly functioning economic system :

- and for $M \rightarrow T$ transformation, any amount of *Work spent* T_d must correspond to a proportional amount of *Money created* M_c, according to possibility 2a,
- and for $T \rightarrow M$ transformation, any amount of *Money spent* M_d must correspond to a proportional amount of *Work created* T_c in accordance with possibility 2b.

However, we see that this is not the case when the g_{TM} and/or g_{MT} coefficients are not constant. We know by definition (Chapter "00- Preamble - Monetary developments", paragraph "Incoherent monetary developments") that :

- the "demand policy" favours consumers but contributes to inflation,
- the "supply-side policy" favours companies but contributes to deflation.

Therefore, whatever policy is pursued, they are both harmful, damaging, detrimental to the proper functioning of the *system*.

However, in the light of this, one should not fall into the trap of indicating that the absence of regulation would be the right solution. Indeed, this hypothesis would very quickly lead to one or the other of these policies being effectively implemented depending on the power of individuals.

Indeed, the essential characteristic of speculation is to make a maximum profit as quickly as possible: speculators with a very high *Avarice*. In order to increase their profit, they evade the proper functioning of the economy by pursuing an incoherent course of action by taking risks. If we assume a speculator increases his *Avarice* as indicated in possibility 2b1 (table $M \rightarrow T$ of the transformation), he decreases the Money M_d he spends, which increases the coefficient g_{MT} and leaves the *created Work* T_c constant. But the supplier is then obliged to increase the *Work* T_d it provides in order to try to make up for what it has previously lost according to possibility 2b2 ($T \rightarrow M$ transformation table). This induces a decrease in the g_{TM} coefficient by leaving the *created Money* M_c constant. Here it is necessary to notice that the *created Work* T_c in the $M \rightarrow T$ transformation is null but that in the $T \rightarrow M$ transformation the *spent Work* T_d increases, because it is always possible to provide a *Work* superior to another. However, the $T \rightarrow M$ transformation shows that the *Money* is constant, that is to say that the *Money created* M_c is null. So this implies an increase in inequality: the speculator by increasing his *Avarice* takes the *Money* at the expense of the supplier who decreases his *Laziness* by doing more *Work*.

We know that one of the Natural Laws of the Universe stipulates that no global evolution of a system can take place if there is no difference in a certain characteristic and that the presence of a difference necessarily induces a change. For example:

- a voltage difference in electromagnetism,
- a temperature difference in thermodynamics,
- a difference in force in mechanics,
- etc.

However, it has been demonstrated in Development that the economy cannot free itself from this requirement. An evolution (growth, increase in purchasing power, increase in wealth, ...) of an economic *system* can only occur if a difference in *Utility* is generated during the elaboration of a *Product* (good or service). Industrialists increasing the *Utility* of bauxite to make cooking utensils can participate in the development of a society, but wholesalers and traders who do not modify the *Products* they handle are totally unable to make any contribution. Of course, this does not in any way preclude strictly internal modifications to the economic *system* envisaged, but its overall characteristics will remain absolutely unchanged. Thus, if one element of the *system* becomes richer, another will become inexorably poorer because the total *wealth* of the *system* will remain constant.

However, it is undeniable that a society becomes more complex over time, until it declines. This complexification leads to a decrease in the ratio between the number of components that can increase *wealth* and the number that cannot. At present, at least in the rich "occidental" countries, the importance of the primary and secondary sectors is diminishing in favour of the tertiary sector, which is becoming preponderant, if not overwhelming. However, the first two are the only ones likely to increase *wealth* because they are the only ones to provide a difference in the *Utility* of Manufactured Products, a contrario, of the tertiary sector which generally does not allow it and therefore cannot generate any *wealth*. All this is perfectly examined, studied, defined and mastered by mathematical analysis in the body of Development, which stipulates that a difference in *Utility* must imperatively exist in order to make *purchasing power* evolve. However, certain components of the tertiary sector such as tourism, sport, conventional as well as electronic commerce, etc., highlighted in the media are totally ineffective in increasing the *wealth* of a system.

For example:

- an e-commerce platform is totally incapable of increasing the *wealth* of the economic *system* of which it is an element because its actions do not cause any change in the *Product* (good or service),
- purchasing center that only engage in trade, do not provide any *Work for economic purposes* and therefore do not collaborate in any increase in *purchasing power*,
- Sports organisations (IOC, FIFA, Tour de France, etc.) do not contribute in any way to any increase in the overall *wealth* of a society,
- etc.

Consequently, all these structures can only become richer at the expense of their suppliers, subcontractors, customers, etc., *i.e.* others.

As soon as an economic *system* is organised, its structure contains elements that do not and cannot participate in the production of monetary *wealth*. As long as these elements are few in number and small in importance, the *system* can live with them. In the early stages, these non-producing components can improve the efficiency of the *system*, but as the *system* becomes more complex, they become more and more abundant, costly and no longer contribute to the creation of *Money*, leading to its general impoverishment.

Consequently, it is necessary and indispensable to establish rules to prevent any attempt to apply one or the other of the *supply* or *demand* policies. As these developments are abnormal, sooner or later an opposite evolution, either devaluation or revaluation, will inevitably occur, bringing the *system* back to a correct functioning.

To explain this differently, it is possible to ensure that inflation and deflation are incoherent evolutions exclusively due to voluntary human actions. It is therefore imperative to prevent these actions through regulations and/or laws prohibiting and possibly sanctioning them.

26 - MICRO-MACRO LINK

ABSTRACT: The term "link" should not be understood in the sense of a relationship, mathematical or otherwise, between microeconomics and macroeconomics, but more precisely as a common point, as something related to these two disciplines.

Competitiveness is defined here as the result of the labour required to elaborate a Product and its price. Indeed, the higher the labour, the better the productivity and the lower the price, the lower the speed of price formation. It is thus possible to specify a field, not spatially as in physics, but by the characteristics of labour and price taken as coordinates. Then, in this field (labour-price), the competitiveness of firms and its evolution could be visualized and compared.

Monetary unit of macroeconomic system

We know the relation 02-01 giving any measure and in particular the *Money*, *i.e.* :

$$M = n \cdot u$$

and its differential (relation 02-02) :

$$dM = n \cdot du + u \cdot dn$$

We also know that in order to enrich an economic *system*, that is to say, to create (destroy) *Money*, it is obligatory to increase (decrease) a *Work with an economic purpose* and that this transformation (*Work*→*Money*) must be carried out according to possibility 3 (3a, 3b), that is to say:

- **3a.** $dn = 0$ and : $du > 0$ ⇒ $(\partial M)_n > 0$ ⇒ **Creation of Money**
- **3b.** $dn = 0$ and : $du < 0$ ⇒ $(\partial M)_n < 0$ ⇒ **Destruction of Money**

Since, in this case, the variation dn in the number n of units is zero, the differential relationship is simplified as follows:

$$(\partial M)_n = n \cdot \partial u$$

The quantity of *Money* created or destroyed is therefore directly proportional to the variation du in the value of the unit u. However, the number n of units is the one involved in the transformation considered and only it. It is obvious that in a complex *system*, such as a country, it is necessary to take into account the total number N of units that exist there. The relationship becomes :

$$\boxed{(\partial M)_{n,N} = \frac{n}{N} \cdot \partial u}$$ **‹26-01›**

But we also know the 04-08 relationship giving the *Money* according to price, namely :

$$dM = - F_A \cdot dp$$

It is therefore possible to write :

$$\frac{n}{N} \cdot \partial u = - F_A \cdot \partial p$$

which gives:

$$\boxed{\partial u = - F_A \cdot \frac{N}{n} \cdot \partial p}$$ **‹26-02›**

This relationship (26-02) and the relationship 04-08 show that :

- ***if the price decreases, wealth increases,***
- ***if the price goes up, wealth decreases.***

Obviously, if the price does not vary, *wealth* remains constant. All human decisions and actions can therefore be discerned according to the variation in price. However, since GDP is a function of economic transactions, it increases when the price of *Products* (goods or services) rises, which is now shown to be harmful. While the current method of calculating GDP cannot be contested, the conclusion drawn from it (the higher the GDP, the richer the *system*) is totally wrong, incorrect and aberrant as regards the measurement of the *wealth* of an economic *system.* In conclusion, any action :

- **which causes a decrease in price is beneficial to society by enriching it,**
- **which leads to an increase in price is detrimental to society by impoverishing it.**

Moreover, this relationship indicates that the issue of monetary units N inexorably leads to a decrease in the value of the unit u, which causes the price p to increase.

Introduction remark

The whole essay focuses on the only approach that allows the creation of *wealth* (*Money*, *purchasing power*, ...) through the study of the transformation of *Work* into *Money.* This is only valid for a single transformation, that is to say, what a single Transformer carries out in order to produce a single copy of the *Product* he manufactures. If we consider a complex (macroeconomic) *system*, such as a country, with a very large number of elements that can provide *Work* and therefore create *Money*, then this essay is still valid for the understanding of each of the transformations, but it cannot apprehend this creation of *wealth* directly in its entirety.

In physics, certain generalisations could be "understood" by the notion of field. For example, in meteorology, it is possible to consider a volume of atmosphere for which certain characteristics (pressure, temperature, speed, etc.) allow its dynamics to be calculated. But in order to perceive the values of these intensive characteristics and this dynamic at a global, if not terrestrial level, fields are used, particularly scalar and vectorial fields.

A priori, from the characteristics defined in the study it is quite possible to determine certain fields, knowing that these characteristics are similar to those of physics, since the formalism used is rigorously identical. In physics the field is generally determined in a geometrical space, which is obviously not the case in economics where this type of space does not exist, which does not prevent one or other from being established.

Labour-Price Field

In physics, fields are generally understood in space : for example, coordinates are usually defined by longitude, latitude, altitude (length, width, height). We know that in this essay, *labour* and *price* are characteristics that are similar to the spatial coordinates of physics. It would therefore be possible to use them in the same way. However, in the study the *labour* and the *price* are respectively considered in one or the other of the transformations $T \rightarrow M$ or $M \rightarrow T$. Now, to determine a *labour-price* field, it is necessary that these two characteristics belong to the same Product, *i.e.* to the same transformation.

In physics, to define a field in a plane, there is a reference zero point and two Cartesian axes called respectively abscissa and ordinate which can be renamed for example longitude and latitude. Still in physics, the velocity v is defined analytically as follows:

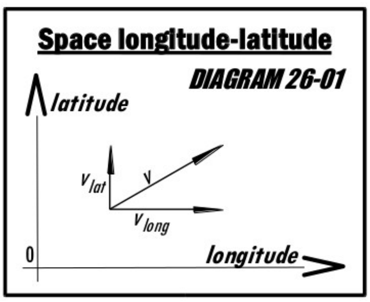
$$\vec{v} = \frac{de}{dt}$$

which can be decomposed into longitude and latitude (Figure 26-01) :

$$\vec{v}_{long} = \frac{de_{long}}{dt} \quad \text{and :} \quad \vec{v}_{lat} = \frac{de_{lat}}{dt}$$

We know the relations giving respectively *productivity* (04-01) and *speed of price formation* (04-02), namely :

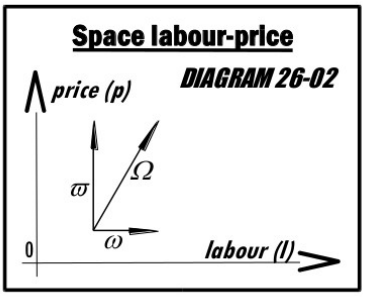
$$\vec{\omega} = -\frac{dl}{dt} \quad \text{and :} \quad \vec{\varpi} = \frac{dp}{dt}$$



These relations indicate, as already mentioned, that labour l and price p are equivalent in economics to space e in physics. Then, by assimilating, for example, labour to longitude and price to latitude, it is possible to define the *labour-price field*

(Figure 26-02) in a way equivalent to the classical longitude-latitude field.

In this new macroeconomic field it is also possible to expose the values (norms) of certain characteristics (*Force*, *Utility*, *productivity*, *purchasing power*, *Work*, *Money*, ...) identically to physics (pressure, temperature, speed, quantity of movement, heat, work, ...).



As in physics, the multiplication of the vector fields of *productivity* and *speed of price formation* (*tachyaxy*) respectively by the scalar fields of Forces F_P and F_A returns the vector fields of *Work* and *Money.*

It is to be specified again that *labour* l expresses the *labour to be done* and not the *labour done* which is of absolutely no interest. Therefore, the *labour to be done* must be reduced as quickly as possible, as this will increase *productivity.* On the other hand, the *price* should increase as slowly as possible during the manufacturing process.

