Heavens above: what equilibrium means for economics. With an appendix on temporality, equilibrium, endogeneity and exogeneity, in the inductive sciences and in economics

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HEAVENS ABOVE
WHAT EQUILIBRIUM MEANS FOR ECONOMICS WITH AN APPENDIX ON TEMPORALITY, EQUILIBRIUM, ENDOGENEITY AND EXOGENEITY, IN THE INDUCTIVE SCIENCES AND IN ECONOMICS

Alan Freeman June 14th 2015

Abstract

This paper presents in formal terms the key notions of the temporalist approach in economics as I have presented it over the years, with an appendix providing a formal definition of such terms as endogenous, exogenous, temporalism, and equilibrium. I thus hope this paper can serve as something of a reference work for these concepts as well as the key terms 'esoteric' and 'exoteric' which are widely used in my writings. The paper incorporates, but supersedes, the prepublication version of a chapter of the same name originally published in Mosini, V. (ed) 2007. "Equilibrium in Economics: Scope and Limits", with a previously unpublished appendix.

It provides the background to the argument I have made in a number of other pieces, (for example Freeman 2004, most recently Freeman 2015) to the effect that economics plays a religious, not a scientific role, in the social sciences.

I argue that the concept of equilibrium in economics plays a special and defining role in this respect which is not adequately recognised either by its defenders, nor by the critics of economics. I term this role *esoteric*, by which I mean that its primary function is not to explain what we experience or observe, but to justify it.

This is a work in progress but summarises, hopefully with as few typographical and mathematical errors as possible, the general arguments that have been developed, or deployed, in my various writings on equilibrium, self-restoration, crisis, and the esoteric function of economics, to this date.

Keywords: equilibrium, temporalism, TSSI, self-restoration, cycles, crisis, endogenous, exogenous, esoteric, exoteric, religion, science

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Introduction

This paper develops, fully and formally, a notion which I have put forward in many other works; that equilibrium is a metaphysical or metatheoretical construct, not a simple mathematical method, although it is invariably introduced in the guise of a pure mathematical technique, disguising its esoteric function.

It thereby plays a religious, or *esoteric* role, not a scientific role. Its function is to justify the state of things that we live through and observe, not to explain them (the *exoteric* function of inductive, fact-based science).

The underlying and unavoidable presupposition that is embedded in the equilibrium concept is that the market works perfectly. All markets clear, there is no force tending to move the economy from its existing state, all expectations are perfectly realised, the economy can continue reproducing indefinitely without changing, Says Law applies, all sellers find buyers, and so on.

That is to say, it is mathematically presupposed from the outset that the market is perfect. The Equilibrium concept stands opposed to the temporalist concept which manifests itself in all schools of thought either as an alternative method of analysis, or as an alternative interpretation of a major thinker, notably Marx and Keynes. The temporal method is the normal method of all other branches of science which seek, inductively, to study the facts of the world as they present themselves to our senses and as we experience them. Notably it is the method of the physical sciences, astronomy and engineering.

In the physical sciences, equilibrium is a *special case* of a temporal argument, in which, the analysis of motion having been conducted, the scientist simplifies the study of a particular case by supposing that some of the parameters are zero. The result is a so-called fixed point solution to a general, dynamic equation which usually takes the form of a difference or differential equation. In Economics, the concept is imposed differently.

The motion is never studied; instead it is pre-supposed that the motion never takes place; it is an ‘adjustment’ or an ‘imperfection’ which can be ignored and (because of the construction) in fact cannot but be ignored. All economic phenomena arising from the internal instability of dynamic economic systems are therefore eliminated by assumption and cannot be put back afterwards. The place of dynamic analysis in the inductive sciences is then taken by what is termed ‘comparative statics’ – movement from a series of static states, one after another, like the photographic stills which make up a celluloid film.

This can be thought of as follows: when a lake changes its level due to the inflow or outflow of water, we do not study the entry or exit of the water. We study only the level of the lake at a certain point in time, and then again at another point in time. This is fine for studying the levels of lakes; what it does not explain is waterfalls and storms. It leads to the conclusion, for

example, that water must always be flat. Nor can it be otherwise, because the very possibility that water can exist in any other state has been removed before the analysis is conducted.

