

Is economics a science? Should economics be rigorous?

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Many mainstream economists (e.g., Lucas, Cochrane) claim that the characteristics of a “science” require rigor, consistency, and mathematics. So if economics is to be a science it must display these characteristics. Paul Samuelson has added the claim that economists must accept the ergodic axiom in their models in their pursuit of economics as a science on par with physics, astronomy, and chemistry. Efficient market theory possesses all these characteristics. So how is it possible that efficient market theorists did not foresee the financial crisis that started in 2008?

Whether they declare themselves Monetarists, Rational Expectation theorists, Neoclassical Synthesis [Old] Keynesians or New Keynesians, the backbone of their mainstream theories is the efficient market analysis where the future can be known. For “Old” and “New” Keynesians the only thing that prevents efficient markets operating in the short run is the presumption of fixity in nominal wages and prices. [Thus, these “Keynesians” urge government action only because, as John Williamson is always telling me, they are too impatient to wait for the long run.]

To stimulate discussion, I wish to address two aspects of these mainstream economists universal beliefs. The first involves a discussion of the difference between a nonergodic stochastic process and an ergodic stochastic process for “knowing” the future. The second and related aspect involves the use of the deductive axiomatic logical analysis and mathematics by mainstream economists to glorify efficient market theory and the Arrow-Debreu-Walrasian general equilibrium or dynamic general equilibrium as the only way to do real world economics.

For example, to “prove” markets are efficient and the use of the Ricardian equivalence theorem to show that fiscal stimulus policies are useless— at least in the long run— requires the presumption that the economic system is “ergodic”.

Efficient market theory, Arrow-Debreu models, Ricardian equivalence, etc. require the households, business enterprises, and politicians to possess a significant correct and accurate message of things that are going to happen in the future if they are to make efficient (optimal) decisions today.

Why? Because time is a device that prevents everything from happening at once. Thus decisions made today usually require significant time to elapse before the payoff of the decision occurs. This is true not only for decisions involving investment projects by entrepreneurs, but also for most consumer decisions, such as the purchase of an auto or an ipad, or even a decision as to what restaurant to go to get a good meal for dinner. [How many of us have sometimes been disappointed in the meal we ordered at the restaurant?]

The message of efficient markets, Arrow-Debreu, Ricardian equivalence, etc. is inapplicable to the world of experience because in the real world, households do not have any significantly reliable information about the future, and neither do budgetary policy makers, nor entrepreneurs. The erroneous message based on the assumption of people having significantly reliable knowledge about the future is the result of accepting bad axioms as the

basis for mainstream theory. It is not the fault of using the deductive method, rigor, and mathematics *per se*. So do not blame the messenger for the message!

The ergodic axiom

First, let us take up the ergodic – nonergodic stochastic process distinction. Paul Samuelson [1969] has written that if economists hope to move economics from “the realm of history” into “the realm of science” they must impose the “ergodic hypothesis” on their theory¹. In other words Nobel Prize Winner Paul Samuelson has made the ergodic axiom the *sine qua non* for the scientific method in economics. Lucas and Sargent [1981] have also claimed the principle behind the ergodic axiom is the only scientific method of doing economics.

Following Samuelson’s lead, most economists (e.g., Cochrane, Stiglitz, Mankiw, M. Friedman, Scholes, etc) and economic textbook writers either implicitly or explicitly have assumed that observable economic events are generated by an ergodic stochastic process.

But not Keynes! Keynes [1936, p. 16] suggested the way to understand why classical economic theory (e.g., efficient market theory) is not relevant to the world of experience, when he noted that old economic thinkers were “like Euclidean geometers in a non-Euclidean world who discover that apparent parallel line collide, rebuke these lines for not keeping straight. Yet, in truth there is no remedy except to throw over the axiom of parallels and to work out a non-Euclidean geometry. Something similar is required to-day in economics”. Keynes developed a theory that is more general than classical and mainstream economic theory because it is based on fewer restrictive fundamental axioms². The fewer the number of underlying axioms, the more general the theory. The most important classical axiom Keynes eliminated in his general theory³ is the *ergodic axiom*.

