Investment Decision and Methodology: Keynes and the Neoclassical

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Introduction

The differences among interpretations of economic events by different schools of thought has been a matter of extensive debate for many years. However, it was only after "the breakdown of the keynesian-neoclassical consensus" (Gerrard, 1990) that the analysis of the methodological aspects of these differences started to receive the necessary attention. Most of this debate has taken place outside the mainstream economics whether amongst heterodox economist or some philosophers of science. However, given the pervasiveness of the consequences of this discussion, it is not surprising that, as time has goes by, economists from all schools of thought have became more interested in this matter.

The aim of this paper is to analyse one specific economic event, the investment decision, to show how differences in the methodological approaches can determine differences in the theories and statements about economic events. Two views were chosen, Keynes and neoclassical, and theoretical and methodological comparisons were made. These allowed the author to conclude that there is a direct relationship between the methodology used by each school of thought and its understanding of the investment process.

The paper is structured in five sections. In the first two, the two investment theories are briefly presented. The discussion focuses only on those aspects which are relevant to the purpose of the paper. In section three, a theoretical comparison is made clarifying the most important differences. In section four, it is shown that behind the theoretical differences between the two schools of thought, there is a deeper methodological difference, in such a way that it conditioned the theoretical differences. Finally, in the last section, some conclusions are drawn, showing how the methodological differences dictate the theoretical statements.

1. The investment decision: the Keynes approach

Keynes' concept of investment decision is set out in Chapters 11 and 12 of his most famous work, *The General Theory of Employment, Interest and Money* (hereafter *GT*). In the former chapter, he analysed the concept of Marginal Efficiency of Capital (hereafter MEC) and in the latter he explained long term expectations. The Keynes approach insists that the two chapters must be analysed together to maintain the correct understanding of Keynes' theory.

In Chapter 11, as a first step in the construction of a theory of investment, the amount of investment at any period of time is related to the marginal efficiency of capital, d, and the interest rate, r. That is:

$$I = f(d, r) \quad .....(1).$$

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To understand the form of this relation, firstly we need to analyse the Keynes concept of MEC. He defines the MEC as the rate of discount that makes the prospective returns obtained from the selling of the outputs from investment (prospective yield) equal to the supply-price (SP) of a capital-good. This supply-price means, in Keynes' words,

> not the market price at which an asset of the type in question can actually be purchased in the market, but the price which would just induce a manufacturer newly to produce an additional unit of such assets, i.e. what is sometimes called its *replacement cost* (Keynes, 1973, p. 135).

The calculation of the MEC of one capital asset deserves a detailed analysis.

The present value of the stream of expected profits (V_0) is given by the formula:[2]

$$V_0 = \Sigma^{n}_{t=j}\ \pi_t\,(1+r)^{-t} \qquad \ldots\ldots\ldots\ldots\ldots\ (2)$$

where : π_t is the expected profit at time t.

If we substitute in equation (2) the interest rate, r, for a rate of discount, d, "which will equate P_k [supply price] with the present value of the profit stream" (Chick, 1983, p. 120), we find the following;

$$SP = \Sigma^{n}_{t=j}\ \pi_t\,(1+d)^{-t} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (3)$$

In other words, the marginal efficiency of capital, d, is equal to the solution of (3) for d.

The value of the MEC is then compared with a current interest rate.

> If it [the MEC] is greater than the interest rate, the return from investing in the machine is greater than the return from lending out an equivalent sum at the current rate of interest, so the producer decides in favour of the machine (Chick, 1983, pp. 120-1).

The concept of marginal efficiency of capital has a central role in Keynes's theory of investment. It is the connection between the profits that accrue in the future and the cost that has to be handled in the present. In this context the investment decision has the key function of linking the present to the future.[3]

This special feature makes the use of the MEC (as it relates to prospective yields) quite distinct from the use of the marginal physical productivity of capital (PMPC) in determining the amount of investment. As Keynes points out,

> The mistake of regarding the marginal efficiency of capital primarily in terms of the *current* yield of capital equipment, which would be correct only in the static state where there is no changing future to influence the present, has had the result of breaking the theoretical link between today and tomorrow (1973, p. 145)[4].

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[2] The notation used here follows Chick, 1983.

[3] For Keynes, time and static are always two concepts whose conciliation is very difficult. In a paper read in a meeting of Parrhesiasts in 1903, he said, "It is, I believe, impossible to arrive at any conception of time which shall be independent of the conception of change." (MSS, MLC, 1903, paper on 'Time', unnumbered page; quoted from Carabelli, 1988, p. 127).

[4] We will discuss this point in detail in Section 3 below.

The discussion of the long-term expectations set out in Chapter 12 completes the understanding of the investment decision, and the introduction of the concept of *animal spirits* into the framework of this kind of decision renders the Keynes approach more complete and realistic. In Chick's words (1983, p.121), "it was Keynes's view that *animal spirits* substantially dominated the investment decision," and the influence of the MEC on investment "is merely that *part* of the decision which is amenable to economic analysis."

Chapter 12 is certainly one of the most important chapters of the whole *GT*. A thorough reading of it reveals to the reader the most important concepts in Keynes's work. In that chapter, Keynes discusses how long-term expectations are formed. As we have seen in the discussion of the MEC, when an investor has to decide how much to invest in a new capital good, he makes assumptions about its prospective yields. However, what is peculiar in Keynes's analysis is the basis on which these expectations are grounded.

To understand this point we have to bear in mind that Keynes treats 'time' as historical. This means that time is irreversible and decisions are irrevocable. Moreover, the past is unrepeatable and the future is unknown. Today's decisions cannot be made using the past as a ***perfect image***[5] of the future and the complete consequences of today's decisions can only be known in the future. So, this conception of time is strongly connected with uncertainty. Thus, when forming their long-term expectations, investors cannot deduce from existing data what the future course of events will be. This means that the social process is not an ergodic process (cf. Davidson, 1982-83), that is, the average calculated from past observation is different from the average of future outcomes (cf. Davidson, 1991). Thus, there is no replicability and the economic process is time-dependent.