Confronted with 'curved water' – the tumultuous movement of real water in real motion either as rain or as falls or indeed, as waves – the economist has no mathematical instrument capable of explaining the motion. Yet it is this motion that accounts for all the important observed features of the planet we live on, just as the motion of the economy accounts for all the important features of the society we live in, notably the most pernicious ones such as crisis, economic cycles, classes, inequality, the dependency of nations on each other, insoluble debt crises, and wars.

Because equilibrium is a metaphysical construct, imposing on all economic schools of thought the prior presupposition that the market works perfectly, the result is not, as is often supposed, specific to any one school of thought such as Keynesian, Marxist, or Marginalist.

Each of these schools contains an equilibrium version (ISLM Keynesianism, Sweezy-Morishima-Steedman equilibrium Marxism, Marshallian Competitive General Equilibrium) and a non-equilibrium, or temporal variant (Keynes' own economics and Kaleckian temporalism, Temporalist interpretations of Marx, Austrian marginalism, and so on). But the equilibrium approach becomes, in each case, the dominant paradigm and, as a result of the generally monotheoretic method of economics (see Freeman 2010) becomes the only version of the theory that is taught, researched, funded, published and practiced. In this way, the *whole* of economics, not just one particular school, is obliged to adopt the presupposition that the market works perfectly.

From any such theory (based on the presupposition of equilibrium), whether it be marginalist, Marxist, Keynesian, Institutionalist, Feminist, Ecological or whatsoever, the possibility of crisis cannot be deduced, since crisis constitutes an internally-generated or endogenous feature of the economy – something that the system itself generates. In consequence, for an equilibrium theory, all crises have to be caused by something external – bad monetary policy, an oil shock, price rigidities, communism, imprudent government, irrational investment behaviour – in fact a scholastic list of more or less fantastical explanations substitute themselves for the simple notion that the capitalist system creates its own problems – since once the presupposition has been introduced that the capitalist system reproduces perfectly (which is what equilibrium in fact means), it is logically impossible for that system to fail.

Equilibrium, I argue, therefore occupies the same status as the concept of God in monotheist religions; it is a shared concept among all such religions that incorporates the notion of divine perfection from the get-go. Its function is not therefore to explain the world as it exists, but to justify it. This is what I term the 'esoteric' function of economics, in which the concept of equilibrium is the absolute lynchpin, not the product of any particular school of thought.

It is precisely for this reason that pluralism cannot be reduced to the choice *between* schools of thought (Marxism 'versus' Marginalism 'versus' Keynesianism) but must include the differentiation *within* each school, most notably between the temporalist and the equilibrium variant of each such school.

The paper presents the formal properties of two counterposed ontological approaches in economics: the temporal and the equilibrium, or steady state, approach. Comparing the equilibrium view with the mediaeval concept of 'heaven' to illustrate, I show that the selection mechanisms of economic theory are dominated by esoteric or ethical-political choices rather than exoteric or explanatory choices, and that the concept of equilibrium should be understood in this light.

This paper will suggest how a natural scientist can understand the use which economics makes of the word 'equilibrium'. I will argue that a simple concept, unexceptionable for the study of many physical phenomena, has been transformed into something completely different. If, therefore, we naively expect to find it applied in economics in the same way as 'energy' in physics or 'molecule' in chemistry, as a means of describing and explaining what an impartial observer may independently verify, we will misunderstand its real significance.

My basic thesis is that the educated public makes a mistake in accepting, at face value, the claim that economics conducts itself as a science. I will argue that, as at present practiced, it conducts itself as a religion. I will argue that the concept of equilibrium[1] is the organising principle of this religion.

Testing such a controversial assertion obviously requires a definition of religion, which the enlightenment has mythologized, portraying it as rooted in fanaticism, dogma, bigotry and the substitution of scriptural authority for evidence.

This description does fits some religionists and, the truly impartial will admit, the occasional economist. However, as a way of defining and understanding what religions really do, and how they really differ from sciences, the myth is neither accurate nor complete. It arises from a political struggle, in which science and religion have been locked since the time of Galileo. It is not an objective scientific description, and has prevented both scientists and economists grasping what really distinguishes a scientific mode of enquiry from a religious one.