This ergodic axiom assumes the economic future is already predetermined⁴. The economy is governed by an existing ergodic stochastic process. One merely has to calculate probability distributions regarding future prices and output to draw significant and reliable statistical inferences [information] about the future. Once self-interested decision makers have reliable information about the future, their actions on free markets will optimally allocate resources into those activities that will have the highest possible future returns thereby assuring global prosperity.

1. P. A. Samuelson,[1969] “Classical and Neoclassical Theory” in *Monetary Theory*, edited by R.W. Clower (Penguin Books,, London) p.12.

2. Keynes [1936, p. 3] stated that the classical economics fundamental axioms are applicable to a “special case....[that] happen[s] not to be those of the economic society in which we live with the result that its teaching is misleading and disastrous if we attempt to apply it to fact of experience”. This “special case” statement is even more applicable today, given the economic austerity discussions in Washington, the UK, Euroland, etc, and the export-led growth , i.e., mercantilist, policies pursued by nations such as China who are still enjoying an “economic miracle” in an otherwise depressed global economy.

3. Two other axioms that Keynes rejected are 1. Money is neutral (at least in the long run) so that changes in the quantity of money do not affect real outcomes, and 2. Gross substitution is ubiquitous and therefore liquid assets are good substitutes for real capital goods. (See Davidson , 2009).

4. Consequently, government action today can only delay, but not change the long run optimal solution already predetermined by free markets.

In order to draw any statistical (probabilistic risk) inferences regarding any universe, however, one should draw a sample from that universe. Since drawing a sample from the future economic universe is impossible, the *ergodic axiom* presumes that the economic future is governed by an already existing unchanging ergodic stochastic process. Consequently, a sample drawn from the past is equivalent to a sample drawn from the future. In other words, calculating the probability distribution from past statistical data sample is presumed to be the same as calculating the risks from a sample drawn from the future.⁵ This ergodic axiom is an essential foundation for all the complex risk management computer models developed by the “quants” on Wall Street. If the economy is nonergodic, however, then *these computer models are weapons of math destruction* [For deterministic models, the “ordering axiom” plays the same role as the ergodic axiom in stochastic models.]

For a technical explanation of the difference between ergodic and nonergodic stochastic processes one should read my book, *The Keynes Solution: The Path To Global Economic Prosperity* [Davidson (2009)] . For our discussion here we merely need note that, in essence, the ergodic axiom imposes the condition that the future is already predetermined by existing parameters (market fundamentals). Consequently the future can be reliably forecasted by analyzing past and current market data to obtain the probability distribution governing future events. In other words, if future events are assumed to be generated by an ergodic stochastic process (to use the language of mathematical statisticians), then the future is predetermined and can be discovered today by the proper statistical probability analysis of past and today's data regarding market “fundamentals”. If the system is nonergodic, calculated past and current probability distributions do not provide any statistically reliable estimates regarding the probability of future events.

New Keynesians such as Stiglitz accept the ergodic axiom as the basis of the economic system but then add additional ad hoc assumptions to try to tame this presumed knowledge of the future approach to better reflect what they believe is reality. Stiglitz, for example, in his asymmetric information theory assumes that some market participants cannot make the proper statistical calculations because they do not perceive the correct information about the future. In other words, Stiglitz imposes the asymmetric information condition that there are some decision makers who act while lacking the correct information about the (presumed to exist today) probability distribution of future events. Consequently these decision makers (speculative fools?) misread the future and thereby mess up the beauty of the efficient market system.

Nobel prize winner Robert Lucas [1981, p. 287] has boasted that the mainstream theory axioms are “artificial, abstract, patently unreal”. Like Nobel Laureate Samuelson, Lucas insists such unreal assumptions are the only scientific method of doing economics. Lucas insists that “Progress in economic thinking means getting better and better abstract, analogue models, not better verbal observations about the real world” [Lucas, 1981, p. 276]. The rationale underlying this argument is that these unrealistic assumptions make the problem more tractable and, with the aid of a computer, the analyst can then predict the future. Never mind that the prediction might be disastrously wrong.