However, the existence of uncertainty, and thereby, the impossibility of making use of frequency distributions does not imply some kind of nihilism.[6] What is wrong with this interpretation is that it implies that expectations are only formed based on some kind of demonstrative logic amenable to formal representation (cf. Dow, 1996). In Keynes's approach, long-term expectations are formed based on convention, qualitative judgement and intuition. These non-formalised elements provide the basis for action.

Moreover, according to Keynes, the *animal spirits* - a characteristic of human nature - make nihilism an impossibility. In an environment of true uncertainty, what makes the difference in the decision process is this characteristic of human behaviour. As Keynes points out,

> Most, probably, of our decisions to do something positive, the full consequences of which will be drawn out over many days to come, can only be taken as a result of animal spirits - of a spontaneous urge to action rather then inaction, and not as the outcome of weighted average of quantitative benefits multiplied by quantitative probabilities" (*CW, VII*, p. 161).

The fact that agents base their behaviours on habits and conventions means that they have to have some hypotheses to guide their decisions. What are these hypotheses ?

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[5] The past could be used as a basis for action but this does not mean that the future is a mirror of the past.

[6] This is a very common criticism of Keynes's approach. As Dow & Dow point out:

> Coddington (1982) pushes the argument further. If long-term expectations formation by the entrepreneurs *cannot* be explained by rational behaviour which can be modelled, he argues then this must be true for all the expectations of agents in all sectors. But then if all decision making is subject to the exogenous influence of expectations shifts, economists must retreat into nihilism (1985, p.146).

i) Human agents have a passive behaviour concerning the future. "Single investors did not think they could influence or determine the future" (Carabelli, 1988, p. 224). In addition, it is considered that recent facts are " a more serviceable guide to the future than a candid examination of past experience would show it to have been hitherto" (Keynes, *CW* XIV, p.114);

ii) Conventional judgement. "We endeavour to fall back on the judgement of the rest of the world which is perhaps better informed" (Keynes, CW *XIV*, p. 114);

iii) Economic agents assume that the "*existing* state of opinion as expressed in prices and the character of existing output is based on a *correct* summing up of the future prospects" (Keynes, *CW* XIV, p. 114). So, economic agents behave *as if* they are perfect Benthamite calculators.

The third hypothesis deserves some consideration. In Chapter 11, Keynes stresses the importance of a sort of calculus in the investment decision, even if it is based on expected variables (marginal efficiency of capital and interest rate). However, in the next chapter he makes it very clear that it is naive to be confident in this calculus, as the grounds for belief in it are very weak (see Dow, 1989). As Keynes says,

> It would be foolish, in forming our expectations, to attach great weight to matters which are very uncertain. It is reasonable, therefore, to be guided to a considerable degree by the facts about which we feel somewhat confident, even though they may be less decisively relevant to the issue than the other facts about which our knowledge is vague and scanty (1973, p. 148).

If it is "foolish", then the investor must base his/her decision on other criteria, which for Keynes means "convention". Thus, Chapter 11 has to be understood as "describing the technique by which investors apply *as if* habit" (Carabelli, 1988, p. 225), whereas in Chapter 12 Keynes makes clear that the long-term expectations and the confidence in them are the most important factors in the investment decision.

2. The Neoclassical Theory of Investment

In economic literature the expression "neoclassical theory of investment" has more than one definition. In this article, the term "neoclassical" means the method of analysis which is based on,

a) what Simon (1976) has defined as substantive rationality: "Behavior is substantively rational when it is appropriate to the achievement of goals within the limits imposed by given conditions and constraints" (p. 130). Moreover, these goals are commonly "some form of utility or profit maximisation" (Lavoie, 1992,, p. 51); and

b) equilibrium, which should be understood as "a logical structure built on *a priori* assumptions about behaviour, with ancillary mathematical assumptions employed which render the system potentially capable of yielding the solution of a unique, stable equilibrium position" (Dow, 1996, p. 116).

It is obvious that this methodological definition of the "neoclassical theory of investment" (hereafter NTI) covers a very large range of theories. However, the differences among these theories are irrelevant in respect to the comparison with the Keynes approach.

The firm's maximisation problem, in the NTI approach, is to choose the paths of employment and investment that maximise its net real cash flow, subject to the evolution of the capital stock. Letting V_t be the value of the firm at time t, the firm's problem is

$$V_t = \max \int_t^{\infty} X_t R(t,s) ds \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

subject to $\Delta K_t = I_t - \delta K_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$

where: $X_t = Y(K_t, L_t) - w_t L_t - p_t I_t$ is the net real cash flow;

$R(t,s) = exp[- \int_t^s r_v]$ is the discount factor that discounts real cash flows at date s back to date t;

r_t is the instantaneous real rate of interest at time t;

δ is the depreciation rate.

Considering a standard neoclassical production function, the solution of the problem above (using the standard optimal control theory) can be expressed in the following equations:

$$Y_L(K_t, L_t) = w_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

$$Y_k(K_t, L_t) = (r + \delta) q_t = c_u \ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

$$p_t = q_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

where, q is the Lagrange multiplier or the costate variable of the Hamiltonian.

Equation (3) shows that the firm hires labour until the point at which the marginal revenue product of labour is equal to the wage rate (w), the marginal cost of labour. Similarly, the marginal revenue of a unit of capital is set equal to its marginal cost, $(r + \delta)q_t$ where q_t is the shadow price of an additional unit of capital (4), which is the famous Jorgenson definition of user cost (c_u) without taxes. Finally, equation (5) shows that a firm chooses a rate of investment such that its marginal cost p_t is equal to the value of an additional unit of installed capital, q (or equal to the shadow price).

Assuming constant returns of scale in K_t and L_t and a constant elasticity of substitution between K_t and L_t (Cobb-Douglas function), Jorgenson (1963) concludes that in the steady-state the desired amount of capital stock, K^*, is proportional to revenue Y, and inversely proportional to the user cost, c_u :

$$K^* = \gamma Y / c_u \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

Jorgenson concludes his model by defining the investment equation, which relates the account of investment to changes in the desired capital between two periods of time, as shown below:

$$I_t = \{\Sigma_{i=o}^{n} \theta_i [K^*_{t-i} - K^*_{t-1-i}]\} + \delta K_t \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

where θ is the power series of the lag operator.