To try and overcome this problem, I will introduce a distinction between two functions of knowledge which, I will show, impose on our consciousness two opposed meanings for the most general abstractions which govern the way we think about our world and our society, obliging us to think as if they had only one meaning. The first function I call the *exoteric* function of knowledge. This defines a relation between society, acting as an observer, and that which society observes. In exercising the exoteric function of knowledge, the observer distinguishes herself from what is observed. To the sphere of exoteric knowledge belong most of the constructs of science – energy, gravitation, atoms, waves, and so on. Through this function of knowledge, society arranges to control nature. The second I call the *esoteric* function of knowledge, which defines a relation between society and itself. In exercising the esoteric function of knowledge, humans become collectively self-conscious and no longer maintain the distinction between the observer and that which is observed. They organise, within a rational structure, systems of law, ethics, morality, and their relations to each other.

With regard to economics, my central thesis is that the esoteric function of equilibrium predominates over the exoteric and that, therefore, to understand the concept as applied in economics, one must unearth its esoteric meaning. Attempts to grasp its significance by approaching it as a purely descriptive instrument are therefore foredoomed.

[1] By the word 'equilibrium' I mean the concept of general or static equilibrium. This refers to a hypothetical static state of the market in which the prices at which goods exchange, and the quantities of goods consumed, are such that there is no reason for these prices and quantities to change. Figuratively speaking, this implies that all 'forces' tending to change exactly cancel each other out, so that motion ceases.

To convince my readers of this point I invite them to discard two simplistic ideas. The first is the enlightenment myth outlined above: that what distinguishes religion from science is irrationality and contempt for evidence. Writers such as Barbour (1990) have effectively demolished this idea, which we will examine further in considering the history of cosmological debate during the time of Galileo. The second such idea is that which economics has crudely adapted from Popper, that 'normative' or ethical judgements stand outside the realm of science. The standard formulation of this view is that:

> *"Normative economics involves ethical precepts and value judgements…there are no right and wrong answers to these questions because they involve ethics and values rather than facts. These issues can be debated, but they can never be settled by science." (Samuelson and Nordhaus: 1992, p. 9)*

A study of the process by which economics selects its theories shows that the normative-positive distinction does not play the role proposed for it. Allegedly positive concepts such as 'market' refer not to anything actual but to an idealised, self-regulating market which does not and cannot exist. This is used, in the formulation of policy, as a standard against which actual markets are judged, so that policies are framed to modify these 'imperfect' markets by bringing them into conformity with this ideal. This notion of 'market' is not a normal abstraction, any more than the idea that a horse is an imperfect unicorn.[2] It does not describe the common properties of all species of market but is logically grounded in properties possessed by no market. It is a normative standard.

On the other hand, ethical propositions such as 'society should be more equal' are fully amenable to rational and evidence-based judgement, once one asks questions such as 'is such a state of affairs actually possible?'; 'what would we have to do, in order to bring it about?' or 'what would happen if we tried to bring it about?' Samuelson's assertion that such questions fall outside of science amounts to a claim that ethics has no rational foundation, which few philosophers concede. It is an abdication of any responsibility of the scientist in the ethical sphere. In fact if a precept such as equality permits us to reorganise society, in the same way that an architect can construct a socially functional and aesthetically pleasing building, then this is a scientifically valid precept. An equal society may not now, exoterically, exist. But if, transformed into a policy, the principle of equality can be embedded in a system of laws, morals and economic relations which bring an equal society into being, then the outcome would conform to the concept, and this would confirm its validity. If on the other hand it were proposed to construct a society without agriculture, this would be dangerously utopian, because there is sound evidence that it cannot be done.

The real problem can now be restated. Experience has shown us that we may *neither* exoterically explain, *nor* esoterically organise, a market economy around theories which rest on the ideal of general, static equilibrium. There have been many attempts to do so, including the programme of financial and economic liberalisation which dominated the last part of the previous millennium and is normally referred to as 'globalisation'. They have all failed.

[2] I am indebted to John Weeks for this analogy

I therefore sustain that i*n no sense* is equilibrium a valid conception, neither as description nor as prescription. It is not, in some deep sense, a 'possible' abstraction. There *is* no such thing as a market economy which is either governed, or governable, by its hypothetical equilibrium state. This is not the outcome of a failure of will. It is a consequence of objective properties of the market which manifest themselves in both exoteric and esoteric applications of equilibrium theory. This theory is therefore wrong absolutely, in the same simple that flat earth theory is wrong: when we act on it, we find that what we expect to happen, does not happen. We find that a state of society, which we expect to arise from our actions, does not arise.

