A New Natural Science of Macroeconomics

Preprint

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A NEW NATURAL SCIENCE OF MACROECONOMICS

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ABSTRACT

We introduce a brief outline of conceptual takeaways from a new natural science of macroeconomics we have developed by building upon the path breaking work of Rod Swenson in the science of far from equilibrium thermodynamics to fill important lacunae in the traditional (aka standard) macroeconomic model's explanatory reach, including: an origin story, a developmental life-cycle model, an endogenous theory of productivity and growth as well as endogenous treatments of money and time.

Swenson's work gives us two important pillars for our extension of economics to new or enhanced explanatory terrain: 1. the Law of Maximum Entropy Production (LMEP),[1] also known as the fourth law of thermodynamics in the literature [2], [3], [4] which gives us a natural law based principle of spontaneous order (Swenson's universal ordering principle) [5], and 2. the autocatakinetic (ACK) classification framework, which gives us a model of generic features of ACKs that we can apply to the economy [6].

Due to space constraints, we will leave the reader to consult references noted above for definitions of key terms: ACK, LMEP and Swenson's universal ordering principle. We also direct readers to Swenson's plenary talk W162 at this ICT2.0 conference for a comprehensive summary of his key ideas. [7]

Keywords: the law of maximum entropy production (LMEP), macroeconomics, autocatakinetic (ACK) systems, universal ordering principle, far from equilibrium thermodynamics, spontaneous order

1. INTRODUCTION

Our proposal for a "new natural science of macroeconomics" begs a definition of "macroeconomics." Suffice to say in the limited space available herewith, that by macroeconomics we are referring to the academic domain alternatively described as traditional economics, standard macroeconomic theory, mainstream economics and neoclassical economics. In this paper, we will use the term "Traditional economics" following the lead of Eric Beinhocker in his book Origin of Wealth (2006). In practice, Traditional economics is what policy makers, central bankers and government economists use to perform their jobs [8]. The one key foundational thread that defines Traditional economics is its use of equilibrium physics and related math for economic modeling purposes. We note here that there have been many attempts in Traditional economics to weaken the assumptions embedded in the equilibrium model (such as replacing perfect rationality with bounded rationality) – all aimed at making Traditional economics more "realistic." However, as Beinhocker explains: "equilibrium is a strict master; and while economists are able to relax one or two assumptions at a time the limitations of equilibrium math mean that truly realistic models require a more radical break from the Traditional framework" [8].

In 2009, shortly after the global financial crisis, eminent establishment economist, Willem Buiter echoed Beinhocker above saying: "Standard macroeconomic theory did not help foresee the crisis, nor has it helped understand it or craft solutions… A new paradigm is needed" [9].

Einstein famously and perhaps apocryphally said: "We can't solve problems by using the same kind of thinking we used when we created them." If we trace back "the economic problem" to the source of its "kind of thinking" we can see a number of prominent sources pointing to the equilibrium physics imported into economics in the late 19th Century by French economist Leon Walras, which still infects Traditional economics as referenced above [8], [10], [11]

One critical problem with the equilibrium model is that the assumptions required to make the model work infacts our common sense understanding of the subject matter of economics.

For example, the equilibrium model fundamentally distorts Adam Smith's "invisible hand" metaphor. According to Meir Kohn in his seminal paper Value and Exchange (2004), the equilibrium model impoverishes the metaphor by draining it of its explanatory power. In fact, the invisible hand is truly invisible in the equilibrium model because it does no "real" work. Equilibrium is satisfied automatically once extraordinary assumptions (including perfect rationality and perfect foresight of individuals) are enlisted. The power of Adam Smith's version of the invisible hand metaphor comes from its ability to help us imagine a real world scenario where *imperfect* individuals interact to achieve a market order that ultimately benefits the common good. [12]

Rod Swenson's work in non-equilibrium thermodynamics provides a nomological explanation for the "invisible hand" metaphor by giving us a natural based law for spontaneous order, thus turning the "invisible hand" into a natural feature of economies. The implications for this one insight are enormous for the field of macroeconomics, including the potential to rehabilitate insights available from classical and Austrian traditions currently out of fashion for lack of mathematical rigor.