As pointed out by Abel (1990), "Jorgenson assumed that there is some exogenous mechanism that determines the rate at which the gap between the desired capital stock and the actual capital stock is closed". In addition, as Jorgenson assumes elasticity of substitution between capital and labour is equal to one, the desired capital stock, and thereby the investment, depends only on the ratio of revenue to the user cost of capital[7].

Moreover, if we suppose that there is no substitutability between labour and capital, it is possible to transform equation (7) into the famous accelerator model (Abel, 1990, p. 761),

[7] Jorgenson defines user cost as "implicit rental of one unit of capital service per period of time" (1963. p. 249).

$$I_t = \{ \Sigma_{i=o}^{n} \theta_i [Y_{t-i} - Y_{t-1-i}] \} + \delta K_t \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

The introduction of adjustment costs into the model does not imply significant modifications to the results. The idea of adjustment cost was introduced by Eisner and Strotz (1963), and could be interpreted as the cost of installation of new equipment. It is a non-negative function and is convex in the rate of investment I_t.[8]

Let z_t (I_t, K_t) be the adjustment cost function. It is related to the cost of an increase in capital stock and the speed of this increment. It is more costly to achieve this increase rapidly rather than slowly.

The introduction of the adjustment cost function into the model changes the equation of the real cash flow as follows:

$$X_t = Y(K_t, L_t) - w_t L_t - p_t I_t - z_t (I_t, K_t) \ldots\ldots\ldots\ldots\ldots (9)$$

In the solution of the maximisation problem of the firm, the only change is in the marginal cost of the investment, that now becomes $p_t + z_t(I_t, K_t)$. Thus, in choosing its rate of investment, a firm has to equate this marginal cost to the value of an additional unit of installed capital, q.

$$p_t + z_t(I_t, K_t) = q \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Equation (10) shows that the investment rate is positively related to the value of q.[9] The value of an additional unit of installed capital (q) is also known as the *marginal q*.

Another modification to the model occurs in the definition of the user cost *(c)*, which becomes,

$$c_u = (r_t + \delta)q_t + q = Y_k(K_t, L_t) - z_k(I_t, K_t) \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

where: q_t is the shadow price, and
q is the capital gain.

As we can see, equation (11) is similar to Jorgenson's conditions. It states that the marginal product of capital is equal to the user cost plus the adjustment cost. The only distinction between this equation and the original Jorgenson conditions is that, as in Jorgenson, the adjustment cost does not exist, so the marginal adjustment cost related to an increase in the capital stock is equal to zero.

In the same way as adjustment cost, the introduction of 'uncertainty' into the model does not represent significant modification. The explanation for this is related to the concept of 'uncertainty' used by the NTI approach. According to Hirshleifer & Riley (1992, p. 7) there are five elements that characterise the decision an investor makes under 'uncertainty':

(i) a *set of acts* available for the agents;
(ii) a *set of states* available to Nature;
(iii) a *consequence function* showing outcomes under all combinations of acts and states;

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[8] There are distinct formulations for the minimum value of the adjustment function. In its original formulation, the adjustment cost has a value of zero at zero investment (Eisner & Strotz, 1963). Many authors have been following this conception (Hayashi 1982; Blanchard & Fischer 1989, among others). Recently, Abel & Eberly have developed a model of an augmented adjustment cost which includes the possibility of fixed costs, and thereby is greater than zero even at zero investment (Abel & Eberly, 1994).

[9] Blanchard and Fischer show, after some algebraic transformations, that positive rates of investment require $q > 1$, and at $q = 1$ the rate of investment is equal to zero (Blanchard & Fischer, 1989, p. 62).

(iv) a *probability function* expressing his beliefs (as to the likelihood of Nature choosing each and every state);

(v) an *elementary utility function* (or *preference-scaling function*) measuring the desirability of the different possible consequences to him.

It is important to note that to use the NTI approach to make a decision under conditions of 'uncertainty', it is not necessary for the *probability function* described in (iv) to be an objective probability distribution. For the results that the NTI approach intends to find, it is sufficient to use subjective probability distributions, which basically are indices of the subjective belief in outcomes.

Using the expected-utility rule, individuals can rank their preferences from the utility derived from their actions. "Given certain 'postulates of rational choice', there is a way of assigning a cardinal preference-scaling function over consequences such that the Expected-utility Rule determines the individual's preference ranking U(x) over actions" (Hirsheifer & Riley, 1992, p. 14), where U(x) is the utility function. This utility function is calculated as the mathematical expectation (the probability-weighted average) of the consequences.

As individuals know all possible results with their probability distribution, and are able to rank these results in a preferential scaling, it is possible to define three patterns of individual behaviour related to these results. First, when persons prefer a certain consequence to any risk prospect whose mathematical expectation equals that certainty, it is said that these persons display *risk aversion*. Second, if these persons behave in the opposite way they are *risk-preferrers*. Finally, if they are indifferent to these two alternatives (certainty and risk) it is said that they are *risk-neutral*.

It is worth considering two observations about this concept of 'uncertainty'. First, in the NTI approach of 'uncertainty', the individuals are not allowed any kind of vagueness or confusion. They always know what is the best possible action to do, even if they recognise that they have imperfect information. As pointed out by Hirshleifer & Riley (1992, p.8),

> our excuse for not picturing vagueness or confusion is that we are trying to model economics, not psychology. Even the very simplest models in economic textbooks, for example indifference-curve diagrams, implicitly postulate a degree of precise self-knowledge that is descriptively unrealistic. The ultimate justification, for indifference-curve diagrams or for theories of decision under uncertainty, is the ability of such models to help us understand and predict behaviour.

This rejection of any kind of vagueness or confusion is a direct consequence of the assumptions. As the probability distribution is always supposed known, there is no source for any kind of haze.

Second, the NTI approach claims to recognise that there is a distinction between risk and 'uncertainty' as postulated by Keynes and Knight.[10] However, they consider this distinction a sterile one, as they can find their results using a subjective probability distribution (Hirshleifer & Riley, 1992, p. 9). We will return to this point later.

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[10] According to Lavoie (1992, p. 44),

> There is *risk*, or certainty equivalence, when each choice leads to a set of possible specific outcomes, the value of which is known, each outcome being associated with a specific probability. There is *uncertainty* when the probability of an outcome is unknown, when the value of an outcome is unknown, when the outcomes that can possibly result from a choice are unknown, or when the spectrum of possible choices is unknown.