Generally speaking, the primary and secondary sectors are the only ones likely to produce (create) *wealth*, but not the tertiary sector. This is not always true, as the luxury goods industry shows. For example, the market for luxury cosmetics which often cost very little (dl very small) are sold at extravagant prices (dp very large). However, the only criterion which allows us to discern with certainty and efficiency the elements which are likely to enrich society from those which cannot is to diagnose the variation in the *Utility of the Product* during its manufacture, according to the rule, often stated, namely :

- ***if an element of the economic system is capable of diminishing for itself, or increasing for others, the Utility of the Product it produces, then it can enrich the system,***
- ***Otherwise, it is impossible for it to generate any monetary wealth.***

It should be noted that GDP is by no means capable of measuring the true *wealth* of a *system* since the monetary transactions relating to the second point above are taken into account in its calculation. For example :

- any sports club has income from supporters and other sources but is totally unable to create *Money* as defined in this study,
- it was demonstrated at the beginning of the note that a banker does not create any *Money*,
- a travel or real estate agency does not in any way enrich the company,
- a doctor or a teacher do not enrich the population in any way,
- etc., etc.

GDP is therefore a misleading index if it is considered to be a measure of the *wealth* of an economic *system.*

The real creators of *wealth* are the agents who produce *Products* by increasing their *Utility* for the consumer, while decreasing their price. It is well known that many farmers only have incomes of less than $500 per month and are therefore among the creators of *wealth* and not the shareholders of the agri-food industries seeking to increase their dividends.

Data and premises

Suppose a convective cell formed by 2 circular vortices, due to a decreasing temperature with altitude, as shown in figure 26-03 below. This presentation is, of course, very theoretical, but it is presented for the sole purpose of showing the analogies but also the differences between economics and physics and to facilitate the explanation.

The speed of the elements (molecules) making up the vortices is constant and is identical for each vortex. Indeed, when a mobile moves, two spaces exist: the *space travelled* through and the *space to be travelled* through. However, at a given moment, these speeds of travel are necessarily equal but with opposite signs, because the speed of increase of the *space travelled* is indeed equal to the speed of decrease of the *space to be travelled.* Therefore, one vortex is relative to the *space travelled* and the other is relative to the *space to be travelled.* But the designations "*space travelled*" or "*space to be travelled*" are only relative to the referential used, or according to the position of the observer. Indeed and for example, if we always refer to figure 26-03, then :

- if the observer is in front of the sheet (classical case) he sees the left vortex turning counterclockwise (positive) and the right vortex turning clockwise (negative),
- if the observer is behind the sheet he sees the same vortex turning in opposite directions: the left-hand vortex is now located on the right and the right-hand one is seen on the left.

Since in a cell the liquid rises in the centre and falls at the periphery, then in vertical section, a cell is always composed of two vortices, which any observer will always discern one on the left, rotating in the positive (counter-clockwise) direction, and the other on the right, rotating in the negative (clockwise) direction.

- ***The principle of relativity applies in all time and space, because it is universal!***

Because in these vortices (Figure 26-03), the elements continually change their direction, there must be a force that causes this change. This force (*F*), always directed towards the centre of the vortices, is therefore accompanied by an acceleration inducing mechanical work (*W*). On the other hand, the velocity vector (*V*) is always tangentially oriented. The vectors representing these two characteristics (force and speed) are therefore always orthogonal and can be respectively decomposed parallel to the axes as shown below:

$\vec{F} = \vec{F}_l + \vec{F}_a$ and : $\vec{V} = \vec{V}_l + \vec{V}_a$

But we know that a velocity is defined as follows:

$$\vec{V} = \frac{de}{dt} \qquad \text{either :} \qquad \vec{V}_a = \frac{da}{dt}$$

The product of the force F_a by the altitude displacement da will return the variation dW of the mechanical work W.

Due to the circularity of the vortices, the force F and the velocity V are constant, which implies that the forces F_l and F_a on the one hand and the velocities V_l and V_a on the other hand, evolve in opposite directions.

For a system that is assumed to be in a stable steady state, the internal energy of a vortex is also constant over time, which allows us to write :

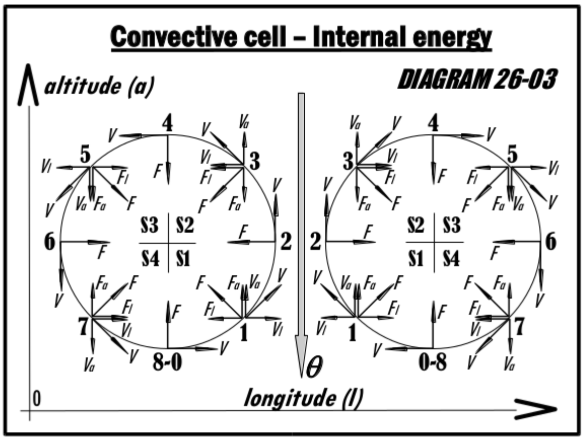
$$dQ + dW = 0$$

according to the first principle of conservation. Thus, the amount of heat and the amount of work included in a vortex vary inversely, their sum remaining fixed.

Thermomechanics

Figure 26-03 describes :

- the velocity field V of the two vortex of a cell and their components in abscissa (longitude V_l) and ordinate (altitude V_a),
- the force field F of the two vortices of a cell and their components in abscissa (longitude F_l) and ordinate (altitude F_a).



The velocity V is equal for each vortex but also constant within each one. However, the components V_l and V_a are variable and evolve from 0 to V alternately, *i.e.* :

if : $V_l = 0$ then : $V_a = V$ and vice versa.

Identically, the force F is equal for each vortex but also constant in each one. However, the components F_l and F_a are variable and evolve from 0 to F alternately, that is to say that :

if : $F_l = 0$ then: $F_a = F$ and vice versa.

Depending on whether it is directed downwards or upwards, the force F_a symbolises respectively the force of gravity or its reaction force due to heating.

The analysis of figure 26-03 gives for the positive vortex (left) :

- ***Point 0 - Start of cooling***
  - $F_l = 0$ and : $F_a = F$
  - $V_l = V$ and : $V_a = 0$
  - $F_a > 0$ and : $da = 0$ $\Rightarrow$ $dW = 0$ $\Rightarrow$ $W = 0$
    $\Rightarrow$ $dQ = 0$ $\Rightarrow$ $Q =$ maxi
  - $Q > W$
  - at point 0 $\Rightarrow$ $U = Q$
  - θ = max

- ***Sector S1 - Cooling***
  - $Fl = \nearrow$ and : $Fa = \searrow$
  - $Vl = \searrow$ and : $Va = \nearrow$
  - $Fa > 0$ and : $da > 0$ $\Rightarrow$ $dW > 0$ $\Rightarrow$ $W = \nearrow$
    $\Rightarrow$ $dQ < 0$ $\Rightarrow$ $Q = \searrow$
  - $Q > W$
  - in point 1 $\Rightarrow$ $U = ¾\ Q + ¼\ W$
  - $\theta = \searrow$

- ***Point 2 - Half of the cooling***
  - $F_l = F$ and : $F_a = 0$
  - $V_l = 0$ and : $V_a = V$
  - $F_a = 0$ and : $da = 0$ $\Rightarrow$ $dW = 0$ $\Rightarrow$ $W =$ average
    $\Rightarrow$ $dQ = 0$ $\Rightarrow$ $Q =$ average
  - $Q = W$
  - at point 2 $\Rightarrow$ $U = ½\ Q + ½\ W$
  - θ = medium

- ***Sector S2 - Cooling***
  - $Fl = \searrow$ and : $Fa = \nearrow$
  - $Vl = \nearrow$ and : $Va = \searrow$
  - $Fa < 0$ and: $da < 0$ $\Rightarrow$ $dW > 0$ $\Rightarrow$ $W = \nearrow$
    $\Rightarrow$ $dQ < 0$ $\Rightarrow$ $Q = \searrow$
  - $Q < W$
  - at point 3 $\Rightarrow$ U = ¼ Q + ¾ W
  - $\theta = \searrow$

- ***Point 4 - End of cooling - Start of heating***
  - $F_l = 0$ and : $F_a = F$
  - $V_l = V$ and : $V_a = 0$
  - $F_a < 0$ and: $da = 0$ $\Rightarrow$ $dW = 0$ $\Rightarrow$ $W =$ maxi

$\Rightarrow \quad dQ = 0 \qquad \Rightarrow \quad Q = 0$

- $Q < W$
- at point 4 $\Rightarrow$ $U = W$
- θ = mini

- ***Sector S3 - Heating***
  - $F_l = \nearrow$ and : $F_a = \searrow$
  - $V_l = \searrow$ and : $V_a = \nearrow$
  - $F_a < 0$ and : $da > 0$ $\Rightarrow$ $dW < 0$ $\Rightarrow$ $W = \searrow$
    $\Rightarrow$ $dQ > 0$ $\Rightarrow$ $Q = \nearrow$
  - $Q < W$
  - at point 5 $\Rightarrow$ $U = ¼\ Q + ¾\ W$
  - $\theta = \nearrow$

- ***Point 6 - Half of the heating***
  - $F_l = F$ and : $F_a = 0$
  - $V_l = 0$ and : $V_a = V$
  - $F_a = 0$ and : $da = 0$ $\Rightarrow$ $dW = 0$ $\Rightarrow$ $W =$ average
    $\Rightarrow$ $dQ = 0$ $\Rightarrow$ $Q =$ average
  - $Q = W$
  - at point 6 $\Rightarrow$ $U = ½\ Q + ½\ W$
  - θ = medium

- ***Sector S4 - Heating***
  - $F_l = \searrow$ and : $F_a = \nearrow$
  - $V_l = \nearrow$ and : $V_a = \searrow$
  - $F_a > 0$ and: $da < 0$ $\Rightarrow$ $dW < 0$ $\Rightarrow$ $W = \searrow$
    $\Rightarrow$ $dQ > 0$ $\Rightarrow$ $Q = \nearrow$
  - $Q > W$
  - at point 7 $\Rightarrow$ U = ¾ Q + ¼ W
  - $\theta = \nearrow$

- ***Point 8 - End of heating***
  - This point can be considered as the beginning of cooling (point 0).

All these stages show that we are indeed in the presence of an engine but the fact that the fluid heats and cools alternately imposes the existence of a hot and a cold source whose respective temperatures are different.

Remarks on the uses of the Product and the Money

In the study the following two cycles were defined:

- ***for the transformation T→M :***
  - manufacturing by the Seller $\Rightarrow$ *Utility of the Product* $\nearrow$ ($dU_P > 0$ - adiabatic transf.)

- tractation Seller-Transformer ⇒ *Utility of the Product* ➔ ($dU_P = 0$ - isophel transf.)
- manufacture by the Transformer ⇒ *Utility of the Product* ➘ ($dU_P < 0$ - adiabatic transf.)
- tractation Transformer-Acquirer ⇒ *Utility of the Product* ➔ ($dU_P = 0$ - isophel transf.)

- ***for transformation M→T :***
  - manufacture by the Seller ⇒ *Utility of Cash* ➔ ($dU_A = 0$ - isophel transf.)
  - tractation Seller-Transformer ⇒ *Utility of Cash* ➘ ($dU_A < 0$ - adiabatic transf.)
  - manufacture by the Transformer ⇒ *Utility of Cash* ➔ ($dU_A = 0$ - isophel transf.)
  - tractation Transformer-Acquirer ⇒ *Utility of Cash* ➚ ($dU_A > 0$ - adiabatic transf.)

Considering the $T \to M$ transformation, the *Utility of the Product* is constant during the negotiations and varies during the manufacturing process. Conversely, in the $M \to T$ transformation, the *Utility of Cash* evolves during the negotiations but remains fixed during the manufacturing process. In the convective cell analysed above there is a continuous negative temperature gradient from bottom to top. We will see that in the economic examples below, there is, in a similar way, a continuous negative gradient of *Utility*, which seems to be contrary to what has just been announced for isophel transformations.

The explanation lies in the fact that the coordinates used are not the same, as shown in the table below, which, by setting out these different possibilities, avoids these contradictions.

	Case	Functions	Properties
Thermomecanic	***isotherm***	$T=f(time)$	***zero gradient***
	field	$T=f(altitude)$	***continuous gradient***
$T \to M$ **Transformation**	***isophel***	$U_p=f(time)$	***zero gradient***
	field	$U_p=f(labour)$	***continuous gradient***
$M \to T$ **Transformation**	***isophel***	$U_A=f(time)$	***zero gradient***
	field	$U_A=f(price)$	***continuous gradient***

Moreover, it is obvious that in economy there is no heat and no temperature. But we have seen in Development that similar characteristics have been defined as presented below.

	Vector-support	Characteristics
Thermodynamics	***Heat***	***Temperature***
$T \to M$ **Transformation**	***Product***	***Utility of Product***
$M \to T$ **Transformation**	***Cash***	***Utility of Cash***

and in the same way :

	Hot source	Engine	Cold source
Thermodynamics	**Boiler**	**Engine**	**Condenser**
$T \to M$ **Transformation**	**Seller**	**Transformer**	**Buyer**
$M \to T$ **Transformation**	**Buyer**	**Transformer**	**Seller**

It should also be remembered that the *Utilities* are always and exclusively related to the Transformer (considered to be located inside the *system*) and never to the Seller or the Buyer (considered to be located outside the *system*), unless otherwise stipulated.
Furthermore, the *Work* is always and exclusively defined as the *Work to be done* and never as the *Work done*.