In the introduction to his book *Against The Gods*, a treatise that deals with the questions of relevance of risk management techniques on Wall Street, Peter L. Bernstein [1996, p. 6] writes:

5. This is equivalent to thinking that drawing the sample of heights from a pygmy tribe in Africa is equivalent to drawing a sample of Swedish citizens' height.

“The story that I have to tell is marked all the way through by a persistent tension between those who assert that the best decisions are based on quantification and numbers, determined by the [statistical] patterns of the past, and those who based their decisions on more subjective degrees of belief about the uncertain future. This is a controversy that has never been resolved . . . to what degree should we rely on the patterns of the past to tell us what the future will be like?”

One would hope that the empirical evidence of the collapse of those “masters of the economic universe “ that have dominate Wall Street machinations for the last three decades has at least created doubt regarding the applicability of the ergodic axiom to our economic world. Even Alan Greenspan in testimony before Congress in October 2008 seems to be having second thoughts although he still has not completely changed his tune. Keynes’s ideas and Soros’s reflexivity concept support Bernstein’s latter group.

Samuelson, Lucas and others adopted the ergodic axiom because they want economics to be in the same class as the “hard sciences” such as physics or astronomy. For example the science of astronomy is based on the presumption of an ergodic stochastic process that governs the movement of all the heavenly bodies from the moment of the “Big Bang” to the day the universe ends. Accordingly probability analysis using past measurements of the movements of heavenly bodies permit astronomers to predict future solar eclipses within a few seconds of when they actually occur. Nothing Congress, the President of the United States, the United Nations, or environmentalists can do will alter the predetermined dates and time for future eclipses. For example, Congress cannot pass a law outlawing solar eclipses in order to provide more sunshine and thereby enhance crop production. In an ergodic world, all future events are already predetermined and beyond change by human action today. The future movement of the heavenly bodies can be known by anyone who has measured past movements and projected these movements into the future. There are no speculative fools, who suffering from asymmetric information, think Mars is going to crash into the earth.

George Soros has explained why the efficient market theory is not applicable to real world financial markets with a slightly different terminology than Keynes but conceptually in the same way. Soros (2008) wrote: “we must abandon the prevailing [efficient market] theory of market. behavior. ” Soros states that there is a direct connection “between market prices and the underlying reality [that] I [Soros] call reflexivity”.

What is this reflexivity? In a letter to the Editor published in the March 15-21, 1997 issue of *The Economist* Soros objects to Paul Samuelson insistence on requiring the ergodic axiom to make economics a science. Soros argues the ergodic hypothesis does not permit “the reflexive interaction between participants’ thinking and the actual state of affairs” that characterizes real world financial markets. In other words, the way people think about the market today can affect and alter the future path the market takes; the future is not predetermined. Soros’s concept of reflexivity, therefore, is the equivalent of Keynes’s rejection of the ergodic axiom⁶. Reflexivity means peoples thoughts and actions *create* the future, while

6. In place of the rejected ergodic axiom Keynes argued that when crucial economic decisions had to be made, decision makers could not merely assume that the future can be reduced to quantifiable risks calculated from already existing market data. Instead they depended on “animal spirits” since most animals do not know how to calculate the moments around the mean!

For decisions that involved potential large spending outflows or possible large income inflows that span a significant length of time, people “know” that they do not know what the future will be. They do know that for

mainstream economists presume the future has already been predetermined and can be discovered by analyzing today's market fundamentals.

Non euclidean economic theory

In creating a "NonEuclidean" economic theory to explain why these unemployment "collisions" occur in the world of experience, Keynes uses the logical deductive method but he had to deny ("throw over") the relevance of several classical axioms for understanding the real world. The classical ergodic axiom which assumes that the future is known and can be calculated as the statistical shadow of the past was one of the most important classical assertions that Keynes rejected.