The introduction of 'uncertainty' in the NTI model (in the way explained above) does not alter the results. As shown by Blanchard & Fischer (1989), Abel (1990), Dixit & Pindyck (1993), Abel & Eberly (1994), among others, the main conclusions of the model with certainty remain the same when 'uncertainty' is introduced. In this case, if the expected present value of marginal revenue products of capital increases, the optimal rate of investment increases accordingly. Some slight modifications are shown by Dixit & Pindyck (1993). Using the concept of user cost of capital, they show that in the presence of 'uncertainty' and irreversibility of investment, the critical profit level for investment now becomes greater than the user cost. In the same way, using Tobin's q theory (Tobin, 1969), the critical value of q now becomes greater than one.

Moreover, as pointed out by Abel, "much of the existing analytic work of investment under uncertainty does not support the notion that greater uncertainty inhibits investment" (1990, p. 771).

3. Theoretical Comparison

A quick analysis of the theories discussed above shows that there is a major difference between the Keynes and the neoclassical theory of investment, that is, in the understanding of the marginal efficiency of capital and its relation with the interest rate.

Since the publication of *GT*, one of the most important and widespread interpretations of the MEC concept has been that it is equal to the concept of Physical Marginal Productivity of Capital (PMPC). This view was incorporated into the NTI approach as we saw in Section II. However, this interpretation has been systematically denied by Post-Keynesian authors, and even Keynes made explicit his disagreement with this opinion (e.g. Keynes, 1973, pp. 137 - 41).

The MEC relates the expected sales of the goods produced by a new capital good with the cost of investment (supply price). The PMPC, on the other hand, is a physical relation between the total output and the variation in the quantity of one factor of production. In Eichner's words, "the essential point ... is that while Keynes's concept of the marginal efficiency of capital does not require that the ratio of capital to other types of inputs vary, the marginal productivity concept does" (Eichner, 1991, p. 430).

What made these different concepts appear similar in mainstream economics, is that there is an assumption that all future output will *necessarily* be sold. Using this assumption, the mainstream transmutes a physical relationship (PMPC) into a monetary relationship (MEC). This transformation is only possible because mainstream economics incorporates the Say Law in its framework, which is rejected by Keynes.

Keynes, on many occasions, makes clear that he completely disagrees with the use of marginal productivity of capital as the determinant of the earnings of capital. This is particularly so when he discusses the effect on the marginal efficiency of capital of an expectation of changes in the prospective cost of production related to an expected innovation. As he says:

> The output from the equipment produced today will have to compete, in the course of its life, with the output from equipment produced subsequently, [...] perhaps by an improved technique, which is content with a lower price for its output and will be increased in quantity until the price of its output has fallen to the lower figure with which it is content. Moreover, the entrepreneur's profit (in

> terms of money) from equipment, old or new, will be reduced, if all output comes to be produced cheaply. In so far as such as developments are foreseen as probable, or even as possible, the marginal efficiency of capital produced today is appropriately diminished (Keynes, 1973, p. 141).

As one can see from the quotation above, Keynes's stress on the expectations of the investors, and consequently on their beliefs, makes clear that for him the investment decision is a speculative process. In another quotation, he says:

> The reader should note that the marginal efficiency of capital is here defined in terms of the *expectations* of yield and of the *current* supply price of the capital asset. It depends on the rate of return expected to be obtainable on money if it were invested in a *newly* produced asset; not on the historical result of what an investment has yielded on its original cost if we look back on its record after its life is over (1973, p. 136).

Thus, as a speculative process, it is evident that the MEC cannot be based on physical products or on features of physical products as productivity.

Despite Keynes's arguments, mainstream economics continues to use both the MEC and the PMPC as synonymous. This interpretation has implications for the understanding of the role of the interest rate.

For NTI - which, in its origin, claims that its interpretation of this point is to be found in Keynes (Hicks, 1937) - there is an inverse relation between the amount of investment and the interest rate. For NTI theorists, the investment will be carried until the marginal productivity of capital - which is decreasing - becomes equal to the interest rate. As the latter decreases, the investment is increased until the decreasing marginal productivity of capital equates to the new interest rate.

Indeed, Keynes, as we have seen above, relates his MEC with the current interest rate, but in a different way. Keynes points out that, at any period of time, the prospective returns of many different kinds of investment can be calculated and thus also their marginal efficiency of capital. If these investments are arrayed in the descending order of their MEC, it should be possible to derive an investment demand schedule. This MEC schedule will be compared with the rate of interest, and obviously, no investment will be made whose MEC is lower than the interest rate.

This contrast with the interest rate has made possible interpretations that generalise this comparison into a direct relationship. That is,

$$I = f(r) \ldots\ldots\ldots (4).$$

This interpretation is a complete misunderstanding of Keynes's view of the investment decision. It is based on a confusion about relevant variables in the investment process. In Keynes's words,

> The equality between the stock of capital goods offered and stock demanded will be brought about by the *prices* of capital goods, not by the rate of interest. It is equality between the demand and supply of loans of money, i.e. of debts, which is brought about by the rate of interest (1973, p. 186).

Moreover, as discussed above, the NTI approach misinterprets one of the most important aspect of the Keynes investment theory, namely, the concept of marginal efficiency of capital. To calculate the marginal efficiency of capital, one has to relate the ***expected value of future*** returns with the ***present*** supply price of equipment. In Keynes' words,

> The schedule of the marginal efficiency of capital is of fundamental importance because it is mainly through this factor (much more than the through the rate of interest) that the expectation of the future influences the present (1973, p.145).

Underlying the concept of marginal efficiency of capital, there are two other concepts closely related to each other, namely uncertainty and time. These are the two key concepts in explaining the differences among schools of thought (see Dow, 1996, chapters 6 and 7).