Note

Up to now, a large number of analogies with physics have been presented in order to better explain economic phenomena. So, let us take for example the horizontal atmospheric circulation field in meteorology. Thus, let us consider an element of atmosphere of cubic shape of 1km of edge. Classically, the trajectory of this element is visualized by a vector whose :

- the point of application is defined by the coordinates in longitude x and latitude y of its location at time t_0,
- the direction is determined by the angle formed by the variations dx and dy of the coordinates $x+dx$ and $y+dy$ at time t_1,
- the norm is specified by the ratio of the variations dx and dy at time t_0+dt.

By doing this for a large number of elements, the set of vectors obtained represents the air mass circulation field.

The observed wind speed can be considered as the resultant of the respective wind speeds according to longitude and latitude.

Competitiveness – Scalar approach

In the present physical case, if one were to carry out the ratio of the two components of the wind speed, one would obtain a dimensionless scalar corresponding to the tangent of the angle indicating the direction of movement of the air mass but not its direction. Moreover, the standard would also no longer be known.

But in economics this ratio, *i.e.* the ratio of *productivity* ω and tachyaxy ϖ , could be defined as the *competitiveness* Ω of a company. Indeed, it would be possible to set the report :

$$\Omega = \frac{\varpi}{\omega}$$ ‹26-03›

or, with the relations 04-01 and 04-02, namely :

$$\omega = -\frac{dl}{dt} \qquad \text{and :} \qquad \varpi = \frac{dp}{dt}$$

and after simplification:

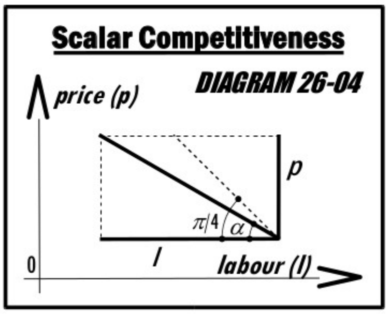
$$\Omega = -\frac{dp}{dl}$$ ‹26-04›

So :

- ***the higher the price, the weaker the competitiveness.***
- ***the more the labour to be done decreases (the more the labour done increases), the greater the competitiveness,***

Considering figure 26-05 opposite, in a general way, this relationship can be written as follows:

$$\Omega = tg\ \alpha$$ ‹26-05›



Indeed, the smaller the angle α, the more competitive the manufacturer (transformer) will be with its competition. Consequently :

- if : $\alpha < \pi/4 \Rightarrow$ *competitiveness*
- if : $\alpha > \pi/4 \Rightarrow$ *unsuitability*

But in addition, we know the relations 04-09 and 04-10 giving respectively *Work* and *Money*, namely :

$$dT = -\ F_P \cdot dl \qquad \text{and :} \qquad dM = F_A \cdot dp$$

which gives:

$$\Omega = \frac{F_P}{F_A} \cdot \frac{dM}{dT}$$ ‹26-06›

In this case :

1. ***the more Money the Buyer has, the higher the competitiveness, and vice versa.***
2. ***the more Work the Acquirer receives, the lower the competitiveness, and vice versa,***

Indeed :

1. if the Buyer has a lot of *Money*, it means that the *price* is low and therefore the *competitiveness* is strong,
2. if the Transformer has carried out a lot of *Work* it means that there is little *Work left to be done* by the Acquirer and therefore competitiveness is important.

All this is perfectly logical.

These four relationships (26-03, 26-04, 26-05, 26-06) can be used to provide a scalar field giving competitiveness but do not allow us to expose its possible chronological evolution since they are strictly and absolutely independent of time.

Therefore, it would be useful and relevant to modify this definition of competitiveness by integrating time, identically to physics. To do this, the ratio of *speeds* (productivity ω and tachyaxis ϖ) must be rejected in favour of their resultant as shown in figure 26-06 below.

Competitiveness – Vectorial approach

In this case, competitiveness is defined as a vector $\vec{\Omega}$ which is the result of the *productivity* ω and *tachyaxis* ϖ speed vectors, and of which :

- the point of application is given by the values of the origin of each *speed* vector (*productivity* and *tachyaxis*),
- the direction and direction are provided the tangent of the angle α equal to :

$$\boxed{tg\ \alpha = \frac{\vec{\varpi}}{\vec{\omega}} = -\frac{dp}{dl}} \qquad \text{‹26-07›}$$

- the standard is set as follows :

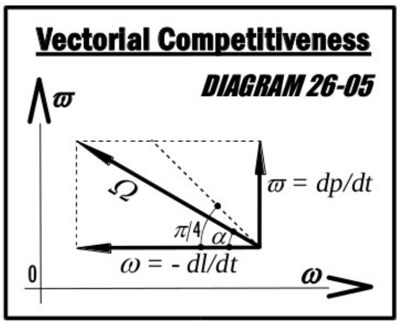
$$\boxed{\Omega^2 = \omega^2 + \varpi^2} \qquad \text{‹26-08›}$$

However, this standard can also be defined as follows:

$$\boxed{\Omega = \frac{\varpi}{\sin\alpha} = \frac{\omega}{\cos\alpha}} \qquad \text{‹26-09›}$$

Thus :

- the point of application is defined by the coordinates on the abscissa of *labour* l and the ordinate of price p at time t_0,



- the direction is determined by the angle formed by the variations *dl* and *dp* of the coordinates *l+dl* and *p+dp* at time t_1,
- the standard is specified by the ratio of the variations *dl* and *dp* at time t_0+dt.

This way of apprehending competitiveness thus makes it possible to make a visual assessment:

- its preferential dependence on *labour* or *price*,
- its sense of evolution,
- its rapidity of evolution.

Consequently, considering *competitiveness* as a speed and no longer as a number must be an undeniable advantage. In conclusion :

- ***competitiveness must be characterised as a speed.***

Competitiveness and performance

By definition, the yield of the $T \rightarrow M$ transformation is defined as follows :

$$\eta = - \frac{M}{T}$$

whose differential is :

$$d\,\eta = \frac{M \cdot dT - T \cdot dM}{T^2} \qquad \textbf{‹26-10›}$$

- Considering a transformation to *Constant Work*, the relationship becomes after simplification :

  $$\partial\,\eta_T = - \frac{\partial M}{T} \qquad \textbf{‹26-11›}$$

  In this relationship, due to the negative sign, the *Money* leaves the system, *i.e.* circulates to the Buyer.

- Considering a transformation to a *constant Money*, the relation becomes after simplification :

  $$\partial\,\eta_M = M \cdot \frac{\partial T}{T^2} = - M \cdot \partial\left(\frac{1}{T}\right) \qquad \textbf{‹26-12›}$$

  In this relationship, the *Work* is done by the Transformer. Since the *Money* is constant, the higher the *Work to be done*, the lower the *yield*. In conclusion :

- ***The better the yield of the Transformer T→M, the better the competitiveness, and vice versa.***

Competitiveness – other relations

We are familiar with the 04-15 and 04-16 relations, namely :

$$T = \frac{1}{2} \cdot c_P \cdot \omega^2 \quad \text{and :} \quad M = - \frac{1}{2} \cdot c_A \cdot \varpi^2$$

from which we draw:

$$\omega^2 = 2 \cdot \frac{T}{c_P} \quad \text{and :} \quad \varpi^2 = - 2 \cdot \frac{M}{c_A}$$

By taking up relationship 26-08, namely:

$$\Omega^2 = \omega^2 + \varpi^2$$

and by replacing, we obtain:

$$\Omega^2 = 2\left(\frac{T}{c_P} - \frac{M}{c_A}\right) \qquad \langle \mathbf{26\text{-}13} \rangle$$

either :

$$\boxed{\Omega = \pm \sqrt{2\left(\frac{T}{c_P} - \frac{M}{c_A}\right)}} \qquad \langle \mathbf{26\text{-}14} \rangle$$

As we have seen above and for example, the calculation of a journey can be understood in two different ways, namely :

1. either add up each unit of length from the path travelled,
2. either subtract each unit of length from the path to be travelled.

This is valid for any change in any characteristic. However, it is compulsory to distinguish between these two hypotheses: the case “travelled” (indexed *pos*) and the possibility “to be travelled” (indexed *neg*). Therefore, by posing :

T_{pos} = *Work done*
T_{neg} = *Work to be done*
M_{pos} = *Money made*

$M_{nég}$ = *Money to be made, still to be created*

this relationship (26-14) authorises you to write :

$$\Omega = \sqrt{2\left(\frac{T_{pos}}{c_P} - \frac{M_{neg}}{c_A}\right)} = \sqrt{2\left(\frac{M_{pos}}{c_A} - \frac{T_{neg}}{c_P}\right)} \qquad \text{‹26-15›}$$

But we also know the relationships 04-17 and 04-18 giving employment e and purchasing power a :

$e = c_P \cdot \omega$ and : $a = - c_A \cdot \varpi$

which allows us to write, with the relations 04-15 and 04-16 already seen above:

$T = \frac{1}{2} \cdot \frac{e^2}{c_P}$ and : $M = - \frac{1}{2} \cdot \frac{a^2}{c_A}$

According to employment and purchasing power, the relation 26-15 giving competitiveness becomes :

$$\Omega = \sqrt{\frac{e^2_{pos}}{c_P} + \frac{a^2_{pos}}{c_A}} = -\sqrt{\frac{a^2_{neg}}{c_A} + \frac{e^2_{neg}}{c_P}} \qquad \text{‹26-16›}$$

However, as in the whole study, only the M_{pos} *Money realized* on the one hand and the T_{neg} *Work to be done* on the other hand were considered, so for the sake of simplicity it is preferable to write :

$$\boxed{\Omega = \sqrt{2\left(\frac{M}{c_A} - \frac{T}{c_P}\right)} = \sqrt{\frac{a^2}{c_A} + \frac{e^2}{c_P}}} \qquad \text{‹26-17›}$$

It is understood that here employment and *purchasing power* do not have the same meaning as usual. In fact, it should always be remembered that *employment* and *purchasing power* are a direct function of the *speed* at which work is done (*productivity*) and the *speed* at which *prices* are formed (*tachyaxy*) respectively.

From the latter relationship it is possible to write :

$$2\left(\frac{M}{c_A} - \frac{T}{c_P}\right) = \frac{a^2}{c_A} + \frac{e^2}{c_P}$$

either :

$$\frac{2M}{c_A} - \frac{2T}{c_P} = \frac{a^2}{c_A} + \frac{e^2}{c_P}$$

or :

$$\frac{2M - a^2}{c_A} = \frac{2T + e^2}{c_P}$$

from which one draws:

$$\frac{c_A}{c_P} = \frac{2M - a^2}{2T + e^2} \qquad \text{‹26-18›}$$

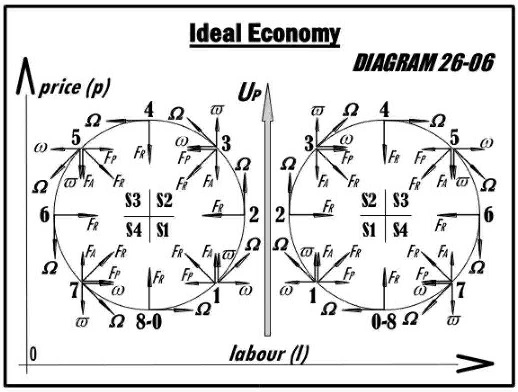
Economy

It is specified here that this whole paragraph relates to a perfect approach, identical to the one explained above for physics.

Tachyaxy and *productivity* are understood as speeds, so in a *labour-price* orthonormal benchmark, it is possible to present the figure 26-06 below.

In physics, the negative thermal gradient is directed from bottom to top due to the fact that the hot and cold springs are at the bottom and top respectively. The arrow representing the temperature is therefore pointing downwards. In this case, the thermal gradient is replaced by the *Utility of Product* gradient. This evolution of the *Utility* is due to the *labour* whose variation causes a creation or destruction of *Money* (*price* variation).

In this case, we know that the *Utility of the Product* must decrease for the Transformer (increase for the Seller and the Buyer) during the elaboration of the *Product* by itself. Consequently, the arrow is pointing upwards because the point 0 corresponds to the beginning of the manufacturing by the Seller.



It has been specified above that, in physics, depending on the position of the observer, the vortex were relative either to the path travelled (positive counterclockwise vortex) or to the path to be travelled (negative clockwise vortex).

Furthermore, in order to avoid errors, misunderstandings, confusion, etc., it must be constantly remembered that all characteristics must always be referred to the Transformer.