Yet economics persists in using the abstraction of equilibrium as if it really did or can describe, in some sense, what markets actually could do, if appropriately governed. The issue is then this: why does a well-paid profession organise itself around the intellectual fiction that an unattainable ideal is a practical approximation to the truth? And, given that the concept of static general equilibrium plays no actual role in describing the society we live in, what is its real meaning for economists? The purpose of this paper is to suggest an explanation for this paradoxical fact and an answer to this difficult question.

Does heaven exist?

To illustrate the difficulties, let us suppose that a team of modern scientists set out to research what 'heaven' meant in mediaeval times. A first, simplistic approach would be to treat it as a protoscientific construct whose purpose is to explain how the stars, planets, moon and sun appeared to move. The pre-Copernican, Ptolemaic system of cosmology, which placed the earth at the centre of the Universe and had the stars fixed in the heavens moving slowly around it, is a rather good approximation to observed reality. It tells us when stars and planets rise and set, and where to find them as the years roll on: it accurately predicts their positions, the seasons, the phases of the moon, and even eclipses. Taking this approach our team could deconstruct works such as Sacrobosco's *Sphaera*[3] (in its day the standard reference work on cosmic motion) as a literal description of planetary, stellar and lunar movements, and would find it tolerably accurate in predicting these movements.

Our team of practical-minded scientists could easily conclude that the word 'heaven' was in its time just a mediaeval synonym for what we now call 'outer space' – in exactly the same way that modern scientists, when they first encounter the concept of 'equilibrium', conclude it is merely an economic synonym for an equivalent physical concept.

This judgement would be contradicted by a different use of the word 'heaven' which figures in the writings of the time – not only in church doctrines but in the common speech of rulers, judges, and ordinary people. In this use, heaven is a sacred term. It was, our team would report, the home of a non-existent prime mover of the universe; literally, God's home. It was the place that good Christians were supposed to go to when they die. Moreover this usage had real and extensive social effects. It shaped history. Millions of people went to extraordinary

[3] See Lattis (1994:249)

lengths – donating house and home, launching Crusades, embarking on long and risky pilgrimages, and spending fortunes on indulgences[4] – to get into 'heaven' when dead. Heavenly origin was primary proof of secular authority, as is clear from the doctrine of the divine right of kings.

Our team would have to acknowledge that the word 'heaven' had two meanings. On the one hand it conveyed a spatial configuration: 'earth' referred to the world below: those parts of the universe which were physically at its known centre and could be reached by traversing its known surface; 'heaven' referred to the distant and inaccessible parts.

But on the other hand it was an organising principle of the social order. It was assumed, as beyond doubt, that the distant, infinite, and inaccessible parts of the universe were composed of a superior substance which Aristotle called 'quintessence' or the fifth element[5] – in short, they were perfect. 'Heaven' thus defined is no more irrational than the other four elements Earth, Air, Fire and Water. On the basis of 'heaven' conceived as the realm of perfect substance, Western society constructed an ideal whose logical premise was the idea that those people and classes most qualified to own and to govern were those who could trace their origins and their policies to the eternal state of the skies above.[6]

No modern Christian promotes the idea that God and Paradise may literally and geographically be found in outer space or among the planets. This would be a blasphemous idea, since it would situate God, whose essence is perfection freed of material limitation, in an imperfect material space amidst lumps of inanimate rock and stellar dust. But in mediaeval times the identity of heaven and divinity was *literal*; people saw no need to make a distinction. The skies themselves were thought to be composed of the most perfect substance and there was no contradiction in placing God in them. The heavens were direct evidence of divine perfection.

We thus have a problem, which as this paper unfolds will become the core of our approach to the concept of equilibrium in economics. The word 'heaven' in mediaeval thought actually had two meanings which people saw no need to distinguish. On the one hand it explained and predicted what people – more precisely, society – observed when it looked upwards. But it had another meaning which cannot simply dismissed as superstition or ignorance. This meaning came to the fore when society had to specify, to its citizens, what was right and what was wrong: what they may and may not do, and the reasons why. 'Heaven' also signified the realm of perfection and, in this role, it was the logical foundation of the mediaeval system of law, morality, and social relations.