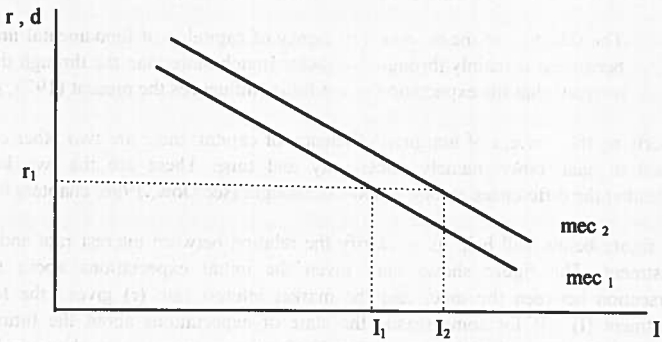
The figure below will help us to clarify the relation between interest rate and the amount of investment. The figure shows that, given the initial expectations about the future, the intersection between the $\mathbf{mec_1}$ and the market interest rate (r) gives the total amount of investment (I). If for some reason the state of expectations about the future changes, the marginal efficiency schedule curve will shift (from $\mathbf{mec_1}$ to $\mathbf{mec_2}$), as shown in Figure 2. Thus, with the same interest rate we have two different amounts of investment, each one related to ***different states of expectation.*** What is important here, is to note that the state of expectation alters the position of the MEC curve. The direct relation supposed by the NTI approach is possible only under the assumption of perfect knowledge of the future. Under complete certainty there will be only one possible position for the MEC curve, and only one possible rational outcome.

A variation in the interest rate may affect the investment level through indirect chains. If this variation alters the state of expectations, the MEC curve will move and the new amount of investment will be defined by the intersection of this new MEC schedule and the new given interest rate. However, this new amount of investment will be different from the old amount depending on the conditions on which industry operates. Since the concept of supply price reflects capacity, there is a presumption of idle capacity, otherwise the MEC would be truncated at the point of full capacity, so the increase in demand resulting from a decrease in the interest rate will have the consequence of an expansion of the amount of investment.[11] But, if one supposes that the capital goods industries work with full capacity or the increase in demand is higher than the idle planned capacity, then there will be no alteration in the amount of investment. Keynes illustrates this argument as follows:

> Suppose, for example, that the extensive increase in the demand for capital in general is due to a *fall* in the rate of interest. I would suggest that the sentence be rewritten: In so far, therefore, as the extensive increase in the demand for capital goods cannot be immediately met by an increase in the total stock, it will have to be held in check for the time being by a rise in the supply price of capital goods sufficient to keep the marginal efficiency of capital in equilibrium with the rate of interest without there being any material change in the scale of investment (1973, p. 187, n. 2).

[11] Supposing that the increase in demand is less than the idle planned capacity.

Figure 1



where :

r is the interest rate

d is marginal efficiency of capital

mec_1 is the schedule of the marginal efficiency of capital given the ***initial*** state of expectations about the future;

mec_2 is the schedule of the marginal efficiency of capital given the ***new*** state of expectation about the future.

What is important here is the fact that, in any case, the reflection on the MEC provided by changes in the expected demand flow is the primary cause of possible changes in the volume of investment, not in the interest rate.

4. Methodological Comparison

A fully understanding of the differences shown above can only be achieved if one goes deeper into the methodological comparison between both interpretations. Behind the disagreement about the MEC, uncertainty, the concept of time and the role of interest rate, there is an underlying difference between the methodological approaches used, which, in the same way, determines a divergent comprehension of the investment decision. In this section, we intend to show how different methodological approaches can dictate the final conclusions of each theory.

Economic analysis can be understood in terms of hierarchy. Starting from the end, we have the following channel: statements, theory, methodology and mode of thought. The statements are made in relation to the real world. Sometimes some prescription of policy could be included in the same level as statement. These statements are made according to some theoretical view

about economic events. Theory itself is based on some methodological approach, which has some correspondence with modes of thought (cf. Dow, 1994).

It is important to make some comments about the elements of the hierarchy briefly described above. The theory that serves as the basis for the statements and/or policy prescription is always made explicit. However, in many situations, the methodology applied is not. The fourth level of hierarchy - mode of thought - is, on almost every occasion, left implicit. However, as it serves as a basis for the choice of methodology and, as methodology serves as a basis for theory and statements, the discussion of mode of thought is crucial.

Here, we adopt Dow's[12] definition of mode of thought: "Mode of thought refers to the level at which a particular world-view and technique of analysis are appraised. ... [It] enables an economist to order observations and ideas in such a way as to form a basis for theorising" (Dow, 1994, p.146).

Historically the most important method of scientific investigation was the Cartesian/Euclidean approach. It consists in a procedure where some basic axioms are established and, through some deductive logic, theorems are derived. These basic axioms have to be true or at least self-evident, and the theorems are not necessarily self-evident. As one can see, mathematics has the best features in which to use this mode of thought, since mathematics is a definitional system which is defined independently of the observation of reality, in such a way that it is possible to establish incontestable axioms. However, it has been applied in many other disciplines, and as pointed out by Dow (1985, p.12) all western scientific thought has been influenced by the ideal of closed systems of axiomatic logic, which is the logical sequel of the utilisation of the Cartesian/Euclidean mode of thought.

The Cartesian/Euclidean approach has two important features that are derived from the aim of building a closed system. The first one is called reductionism (or atomism). The necessity for the axioms to be as close as possible to the truth or at least the best approximation of what is self-evident means that the propositions must be broken into their smallest part ('atom').

Second, there is a tendency in this approach to classify "concepts, statements and events according to duals, as belonging to only one of two all encompassing categories: true or false, logical or illogical, positive or normative, fact or opinion and so on" (Dow, 1985, p. 14). As one can see, dualism excludes any kind of middle ground: "given a category x, any entity must fall either into the category x, or into the category not-x" (Dow, 1990, p.143). It is a method which claims the advantage of imposing order on ideas, or on perceptions of reality, and allows the possibility of drawing distinctions.

The application of the Cartesian/Euclidean mode of thought in social science implies that reality must be dual, either in practice or in principle. In other words,

> [V]ariables must be measured in practice, and correspondence between dualistic theory and reality must be presumed. The problem is limited by testing only reduced form relationships, so that many of the measurement, and correspondence with reality of interior relationships, can be retained 'in principle' (Dow, 1990, p. 146).