Keynes's general theory is a deductive method of analysis. Keynes's concept of uncertainty about the economic future requires the economic system to be generated by a nonergodic stochastic process. At the time of his writing *The General Theory*, Keynes did not know of the ergodic stochastic theory that was being developed by the Moscow School of Probability in the 1930s. Nevertheless in his criticism of Tinbergen's [econometric] method, Keynes [1939] wrote⁷ that Tinbergen's method is not valid for any economic forecasting because economic data "are not homogeneous" over time. Non homogeneity is a sufficient condition for nonergodicity.

Taleb's Black Swan concept attempts to explain market crashes as an event lying in the far off tail of an ergodic probability distribution. It should be noted that Knight's vision of uncertainty and Taleb's Black Swan concept are both based on the ergodic presumption for the economy. Taleb's Black Swan is an already predetermined outcome but the Black Swan event is so far out in the tail of the ergodic probability distribution that its occurrence is so rare that it is never likely to be observed— except in the long run when we will all be dead. Similarly Knight's applied his uncertainty concept to an event that is "in a high degree unique"⁸ and hence so far out in the distribution as to be observed perhaps only once in several lifetimes.

For Keynes, as well as for Soros, the belief that intelligent people "know" that they cannot know the future is an essential element in understanding the operation of our economic world. For decisions that involved potential large spending outflows or possible large income inflows that span a significant length of time, people "know" that they do not know what the future will be. They do know, however, that for these important decisions, making a mistake about the future can be very costly and therefore sometimes putting off a commitment today in order to remain liquid maybe the most judicious decision possible.

Our modern capitalist society has attempted to create an arrangement that will provide people with some control over their uncertain economic destinies. In capitalist economies the use of money and legally binding money contracts to organize production, sales and purchases of goods and services permits individuals to have some control over their future cash inflows

these important decisions, making a mistake about the future can be very costly and therefore sometimes putting off a commitment by maintaining liquidity today may be the most judicious decision possible.

7. J. M. Keynes [1939], "Professor Tinbergen's Method" *Economic Journal*, 49, reprinted in *The Collected Writings of John Maynard Keynes* vol. 14, edited by D. Moggridge [Macmillan, London, 1973].

8. F. Knight, (1921), *Risk, Uncertainty and Profit* (Houghton Mifflin, New York) p.233

and outflows and therefore some control of their monetary economic future. It also enables other parties (business firms) to engage in money sales contracts with the legal promise of current and future cash inflows sufficient to meet the business firms' costs of production and generate a profit.

Households and business entrepreneurs willingly enter into money contracts because each party thinks it is in their best self-interest to fulfill the terms of the contractual agreement. If, because of some unforeseen event, either party to a contract finds itself unable or unwilling to meet its contractual commitments, then the judicial branch of the government will enforce the contract and require the defaulting party to either meet its contractual obligations or pay a sum of money sufficient to reimburse the other party for damages and losses incurred. Thus, as the biographer of Keynes, Lord Robert Skidelsky has noted, for Keynes "injustice is a matter of uncertainty, justice a matter of contractual predictability". In other words, by entering into contractual arrangements people assure themselves a measure of predictability in terms of their contractual cash inflows and outflows, even in a world of uncertainty.

Uncertainty, money contracts and liquidity

In their book, Arrow and Hahn (1971, pp. 256-7 emphasis added) wrote:

"The terms in which contracts are made matter. In particular, if money is the goods in terms of which contracts are made, then the prices of goods in terms of money are of special significance. This is not the case if we consider an economy without a past or future. . . . *If a serious monetary theory comes to be written, the fact that contracts are made in terms of money will be of considerable importance*".