[4] An interesting PhD topic would be to apply modern utility theory to the demand and supply of indulgences in the early modern epoch.

[5] Lattis (1994:54)

[6] Cf Farringdon (1939) for a particularly clear exegesis of this point.

Paradigm change

In the course of time, it became necessary to make a distinction between the two meanings of heaven. By the time Galileo Galilei began constructing his controversial defence of Copernicus' revolutionary theories,[7] most writers about astronomy were fully aware that the model they had been using for many centuries was seriously wanting. They approached the decision in a way that modern science would not find altogether foreign; they considered a variety of hypotheses, considered the predictions that these hypotheses gave rise to, and assessed their likelihood in a logical manner. Nor were they unaware of Copernicus' theory or unsympathetic to Galileo's defence of it. The Pope so enjoyed Galileo's early writings that he had them read to him in his bath.

We must now grapple with a difficult point. As noted in the introduction, enlightenment mythology has rewritten the story of Galileo as a simple battle between the forces of reason and light, represented by Copernicanism, and the forces of darkness and superstition, represented by the Catholic Church.

This mythic enlightenment history was carefully constructed by Galileo's faithful student Viviano in order to marshal forces for the political battle which protestantism successfully concluded against Catholicism and whose purpose was, in essence to take away the church's right to interfere in the pursuit of exoteric knowledge. This battle became a general project of rationalism and was adopted by the left wing of the workers' movement, as can be seen in Bertold Brecht's retelling of the Galileo fable. According to this mythology the church is a simple instrument of clerical reaction. It was not scientific for the simple reason that it was uninterested in truth.

This mythology is now being carefully re-examined. Writers such as Drake (1999) and Sobel (1999) have pointed out that Galileo himself was a devout catholic and sought not to exclude the church from science but to protect it from adopting wrong ideas which he (rightly) believed would utterly discredit it. They and Lattis (1994) have shown that the church in turn was far from wilfully ignorant of the key cosmological issues at stake, and was no stranger at all to rational and evidence-based discussion. It is inadequate to present the church's opposition to Copernicanism as a simple battle between the force of informed reason and prejudiced reaction.

It is not even the case that science is universally pursued by scientists and religion by religionists – most if not all of Galileo's protagonists were themselves religionists, but of a different, protestant, persuasion. Galileo himself was a sincere pious man.[8] Since we find, in history, religionists pursuing a scientific mode of enquiry, we should not discount the possibility of finding scientists pursuing a religious mode of enquiry. When we understand where the distinction between the religious and the scientific mode of enquiry really does lie,

[7] The word 'revolution' itself in modern speech derives from the title of Copernicus' major work 'On the Revolution of the Heavenly Spheres'

[8] like Newton, guru of enlightenment mythology and a devout if secretive follower of the Arian heresy. Cf. Fara (2002)

we are driven to realise that economics, as it now conducts itself, falls on the wrong side of the divide.

In a very fundamental sense the catholic church did get it wrong, because the heavens really do not revolve about the earth, and it forbade people to say that. It imposed a wrong mode of enquiry, which it finally admitted in 1992. It is this mode of enquiry that I believe can rightly be characterised as religious and not scientific. The question is, in precisely what sense was this so? The distinction does not lie, I would argue, where enlightenment mythology has placed it. We are not adequately served by a crude counter-position between science which is positivist, rational, and right, and religion which is normative, irrational, and wrong.

The definition I will advance is that a mode of enquiry can be characterised as religious when it can be demonstrated that *esoteric considerations dominate over exoteric considerations in its selection of theories.*

My basic approach is to shift the focus from the nature of the knowledge and theories deployed by religious and scientific enquiry as such, to the process by which these theories are selected. In this, the ground has been prepared by Thomas Kuhn's (1962) pathbreaking account of 'paradigm change', of which no scientist can fail to be aware.

Kuhn's fundamental insight is that scientists themselves do not behave as simple Popperian positivists. They do not in fact simply drop one explanation as soon as the facts refute it, and pick up another superior explanation. Science, as an organised social body, passes through periods of intense competition between rival explanations, at the end of which the new explanation triumphs over the old.