The acceptance of this mode of thought imposes a methodological approach that preserves its main features. In economics this methodology could be defined as deductivism/positivism and

[12] Dow (1985, 1996).

is used by the mainstream economics[13] (Dow, 1985, 1990, 1994, 1996; Lawson, 1994a, 1994b, 1995; Gerrard, 1990, 1995). For the mainstream, the central aim of science is to seek out constant conjunctions, so as to make possible some kind of 'rational prediction';

> it [positivism] is a claim that human knowledge takes the form of sense-experience or impression. [...] if particular knowledge is of events sensed in experience then any possibility of *general* (including scientific) knowledge must be of the constant patterns, if any, that such events reveal in space and over time (Lawson, 1994b, p. 111).

The objective of this approach is to find universal laws, in such a way that whenever event *x* occurs then event *y* follows. For statements of this kind to be valid, or in other words, to have a wide applicability, it is necessary for them to be applied in a sealed system. Thus, for mainstream economics, reality is seen as a closed system, with atomistic events. Moreover, this conception of reality allows the use of experience (empirical test) to prove the validity of some theorem.[14]

It should also be noted that any methodology must presuppose a social theory - related to human agency and institutions - which explains the way knowledge is produced. "Positivism, ... , supports a conception of human agents as passive sensors of atomistic events and recorders of their constant conjunctions" (Lawson, 1994, p. 112).

Mainstream economists have made use of this mode of thought and this methodology, although even they do not make explicit these options. We can find the most important features of the Cartesian/Euclidean mode of thought (atomism and dualism) and the positivist methodology (science based on event regularity and social theory based upon the atomistic individual) in the discussion about the neoclassical approach to the investment decision.

The atomism is shown by the utilisation of the individual and of the firm as the smallest units of enquiry. The maximising behaviour of the firm and the individual is taken as a true or self-evident characteristic of the system and so, it is used as an axiom. As this axiom is always observed there is only one procedure for the economic agent when he/she has to decide how much to invest. The economic agent is completely passive. He/she only responds to changes in the value of an external variable, the interest rate. Dualism is also observed. Given the relevant variables, there are only two dual patterns of behaviour: 'rational', which means maximisation, and 'irrational', which means any other behaviour. Finally, the relationship between interest rate and investment is defined such that always, when the interest rate increases (decreases) the amount of investment decreases (increases), and thus, it is a universal law.

The use of this methodology explains why, for the mainstream, the treatment of *animal spirits* as exogenous constitutes a problem. As Dow & Dow (1985, p. 54) point out,

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[13] It is necessary to say that this methodological choice is not evident. On many occasions, mainstream authors have argued that methodological questions do not matter, and in some cases are inadmissible. Hahn (1992) makes explicit his opinion about this question and says that discussing methodology "makes little difference for economic practice, and any effect it does have is unhelpful" (Dow, 1994, p.14). Backhouse (1992) and Lawson (1992) point out that this opinion is in itself a methodological approach. Lawson (1994) explains that this position is connected to the positivist approach. For positivism, empirical success is sufficient to establish connection to the truth of facts. So, every time that empirical success is alleged to be achieved, discussion about methodology becomes irrelevant.

[14] This aspect does not carry consensus in the mainstream economics. There is a group, including Hahn in particular, which argues that if the theorems are deduced and proved using a logical deductive process, it is not necessary to go to experience to prove the validity of the theorem. For more details see Dow (1994) and in the special number of the Economic Journal, vol. 101, 1991.

> If the long-term expectations are generated by the conventional optimising procedure, using 'rational criteria', then it is simply a question of finding the appropriate technique with which to model them. The only other possibility considered is that the process as irrational. But irrational in this context can only mean not susceptible to modelling; rationality in general requires the application of reason, which may nevertheless elude modelling.

Despite the fact that one could find regularities in special circumstances in physical sciences[15], the use of this mode of thought and this methodology in social science is seldom helpful and could generate (and frequently generates) statements about the real world which are unrealistic. The basic reason for this inapplicability in social science is that human beings make intentional choices. If this is true, we must agree that a human beings, when asked to make a choice, could choose a different action from another that they had chosen in the past. Moreover, sometimes when asked to make a choice, human being have to deal with future expectations and current facts which add a component of uncertainty in this process. So, the world must be considered an open system so as to deal with these different choices, which produce different results (Lawson**Erro! Indicador não definido.**, 1994, 1995).

To deal with the elements raised above it is necessary to use alternative mode of thought and methodology. These could be the Babylonian mode of thought (Dow, 1985, 1990, 1996), and the critical realism methodology (Lawson, 1988, 1994, 1995). The Babylonian approach could be defined as holistic. It starts from the recognition of the impossibility in general of establishing watertight axioms, since reality is taken as complex, that is, it is regarded "as being beyond complete understanding, and thus endemically uncertain" (Dow, 1990, p. 146). So, this perspective of reality implies that any approach about any issue could be made using a variety of starting points, many of them reinforcing each other. The complete picture is built using partial analyses. It is worth noting that these partial analyses could be derived from some axioms, but what is important is that these axioms could not be true or self-evident as in the Cartesian/Euclidean approach, but a conclusion of another partial analysis. So, the Babylonian approach assumes open systems and derives methodology from that assumption. It is the different logic that allows one to deal with open theoretical systems (cf. Dow, 1994, p. 26).

In this sense the Babylonian approach could appear inconsistent, since every part of analysis cannot be gathered into a unique formal and cohesive system. But, as pointed out by Dow (1994, p. 148), this conception of inconsistency cannot be applied to a Babylonian system, since it involves the acceptance of the dualist approach. A system could be logically consistent even when it departs from a different starting point. Again the distinction between the two approaches becomes clear. The universality that the Cartesian/Euclidean mode of thought claims is one that could be summarised in the expression: 'if A then always B'. In other words, it is a positive approach in which whenever the axiom A is verified then the conclusion B could be derived. What is universal is the structure of the mode of reasoning. On the other hand, what is universal in the Babylonian approach is its ability in face of different problems (Cf. Dow, 1985, p. 17).