Let's refer back to Buiter's quote above and note that while Traditional economics was silent about macroeconomic risks ahead of the 2008 financial crisis, economists steeped in the

Austrian economics tradition and its Austrian Business Cycle Theory (ABCT) voiced concerns about the Fed's easy money policy fueling a dangerous economic and financial bubble [13].

We posit that the Austrian tradition was able to see risk where standard macroeconomic theory was blind because Austrian economics is not blinkered by assumptions and insights forced by equilibrium economics; rather it focuses on dynamic economic processes. This is not meant to endorse Austrian economics per se, only to highlight an example where a non-equilibrium based economic perspective outperformed the Traditional macro model.

2. LITERATURE

We have woven together cross disciplinary insights from three separate literatures for this project. First, we used the very extensive literature regarding the question of "what is wrong with economics?" (a.ka "the problem of economics") to understand where particular lacunae in traditional economics might be begging a better explanation [8], [9], [10], [11], [12].

Our creative attempt to find answers to "the problem of economics" beyond what was and still is available in the modern economic literature was disappointing for important reasons relevant to our project, but too numerous to outline here. Suffice to say here, that our quest for answers led us to economic history, and in particular, to the literature by and on the classical economists, especially key figures of the Scottish Enlightenment. There we found a surprisingly robust literature elaborating a "theory of spontaneous order" so described by economic historians [14], [15], [16]. We followed this spontaneous order tradition thread through economic history to FA Hayek and his work [17].

The sophisticated and enduring intellectual tradition aimed at building and elaborating a coherent theory of spontaneous order in the history of economics made us wonder if there might be a natural law explanation for what remained for so many years merely an observational, qualitative narrative.

No sooner had we posed this question, than we discovered Rod Swenson's work, which became the hard core of our new natural science of macroeconomics research program [7].

3. RESULTS AND DISCUSSION

We now introduce an extended quote from Swenson outlining the generic properties of ACK systems, which we will then use to build insights and intuitions for human economies not available from modern mainstream macroeconomics:

"Real world systems, particularly, but not by any means exclusively, living things and the intentional dynamics that distinguish them are remarkably insensitive to initial conditions. Because orthodox theory adheres to an impoverished causal description of the world, namely that it is essentially microdetermined, it has no basis to admit what amounts to macroscopic causality, or downward causality into its explanatory framework. …. Insensitivity to initial conditions, downward causality or macro determinism is a generic property of ACK systems.

"The general conditions for the establishment of an ACK system is generic across scales. In each case it involves 1) stochasticity or "blind" variation" at the micro level that "seeds" order at the macro level, 2) circular causality that amplifies the microscopic seeding to establish autocatokinesis at the new macroscopic level and 3) a source-sink gradient above some minimal critical level sufficient to pump up or fill out the new dimensions of space-time that the establishment and maintenance of autcatakinesis entails [6].

3.2 Theory of Origin of the Economy

One of the biggest elephants in the room of the modern mainstream economics establishment is the fact that its theoretical framework does not include a theory of the origin.

Eric Beinhocker opines in his book Origin of Wealth:

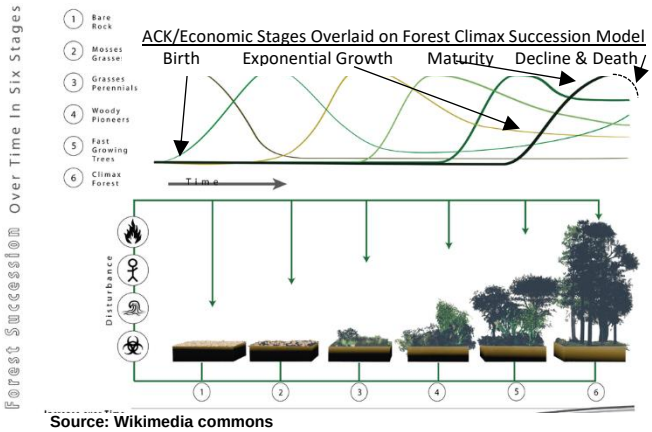
Questions of origin play prominent roles in most sciences… It would be hard to believe that economics could ever truly succeed as a science if it were not able to answer the question "Where do economies come from"…. The process of economy formation presents us with a first class scientific puzzle…. [8].