But Kuhn himself goes to the opposite extreme of enlightenment mythology. He presents the Copernican revolution merely as one instance of a scientific paradigm change. Why didn't scientists simply abandon the Ptolemaic view immediately? Because, according to Kuhn, that is what scientists do. This is how science progresses.

There are two problems. First, Kuhn never considers the social sciences, which means the evidence is somewhat incomplete. Second, the transition to Copernicanism, which he presents almost as an archetype in his study of science, does not conform to the pattern of the other scientific revolutions which he studies. The Galilean heresy was not adopted in the same way as the wave theory of light, or oxygen, or relativity, or any other more modern scientific doctrine. Both the process of change, and the factors that governed it, were quite different.

The debate on relativity was over in less than a generation. Michelson first asserted that the velocity of light was constant in 1880, and proved it with Morley in 1887. Poincaré more or less correctly formulated modern doctrine in 1898. Einstein published the special theory in 1905. By 1920 the new theories were more or less universally accepted in the scientific world.[9] The transition thus lasted, at an absolute maximum, fifty years. But Copernicus' work predates the victory of Galileo's version of it by two hundred years, and was moreover originally available two thousand years earlier, when it was first advanced by Aristarchus of

[9] Cf. <http://www-groups.dcs.st-and.ac.uk/~history/HistTopics/Special_relativity.html>

Samos,[10] only to be suppressed at the instigation of the Greek oligarchs. The transition was the longest in scientific history.

Moreover Copernicanism, which was fully known and understood by pre-Galilean scholars, was not 'rejected' through some process of natural selection. It was suppressed. The Holy Office in 1616

> *"Judged formally heretical the proposition that the sun is the center of the world and completely immovable by local motion. At the same time they judged erroneous in faith the proposition that the earth is neither the center of the cosmos nor immovable but moves as a whole and with a diurnal motion (Lattis 1994:139)"*

The Congregation of the Index in the same year condemned Foscarini's pro-Copernican book and suspended 'until corrected' Copernicus's own *de revolutionibus.* Galileo was not simply rejected for publication or passed over for promotion: he was instructed to recant, placed under house arrest and solemnly forbidden to disseminate his ideas. Copernicus's works were condemned as heresy and their promulgation prohibited for centuries.

The decisive question is: by what actual process were Galileo's views rejected? How did the church and its scholars actually arrive at these decisions? The purely intellectual, exoteric debate cannot be ripped out of this social, political and esoteric context. When this question is asked, we can begin to grasp why, despite its scholarly and logical approach, mediaeval cosmology cannot be treated as a simple body of scientific knowledge.

Scientific and religious processes of paradigm change

Resistance to heliocentrism did not centre on observational accuracy at all. It centred on the esoteric significance of the substance of heaven. Faced with alternative hypotheses about reality, both of them logical and both containing an explanation of what could be observed, the choice made by the church was determined by what these hypotheses conveyed about the social order. If the very heavens are corrupt, then mere human imperfection requires neither king nor cardinal, emperor nor pope, to right it. Ptolemaic cosmology was defended because it conferred on the papacy authority as lawgiver and arbitrator in the never-ending disputes between the kings, queens, emperors, knights, and other temporal rulers of the imperfect earth.

Moreover this approach to heaven was not simply 'arrived at by observation'. It was consciously introduced Plato, who requires that the gods should reside in the heavens precisely in order to make them inaccessible to the common people:

> *"When you and I try to prove the existence of the gods by pointing to these very objects – sun, moon, stars and earth – as instances of deity and divinity, people who have been converted by these scientists [Anaxagoras -AF] will assert that these things are simply earth and stone, incapable of paying any heed to human affairs" (*Laws *10:886D cited in Sambursky(1987:54))*

[10] See for example Sambursky (1987)

Plato's answer makes clear his concern. Greek heliocentric cosmology, adopted with scant modification by early christianity, was never merely a theory of nature. It was simultaneously a theory of society. It was an account of human conduct, of the social order. Plato is cynically explicit: people must believe that the heavens are perfect, because otherwise they will not accept them as the abode of astral gods.