The analysis of figure 26-06 gives for the negative vortex (clockwise) :

- ***Point 0 - Start of manufacture by the Seller***

- $F_P = 0$ and : $F_A = F_R$
- $\omega = \Omega$ and : $\varpi = 0$
- $F_A > 0$ and: $dp = 0$ $\Rightarrow$ $dM = 0$ $\Rightarrow$ $M = 0$
  $\Rightarrow$ $dT = 0$ $\Rightarrow$ $T =$ maxi
- $T > M$
- at point 0 $\Rightarrow$ $E_{TM} = T$
- $U_P =$ mini for the Transformer (maxi for the Seller)

- ***Sector S1 - Manufacturing by the Seller***
  - $F_P =$ ➚ and : $F_A =$ ➘
  - $\omega =$ ➘ and : $\varpi =$ ➚
  - $F_A > 0$ and: $dp > 0$ $\Rightarrow$ $dM > 0$ $\Rightarrow$ $M =$ ➚
    $\Rightarrow$ $dT < 0$ $\Rightarrow$ $T =$ ➘
  - $T > M$
  - at point 1 $\Rightarrow$ $E_{TM} = ¾\ T + ¼\ M$
  - $U_P =$ ➚ for the Transformer (➘ for the Seller)

- ***Point 2 - End of manufacture by the Seller***
  - $F_P = F_R$ and : $F_A = 0$
  - $\omega = 0$ and : $\varpi = \Omega$
  - $F_A = 0$ and: $dp = 0$ $\Rightarrow$ $dM = 0$ $\Rightarrow$ $M =$ medium
    $\Rightarrow$ $dT = 0$ $\Rightarrow$ $T =$ medium
  - $T = M$
  - at point 2 $\Rightarrow$ $E_{TM} = ½\ T + ½\ M$
  - $U_P =$ average for the Transformer (average for the Seller)

- ***Sector S2 - Seller Transformer Tractation***
  - $F_P =$ ➘ and : $F_A =$ ➚
  - $\omega =$ ➚ and : $\varpi =$ ➘
  - $F_A < 0$ and : $dp < 0$ $\Rightarrow$ $dM > 0$ $\Rightarrow$ $M =$ ➚
    $\Rightarrow$ $dT < 0$ $\Rightarrow$ $T =$ ➘
  - $T < M$
  - at point 3 $\Rightarrow$ $E_{TM} = ¼\ T + ¾\ M$
  - $U_P =$ ➚ for the Transformer (➘ for the Seller)

- ***Point 4 - Seller-Transformer Transaction***
  - $F_P = 0$ and : $F_A = F_R$
  - $\omega = \Omega$ and : $\varpi = 0$
  - $F_A < 0$ and : $dp = 0$ $\Rightarrow$ $dM = 0$ $\Rightarrow$ $M =$ max
    $\Rightarrow$ $dT = 0$ $\Rightarrow$ $T = 0$
  - $T < M$
  - at point 4 $\Rightarrow$ $E_{TM} = M$
  - $U_P =$ max for the Transformer (min for the Seller or for the Buyer)

- ***Sector S3 - Transformer Manufacturing***
  - $F_P =$ ➚ and : $F_A =$ ➘

- ω = ➘ and : ϖ = ➚
- $F_A < 0$ and : $dp > 0$ $\Rightarrow$ $dM < 0$ $\Rightarrow$ M =➘
  $\Rightarrow$ $dT > 0$ $\Rightarrow$ T =➚
- $T < M$
- at point 5 $\Rightarrow$ $E_{TM} = ¼\ T + ¾\ M$
- U_P = ➘ for the Transformer (➚ for the Buyer or for the Seller)

- ***Point 6 - End of manufacture by the Transformer***
  - $F_P = F_R$ and : $F_A = 0$
  - $\omega = 0$ and : $\varpi = \Omega$
  - $F_A = 0$ and: $dp = 0$ $\Rightarrow$ $dM = 0$ $\Rightarrow$ M = medium
    $\Rightarrow$ $dT = 0$ $\Rightarrow$ T = medium
  - $T = M$
  - at point 6 $\Rightarrow$ $E_{TM} = ½\ T + ½\ M$
  - U_P = average for the Transformer (average for the Buyer or for the Seller)

- ***Sector S4 - Tractation Transformer-Acquirer***
  - F_P = ➘ and : F_A = ➚
  - ω = ➚ and : ϖ = ➘
  - $F_A > 0$ and : $dp < 0$ $\Rightarrow$ $dM < 0$ $\Rightarrow$ M = ➘
    $\Rightarrow$ $dT > 0$ $\Rightarrow$ T = ➚
  - $T < M$
  - at point 7 $\Rightarrow$ $E_{TM} = ¾\ T + ¼\ M$
  - U_P = ➚ for the Transformer (➚ for the Buyer or for the Seller)

- ***Item 8 - Transformer-Acquirer Transaction***
  - This point can be considered as the start of use by the Buyer or the start of manufacture by the Seller (point 0).

Real approach

It is quite obvious that in reality, the inverse evolutions of the F_P and F_A *Forces* are not regular, as shown in Figure 26-07 in the previous paragraph, *i.e.* the evolution is not represented by a circle. It has already been pointed out that this evolution is divided into four stages, namely :

1. manufacture by the Seller or use by the Buyer,
2. Seller-Transformer tractation,
3. manufacture by the Transformer,
4. Transformer-Acquirer tractation.

The economic agents (Seller, Buyer, Transformer) can be more or less lazy during the manufacturing or use phases and more or less stingy during the negotiation episodes.So considering any manufacturer:

- ***for a certain amount of Money he receives, the Work he performs can take any value,***

- ***for a certain amount of Work he does, the Money he receives can take any value.***

Consequently, the Ω *competitiveness* can vary in very large proportions.
Now, a company (manufacturer) is assimilated to a Transformer. Therefore, considering a group of enterprises, it would be possible to plot a set of vectors, each of which represents the *competitiveness* of each enterprise. This would be identical to a wind speed field in meteorology. These vectors would be defined :

- ***by their point of application corresponding to the respective values of labour and price.***
- ***by their direction corresponding to the tangent of the angle formed by labour and price (relation 26-07),***
- ***by their norm corresponding to the competitiveness (relation 26-08).***

GDP – Energy Cloupling

Despite the microeconomic nature of the essay, this paragraph is an intrusion into the macroeconomic domain. All econometric studies unambiguously indicate a strong correlation (of the form : y = a.x) between the amount of energy consumed by any economic system and its Gross Domestic Product (GDP), but this relationship does not prove their causality.

We know the following relationships (04-15 and 04-16):

$$T=\frac{1}{2}.c_p.\omega^2 \quad \text{and} \quad M=-\frac{1}{2}.c_A.\varpi^2$$

We also know that the higher the speed of production ω of a product, the slower the speed of price formation ϖ . It is therefore possible to write :

$$M=-\frac{1}{2}.c_A.\omega^2$$

As the two speeds are not necessarily equal, it is necessary to introduce a proportionnality coefficient which is also a function of the units used for their respective measurement. This relationship is only valid for one product, the coefficient K being variable for each. However, it is possible to design an average speed ω_m . Then, the more Products are taken into account, the more the coefficient K can be considered constant, and therefore only a function of the units used. At the macroeconomic level, it is therefore possible to pose :

$$M_{created} = K \cdot T_{spent}$$

We know that GDP is the sum of all the Money spent in a system for each Money→ Labour transformation, but also that al this Money had to be previously created in each Work → Money transformation. Consequently, it is possible to write :

$$GDP = K \cdot T_{spent}$$

However, we also know that in anay system, there is energy consumed that does not participate in the creation of Money, i.e. in the enrichment of the system. If we take into account this energy, which only influences the slope of the right-hand side, the relationship becomes:

$$GDP = K \cdot W_{consumed}$$

which shows the absolute coupling of the GDP of a system to the energy consumed in it.

27 MAIN RECAPITULATION

RECAPITULATIONS OF THE MAIN RELATIONSHIPS - ANALOGY AND SYMMETRY					
THERMOMECHANICS TRANSFORMATION Heat→Work		ECONOMY TRANSFORMATION Work→Money		ECONOMY TRANSFORMATION Money→ Work	
Speed	$v = \frac{\mathrm{de}}{\mathrm{dt}}$	Tachyaxy	$\varpi = \frac{\mathrm{dp}}{\mathrm{dt}}$	Productivity	$\omega = -\frac{\mathrm{dl}}{\mathrm{dt}}$
Acceleration	$\gamma = \frac{d^2 e}{\mathrm{dt}^2}$	Inflation	$\gamma_{\varpi} = \frac{d^2 p}{\mathrm{dt}^2}$	Gain of productivity	$\gamma_{\omega} = -\frac{d^2 l}{\mathrm{dt}^2}$
Force	$F = m \cdot \gamma$	Force	$F_A = -c \cdot \gamma \varpi$	Force	$F_P = c \cdot \gamma\, \omega$
Work	$\mathrm{dW} = F \cdot \mathrm{de}$	Money	$\mathrm{dM} = -F_A \cdot \mathrm{dp}$	Work	$\mathrm{dT} = F_P \cdot \mathrm{dl}$
Amount of movement	$p = m \cdot v$	Purchasing power	$a = -c \cdot \varpi$	Employment	$e = c \cdot \omega$
Kinetic energy	$E^{\mathrm{cin}} = \frac{1}{2} \cdot m \cdot v^2$	Kinetic energy	$E^{\mathrm{cin}} = -\frac{1}{2} \cdot c \cdot \varpi^2$	Kinetic energy	$E^{\mathrm{cin}} = \frac{1}{2} \cdot c \cdot \omega^2$
Principe of equivalence	$W = J \cdot Q$	Principle of Equivalence	$M = g_{\mathrm{TM}} \cdot T$	Principle of Equivalence	$T = g_{\mathrm{MT}} \cdot M$
First Principle	$\underbrace{\mathrm{dQ}}_{\text{cause}} + \underbrace{\mathrm{dW}}_{\text{effect}} = 0$	First Principle	$\underbrace{\mathrm{dT}}_{\text{cause}} + \underbrace{\mathrm{dM}}_{\text{effect}} = 0$	First Principle	$\underbrace{\mathrm{dM}}_{\text{cause}} + \underbrace{\mathrm{dT}}_{\text{effect}} = 0$
Second Principle	$\frac{Q_1}{T_1} + \frac{Q_2}{T_2} = 0$	Second Principle	$\frac{T_1}{U_{\mathrm{P1}}} + \frac{T_2}{U_{\mathrm{P2}}} = 0$	Second Principle	$\frac{M_1}{U_{\mathrm{A1}}} + \frac{M_2}{U_{\mathrm{A2}}} = 0$
Core Law	$P \cdot V = r \cdot T = \mathrm{Cte}$	Core Law	$F_A \cdot V = r_P \cdot U_P = \mathrm{Cte}$	Core Law	$F_P \cdot B = r_A \cdot U_A = \mathrm{Cte}$
Heat	$\mathrm{dQ} = T \cdot \mathrm{dS}$	Work	$\mathrm{dT} = -U_P \cdot \mathrm{dP}$	Money	$\mathrm{dM} = U_A \cdot \mathrm{dA}$
Work	$\mathrm{dW} = -P \cdot \mathrm{dV}$	Money	$\mathrm{dM} = F_A \cdot \mathrm{dV}$	Work	$\mathrm{dT} = -F_P \cdot \mathrm{dB}$
Internal energy	$\mathrm{dU} = T \cdot \mathrm{dS} - P \cdot \mathrm{dV}$	Internal energy	$\mathrm{dE} = -U_P \cdot \mathrm{dP} + F_A \cdot \mathrm{dV}$	Internal Work	$\mathrm{dE} = U_A \cdot \mathrm{dA} - F_P \cdot \mathrm{dB}$
Isothermal work	$W = -r \cdot T \cdot \ln \frac{Vf}{Vi}$	Isopheles Money	$M = r_P \cdot U_P \cdot \ln \frac{Vf}{Vi}$	Isopheles Work	$T = -r_A \cdot U_A \cdot \ln \frac{Bf}{Bi}$
Adiabatic work	$W = \frac{r}{\gamma - 1} \cdot \left(T_f - T_i\right)$	Adiabatic Money	$M = -\frac{r_P}{\gamma_P - 1} \cdot \left(U_{\mathrm{Pf}} - U_{\mathrm{Pi}}\right)$	Adiabatic Work	$T = \frac{r_A}{\gamma_A - 1} \cdot \left(U_{\mathrm{Af}} - U_{\mathrm{Ai}}\right)$
Isobaric Work	$W = -P \cdot \left(V_f - V_i\right)$	Isobaric Money	$M = F_A \cdot \left(V_f - V_i\right)$	Isobaric Work	$T = -F_P \cdot \left(B_f - B_i\right)$
Isochore work	$W = 0$	Isoax Money	$M = 0$	Isoergue Work	$T = 0$
Isothermal heat	$Q = T \cdot \left(S_f - S_i\right)$	Isopheles Work	$T = -U_P \cdot \left(P_f - P_i\right)$	Isophles Money	$M = U_A \cdot \left(A_f - A_i\right)$
Adiabatic	$Q = 0$	Adiabatic	$T = 0$	Adiabatic	$M = 0$

heat		Work		Money	

The table below specifies the terminological correspondences of the characteristics used in the note between the two disciplines Thermomechanics and Economics.

