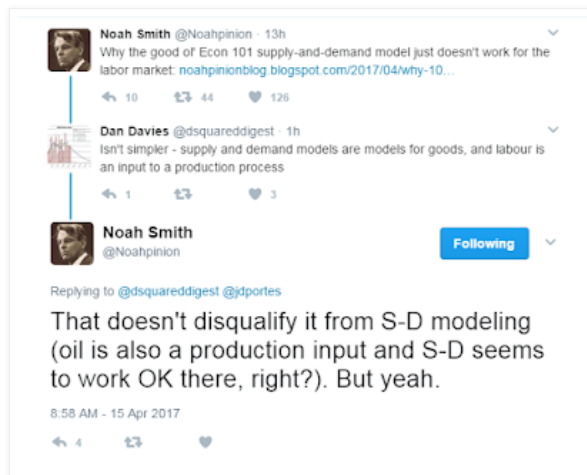# Information Transfer Economics

A working paper exploring the idea that information equilibrium is a general principle for understanding economics. [Here] is an overview.

---

**Saturday, April 15, 2017**

## It's a production input. No, it's a market good. Relax, it's both.



From twitter:

> *Noah Smith @Noahpinion*
> *Why the good ol' Econ 101 supply-and-demand model just doesn't work for the labor market: http://noahpinionblog.blogspot.com/2017/04/why-101-model-doesnt-work-for-labor.html …*

> *Dan Davies @dsquareddigest*
> *Isn't simpler - supply and demand models are models for goods, and labour is an input to a production process*

> *Noah Smith @Noahpinion*
> *That doesn't disqualify it from S-D modeling (oil is also a production input and S-D seems to work OK there, right?). But yeah.*

I don't think there could be a more perfect way to bring up the major difference in the information equilibrium model of supply and demand versus the normal understanding. I went into more detail about this in this post, but there is one observation I'd like to make here.

What we have is a model with two "scales". One is the time it takes for demand to adjust to changes in supply. The other is the time it takes for ~~demand~~ supply to adjust to changes in ~~supply~~ demand. Let's call these $t_{d \to s}$ and $t_{s \to d}$. We have three major scenarios:

$$t_{s \to d} \gg t \gg t_{d \to s}$$
$$t_{d \to s} \gg t \gg t_{s \to d}$$
$$t \gg t_{d \to s}, t_{s \to d}$$

In the first, demand moves faster (a shift in the demand curve). In the second, supply moves faster (a shift in the supply curve). In the third, we have adjustment back to "general equilibrium" as both have had a chance to adjust to each other.

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**Check out my 2nd book!**

***A Workers' History of the United States***
Available on Amazon
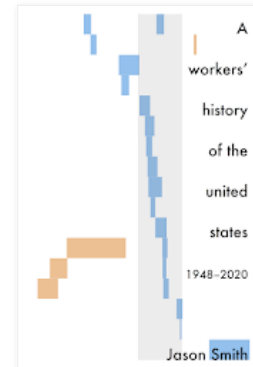


**Book website**

- A random physicist

**Information equilibrium (draft papers/talks)**

- Collected presentations & papers
- Outside the Box Workshop (UW Econ Dept, 2018)
- Maximum entropy and information theory approaches to economics (2018)
- A tour of information equilibrium (2017)
- Information equilibrium as an economic principle (2015)
- Maximum entropy and information theory approaches to economics (7th BPE conference 2016)
- Dynamic information equilibrium (2017)
- Ensembles and macroeconomics (2017)
- Forecasting with information equilibrium (2017)
- Utility maximization and entropy maximization (2015)
- General information transfer model for physical systems (Fielitz and Borchardt paper, 2009)

**Useful site links**

- FAQ
- Basic definitions
- GitHub repositories (Mathematica/python)
- Aggregated prediction link
- Moderation and comment policy

**Information equilibrium short course**

- Information theory 101
- Information equilibrium 101
- Standard economics from information equilibrium

According to the information equilibrium condition, we have (for concreteness talking about the labor market with aggregate demand $N$ (possibly from many factors) and labor supply $L$ with abstract price $p$):

$$p \equiv \frac{\partial N}{\partial L} = k \frac{N}{L}$$

If $N = N(L, x, y, \dots)$, then this has general solution:

$$N(L, x, y, \dots) \sim f(x, y, \dots) L^k$$

but only when we look at time scales in the third regime where supply and demand adjust well before we observe the system. Note that this is precisely the form that operates as a production input for a Cobb-Douglas production function (see e.g. here). In the other two regimes, we treat either $N$ or $L$ as approximately constant, which yields supply and demand curves (per here or here).

So for long times $t \gg t_{N \to L}, t_{L \to N}$, we can treat $L$ as a production input. More labor means more output. However, in the case of the labor market, because the labor supply are people who buy stuff we might never have the first two regimes because adding to the labor force also adds aggregate demand.