As such it was the foundation of a rational and law-governed system. When deciding on such questions as the legitimacy of succession or the punishment of crime, the pope and his agents referred not to arbitrary tyrannical whim but to scripture, precedent and scholarly interpretation – in short, law. It is of course true that the church was notorious for its blatant disregard of its own laws.[11] Nevertheless, if what was involved was a simple fraud, we cannot explain why, when church decisions appeared wrong, they were challenged and opposed on the precise grounds that they contradicted divine law. Most struggles both against and within the church, until very late in history, took the form of disputes not about its right to legislate but the way it chose to interpret the law – that is, they accepted the logical premise and even the manner of reasoning, disputing only its application.

Does this imply that in the two thousand intervening years, science was set aside for political expediency? The evidence does not support this. One only has to read the debates among the Ptolemaic astronomers to realise that they passionately believed their theories. The point is, however, that they simultaneously understood these theories as an exoteric account of what the heavens really consisted of, and as an esoteric account of their own status on earth as observers of these same heavens.

To displace the earth from the centre of the universe did not just deprive Plato's successors and Galileo's peers of an explanation of material movement; it deprived them of an explanation of why they were there to observe it. Political expediency then intersected this theoretical dilemma, not as in enlightenment mythology as the crude suppression of obvious truth, but as the determinant of the selection mechanism. It was simply *easier,* and more likely to lead to a productive career, for an astronomer of the day to skirt round and avoid theories and ideas which might well deprive him of office, income and, possibly, his life. As Lattis notes

> *"Before the condemnation [of 1616, see above – AF] they [the Jesuit astronomers] would have had to be somewhat cautious about expressing Copernican sympathies in part so as not to offend collegial sensibilities in the Collegio Romano. But the automatic and obligatory anti-Copernican prejudice after the condemnation effectively forced them not to consider that alternative at all." (Lattis 1994:202)*

In just the same way today it is simply *easier* for a promising young economist discretely to steer clear of the heretical ideas of Marx, the radical readings of Keynes, or the uncomfortable conclusions of the Austrians. What leads to publication, promotion, and funding are theories which do not provoke existential angst among politicians and bankers. But these career-determinate selection mechanisms constitute the actual social and political process by means of which an economic theory is arrived at.

[11] See for example Chamberlain (2003)

The economist of today, like the astronomer of yesterday, perceives she has a choice between alternative theories. Yet a selection mechanism operates, then as now, which operates by determining the range of alternatives which the profession considers it legitimate to consider and, not least, for which it can secure admission, funding, fame and promotion. When one steps back and views the process as a whole, the outcome of the selection process is to favour those theories whose esoteric functions perpetuate the existing order and its interests. Just as the Ptolemaic system was a theology and not a science, not because it was observationally inferior but because in the social process which preserved it, its esoteric properties dominated its exoteric properties, in the same manner, I will argue, the concept of equilibrium is, as currently defended and applied within economics, in a theological and not a scientific manner and is, therefore, only to be understood by unearthing its significance for the social order.

Equilibrium and temporal paradigms stated and compared

This second part of this paper aims to demonstrate that the concept of 'equilibrium' has played the same role in economics as the idea of 'heaven' in mediaeval cosmology.

I set aside an innocent use of the concept which borrows from the natural sciences, and which involves the idea of equal but opposed forces operating at a particular point – for example in fixing the price of one good. Sometimes known as 'partial equilibrium', this idea has no necessary ideological implications. In modern economics, however, the idea developed under the influence of Walras and Marshall into a more general conception which has transformed it into something altogether different. This is the idea of 'general equilibrium', sometimes known as comparative statics. Its earliest form was the doctrine against which both Marx and Keynes alike railed at great length, and was originally known as Say's Law, widely regarded as a prototype of all later theories of general static equilibrium.[12]

In the physical sciences the idea is associated with a relation between force and movement. But economics has stripped away this meaning to reveal an absolute logical core, namely the *absence of movement.* The basic idea of general equilibrium is that we should abstract from movement by means of a particular device, which is to suppose that this movement has stopped. General equilibrium then solves a set of simultaneous equations expressing this condition by supposing that the prices charged and the quantities sold – including the jobs performed – are the same at the end of a given period of time as they were at the beginning. It then solves for those prices and quantities which would allow such an economy to exist.

An analogy might be the following: if we want to know in the most general sense how a body of water behaves (for example to decide how much concrete to put in a dam) then we do not want to be preoccupied with random disturbances such as waves; we should therefore treat the body of water as if it was a still and flat lake.