Yet all mainstream models including the Arrow-Debreu model assumes people enter into "real contracts" i.e., they "know" the future real outcome with at least actuarial certainty of any contract they sign today. Thus intelligent mainstream economists such as Arrow and Hahn in emphasizing the importance of money contracts cannot help but let their common sense intervene in their view of the economy – to the detriment of their logical consistency with their general equilibrium (Arrow-Debreu-Walrasian) model.

Keynes's liquidity theory provides what Arrow and Hahn call "A serious monetary theory" for domestic and international transactions as a way of coping with an uncertain future.

Money is that thing that government decides will settle all legal money contractual obligations. An individual is said to be liquid if he/she can meet all contractual obligations as they come due. For business firms and households the maintenance of one's liquid status is of prime importance if bankruptcy is to be avoided. In our world, bankruptcy is the economic equivalent to a walk to the gallows. Maintaining one's liquidity permits a person or business firm to avoid the gallows of bankruptcy. [Yet as my good Monetarist friend Alan Meltzer has often told me "bankruptcies are good for the health of the capitalist system."]

Thus, liquidity is at the center of the operations of our monetary economy and therefore financial markets that are well organized and *orderly* permit decision makers to maintain liquidity in case some unforeseen future event should make it otherwise impossible to meet a future money contractual obligation unless they can readily sell a liquid asset for money in an orderly market system.

Keynes provided a NEW way of economic thinking to explain the operations of a monetary economy where entrepreneurs enter into nominal contracts in order to organize production and exchange activities. *The sanctity of money contracts is the essence of the capitalist system and Keynes's liquidity analysis*⁹.

In Keynes's analysis, liquidity, i.e., the ability to meet one's money contractual commitments domestically and internationally becomes an essential foundation for understanding the operation of our entrepreneurial economy. The primary function of well-organized and orderly financial and exchange rate markets is to provide liquidity so that holders of financial assets traded on such markets "know" they can make a fast exit and liquify their portfolio at a price close to the previous market price at any time they fear something bad may happen in the uncertain future. With sufficient liquidity, one can always meet one's money contractual commitments no matter what. The maintenance of one's liquid position is of prime importance if default and bankruptcy is to be avoided.

Once it is recognized that in a money using entrepreneurial economy decision makers "know" that the future is uncertain (in the nonergodic sense) and can be created in ways not even all decision makers understand, then the demand for liquidity as a security blanket to meet unforeseen possible dire net cash flow problems becomes paramount in decision makers' plans

In our uncertain economic world, by entering into forward money contracts, decision makers gain some control over their future cash inflows and outflows. If market participants think the future is more uncertain than it was yesterday, then they will try today to reduce cash outflow commitments for goods and services (save more) in order to increase their liquidity position. Faced with this reduction in market demand, businesses will reduce hiring of workers.

Blaming the messenger for the mainstream message

If the future is nonergodic, then mainstream economic theory is creating a completely artificial world remote from reality since the theory requires the ergodic axiom. Keynes [1936, p. 192] noted that classical theorists "offers us the supreme intellectual achievement, unattainable by weaker spirits, of adopting a hypothetical world remote from experience as though it were the world of experience and then lived in it consistently".

Mainstream economists are not wrong in the need for rigor in economic theorizing. It is not rigor and the use of mathematics *per se* that creates the useless economic models that make mainstream economists look so poorly. Rigor means that the only valid claims are logical deductions from specified assumptions [i.e., axioms]. Consistency and rigor are features of any deductive approach, which draws conclusions from a group of axioms – and whose empirical relevance depends entirely on the validity of the axioms.

Keynes applied rigor to his general theory – but only after he threw out three classical axioms that he felt had no empirical justification. So Keynes required induction in developing his

9. The first question for theorists, therefore, is: why are all production and exchange agreements – whether between entities in the same common currency area or between entities in nations that use different monies, sealed with contracts denominated in a specific money? Why are people in the world of experience not like the people of mainstream economic theory, where all contracts are in real terms?

theory to check on the validity of the axioms. Accordingly Keynes did not develop a completely artificial world. Unfortunately Paul Samuelson, who grasped for the Keynes mantle immediately after the Second World War, ignored Keynes general theory. As I point out in my book *The Keynes Solution; The Path to Global Economic Prosperity*, Samuelson has admitted that he found the General Theory “unpalatable” and incomprehensible. Samuelson said he merely assumed that the Keynes analysis was simply a Walrasian system with fixity of wages and prices. In so doing Samuelson aborted the Keynes revolution.