This puzzle is solved when we put the economy into the ACK taxonomy outlined above. First, let us note the "launch" of modern economies across the globe in very different cultures and physical environments, with vastly different political systems and institutional arrangements is prima facie evidence for the insensitivity of human economies to initial conditions.

Next, micro-stochasticity and circular causality are facilitated when human institutions emerge that facilitate labor specialization (e.g. private property regimes -- including courts and government) and self-interested trade opportunities. Money is a key institution which provides a quantum leap in the economy's ability to self-amplify.

Finally, an economy is "born" (i.e. "launches") when trade and production reaches a critical level such that economy's source-sink gradient exceeds the minimal critical level sufficient to pump up or fill out the new dimensions of space time that the establishment and maintenance of a generic ACK entails. At the moment of "launch", the economy goes through a symmetry breaking phase change per the generic behavior of ACKs.

3.3 Theory of Economic Development Life Cycle



Source: Wikimedia commons

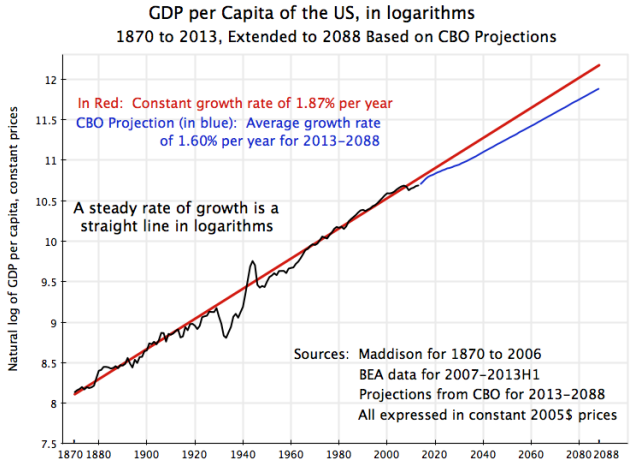
FIGURE 1: Development Life Cycle S-Curve Model

Another generic feature of complex, nested ACK systems that we may use to enhance our understanding of economies is that they follow predetermined life cycle stages. In the paradigmatic example of the forest climax system, the stages follow a standard pattern: birth, growth, maturity, decline or senescence and death. [7]

The s-curve framework based on the logistical growth equation gives us a graphical depiction of the generic lifecycle pattern for ACKs. Figure 1 shows a forest climax system following the s-curve pattern where stages of development map to segments of the s-curve. We propose human economies follow such an s-curve development lifecycle pattern.

3.4 Where Are We Now? ACK System Aging

Another profound puzzle (this one empirical) for the US economy – (and many similarly developed ones) – is that real GDP growth has been remarkably faithful to a 1.87% growth trend since 1870. There are wobbles around the trend line and occasion big dips, e.g. the Great Depression, but the line has always reverted back to trend. See fig. 2 [18]. The solution to this puzzle, once again, falls out of generic ACK taxonomy. The straight line graph of GDP growth rate trend for the US economy over the past 150 years is the second derivative of the exponential growth phase of the Logistical Growth equation -- which maps to the exponential growth stage of the ACK lifecycle model.



Source: AnEconomicSense.org by Frank Lysy

FIGURE 2: US growth trend since 1870

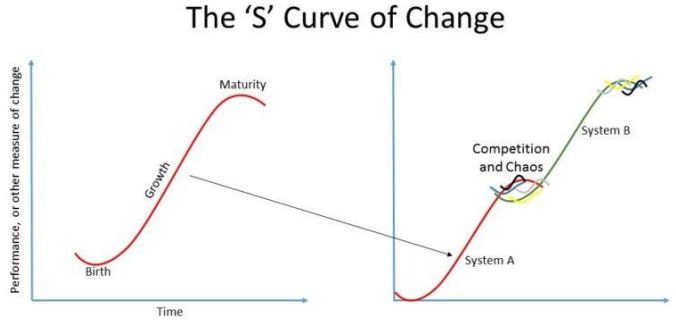
A variety of empirical evidence suggests the US economy may be exiting the exponential growth stage and entering the maturity / decline stage. For one, the historically slow recovery to trend for US GDP growth after the 2008 global crisis has been used by former Treasury Secretary, Lawrence Summers, to defend his theory of secular stagnation, which argues the economy won't grow as fast as it has in the past unless policy interventions are implemented asap [19]. The Congressional Budget Office (CBO) recently published a study supporting the secular stagnation hypothesis forecasting that long term US GDP trendline will decline from 1.87% to 1.6% over the next 25 or 30 years. Again see Figure 2 the CBO forecast plot in blue diverts in 2008 to a lower growth trajectory vs the historical trendline. Our framework shows why Summer's proposed policy interventions may be counter-productive if they result in premature system aging, leading to further declines in trend GDP.