TERMINOLOGY - CORRESPONDENCE					
THERMOMECHANICS TRANSFORMATION Heat→Work		ECONOMY TRANSFORMATION Work→Money		ECONOMY TRANSFORMATION Money→ Work	
gas		*Product*		*Cash*	
engine		*Transformer*		*Transformer*	
hot source		*Seller*		*Buyer - Acquierer*	
cold source		*Buyer - Acquierer*		*Seller*	
distance travelled	e	*prices*	p	*labour to be done*	l
travel	d	*Added value*	V	*Task to be added*	B
mass	m	*complexity*	C_P	*complexity*	C_A
time	t	*time*	t	*time*	t
amount of movement	p	*Purchasing power*	a	*employment*	e
speed	v	*Speed of price formation*	ϖ	*productivity*	ω
acceleration - deceleration	γ	*Enrichment - impoverishment*	γ_{ϖ}	*Gain – loss of productivity*	γ_{ω}
force	F	*Force of Avarice*	F_A	*Force of Laziness*	F_P
Mechanical work	W	*Money realized*	M	*Economic work to be done*	T
Kinetic energy	W	*Kinetic energy*	E^{CIN}	*Kinetic energy*	E^{CIN}
volume	W	*Price – added value*	P - V	*Labour – task to be added*	L - B
temperature	T	*Utility of Product*	U_P	*Utility of Cash*	U_A
heat	Q	*Economic work to be done*	T	*Money realized*	M
Internal energy	U	*Internal energy*	E_{TM}	*Internal energy*	E_{MT}
entropy	S	*Laziness*	P	*Avarice*	A
Isothermal transformation		*Isopheles transformation*		*Isopheles transformation*	
Isochore transformation		*Isoaxis transformation*		*Isoergue transformation*	
Isobaric transformation		*Isobaric transformation*		*Isobaric transformation*	

Adiabatic transformation		*Adiabatic transformation*		*Adiabatic transformation*	

DYNAMIC POTENTIALS AND MAGICAL RELATIONSHIPS - ANALOGY AND SYMMETRY					
THERMOMECHANICS TRANSFORMATION Heat→Work		ECONOMY TRANSFORMATION Work→Money		ECONOMY TRANSFORMATION Money→ Work	
Energy internal	$dU = T \cdot dS - P \cdot dV$	Energy internal	$dE_{TM} = -U_P \cdot dP + F_A \cdot dV$	Energy internal	$dE_{MT} = U_A \cdot dA - F_P \cdot dB$
Free Energy	$dF = -S \cdot dT - P \cdot dV$	Free Energy	$dE_{TM}^L = P \cdot dU_P + F_A \cdot dV$	Free Energy	$dE_{MT}^L = -A \cdot dU_A - F_P \cdot dB$
Enthalpy	$dH = T \cdot dS + V \cdot dP$	Empraxia	$dX = -U_P \cdot dP - V \cdot dF_A$	Enomaillie	$dL = U_A \cdot dA + B \cdot dF_P$
Free Enthalpy	$dG = -S \cdot dT + V \cdot dP$	Free Empraxia	$dX^L = P \cdot dU_P - V \cdot dF_A$	Free Enomaillie	$dL^L = -A \cdot dU_A + B \cdot dF_P$
$T = \left(\frac{\partial U}{\partial S}\right)_V$	$P = -\left(\frac{\partial U}{\partial V}\right)_S$	$U_P = -\left(\frac{\partial E_{TM}}{\partial P}\right)_V$	$F_A = \left(\frac{\partial E_{TM}}{\partial V}\right)_P$	$U_A = \left(\frac{\partial E_{MT}}{\partial A}\right)_B$	$F_P = -\left(\frac{\partial E_{MT}}{\partial B}\right)_A$
$S = -\left(\frac{\partial F}{\partial T}\right)_V$	$P = -\left(\frac{\partial F}{\partial V}\right)_T$	$P = \left(\frac{\partial E_{TM}^L}{\partial U_P}\right)_V$	$F_A = \left(\frac{\partial E_{TM}^L}{\partial V}\right)_{U_P}$	$A = -\left(\frac{\partial E_{MT}^L}{\partial U_A}\right)_B$	$F_P = -\left(\frac{\partial E_{MT}^L}{\partial B}\right)_{U_A}$
$T = \left(\frac{\partial H}{\partial S}\right)_P$	$V = \left(\frac{\partial H}{\partial P}\right)_S$	$U_P = -\left(\frac{\partial X}{\partial P}\right)_{F_A}$	$V = -\left(\frac{\partial X}{\partial F_A}\right)_P$	$U_A = \left(\frac{\partial L}{\partial A}\right)_{F_P}$	$B = \left(\frac{\partial L}{\partial F_P}\right)_A$
$S = -\left(\frac{\partial G}{\partial T}\right)_P$	$V = \left(\frac{\partial G}{\partial P}\right)_T$	$P = \left(\frac{\partial X^L}{\partial U_P}\right)_{F_A}$	$V = -\left(\frac{\partial X^L}{\partial F_A}\right)_{U_P}$	$A = -\left(\frac{\partial L^L}{\partial U_A}\right)_{F_P}$	$B = \left(\frac{\partial L^L}{\partial F_P}\right)_{U_A}$
Pressure	$P = -\left(\frac{\partial U}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial V}\right)_T$	Force	$F_A = \left(\frac{\partial E_{TM}}{\partial V}\right)_P = \left(\frac{\partial E_{TM}^L}{\partial V}\right)_{U_P}$	Force	$F_P = -\left(\frac{\partial E}{\partial B}\right)_A = -\left(\frac{\partial E^L}{\partial B}\right)_{U_A}$
Volume	$V = \left(\frac{\partial H}{\partial F}\right)_S = \left(\frac{\partial G}{\partial P}\right)_T$	Added value	$V = -\left(\frac{\partial X}{\partial F_A}\right)_P = -\left(\frac{\partial X^L}{\partial F_A}\right)_{U_P}$	Task to be aded	$B = \left(\frac{\partial L}{\partial F_P}\right)_A = \left(\frac{\partial L^L}{\partial F_P}\right)_{U_A}$
Temper.	$T = \left(\frac{\partial U}{\partial S}\right)_V = \left(\frac{\partial H}{\partial S}\right)_P$	Utility of Product	$U_P = -\left(\frac{\partial E}{\partial P}\right)_V = -\left(\frac{\partial X}{\partial P}\right)_{F_A}$	Utility of Cash	$U_A = \left(\frac{\partial E_{MT}}{\partial A}\right)_B = \left(\frac{\partial L}{\partial A}\right)_{F_P}$
Entropy	$S = -\left(\frac{\partial F}{\partial T}\right)_V = -\left(\frac{\partial G}{\partial T}\right)_P$	Work Economy	$P = \left(\frac{\partial E_{TM}^L}{\partial U_P}\right)_V = \left(\frac{\partial X^L}{\partial U_P}\right)_{F_A}$	Money Economy	$A = -\left(\frac{\partial E^L}{\partial U_A}\right)_B = -\left(\frac{\partial L^L}{\partial U_A}\right)_{F_P}$
$\left(\frac{\partial P}{\partial T}\right)_V \cdot \left(\frac{\partial T}{\partial V}\right)_P \cdot \left(\frac{\partial V}{\partial P}\right)_T = -1$		$\left(\frac{\partial F_A}{\partial U_P}\right)_V \cdot \left(\frac{\partial U_P}{\partial V}\right)_{F_A} \cdot \left(\frac{\partial V}{\partial F_A}\right)_{U_P} = -1$		$\left(\frac{\partial F_P}{\partial U_A}\right)_B \cdot \left(\frac{\partial U_A}{\partial B}\right)_{F_P} \cdot \left(\frac{\partial B}{\partial F_P}\right)_{U_A} = -1$	
Maxwell relations	$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$	(Maxwell) relations	$\left(\frac{\partial U_P}{\partial V}\right)_P = -\left(\frac{\partial F_A}{\partial P}\right)_V$	(Maxwell) relations	$\left(\frac{\partial U_A}{\partial B}\right)_A = -\left(\frac{\partial F_P}{\partial A}\right)_B$
	$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$		$\left(\frac{\partial P}{\partial V}\right)_{U_P} = \left(\frac{\partial F_A}{\partial U_P}\right)_V$		$\left(\frac{\partial A}{\partial B}\right)_{U_A} = \left(\frac{\partial F_P}{\partial U_A}\right)_B$

	$\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$
	$\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$

	$\left(\frac{\partial U_P}{\partial F_A}\right)_P = \left(\frac{\partial V}{\partial P}\right)_{F_A}$
	$\left(\frac{\partial P}{\partial F_A}\right)_{U_P} = -\left(\frac{\partial V}{\partial U_P}\right)_{F_A}$

	$\left(\frac{\partial U_A}{\partial F_P}\right)_A = \left(\frac{\partial B}{\partial A}\right)_{F_P}$
	$\left(\frac{\partial A}{\partial F_P}\right)_{U_A} = -\left(\frac{\partial B}{\partial U_A}\right)_{F_P}$

ECO-ELASTIC AND ECOMETRIC COEFFICIENTS - ANALOGY AND SYMMETRY					
THERMOMECHANICS TRANSFORMATION Heat→Work		ECONOMY TRANSFORMATION Work→Money		ECONOMY TRANSFORMATION Money→ Work	
Thermo-elastic coefficients	$\alpha = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P = \frac{1}{T}$	Eco-elastic coefficients	$\alpha_{TM} l = -\frac{1}{V}\left(\frac{\partial V}{\partial U_P}\right)_{F_A} = -\frac{1}{U_P}$	Eco-elastic coefficients	$\alpha_{MT} = \frac{1}{B}\cdot\left(\frac{\partial B}{\partial U_A}\right)_{F_P} = \frac{1}{U_A}$
	$\beta = \frac{1}{P}\left(\frac{\partial P}{\partial T}\right)_V = \frac{1}{T}$		$\beta_{TM} = -\frac{1}{F_A}\left(\frac{\partial F_A}{\partial U_P}\right)_V = -\frac{1}{U_P}$		$\beta_{MT} = \frac{1}{F_P}\cdot\left(\frac{\partial F_P}{\partial U_A}\right)_B = \frac{1}{U_A}$
	$\chi_T = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T = \frac{1}{P}$		$\chi_{TM} = \frac{1}{V}\left(\frac{\partial V}{\partial F_A}\right)_{U_P} = -\frac{1}{F_A}$		$\chi_{MT} = -\frac{1}{B}\cdot\left(\frac{\partial B}{\partial F_P}\right)_{U_A} = \frac{1}{F_P}$
	$P = \frac{\alpha}{\beta\cdot\chi_T}$		$F_A = -\frac{\alpha_{TM}}{\beta_{TM}\cdot\chi_{TM}}$		$F_P = \frac{\alpha_{MT}}{\beta_{MT}\cdot\chi_{MT}}$
Calori-metric coefficients	$C_V = T\cdot\left(\frac{\partial S}{\partial T}\right)_V$	Ecometric coefficients	$\Phi_V = U_P\cdot\left(\frac{\partial P}{\partial U_P}\right)_V$	Ecometric coefficients	$\Phi_B = U_A\cdot\left(\frac{\partial A}{\partial U_A}\right)_B$
	$C_P = T\cdot\left(\frac{\partial S}{\partial T}\right)_P$		$\Phi_{F_A} = U_P\cdot\left(\frac{\partial P}{\partial U_P}\right)_{F_A}$		$\Phi_{F_P} = U_A\left(\frac{\partial A}{\partial U_A}\right)_{F_P}$
	$l = T\cdot\left(\frac{\partial S}{\partial V}\right)_T$		$l_{TM} = U_P\cdot\left(\frac{\partial P}{\partial V}\right)_{U_P}$		$l_{MT} = U_A\cdot\left(\frac{\partial A}{\partial B}\right)_{U_A}$
	$h = T\cdot\left(\frac{\partial S}{\partial P}\right)_T$		$h_{TM} = U_P\cdot\left(\frac{\partial P}{\partial F_A}\right)_{U_P}$		$h_{MT} = U_A\cdot\left(\frac{\partial A}{\partial F_P}\right)_{U_A}$
	$\lambda = T\cdot\left(\frac{\partial S}{\partial V}\right)_P$		$\lambda_{TM} = U_P\cdot\left(\frac{\partial P}{\partial V}\right)_{F_A}$		$\lambda_{MT} = U_A\cdot\left(\frac{\partial A}{\partial B}\right)_{F_P}$
	$\mu = T\cdot\left(\frac{\partial S}{\partial P}\right)_V$		$\mu_{TM} = U_P\cdot\left(\frac{\partial P}{\partial F_A}\right)_V$		$\mu_{MT} = U_A\cdot\left(\frac{\partial A}{\partial F_P}\right)_B$
Heat	$dQ = C_V\cdot dT + l\cdot dV$ $dQ = C_P\cdot dT + h\cdot dP$ $dQ = \lambda\cdot dV + \mu\cdot dP$	Work	$dT = \Phi_V\cdot dU_P + l_{TM}\cdot dV$ $dT = \Phi_{F_A} dU_P + h_{TM} dF_A$ $dT = \lambda_{TM}\cdot dV + \mu_{TM}\cdot dF_A$	Money	$dM = \Phi_B\cdot dU_A + l_{MT}\cdot dB$ $dM = \Phi_{F_P}\cdot dU_A + h_{MT} dF_P$ $dM = \lambda_{MT}\cdot dB + \mu_{MT}\cdot dF_P$
Relations between coefficients	$l = \left(C_P - C_V\right)\cdot\left(\frac{\partial T}{\partial V}\right)_P$	Relations between coefficients	$l_{TM} = \left(\Phi_{F_A} - \Phi_V\right)\cdot\left(\frac{\partial U_P}{\partial V}\right)_{F_A}$	Relations between coefficients	$l_{MT} = \left(\Phi_{F_P} - \Phi_B\right)\cdot\left(\frac{\partial U_A}{\partial B}\right)_{F_P}$
	$h = -\left(C_P - C_V\right)\cdot\left(\frac{\partial T}{\partial P}\right)_V$		$h_{TM} = -\left(\Phi_{F_A} - \Phi_V\right)\cdot\left(\frac{\partial U_P}{\partial F_A}\right)_V$		$h_{MT} = -\left(\Phi_{F_P} - \Phi_B\right)\cdot\left(\frac{\partial U_A}{\partial F_P}\right)_B$
	$\lambda = C_V\cdot\left(\frac{\partial T}{\partial P}\right)_V$		$\lambda_{TM} = \Phi_V\cdot\left(\frac{\partial U_P}{\partial F_A}\right)_V$		$\lambda_{MT} = \Phi_B\cdot\left(\frac{\partial U_A}{\partial F_P}\right)_B$
	$\mu = C_P\cdot\left(\frac{\partial T}{\partial V}\right)_P$		$\mu_{TM} = \Phi_{F_A}\cdot\left(\frac{\partial U_P}{\partial V}\right)_{F_A}$		$\mu_{MT} = \Phi_{F_P}\cdot\left(\frac{\partial U_A}{\partial B}\right)_{F_P}$