Since biblical times humans have tried to understand the world about them and what caused things that humans observed to happen. In general the human mind believes that there must be a cause for any event we observe.

For most of the history of mankind, it was believed that the design of God or the Gods was the cause of anything that happened in the world of experience. Beginning in the 17th century, however, philosophers believed that explanations of events that one observed could be developed on the basis of reasoning of the mind rather than religious belief. This was the beginning of the intellectual movement historians call The Enlightenment or The Age of Reason where order and regularity was seen to come from the human analysis of observed phenomena. The power of reason was not in the possession of truth, but in the acquisition of truth.

Any understanding of the world as humans perceive it will always be the creation of the human mind. Reasoning involves the mind creating a deductive theory to explain what people observe happening about them (using inductive views). For example, Sir Isaac Newton saw an apple fall from the bough of a tree to the ground. Newton explained why apples always fall to the ground by the theory of gravity.

A theory is the way humans describe real world observations on the basis of a model that starts with a few axioms (hopefully based on inductive reasoning from the world of experience). An axiom is an assumption accepted as a universal truth that does not need to be proved. From this axiomatic foundation, the theorist uses the laws of logic to deduce conclusions that explain what we observe in the world of experience. All theories are generally accepted in some tentative fashion. Theories are not ever conclusively established and can be replaced when events are observed that are deviations from the current existing theory. Thus, the financial crisis of 2007-2009 should have been sufficient empirical evidence to indicate that the axiomatic basis of the mainstream theory needs to be replaced.

Economic theory is an analytical device where the economic theorist builds a model by starting with some axioms that he/she accepts as a self-evident truth. The tools of logical deduction are then used to reach one or more conclusions. These conclusions are then presented to the public as the explanation of economic events that are occurring in the world of experience. The theory can then be used to suggest the cure for any real world economic problems.

Accordingly, it is perfectly acceptable to have rigor and even math in economic models – as both Marshall and Keynes had. But the axioms underlying the model must be thoroughly examined to see if they are applicable to the real world. What Samuelson, Lucas and others have done is impose axioms, such as the ergodic axiom, that have no relationship to the world we live in.

Keynes's general theory is rigorous and consistent – and once one recognizes that the future is uncertain in terms of a nonergodic stochastic process, then one can understand the self-interest of individuals is to protect themselves from an uncertain future where bankruptcy can occur if one cannot meet one's money contractual obligations in a capitalist system.

Thus money contracts (inflows and outflows) are used by individuals to protect themselves from adverse unmanageable net cash flows. The purpose of liquid assets¹⁰ traded on organized and orderly financial markets is to provide a security blanket against one's inability to meet a contractual obligation outflow.

Thus when the market for mortgage backed derivatives that were advertised to be “as good as cash” i.e., perfectly liquid (and triple A rated) collapsed, the loss of so much liquidity caused panic (a reflexivity response) in other markets for assets that had been previously thought to be very liquid. Asset holders in many markets tried to make “fast exits” and the result was a financial collapse and crisis.

In sum, Keynes's liquidity theory of the operation of financial markets is a rigorous, logically deductive system that appears to be applicable to the real world in which we live and should replace the artificial world model of Lucas and other mainstream economists.

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10. Keynes has an entire chapter in the *General Theory* entitled “The Essential Properties of Interest and Money” in which he specifically indicates that all liquid assets have certain essential mathematical properties, namely (1) the elasticity of production is zero and (2) the elasticity of substitution between liquid assets and durable producible goods is zero. Keynes specified these elasticity properties by induction via his knowledge of financial markets.