Another source of empirical evidence for system aging shows up in rising income inequality across the developed world. Going back to the climax forest analogy: in the maturity to declining life cycle stages, larger trees begin to crowd out lower sub-components of the forest system. Consequently, degrees of freedom of the system are frozen out as throughput on which the ecosystem depends is effectively shunted and sequestered in the largest trees and especially in the non-productive parts of the trees, i.e. their trunks, much of which is "dead" [7]. In economies, this shunting and sequestering dynamic shows up as growing income inequality and increased market concentration and consolidation as we've seen play out in many markets, including finance, technology and media which are dominated by a handful of mega corporations.

As the ACK system continues to age, it becomes increasingly brittle such that it is vulnerable to systemic collapse from ever smaller perturbations, such as fire or disease that wouldn't have posed such a risk in an early life cycle stage [7]. We believe evidence of such endemic brittleness in the world economy has been highlighted by the Covid19 pandemic which has revealed a lack of resilience and even outright weakness or failure across political, social and economic institutional dimensions and domains.

3.5 What's Next?

Having laid out our argument that a developmental model for the economy is appropriate and useful, we must make an important clarification. We are not saying modern developed economies are inevitably headed for collapse. Embedded in the human economy is a flexibility not available to a forest ecosystem, which unlike a human economy a climax has more or less fixed interaction rules and replicating components. We propose that a new economic system with a new set of interaction rules (i.e. institutional "design") could spontaneously emerge or "launch" in our terminology in parallel well before our current economic system heads into decline or collapse [20].



Source: https://stevenrsouthard.com/how-things-change/

FIGURE 3: System A is modern economy, System B is the potential successor economy.

To fully elaborate this point, again, requires a separate paper. Suffice it to say here that this new system and associated interaction rules cannot be designed, planned and created as a human engineered entity or structure ex nihilo but rather would have to emerge and launch spontaneously like all natural spontaneously ordered ACK systems including its ACK predecessor – the modern capitalist industrial economic system.

3.4 Theory of Structural Productivity and Growth

Another missing piece in traditional economics which falls right out of another generic feature of ACKs is an endogenous theory of long term structural productivity. In order for an ACK to maintain its structured order, it continues to access new dimensions of spacetime at some sustained rate. The ability of ACKs to access new dimensions of spacetime, is another way of saying the system is able to endogenously sustain productivity growth [6] Thus, we propose that simply classifying the economy as an ACK offers deep insights about the source and sustainability of structural productivity and in turn of economic growth – which is ultimately bound to and supported by productivity growth.

3.5 Endongenous Theory of Money and Time: Central Banking, Fiat Money Tied to System Aging

Finally, we introduce another deep and profound "problem with economics" related to the equilibrium model: that is its unrealistic and ad hoc treatment of both money and time. Professor Steve Horwitz argues that "time and money are universals of macroeconomic theorizing," yet mainstream economics treat them "far too superficially in comparison to the central roles that they play in real-world economies" [21].

We have already shown how Swenson's ACK model gives us an endogenous modeling of time via the developmental life cycle model. We now show how ACK does the same for money. Non-commodity backed fiat monetary systems like we have today de-couples a conserved quantity from an unconserved quantity (i.e. a finite commodity like gold is replaced by "unbacked" fiat money).

Such a de-coupling facilitates generic self-destructive behavior in the economy (e.g. resource shunting and sequestering) as often manifest in increased wealth inequality and exaggerated boom / bust cycles both of which we have seen repeatedly and quite dramatically over the past 20 years.

The issue of climate change may also be explained by excessive "order production" (what economists call GDP growth) facilitated by massive central bank money printing -- clearly evidenced by an explosion over the past 20 years in global debt – both private and public. Since order and disorder production is coupled as per LMEP, it is no surprise that the excess order created by central bank fiat-money printing has been associated with exaggerated disorder in the form of CO2 emissions – and other systemic environmental stresses. All of these distortions are circumstantial evidence of system "aging," and thus we demonstrate how money and time are not only endogenous to our model, but linked.