	02 - VALUE OF THE MONETARY UNIT
02-01	$M = n \cdot u$
02-02	$dM = n \cdot du + u \cdot dn$

	03 - BASIC DEFINITIONS
03-01	$dR_m > 0$
03-02	$dR_{m_{(i)}} > 0$

	04 - MECHANICS OF EXCHANGE
04-01	$\omega = - \dfrac{dl}{dt}$
04-02	$\varpi = \dfrac{dp}{dt}$
04-03	$\gamma_\omega = \dfrac{d\omega}{dt} = - \dfrac{d^2 l}{dt^2}$
04-04	$\gamma_\varpi = \dfrac{d\varpi}{dt} = \dfrac{d^2 p}{dt^2}$
04-05	$F_P = c_P \cdot \gamma_\omega$
04-06	$F_A = - c_A \cdot \gamma_\varpi$
04-07	$dT = F_P \cdot dl$
04-08	$dM = - F_A \cdot dp$
04-09	$dT = - F_P \cdot dB$
04-10	$dM = F_A \cdot dV$
04-11	$dT = - c_P \cdot \dfrac{d\omega}{dt} \cdot dB$
04-12	$dM = - c_A \cdot \dfrac{d\varpi}{dt} \cdot dV$

04-13	$dT = c_P \cdot \omega \cdot d\omega$
04-14	$dM = - c_A \cdot \varpi \cdot d\varpi$
04-15	$T = \frac{1}{2} \cdot c_P \cdot \omega^2$
04-16	$M = - \frac{1}{2} \cdot c_A \cdot \varpi^2$
04-17	$e = c_P \cdot \omega$
04-18	$a = - c_A \cdot \varpi$
04-19	$de = c_P \cdot d\omega$
04-20	$da = - c_A \cdot d\varpi$
04-21	$de = F_P \cdot dt$
04-22	$da = F_A \cdot dt$
04-23	$\frac{F_A}{F_P} = \frac{da}{de} = - \frac{c_A}{c_P} \cdot \frac{d\varpi}{d\omega}$
04-24	$(\partial u)_n = - F_A \cdot \frac{\partial p}{n}$
04-25	$\Gamma_M = \frac{dM}{dt}$
04-26	$\Gamma_T = \frac{dT}{dt}$

	05 – BASIC PRINCIPLES
05-01	$M = g_{TM} \cdot T$
05-02	$T = g_{MT} \cdot M$
05-03	$g_{TM} = \frac{1}{g_{MT}}$
05-04	$dT = - U_P \cdot dP$
05-05	$\underbrace{dT}_{cause} + \underbrace{dM}_{effect} = 0$

05-06	$F_A^{ext} = - F_A^{int}$
05-07	$dM = U_A \cdot dA$
05-08	$\underbrace{dM}_{cause} + \underbrace{dT}_{effect} = 0$
05-09	$F_P^{ext} = - F_P^{int}$

	06 - INTERNAL ENERGIES
06-01	$dE_{TM} = \underbrace{dT}_{cause} + \underbrace{dM}_{effect}$
06-02	$dE_{TM} = - \underbrace{U_P \cdot dP}_{cause} + \underbrace{F_A^{ext} \cdot dV}_{effect}$
06-03	$dE_{MT} = \underbrace{dM}_{cause} + \underbrace{dT}_{effect}$
06-04	$dE_{MT} = \underbrace{U_A \cdot dA}_{cause} - \underbrace{F_P^{ext} \cdot dB}_{effect}$
06-05	$U_{P\,(supplier)} < U_{P\,(consumer)}$
06-06	$\partial P_{(supplier)} \geq 0$
06-07	$U_{A\,(supplier)} > U_{A\,(consumer)}$
06-08	$\partial A_{(supplier)} \leq 0$
06-09	$U_{P\,(A)} = U_{P\,(B)}$ *at the transaction*
06-10	$U_{A\,(A)} = U_{A\,(B)}$ *at the transaction*
06-11	$U_{P\,(A)} = U_{A\,(B)}$ *at the transaction*
06-12	$U_{A\,(A)} = U_{P\,(B)}$ *at the transaction*

	08 – CORE LAWS
08-01	$C = \frac{U_P}{p}$
08-02	$C = F_A = \frac{U_P}{p}$

08-03	$r_P = \mathrm{f}(c_P)$
08-04	$F_A \cdot p = r_P \cdot U_P$
08-05	$p_e = r_P \cdot \frac{dU_P}{dF_A}$
08-06	$\frac{p_1}{U_{P1}} = \frac{p_2}{U_{P2}}$ *at Constant Avarice Force*
08-07	$\frac{F_{A1}}{U_{P1}} = \frac{F_{A2}}{U_{P2}}$ *at Constant price*
08-08	$F_{A1} \cdot p_1 = F_{A2} \cdot p_2$ *at contant Utility of Product*
08-09	$C = \frac{U_A}{l}$
08-10	$C = F_P = \frac{U_A}{l}$
08-11	$r_A = \mathrm{f}(c_A)$
08-12	$F_P \cdot l = r_A \cdot U_A$
08-13	$l_e = r_A \cdot \frac{dU_A}{dF_P}$
08-14	$\frac{l_1}{U_{A1}} = \frac{l_2}{U_{A2}}$ *at constant Lazy Force*
08-15	$\frac{F_{P1}}{U_{A1}} = \frac{F_{P2}}{U_{A2}}$ *at constant labour*
08-16	$F_{P1} \cdot l_1 = F_{P2} \cdot l_2$ *at Constant Utility of Cash*

09 - ADDITIONAL DEFINITIONS	
09-01	$\Phi = \frac{dT}{dU_P}$
09-02	$\Phi = \frac{dM}{dU_A}$
09-03	$\Delta P_{(E)} + \frac{\Delta E_{TM(E)}}{U_{P0}} \geq 0$
09-04	$\Delta P_{Entrepreneur} \leq \frac{T}{U_{P0}}$

09-05	$\Delta A_{(E)} - \dfrac{\Delta E_{MT(E)}}{U_{A0}} \geq 0$
09-06	$\Delta A_{Entrepreneur} \leq \dfrac{M}{U_{A0}}$
09-07	$Empraxy = X = E_{TM} - F_A \cdot p$
09-08	$T_{F_A} = X_{(f)} - X_{(i)}$
09-09	$X_{(f)} - X_{(i)} \geq 0$
09-10	$dX = - U_P \cdot dP - p \cdot dF_A$
09-11	$Enomailie = L = E_{MT} + F_P \cdot l$
09-12	$M_{F_P} = L_{(f)} - L_{(i)}$
09-13	$L_{(f)} - L_{(i)} \leq 0$
09-14	$dL = U_A \cdot dA + l \cdot dF_P$
09-15	$(\partial T)_{F_A} = (\partial X)_{F_A}$
09-16	$(\partial T)_p = (\partial E_{TM})_p$
09-17	$(\partial M)_{F_P} = (\partial L)_{F_P}$
09-18	$(\partial M)_l = (\partial E_{MT})_l$

10 - DIFFICULTIES	
10-01	$\Phi_V = \left(\dfrac{\partial T}{\partial U_P}\right)_V = \left(\dfrac{\partial E_{TM}}{\partial U_P}\right)_V$
10-02	$\varphi_V = \dfrac{1}{N} \cdot \left(\dfrac{\partial T}{\partial U_P}\right)_V = \dfrac{1}{N} \cdot \left(\dfrac{\partial E_{TM}}{\partial U_P}\right)_V$
10-03	$\Phi_{F_A} = \left(\dfrac{\partial T}{\partial U_P}\right)_{F_A} = \left(\dfrac{\partial X}{\partial U_P}\right)_{F_A}$
10-04	$\varphi_{F_A} = \dfrac{1}{N} \cdot \left(\dfrac{\partial T}{\partial U_P}\right)_{F_A} = \dfrac{1}{N} \cdot \left(\dfrac{\partial X}{\partial U_P}\right)_{F_A}$

10-05	$r_P = \Phi_V - \Phi_{F_A}$
10-06	$\frac{\partial F_A}{F_A} + \frac{\partial V}{V} = \frac{\partial U_P}{U_P}$
10-07	$\gamma_{TM} = \frac{\Phi_{F_A}}{\Phi_V}$
10-08	$\gamma_{TM} < 1$
10-09	$F_A \cdot V^{\gamma_{TM}} = k_{FV}$
10-10	$U_P \cdot V^{\gamma_{TM} - 1} = k_{UV}$
10-11	$U_P^{\gamma_{TM}} \cdot F_A^{1 - \gamma_{TM}} = k_{UF}$
10-12	$\Phi_B = \left(\frac{\partial M}{\partial U_A}\right)_B = \left(\frac{\partial E_{MT}}{\partial U_A}\right)_B$
10-13	$\varphi_B = \frac{1}{N} \cdot \left(\frac{\partial M}{\partial U_A}\right)_B = \frac{1}{N} \cdot \left(\frac{\partial E_{MT}}{\partial U_A}\right)_B$
10-14	$\Phi_{F_P} = \left(\frac{\partial M}{\partial U_A}\right)_{F_P} = \left(\frac{\partial L}{\partial U_A}\right)_{F_P}$
10-15	$\varphi_{F_P} = \frac{1}{N} \cdot \left(\frac{\partial M}{\partial U_A}\right)_{F_P} = \frac{1}{N} \cdot \left(\frac{\partial L}{\partial U_A}\right)_{F_P}$
10-16	$r_A = \Phi_{F_P} - \Phi_B$
10-17	$\frac{\partial F_P}{F_P} + \frac{\partial B}{B} = \frac{\partial U_A}{U_A}$
10-18	$\gamma_{MT} = \frac{\Phi_{F_P}}{\Phi_B}$
10-19	$\gamma_{MT} > 1$
10-20	$F_P \cdot B^{\gamma_{MT}} = k_{FB}$
10-21	$U_A \cdot B^{\gamma_{MT} - 1} = k_{UB}$
10-22	$U_A^{\gamma_{MT}} \cdot F_P^{1 - \gamma_{MT}} = k_{UF}$