And this is part of the point I was trying to make in my very long short play. Until you understand the scope of the theory or model under consideration, you're not really "doing science". Instead you are making *ad hoc* theories like Noah and Dan above. *Labor is a production input, not a market good so supply and demand doesn't work. But oil is also a production input, and supply and demand works fine there.*

Effectively, without the idea of model scope and scales, you're left with *sometimes supply and demand works and sometimes it doesn't* which is totally unscientific. Now the information equilibrium picture may not be correct, but it shows at least one way you can understand this idea of "sometimes it works" in a much more scientific and rigorous way.

And that is the more general theme of my short play: (to me) there does not seem to be any real organizing principle for this situation among the hundreds of (macro)economic models. Sometimes you use a DSGE model. Sometimes it doesn't work. Sometimes you use a VAR model. Sometimes it doesn't work. Olivier Blanchard and Dani Rodrik essentially try to make the question a question of methodology. You should use certain models in certain situations or for certain questions. But really it's a question for the models themselves (well, the model's authors). A DSGE model should tell you about its own scope. If it fails to perform within that scope, then it should be rejected.

**And this is where the math comes in** because it shouldn't be economists just declaring the model's scope by fiat (that's what Blanchard is basically doing in his blog post, but not even about specific models but rather **for whole classes of models** – to borrow a phrase from the British, *it does my head in*). You should show how the scope conditions apply due to the mathematical assumptions. In the information equilibrium model above, you can literally only derive the supply and demand curves mathematically by making assumptions about how fast supply and demand change (i.e. setting scope conditions). There are no supply and demand curves if we ignore the scope conditions listed above, only production functions.

...

PS I am not in any way saying adjustment time is the proper or even only scope condition. This is just one of the simplest – i.e. something that should be taught in Econ 101 as an example, but in graduate school you move on to more complicated models.

...

**Update:** There are some simulation animations here of these two regimes. The simulation below shows a case where demand adjusts a bit slower to an increase in supply resulting in a fall in the price:

- Information equilibrium as a framework
- The economic state space
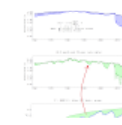- Economics as information theory
- How money transfers information

**Featured Post**

**Exploration of an abstract space: prices, money, and ... ships at sea?**

AIS data from ships at sea. Credit: Spire Maritime . I was asked a question on Twitter that I think does help us understand how ...

**Random Posts**

Modeling macroeconomic fluctuations

...
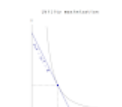
Affordable housing through increased supply?

...

More updates to the python IEtools

...

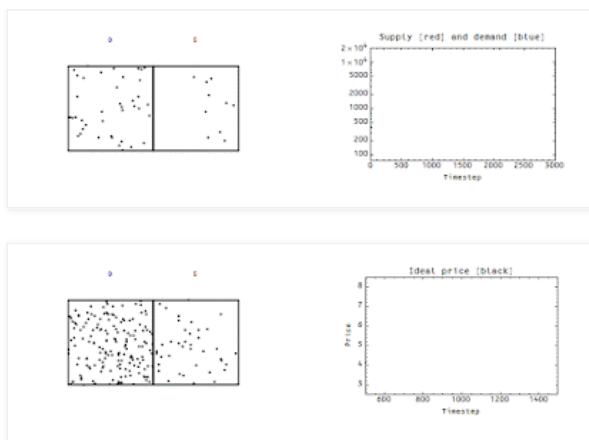Adam Smith's circular logic and path dependence in economic theory

...

What is Okun's law about, anyway?

...

**Blog Archive**

Over time $(t \gg t_{d \to s}, t_{s \to d})$ we return to the production input view where $D \sim S^k$ and $P \sim S^{k-1}$.

**Update, the second:** I should add that there is a fourth regime, but it's trivial:

$$t_{d \to s}, t_{s \to d} \gg t$$

In this regime, nothing happens.

Posted by Jason Smith at 11:04 AM

# 11 comments:

Anonymous April 15, 2017 at 9:46 PM

Economics is by no means a hard science, hence it can be scientific only in the measure economic phenomena are studied using a proper scientific approach and grammar. Since such phenomena deal with power structure and fight for net product sharing even letting aside a Max Planck's quotation, it seems they facilitate the producing of a reign of sycophants and sophists. In fact dominant neoclassical economics has been reduced to an insane and anti-scientific fiction with the main scope purely ideological. Since intelligent people usually get quick dissatisfied of such idiocy the field is easily dominated by second-rate brains and ideologists, and the math language has the function of delivering an appearance of science to a fictional tale. So it is not a surprise that usually tautological consequences and properties of abstract conjunctures and descriptive models are considered reality, according to the ideological scopes and political interests.