Another important feature of the Babylonian system is related to uncertainty. This relation gives to it an epistemological explanation. Presuming that full knowledge of reality is

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[15] It is important to make clear that these circumstances are very special and do not correspond to the wide view of physical sciences. Chick (1995) makes this very clear. Discussing Prigogine and Stengers's (1984) view of physical science she says:

> They argue that there are two apparently contradictory tendencies operating in the physical world: ordered systems are continually breaking down, producing chaos where before there was order, and, under special but not particularly rare conditions, chaos is being transformed into order (pp. 26-7).

impossible to attain, the use of partial systems analysis allows one to deal with the incompleteness of knowledge. In the Babylonian thought, information is not treated as known or not known, a dual approach. An intermediate category could exist. Information could be treated as known, subject to uncertainty of various degrees which are in general non-quantifiable.

Keynes's view of uncertainty makes clear that he can be labelled Babylonian. For the Keynes approach, as the future is not a mirror of the past, there is an inherent uncertainty related to actions, of which the sequels still exist for a long time. In this situation, some actions must be made with incomplete knowledge[16] about their premises and their sequels. In other words, direct knowledge is partial and "then the decision maker has to fill the voids, has to 'create' the additional premises which may be needed in order to apply logical methods to them" (Carvalho, 1988, p. 74).

In addition, the relevance of the set of direct knowledge is connected to the duration of the process in question. Thus, the longer the process, the greater the relevance of indirect knowledge derived by induction. This is very clear in the following quotation from Keynes:

> The considerations upon which expectations of prospective yields are based are partly existing facts which we can assume to be known more or less for certain, and partly future events which can only be forecast with more or less confidence (1973, p.147).

However it is important to make clear that for Keynes, it is impossible, due to uncertainty, to make use of any kind of frequency distribution that would transform uncertainty into risk[17]. In Keynes's words,

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[16] It is important to note that this incomplete knowledge is very different from that supposed by the New Keynesians. It is not a problem of market failure or information cost. Keynes's concept of knowledge is connected to his view of probabilities. He makes an explicit distinction between direct and indirect knowledge and their role in the probability relation. Direct knowledge is that which is a result of reflections about the objects of acquaintance (sensations, ideas, meaning, facts, relations, etc.). Indirect knowledge, on the other hand, is obtained by argument, that is, through the perception of the probability relation between two propositions, one of them being that of which we seek knowledge. So, it is an intuitive knowledge that we have in a probability relation. In Keynes's words:

> That part of our knowledge which we obtain directly, supplies the premises of that part which we obtain by argument. From these premise we seek to justify some degree of rational belief about all sort of conclusions. We do this by perceiving certain logical relations between the premises and the conclusions. The kind of rational belief which we *infer* in this manner is termed probable (or in the limit certain), and the logical relations, by the perception which it is obtained, we term *relation of probability* (*TP, CW, VIII*, p. 121).

[17] Keynes's vision of probability is a very special case. Since the beginning of the 1980's it has been a subject of debate, mainly by the post-Keynesians (Carabelli, 1985, 1988, 1992 and 1995; O'Donnell, 1989, 1990, 1991; Lawson, 1985, 1988, among others). It differs radically from the classical view of probability, i.e. the distribution of frequency.

> In Keynes's concept, "probability was embodied in arguments and judgements which had no direct relationship with empirical and physical entities and which referred to the process of reasoning, rather than to the happening of events" (Carabelli, 1988, p. 15). Probability is a relation between two arguments: one set as a premise and the other set as a conclusion. This conclusion is achieved by using logical deductions. To this conclusion we designed some degree of confidence. This relation, between the premise and the conclusion is said to be probable (Carabelli, 1988, 1992, 1995; Carvalho, 1988, 1995; Lawson, 1985, 1988, 1994, 1995; O'Donnell, 1989, 1990, 1991; among others).

> The whole object of the accumulation of wealth is to produce results, at a comparatively distant, and sometimes at an *indefinitely* distant date. Thus the fact that our knowledge of the future is fluctuating, vague and uncertain, renders wealth a peculiarly unsuitable subject for the methods of the classical economic theory ... . By 'uncertain' knowledge, let me explain, I do not mean merely to distinguish what is known for certain from what is only probable. The game of roulette is not subject, in this sense, to uncertainty; nor is the prospect of a Victory bond being drawn. Or, again, the expectation of life is only slightly uncertain. Even the weather is only moderately uncertain. The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of copper and the rate of the interest twenty years hence, or the obsolescence of a new invention, or the position of private wealth owners in the social system in 1970. About these matters there is no scientific basis on which to form any calculable probability whatever. We simply do not know (*CW* XIV, pp. 113-4).

It is clear from the quotation above that in the presence of uncertainty, decision makers have to deal with insufficient information and thereby, insufficient conditions for predicting future events by frequency distributions.

From what we have so far been discussing, it is clear that for Keynes the use of a mode of thought based on universal laws and watertight axioms is not helpful for the study of the economy. Moreover, the adoption of the Babylonian mode of thought makes the use of the deductivism/positivism methodological approach insufficient and imposes the necessity of searching for an alternative methodology.

The methodological approach used by Keynes is very close to the critical realism methodology (Lawson, 1988, 1994, 1995). The conception of the world for critical realism can be understood from the following quotation:

> the world is composed not only of events and our experience or impression of them, but also of (irreducible) structures and mechanisms, powers and tendencies, etc., that, although perhaps not directly observable, nevertheless underlie actual events that we experience and govern or produce them (Lawson, 1994, p. 262).

From the critical realistic view, the world is composed of objects that are structured and intransitive. The former means that the world cannot be reduced to events of experience and the latter means that these objects exist and act independently of their identification.

This approach to reality has implications for the concept of science:

> According to transcendental realism[18] ... science ... is primary concerned not with events at all. Instead, the concern is with identifying and illuminating the structures and mechanisms, powers and tendencies, that govern or facilitate the

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It is clear from the quotations above that probability is a branch of logic, in Keynes's formulation. As pointed out by Carabelli (1988, p. 18) "Keynes's logic of probability appealed to those categories traditionally associated with the theory of belief, opinion, limited knowledge, logical doubt and ignorance, i.e. uncertainty and probability." Logic in this sense is not mainly concerned with demonstrative knowledge or truth relations. It is just the opposite. In Keynes's conception, one important feature is that the arguments, in general, are non-demonstrative and non-conclusive and, thereby completely opposed to Cartesian/Euclidean mode of thought. Moreover, this logic is "non-demonstrative because it referred to organic relations would not be amenable to formal representation" (Dow, 1996, p.7).