11 - STRUCTURE OF THE EXCHANGES

11-01	$\delta T_{total} = \delta T_{lost} + dT_{useful}$
11-02	$dT_{total} = \delta T_{lost} + \delta T_{useful}$
11-03	$\delta M_{total} = \delta M_{lost} + dM_{useful}$
11-04	$dM_{total} = \delta M_{lost} + \delta M_{useful}$
11-05	$T_{spent} > M_{created} = M_{spent} > T_{created}$
11-06	$M_{spent} > T_{created} = T_{spent} > M_{created}$

	12 - CYCLES
12-01	$T = - U_P \cdot (P_{(f)} - P_{(i)})$
12-02	$T = 0$
12-03	$M = r_P \cdot U_P \cdot \ln \frac{p_{(f)}}{p_{(i)}}$
12-04	$M = \frac{r_P}{1 - \gamma_{TM}} \cdot (U_{P(f)} - U_{P(i)})$
12-05	$M = 0$
12-06	$M = F_A \cdot (p_{(f)} - p_{(i)})$
12-07	$M = U_A \cdot (A_{(f)} - A_{(i)})$
12-08	$M = 0$
12-09	$T = - r_A \cdot U_A \cdot \ln \frac{l_{(f)}}{l_{(i)}}$
12-10	$T = \frac{r_A}{\gamma_{MT} - 1} \cdot (U_{A(f)} - U_{A(i)})$
12-11	$T = 0$
12-12	$T = - F_P \cdot (l_{(f)} - l_{(i)})$

	13 - MONEY AND WORK - CONDITIONS OF CREATION

13-01	$T_1 + T_2 < 0 \Rightarrow$ *prohibition*
13-02	$\dfrac{T_1}{U_{P1}} + \dfrac{T_2}{U_{P2}} < 0 \Rightarrow$ *prohibition*
13-03	$M_1 + M_2 < 0 \Rightarrow$ *prohibition*
13-04	$\dfrac{M_1}{U_{A1}} + \dfrac{M_2}{U_{A2}} > 0 \Rightarrow$ *prohibition*
13-05	$\dfrac{T_1}{T_2} = \dfrac{M_1}{M_2} = - \dfrac{U_{P1}}{U_{P2}} = - \dfrac{U_{A1}}{U_{A2}}$
13-06	$\alpha + \beta = \dfrac{\pi}{4}$
13-07	$\mathrm{tg}\,\alpha = \dfrac{1 - \mathrm{tg}\,\beta}{1 + \mathrm{tg}\,\beta}$
13-08	*to the balance between Work and Money economies* $\alpha = \beta = \dfrac{\pi}{8} \Rightarrow tg\ \alpha = tg\ \beta = \sqrt{2} - 1$

14 - YIELDS OF TRANSFORMATIONS	
14-01	$\eta_{TM} \geq 1 - \dfrac{U_{P2}}{U_{P1}}$
14-02	$0 \leq \eta_{TM} \leq 1$
14-03	$\eta_{MT} \leq 1 - \dfrac{U_{A2}}{U_{A1}}$
14-04	$0 \leq \eta_{MT} \leq 1$
14-05	$\eta_g = \left(1 - \dfrac{U_{P2}}{U_{P1}}\right)^2 = \left(1 - \dfrac{U_{A2}}{U_{A1}}\right)^2 = \left(1 - \dfrac{U_{P2}}{U_{P1}}\right) \cdot \left(1 - \dfrac{U_{A2}}{U_{A1}}\right)$
14-06	$\eta_g = (1 - \mathrm{tg}\,\alpha)^2 = \left(\dfrac{2\ \mathrm{tg}\,\beta}{1 + \mathrm{tg}\,\beta}\right)^2$
14-07	$\eta_{g\,max} = \left(2 - \sqrt{2}\right)^2 \approx 0{,}3431$
14-08	$\eta_{TM\,opt} = \eta_{MT\,opt} = \left(2 - \sqrt{2}\right) \approx 0{,}5858$
14-09	$\eta_{g\,max} = \eta_{opt}^{\ 2}$
14-10	$\eta_{opt} = 1 - \mathrm{tg}\,\alpha = \dfrac{2\ \mathrm{tg}\,\beta}{1 + \mathrm{tg}\,\beta}$

14-11	$\eta_{TM} = 0$
14-12	$\eta_{MT} = 0$

15 - PRODUCT AND MONEY - SUPPLY AND DEMAND	
15-01	$S = \frac{dQ_S}{dt}$
15-02	$D = \frac{dQ_D}{dt}$
15-03	$\frac{D}{S} = \frac{dQ_D}{dQ_S} \leq 1$
15-04	$D_P = \frac{S_A}{p}$
15-05	$D_A = S_P \cdot p$
15-06	$p = \frac{S_A}{D_P}$
15-07	$p = \frac{D_A}{S_P}$
15-08	$S_A \cdot S_P = D_A \cdot D_P$
15-09	$D_P = S_A \cdot l$
15-10	$D_A = \frac{S_P}{l}$
15-11	$p \cdot l = 1$
15-12	$S_A = \frac{D_P \cdot F_P}{r_A \cdot U_A}$
15-13	$S_P = \frac{D_A \cdot F_A}{r_P \cdot U_P}$
15-14	$D_A = \frac{S_P \cdot F_P}{r_A \cdot U_A}$
15-15	$D_P = \frac{S_A \cdot F_A}{r_P \cdot U_P}$

16 - ECODYNAMIC POTENTIALS	
16-01	$E_{TM}^{L} = E_{TM} + U_P \cdot P$

16-02	$E^{L}_{TM(f)} - E^{L}_{TM(i)} \geq 0$
16-03	$dE^{L}_{TM} = P \cdot dU_{P} + F_{A} \cdot dp$
16-04	$X^{L} = E_{TM} + U_{P} \cdot P - F_{A} \cdot p$
16-05	$X^{L}{}_{(f)} - X^{L}{}_{(i)} \geq 0$
16-06	$X^{L} = E^{L}_{TM} - F_{A} \cdot p$
16-07	$X^{L} = X + U_{P} \cdot P$
16-08	$dX^{L} = P \cdot dU_{P} - p \cdot dF_{A}$
16-09	$E^{L}_{MT} = E_{MT} - U_{A} \cdot A$
16-10	$E^{L}_{MT(f)} - E^{L}_{MT(i)} \leq 0$
16-11	$dE^{L}_{MT} = - A \cdot dU_{A} - F_{P} \cdot dl$
16-12	$L^{L} = E_{MT} - U_{A} \cdot A + F_{P} \cdot l$
16-13	$L^{L}{}_{(f)} - L^{L}{}_{(i)} \leq 0$
16-14	$L^{L} = E^{L}_{MT} + F_{P} \cdot l$
16-15	$L^{L} = L - U_{A} \cdot A$
16-16	$dL^{L} = - A \cdot dU_{A} + l \cdot dF_{P}$
16-17	$F_{A} = + \left(\frac{\partial E_{TM}}{\partial V}\right)_{P} = + \left(\frac{\partial E^{L}_{TM}}{\partial V}\right)_{U_{P}}$
16-18	$V = - \left(\frac{\partial X}{\partial F_{A}}\right)_{P} = - \left(\frac{\partial X^{L}}{\partial F_{A}}\right)_{U_{P}}$
16-19	$U_{P} = - \left(\frac{\partial E_{TM}}{\partial P}\right)_{V} = - \left(\frac{\partial X}{\partial P}\right)_{F_{A}}$
16-20	$P = + \left(\frac{\partial E^{L}_{TM}}{\partial U_{P}}\right)_{V} = + \left(\frac{\partial X^{L}}{\partial U_{P}}\right)_{F_{A}}$

16-21	$F_P = - \left(\frac{\partial E_{MT}}{\partial B}\right)_A = - \left(\frac{\partial E^L_{MT}}{\partial B}\right)_{U_A}$
16-22	$B = + \left(\frac{\partial L}{\partial F_P}\right)_A = + \left(\frac{\partial L^L}{\partial F_P}\right)_{U_A}$
16-23	$U_A = + \left(\frac{\partial E_{MT}}{\partial A}\right)_B = + \left(\frac{\partial L}{\partial A}\right)_{F_P}$
16-24	$A = - \left(\frac{\partial E^L_{MT}}{\partial U_A}\right)_B = - \left(\frac{\partial L^L}{\partial U_A}\right)_{F_P}$
16-25	$- \left(\frac{\partial U_P}{\partial V}\right)_P = + \left(\frac{\partial F_A}{\partial P}\right)_V$
16-26	$+ \left(\frac{\partial P}{\partial V}\right)_{U_P} = + \left(\frac{\partial F_A}{\partial U_P}\right)_V$
16-27	$- \left(\frac{\partial U_P}{\partial F_A}\right)_P = - \left(\frac{\partial V}{\partial P}\right)_{F_A}$
16-28	$+ \left(\frac{\partial P}{\partial F_A}\right)_{U_P} = - \left(\frac{\partial V}{\partial U_P}\right)_{F_A}$
16-29	$+ \left(\frac{\partial U_A}{\partial B}\right)_A = - \left(\frac{\partial F_P}{\partial A}\right)_B$
16-30	$- \left(\frac{\partial A}{\partial B}\right)_{U_A} = - \left(\frac{\partial F_P}{\partial U_A}\right)_B$
16-31	$+ \left(\frac{\partial U_A}{\partial F_P}\right)_A = + \left(\frac{\partial B}{\partial A}\right)_{F_P}$
16-32	$- \left(\frac{\partial A}{\partial F_P}\right)_{U_A} = + \left(\frac{\partial B}{\partial U_A}\right)_{F_P}$
16-33	$E_{TM(f)} - E_{TM(i)} \geq 0$
16-34	$E_{MT(f)} - E_{MT(i)} \leq 0$

	17 - ECO-ELASTIC COEFFICIENTS
17-01	$\alpha_{TM} = - \frac{1}{V} \cdot \left(\frac{\partial V}{\partial U_P}\right)_{F_A}$

17-02	$\beta_{TM} = -\dfrac{1}{F_A}\cdot\left(\dfrac{\partial F_A}{\partial U_P}\right)_V$
17-03	$\chi_{TM} = \dfrac{1}{V}\cdot\left(\dfrac{\partial V}{\partial F_A}\right)_{U_P}$
17-04	$F_A = -\dfrac{\alpha_{TM}}{\beta_{TM}\cdot\chi_{TM}}$
17-05	$\alpha_{TM} = -\dfrac{1}{U_P}$
17-06	$\beta_{TM} = -\dfrac{1}{U_P}$
17-07	$\chi_{TM} = -\dfrac{1}{F_A}$
17-08	$\alpha_{MT} = \dfrac{1}{B}\cdot\left(\dfrac{\partial B}{\partial U_A}\right)_{F_P}$
17-09	$\beta_{MT} = \dfrac{1}{F_P}\cdot\left(\dfrac{\partial F_P}{\partial U_A}\right)_B$
17-10	$\chi_{MT} = -\dfrac{1}{B}\cdot\left(\dfrac{\partial B}{\partial F_P}\right)_{U_A}$
17-11	$F_P = \dfrac{\alpha_{MT}}{\beta_{MT}\cdot\chi_{MT}}$
17-12	$\alpha_{MT} = \dfrac{1}{U_A}$
17-13	$\beta_{MT} = \dfrac{1}{U_A}$
17-14	$\chi_{MT} = \dfrac{1}{F_P}$
17-15	$\dfrac{F_A}{F_P} = -\dfrac{\alpha_{TM}}{\alpha_{MT}}\cdot\dfrac{\beta_{MT}}{\beta_{TM}}\cdot\dfrac{\chi_{MT}}{\chi_{TM}}$
17-16	$\dfrac{F_A}{F_P} = -\dfrac{\chi_{MT}}{\chi_{TM}}$

18 - ECOMETRIC COEFFICIENTS

18-01	$dT = dE_{TM} - F_A \cdot dV$
18-02	$dT = dX + V \cdot dF_A$
18-03	$dT = \Phi_V \cdot dU_P + l_{TM} \cdot dV$
18-04	$dT = \Phi_{F_A} \cdot dU_P + h_{TM} \cdot dF_A$
18-05	$dU_P = \left(\frac{\partial U_P}{\partial F_A}\right)_V \cdot dF_A + \left(\frac{\partial U_P}{\partial V}\right)_{F_A} \cdot dV$
18-06	$\Phi_V \cdot \left(\frac{\partial U_P}{\partial F_A}\right)_V = \lambda_{TM}$
18-07	$dT = \lambda_{TM} \cdot dF_A + \left[\Phi_V \cdot \left(\frac{\partial U_P}{\partial V}\right)_{F_A} + l_{TM}\right] \cdot dV$
18-08	$\Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial V}\right)_{F_A} = \mu_{TM}$
18-09	$dT = \left[\Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial F_A}\right)_V + h_{TM}\right] \cdot dF_A + \mu_{TM} \cdot dV$
18-10	$dT = \lambda_{TM} \cdot dF_A + \mu_{TM} \cdot dV$
18-11	$\tau_1 = \left(\Phi_{F_A} - \Phi_V\right) \cdot \left(\frac{\partial U_P}{\partial V}\right)_{F_A}$
18-12	$\tau_2 = \left(\Phi_V - \Phi_{F_A}\right) \cdot \left(\frac{\partial U_P}{\partial F_A}\right)_V$
18-13	$\tau_3 = \Phi_V \cdot \left(\frac{\partial U_P}{\partial F_A}\right)_V$
18-14	$\tau_4 = \Phi_{F_A} \cdot \left(\frac{\partial U_P}{\partial V}\right)_{F_A}$
18-15	$dM = dE_{MT} + F_P \cdot dB$
18-16	$dM = dL - B \cdot dF_P$