Any static model specially of equilibrium, be it partial or general or improperly inter-temporal and dynamic, not only presents great limit in understanding reality and actual capitalistic economy but is extremely misleading, which by the way seems to be its goal.

Your interesting approach, one of the very few scientific and worthy of being read, though leads itself to a dead end has at least the great merit of clarify some important distinctions such as descriptive model and explanatory one, causality and correlation, effective forecasts and implicit assumptions, real world and artificial ideological parallel universe, among others.

However, a scientific approach to economic phenomena and capitalism requires not only the adoption from the beginning of a real dynamic model but some additional elements integrating a proper grammar beyond math language, in order to "close" the model.

In the case of labor demand and supply in capitalism on a certain scale demand depends on the grade and rate of accumulation and technological progress, while supply on natural rate of growth of population (or labor force and immigration) and technological progress. On a sub-dimensional scale demand will depend on effective demand, which means that there is a high probability that it will be insufficient and unfortunately (for the losers and not the one percent) the adjustment will happen via reduction and destruction of saving and unemployment.

Somewhere you have the intuition that the reduced growth has much more likely caused the financial crisis and great recession than other facts and you are right on the spot.
M

Reply

Anonymous April 16, 2017 at 3:01 PM

Apparent typo:

"One is the time it takes for demand to adjust to changes in supply. The other is the time it takes for demand to adjust to changes in supply."

**Creative Commons**

You can read more about me here.

**BROKEN Twitter widget LOL**

Tweets by infotranecon

12/7/25, 4:01 PM

Information Transfer Economics: It's a production input. No, it's a market good. Relax, it's both.

:)

Reply

> Replies
>
> **Jason Smith**    April 16, 2017 at 3:41 PM
>
> Thanks; fixed!

**Reply**

---

**Anonymous** April 16, 2017 at 3:12 PM

As an aside, does supply and demand really work in the oil market? At least, in the retail gas market. Unless something has changed that I have missed, we have a glut of oil, but gas prices have been rising in the U. S., as they do this time of year. Why? Because the oil companies have colluded, probably without illegal communication, to cut back production while they do work on their refineries. That is, the oil market is manipulated. Besides, why is there an oil glut? Because major producers, like Saudi Arabia, want to break the back of the nascent fracking industry. Isn't the market in oil one of the most manipulated markets in the world?

Reply

> Replies
>
> **Jason Smith**    April 16, 2017 at 3:54 PM
>
> Actually, oil seems to work with the dynamic equilibrium model (which would be the general eq regime t >> td, ts and not the supply and demand regimes td >> t >> ts or ts >> t >> td):
>
> http://informationtransfereconomics.blogspot.com/2017/02/dynamic-equilibrium-price-of-gold.html
>
> OPEC does operate as a consortium manipulating the market (see the link). However in the short run, there really do seem to be responses to supply and demand shocks (even RBC investment cycles). See here. The paper linked there is probably what Noah Smith has in mind.
>
> The thing is that a market can be totally manipulated, but still follow the information equilibrium processes. A good example is short term interest rates in the US that are practically set by the Fed.
>
> I guess what I'm trying to say is that even manipulated markets still react to and feel pressure from "supply and demand".
>
> **Anonymous** April 16, 2017 at 11:36 PM
>
> Thanks. :)
>
> I would have thought that the smaller number of players (coalitions) in a manipulated market would tend to deviations from an information equilibrium.
>
> **Anonymous** April 17, 2017 at 2:12 PM
>
> "I guess what I'm trying to say is that even manipulated markets still react to and feel pressure from "supply and demand"."
>
> That appears to be quite a realistic and obvious conclusion. Even better of the questionable previous relativism.
>
> In the case of Saudi Arabia as price setter they usually have operated on the quantity after considering free riders and political pressures.
> Monopolies and oligopolies which nowadays dominate economy and world can set the price they want, though obviously not without considering at least demand. However, their price policy has big consequences on contemporary capitalism quite far from those of a competitive condition.

**Reply**

---

**Jamie** April 18, 2017 at 7:45 AM

Jason: "Effectively, without the idea of model scope and scales, you're left with sometimes supply and demand works and sometimes it doesn't which is totally unscientific"

Yes, I agree completely but economists don't ask themselves challenging questions. For example,

12/7/25, 4:01 PM

Information Transfer Economics: It's a production input. No, it's a market good. Relax, it's both.

the supply of digital goods such as movies or music is effectively infinite, so what price should we expect for these goods under supply and demand curve thinking. And why does iTunes charge the same price for an Adele album which sells millions and other albums which sell almost no copies?