[18] What Lawson called transcendental realism is different from what is called empirical realism. The latter is considered a wrong approach as it claims that being experienced (or possibly experienced) is an essential feature of reality, i.e. reality is only what is experienced.

> phenomena of experience. ... . Explanation then entails providing an account of those structures that have contributed to the production of, or facilitated, some already identified phenomenon of interest (Lawson, 1994, p. 264).

From this point of view, knowledge, especially in social science, is not something that exists apart from human action, still waiting to be discovered. Here knowledge is a social product, produced by antecedent social product (antecedent knowledge), and thereby, science is a transformative social activity.

In conclusion, to identify the underlying causal process which generates the surface outcomes it is necessary to use an "open system methodology, where assumptions are simplifications rather than abstractions, and where a range of (often incommensurate) methods are employed in order to build up knowledge of complexity of the economic system" (Dow, 1996, p. 16).

Keynes's methodology has been shown to be more appropriate in dealing with the questions raised above. His concept of methodology was directly associated with his view of probability and the economic system. As Dow points out:

> Keynes's experience of the economic system indicated that it was predominantly organic *[not atomistic]*. Economists' theoretical knowledge or belief must therefore be inferred from experience using methods of which statistical inference would form only a small part. ... The most obvious consequence of a generally organic view of the economy as a whole was to regard macroeconomics as something other than an aggregation of atomistic parts[19] (1989, p. 151).

This methodology is very clear in Keynes's investment decision. The discussion about the formation of long-term expectations, conventions and *animal spirits* shows how Keynes is concerned about the organic structure of the economy and how it is difficult to discuss these matters making use of the atomistic approach and universal laws. The investor is not alone in the world and, does not make his/her decisions without taking into account the environment in which he/she is inserted, which must be considered as being a result of previous economic agents' decisions.

5. Conclusion: What is the real difference?

In the discussion above we have seen that there is a difference between the mainstream economics and Keynes' thought in their understanding of the investment decision process. This difference is determined by the fact that they look for distinct variables during the investment process. For the NTI approach, the marginal productivity of capital and the interest rate play a fundamental role in this process. For Keynes, on the other hand, the most important aspects are the long-term expectations and the *animal spirits*.

However, these differences are, in part, a consequence of the use of distinct methodologies and modes of thought. For the mainstream economics the correct mode of thought is the Cartesian/Euclidean, which claims that the best procedure for scientific investigation is the establishment of basic axioms and, through some deductive logic, the derivation of some theorems. As we have seen, this mode of thought sustains the deductivism/positivism

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[19] One important example of this is known by the name of fallacy of composition:

> For a single individual a means of accumulating was to abstain from consuming and allot his abstinence to saving. However, this attitude would have been foolish for the collectively as whole *[as the income will decrease]*. A way to increase the collective wealth was to spend more and to give up saving (Carabelli, 1988, p. 213).

methodological approach which asserts that the central aim of any science is to seek out constant conjunctions, so as to make predictions possible.

The use of this mode of thought, and of methodology, by the mainstream economics restricted its analysis of economic events. The sacred necessity of looking for universal laws means that, to be considered as scientific, one event must show regularities. Moreover, these regularities must exclude the possibility of results that are not foreseen. This framework imposes a conception of time (mechanical) and a process of formation of expectations, which guarantee the observation of these regularities. This methodological structure allows the concepts of MEC and PMPC to appear similar, and determines both (a) the directed relationship between interest rate and the amount of investment and (b) the use of one concept of uncertainty that fits in with to the use of probability distributions.

Moreover, the acceptance of this methodological structure renders Chapter 12 of the *GT* completely redundant and the concepts of long-term expectations, conventional behaviour and *animal sprits* non-scientific.

The Keynes approach, on the other hand, uses another mode of thought (Babylonian) and, thereby, another methodology. Starting from the understanding that reality is organic, complex and uncertain, the Babylonian method claims that any approach to any issue could be made using a variety of starting points. This means that this mode of thought rejects two important characteristics of the Cartesian/Euclidean method - reductionism and dualism - which means the rejection of the use of universal laws and watertight axioms. Indeed, to understand the process of the investment decision, Keynes utilises a variety of chains of reasoning to deal with an economic agent that behaves *as if* they are Benthamite calculators - as we see in the discussion of Chapter 11 - *but*, at the same time, uses conventional behaviour as a guide for her/his actual actions.

Therefore, this mode of thought demands the use of an alternative methodology from that used by the mainstream economics, and this is called critical realism.[20] Here, the primary concern of science is the study of the deepest governing structures. It is only this methodological approach that can attain a full understanding of the formation of long-term expectations. For Keynes, these expectations are not grounded in regularities or events that exist on the surface, but they are formed through conventions. This can only be understood if one analyses habits, institutions, their relations, and the whole social structure, which are phenomena that work beneath the surface of the economic system.

What must be understood is that the two schools of thought discussed here use different scientific paradigms[21], which implies that the appraisal of one school of thought has to be carried out using the same paradigm as this specific school. The sequel is that methodology comparisons and, more importantly, methodology appraisals constitute a very difficult process. However, when we make the analysis together with the discussion of the mode of thought, we think that it is possible, at least, to discuss the suitability of a specific methodology to the specific object of analysis of some discipline.

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[20] Despite the fact that Keynes does not assumes this methodology explicitly, a deeper analysis could show that he uses many of the characteristics of the critical realism methodology.

[21] The definition of scientific paradigms used here is strictly related to Kuhn's (1962) definition. For him the concept of paradigm is comprehensive. It ranges from practical analysis to the world view and mode of thought of the scientist. Among other things, a paradigm defines the technical procedures; the relevant problems to be responded to; and, the correct approach to these problems. "In 'holding' a certain paradigm, what the scientists 'see', or do not 'see', is determined by the paradigm. Observations are not independent and 'theory free', but rather are a product of the paradigm and are 'theory laden'" (Hands, 1994, p. 77).

We think that from the discussion above, the Keynes approach, in combining relevant aspects of the Keynes method, the Babylonian mode of thought and critical realism methodology, provides the economist with a better approach to the investigation of economic reality.

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