18-17	$dM = \Phi_B \cdot dU_A + l_{MT} \cdot dB$
18-18	$dM = \Phi_{F_P} \cdot dU_A + h_{MT} \cdot dF_P$
18-19	$dU_A = \left(\frac{\partial U_A}{\partial F_P}\right)_B \cdot dF_P + \left(\frac{\partial U_A}{\partial B}\right)_{F_P} \cdot dB$
18-20	$\Phi_B \cdot \left(\frac{\partial U_A}{\partial F_P}\right)_B = \lambda_{MT}$
18-21	$dM = \lambda_{MT} \cdot dF_P + \left[\Phi_B \cdot \left(\frac{\partial U_A}{\partial B}\right)_{F_P} + l_{MT}\right] \cdot dB$
18-22	$\Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial B}\right)_{F_P} = \mu_{MT}$
18-23	$dM = \left[\Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial F_P}\right)_B + h_{MT}\right] \cdot dF_P + \mu_{MT} \cdot dB$
18-24	$dM = \lambda_{MT} \cdot dF_P + \mu_{MT} \cdot dB$
18-25	$\sigma_1 = (\Phi_{F_P} - \Phi_B) \cdot \left(\frac{\partial U_A}{\partial B}\right)_{F_P}$
18-26	$\sigma_2 = (\Phi_B - \Phi_{F_P}) \cdot \left(\frac{\partial U_A}{\partial F_P}\right)_B$
18-27	$\sigma_3 = \Phi_B \cdot \left(\frac{\partial U_A}{\partial F_P}\right)_B$
18-28	$\sigma_4 = \Phi_{F_P} \cdot \left(\frac{\partial U_A}{\partial B}\right)_{F_P}$

19 - LINK HEAT CONSUMED MONEY CREATED	
19-01	$Q_{consumed} = -M_{created} \cdot \frac{1}{\prod \eta_{i_{(\mathbf{QW})}}} \cdot \frac{1}{\prod \eta_{i_{(TM)}}}$
19-02	$Q_{consumed} = -\frac{F_A \cdot p}{\prod \eta_{i_{(QW)}} \cdot \prod \eta_{i_{(TM)}}}$
19-03	$Q_{consumed} = \frac{1}{2} \cdot \frac{c_A \cdot \varpi^2}{\prod \eta_{i(QW)} \cdot \prod \eta_{i(TM)}}$

19-04	$Q_{consumed} = \frac{1}{2\,c_A} \cdot \frac{a^2}{\prod \eta_{i\,(QW)} \cdot \prod \eta_{i\,(TM)}}$
19-05	$dS = -\frac{1}{T_{(temperature)}} \cdot \frac{dM_{created}}{\eta_g} = \frac{1}{T_{(temperature)}} \cdot \frac{dT_{supplied}}{\eta_g}$

	20 - CONSERVATION LAWS
20-01	$a_{t2} = a_{t1}$
20-02	$E_{t2}^{tot} = E_{t1}^{tot}$
20-03	$e_{t2} = e_{t1}$
20-04	$E_{t2}^{tot} = E_{t1}^{tot}$

	22 - MONOPOLIES
22-01	$dE_{TM} = dT = 0$
22-02	$dE_{MT} = dM = 0$

	24 - MISCELLANEOUS OBSERVATIONS
24-01	$t = \frac{p}{C_h}$
24-02	$t = \frac{1}{2} \cdot e \cdot l \cdot \frac{1}{T}$
24-03	$p = (1/2) \cdot \underbrace{(e \cdot C_h)}_{PART\ 1} \cdot \underbrace{(l \cdot T^{-1})}_{PART\ 2}$
24-04	$p_2 \leq p_1 \cdot \frac{r_{P2} \cdot U_{P2}}{r_{P1} \cdot U_{P1}}$
24-05	$p_2 \leq p_1 \cdot \frac{U_{P2}}{U_{P1}}$
24-06	$p_2 \leq p_1$
24-07	$U_{P2} \geq U_{P1}$
24-08	$l_2 \leq l_1 \cdot \frac{r_{A2} \cdot U_{A2}}{r_{A1} \cdot U_{A1}}$

24-09	$l_2 \le l_1 \cdot \frac{U_{A2}}{U_{A1}}$
24-10	$l_2 \le l_1$
24-11	$U_{A2} \ge U_{A1}$
24-12	$p_l = \frac{r_P}{F_{A_{(c)}}} \cdot U_{P1_{(c)}} - \frac{r_P}{F_{A_{(f)}}} \cdot U_{P2_{(f)}}$
24-13	$For\ the\ consumer: \ p_l = \frac{r_P}{F_A} \cdot \left(U_{P1_{(c)}} - U_{A2_{(c)}} \right)$
24-14	$For\ the\ supplier: \ p_l = \frac{r}{F_A} \cdot \left(U_{A1_{(f)}} - U_{P2_{(f)}} \right)$
24-15	$For\ the\ borrower: \ p_l = \frac{r_P}{F_A} \cdot \left(U_{P1} - U_{A2} \right)$
24-16	$For\ the\ lender: \ p_l = \frac{r_P}{F_A} \cdot \left(U_{A1} - U_{P2} \right)$
24-17	$For\ the\ consumer: \ p_l = \frac{r}{F_A} \cdot \left(U_P - U_A \right)$
24-18	$For\ the\ supplier: \ p_l = \frac{r}{F_A} \cdot \left(U_A - U_P \right)$

25 – ON THE PRINCIPLES OF EQUIVALENCE	
25-01	$\frac{M_{created}}{M_{spent}} \ge 1$
25-02	$\frac{T_{created}}{T_{spent}} \le 1$
25-03	$P = \frac{r_P}{ln\ p}$
25-04	$A = \frac{r_A}{ln\ l}$
25-05	$G = A + P$
25-06	$G = \frac{r_A}{ln\ l} + \frac{r_P}{ln\ p}$
25-07	$dM_c = g_{TM} \cdot dT_d + T_d \cdot dg_{TM}$
25-08	$dM_d = \frac{g_{MT} \cdot dT_c - T_c \cdot dg_{MT}}{g_{MT}{}^2}$
25-09	$g_{TM} \cdot dT_d + T_d \cdot dg_{TM} \ge \frac{g_{MT} \cdot dT_c - T_c \cdot dg_{MT}}{g_{MT}{}^2}$

25-10	$g_{TM} \cdot g_{MT} = \frac{dT_c}{dT_d}$
25-11	$\frac{T_c}{T_d} = -\, g_{MT^2} \cdot \frac{dg_{TM}}{dg_{MT}}$
25-12	$\frac{T_c}{T_d} = \frac{dg_{TM}}{d\left(\frac{1}{g_{MT}}\right)}$

	26 – ON THE MICRO MACRO LINK
26-01	$(\partial M)_{n,N} = \frac{n}{N} \cdot \partial u$
26-02	$\partial u = -\, F_A \cdot \frac{N}{n} \cdot \partial p$
26-03	$\Omega = \frac{\varpi}{\omega}$
26-04	$\Omega = -\frac{dp}{dl}$
26-05	$\Omega = tg\ \alpha$
26-06	$\Omega = \frac{F_P}{F_A} \cdot \frac{dM}{dT}$
26-07	$tg\ \alpha = \frac{\vec{\varpi}}{\vec{\omega}} = -\frac{dp}{dl}$
26-08	$\Omega^2 = \omega^2 + \varpi^2$
26-09	$\Omega = \frac{\varpi}{sin\ \alpha} = \frac{\omega}{cos\ \alpha}$
26-10	$d\,\eta = \frac{M \cdot dT - T \cdot dM}{T^2}$
26-11	$\partial\,\eta_T = -\frac{\partial M}{T}$
26-12	$\partial\,\eta_M = M \cdot \frac{\partial T}{T^2} = -\, M \cdot \partial\left(\frac{1}{T}\right)$
26-13	$\Omega^2 = 2\left(\frac{T}{c_P} - \frac{M}{c_A}\right)$
26-14	$\Omega = \pm\sqrt{2\left(\frac{T}{c_P} - \frac{M}{c_A}\right)}$
26-15	$\Omega = \sqrt{2\left(\frac{T_{pos}}{c_P} - \frac{M_{neg}}{c_A}\right)} = \sqrt{2\left(\frac{M_{pos}}{c_A} - \frac{T_{neg}}{c_P}\right)}$
26-16	$\Omega = \sqrt{\frac{e_{pos}^2}{c_P} + \frac{a_{pos}^2}{c_A}} = -\sqrt{\frac{a_{neg}^2}{c_A} + \frac{e_{neg}^2}{c_P}}$

26-17	$\Omega = \sqrt{2\left(\frac{M}{c_A} - \frac{T}{c_P}\right)} = \sqrt{\frac{a^2}{c_A} + \frac{e^2}{c_P}}$
26-18	$\frac{c_A}{c_P} = \frac{2M - a^2}{2T + e^2}$

29 BIBLIOGRAPHIC NOTE

By definition, a bibliography includes a list of various sources (books, videos, sounds, ...) to which the work refers.

However, as this essay deals with notions and concepts that are totally different from those commonly used in Economics, it is obvious that the usual references cannot be used.

For example :

- the fact that the law of supply and demand, systematically present in the classical doctrines, is rejected, banished, excluded, in favor of another experimental law, thus eliminating all the economic corpus referring to it;
- the fact that the definition of money is completely different from the one classically expounded, thus eliminating any reference to conventional sources;
- the fact that the basic principles and laws on which the essay is built are unpublished and therefore, to my knowledge, have never been exhibited, it is obvious that no reference to these concepts can be presented. It is of course the same for all the considerations, deductions and consequences directly resulting from them
- etc.

The only references that can possibly be presented are only :

- courses in general mechanics ;
- courses in classical thermodynamics.

30 INTRODUCTION OF THE AUTHOR

Born in Rouergat in a mining and steel industry area during the second world war, I sacrificed the conventional school obligations in the National Professional Schools (since disappeared), with a very particular educational curriculum.

After some time spent in the French Forces in Germany, I started my civilian activities as a metallurgist by my participation in the elaboration of very large pieces of forge (chemical synthesis tubes, turbines, alternators, nuclear reactor tanks, nuclear reactor vessels, nuclear submarine structures, ...) and especially in the improvement of their characteristics. I then worked in an oil refinery (monitoring, control, reception of material, definition of welding specifications, ...). I continued my peregrinations to manufacture zinc, copper and copper and cadmium until the first intrusion of the Katangese rebels in Shaba, which led me to which led me to return to France before the French Foreign Legion jumped on Kolwezi. Installed then as a as a freelancer, I took the plans of buildings, mainly historical or classified monuments before finishing by taking care of my vegetable garden, orchard and farmyard.

It is useful to specify here, that at 14 years old, I found myself in front of a vice with a set of files, a square and a caliper and a few other tools, being required to make adjustments in a given time. But, not strong if not weak, I was happily exceeding the time limits, and as a result, I was systematically penalized for being late with reduced marks. I thus had the advantage and perhaps even the privilege of understanding very early on that one that nothing can be obtained for nothing; like all things, no good grades, no money, without work (energy); "*ex nihilo nihil, in nihilum posse reverti*".

During decades, ignorant in economy, I did like many: listen, read and see what the "makers of opinion makers" on the mass media, which did not satisfy my mind. Then, a quarter of a century ago, I wanted to understand. For this purpose I acquired a wheelbarrow of economics books, from school courses to books for professionals. After nine months of assiduous reading, I didn't know more than the first day, still having understood anything.

Knowing that "*scientific knowledge progresses by freeing itself from the fascination that exerts on the minds certain facts held for obvious and by there withdrawn from the criticism*" (Jean-Michel BESNIER) and having forged me the motto "*the common sense to banish, the reason to seek*", I applied myself to develop some similarities with physics, that sometimes I detected in a very fleeting way. It was not easy, because "*the difficulty is not to understand the new ideas, but to escape from the old ideas which have pushed their ramifications in all the corners of the mind*" (John Maynard KEYNES). Thus, it took me four years to identify the phenomena and two more to perfect the system analytically.