Dan Davies: "supply and demand models are models for goods, and labour is an input to a production process"

Noah Smith: "That doesn't disqualify it from S-D modeling (oil is also a production input and S-D seems to work OK there, right?"

With respect to scale, economists are very poor in identifying when they are talking about micro and when they are talking about macro.

At a micro level, we can think of crude oil and labour as two inputs into the oil refining process. An oil company would want to minimise the costs associated with both. Automation can be used to reduce and ideally (from the company's perspective) remove the labour input. However, the oil refining process would grind to a halt without the crude oil.

At a macro level, we need to think of the production process as an end-to-end macro process. The materials and energy sources which feed into this process are obtained from nature. Nature does not charge us for these things over and above requiring us to make some effort (ingenuity and labour) to extract the materials and to utilise the energy sources. We do buy materials, energy sources and finished products from overseas. However, we subtract the costs of those from the amount we spend on new goods & services when we calculate GDP.

Hence, at the macro level, it is the amount and reward of labour, rather than the cost of the materials and energy sources, which is most important. At the macro level, labour should be contrasted with other recipients of the money arising from GDP i.e. capital owners and the government.

When we talk about the 'labour market' at a macro level, we imply that it is a resource to be minimised. Other things equal, that means we prefer that money goes to capital owners and / or to the government. This is highly political. It is more appropriate to talk about the labour share of GDP and to contrast this share with the capital owners' share and the government's share.

This is what Marx and Keynes were talking about. Unfortunately, many modern mainstream economists don't appear to understand this. It is in the interests of INDIVIDUAL businesses to minimise the amount paid to workers, as workers are a resource at the micro level. However, it is in the interest of businesses AS A WHOLE to maximise the labour share of GDP as labour has a higher marginal propensity to consume the products of business than capital.

In your terms, excessive retained profit from the capital share is an anti-entropic force in the macroeconomy as it slows down (or even stops) the circulation of money. That means that, if we think that entropy is important, it must be the job of the banking system and the government to oppose that force to maintain an entropic system (if that is a valid term).

Reply

Replies

**Jason Smith**     April 22, 2017 at 10:53 AM

I completely agree that talking about labor purely as a production input (to be minimized) is highly political and that since labor is the primary means by which most people have income it can't possibly be good if labor's share falls.

I do hope that the coupling of labor supply and labor demand in the "theory" above can be seen as a step towards understanding that growth itself is tied to labor -- i.e.

log NGDP ~ k log L

So that if L falls, then NGDP falls. This is the basis for what I called the "quantity theory of labor".

Regarding your latter point, yes wealth concentration can be seen as an "anti-entropic force" since it causes the distribution of money over the economic state space to not be uniformly distributed. This point is one where most physicists who try to make analogies with thermodynamics and economics fail -- I've made analogies with thermodynamics before, but really econ (at least in my view) is more like thermodynamics without its second law (entropy increases).

The "second law" as applied in econ would say that growth is always positive -- which is clearly false.

Reply

**Anonymous** April 20, 2017 at 9:17 AM

The dominant ideological fairy tale has the chief scope of being an effective ideological tale, hence all sorts of non senses and unscientific claims are just substantial accessories. According to the static utopian parallel universe fabricated rate of profit is zero and factors of production gets the

conjectured marginal productivity. Everybody is happy and everything is perfect.

Any rise of the rate of nominal wage is meaningless and ineffective.

Since reality is unacceptably wrong it must be corrected to adapt itself to the paradise of the fantastic world, so they even screw up reality more.

It is like the purposely corporate fake news, their goal is distorting and fabricating consensus, therefore it would be just delusional wasting time in complaining about the fake world they fabricate.

Any rise of the rate of nominal wage should reduce the rate of profit and increase effective demand, which, while possible and likely in a competitive context, in monopolistic world is not necessarily consequential and in theory and practice even the opposite could happen.

Nice also your reference to entropy and income and wealth concentration, since by its very nature capitalism, specially when abandoned to its forces, concentrate income and wealth into the hands of the one percent or less, entropy can go almost to zero.

M

Reply

> Replies
>
> **Jason Smith**          April 22, 2017 at 10:55 AM
>
> "concentrate income and wealth into the hands of the one percent or less, entropy can go almost to zero"
>
> That would definitely be true. And this is one way that information equilibrium economics differs from thermodynamics: there is no second law of thermodynamics (entropy increases) for economics (i.e. growth isn't always positive), so there is nothing preventing wealth concentration, groupthink, or other correlating behaviors. These things lead to lower growth.

**Reply**

Enter Comment

Comments are welcome. Please see the Moderation and comment policy.

Also, try to avoid the use of dollar signs as they interfere with my setup of mathjax. I left it set up that way because I think this is funny for an economics blog. You can use € or £ instead.

Note: Only a member of this blog may post a comment.

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