4. CONCLUSION

Re-classifying the human economy as a naturally emergent, far from equilibrium, spontaneously organizing and self-reinforcing physical system of exchange, what Swenson defines as an ACK, provides a principled foundation for the development of a uniquely parsimonious, natural law based macroeconomic theory, what we call "a new natural science of economics." Our new theory trades what has proven to be unreliable economic forecasting for a new fundamental understanding of economies, including their launch, productivity, growth dynamics, and developmental life cycle evolution patterns. In so doing it offers the potential for pursuing a more realistic prediction approach leveraging the inherent downward causality dynamics that emerge as life cycle stage patterns we can expect in ACK systems – the study of which may be enhanced by new tools and forensic approaches to be developed.

REFERENCES

[1] R. Swenson, Autocatakinetics, Evolution, and the Law of Maximum Entropy Production: A Principled Foundation for the Study of Human Ecology. Advances in Human Ecology Vol, 6., 1997.

[2] M. Martínez-Kahn & L. Martínez-Castilla, The Fourth Law of Thermodynamics: The Law of Maximum Entropy Production (LMEP), Ecological Psychology, 22:1, 69-87, 2010.

[3] R. Swenson. The Fourth Law of Thermodynamics or LMEP. Chemistry, Vol. 18, Iss. 5. 2009.

[4] R.E Morel, G. Fleck, A Fourth Law of Thermodynamics. Chemistry, Vol. 15 Iss. 4. 2006.

[5] R. Swenson, Emergent Attractors and the law of maximum entropy production: Foundations to a general theory of evolution. Systems Research, 6, 187-197. 1989.

[6] R. Swenson, Autocatakinetics, Yes – Autopoiesis, No: Steps toward a Unified Theory of Evolutionary Ordering. General Systems, vol. 21, pp. 207-228: 1992.

[7] R. Swenson, Autocatakinetics, the 4th Law of Thermodynamics (LMEP), and the Rise, Development, and Collapse of Socioeconomic Systems W162, ICT2.0 Conference, 2020

[8] E.D. Beinhocker, *The Origin of Wealth.* Boston: Harvard Business School Press, 2006.

[9] W. Buiter, "The Unfortunate Uselessness of Most 'State of the Art' Academic Monetary Economics" VoxEU, March 6, 2009. [Online]. Available: ssrn.com/abstract=2492949

[10] R.L. Heilbroner, *The Crisis of Vision in Modern Economic Thought.* New York: Cambridge University Press, 1995.

[11] T. Lawson, *Essays on The Nature and State of Modern Economics.* London and New York: Routledge, 2016

[12] M. Kohn, "Value and Exchange" Cato Journal, Vol. 24, No. 3, Fall 2004.

[13] R. Ebeling, "The current Economic Crisis and The Austrian Theory of the Business Cycle, The Freeman: Ideas on Liberty, June 2008.

[14] C. Smith, *Adam Smith's Political Philosophy: The Invisible hand and Spontaneous Order.* London and New York: Routledge, 2006.

[15] R. Hamowy, *The Scottish enlightenment and the Theory of Spontaneous Order.* Carbondale and Edwardsville: Southern Illinois University Press, 1987.

[16] S. Horwitz, From Smith to Menger to Hakek: Liberalism in the Spontaneous-Order Tradition. The Independent Review, v. VI, n.1, Summer 2001.

[17] L. Hunt, & P. McNamara, *Liberalism, Conservatism, and Hayek's idea of Spontaneous Order.* New York: Palgrave MacMillan, 2007.

[18] F. Lysy, "The Rate of Economic Growth and the Budget Gap: Returning to the Long-Term Average Growth Rate Would Eliminate It" AnEconomicSense.org, October 15, 2013.

[19] L. Summers, "Reflections on Secular Stagnation" Speech at Julius-Rabinowitz Center, Princeton University, February 19, 2015.

[20] S. Southard, "How-Things-Change" [Online). Available: stevenrsouthard.com/tag/s-curve/

[21] S. Horwitz, *Microfoundations and Macroeconomics.* London and New York: Routledge, 2009.