This is not to say that the equilibrium economist does not wish to study change. She studies it, however, as the difference between two static states. Continuing the analogy of the lake, one may wish to know, for example, whether it will be necessary to build a stronger dam if the

[12] See Sowell (1972)

lake is made six feet deeper. One is not interested in what happens while the lake is filling up; only in what will happen to the dam, when the extra six feet of water have been added. In the same way, an economist does not interest herself in the way prices will 'adjust' if the government increases tax from 20 to 23 per cent. She asks only what difference exists between two ideal models of the economy; in one of these models, tax is 20 per cent. All prices, job levels and quantities consumed are supposed static. In the second model, tax is 23 per cent. All prices and quantities are again static, but at a different level.

The idea introduces a key ideological presupposition by the back door, in assuming that a static state may ever be arrived at. It supposes in advance, in effect, that the market works. It this introduces a *petitio principii*: it assumes the market is perfect in order to study the cause of imperfection. This is the key to the esoteric properties of the equilibrium paradigm. I draw attention to four of its key properties.

(1) some variables are in fact allowed to change – in the above example, the tax rate. In other models this might be technology, or consumer preferences, or entrepreneurial behaviour. Thus the economist separates her or his variables into two broad groups: the *exogenous* variables, which are determined from outside the economy by politics, culture or psychology, and the *endogenous* variables – usually prices and quantities – which respond to these exogenous changes by adjusting their levels. Thus we can be more precise about the elimination of dynamics: such models assume away all dynamic effects of the endogenous variables

(2) the movement of prices, jobs and quantities is not just unimportant – it is eliminated. In reality, changing the tax rate will provoke a more or less disruptive shift in prices and employment, launching it on a path different at all points from either hypothetical static state. These disruptions may or may not produce lasting effects. There exist, however, decisive phenomena – long-term unemployment, business cycles, world inequality, the prolonged phases of declining profit rates sometimes identified with Kondratieff waves, and so on – which cannot be explained in any other way except to recognise that dynamic or 'path-dependent' effects, as they are known, do indeed produce lasting effects of enormous importance to the world we live in. In an equilibrium theory, these effects do not and cannot exist. The theory simply cannot express them. All dynamic effects are assumed away *a priori* and cannot subsequently be reintroduced. To pursue the analogy of the lake, therefore, the theory cannot explain the phenomenon of a waterfall or a river.

(3) In consequence, all such theories must necessarily attribute to an external cause any deviation of the market from the equilibrium ideal. In them, the exogenous variables are the only possible source of motion, so that they bear the entire weight of explaining what really goes on. To pursue the analogy to its conclusion, the economist would have to explain curved water, as seen in waterfalls, by arguing that somebody bent it. Economic theory and policy is a litany of non-market causes for the market's problems – bad governance, poor monetary regulation, terrorism, oil shocks, trade unions, regulatory régime – everything but the market itself.

It is useful to summarise this system mathematically. A mathematical formulation, properly applied, encompasses the most general properties of all equilibrium systems. It therefore exposes what is necessarily and logically common to all such systems. It is then incumbent on any economist that disputes the conclusions, or wishes to claim that they do not apply to a particular model or branch of economic theory, either to demonstrate a flaw in the mathematical logic, or to demonstrate that the particular model which she or he wishes to defend against my conclusions, is not a system of this type.

This extends to systems such as rational expectations which do not explicitly declare themselves as equilibrium systems. Rational expectations supposes that agents act in such a way that their actions result in a future state of affairs which confirm these actions, generating demands and supplies which do not lead to any general excess of either. A society that conforms to this supposition is defined by a set of simultaneous equations which express the condition that demand and supply balance in all sectors and is hence covered by the mathematical formulation given below. Whether or not such a system is etymologically described by its proponents as a general equilibrium system it is mathematically and logically identical to one.

By providing a mathematical statement of an equilibrium system I offer a definition of the conception of equilibrium to which this paper refers. Other scholars are at liberty to advance theses about the alternative concepts of equilibrium in economics which depart from this definition, and if adopted, such ideas may even free economics of its esoteric prejudices. However this paper concerns the actual role that the concept of equilibrium has played in the evolution of economic thought. Moreover my formalisation conforms to the version advanced by equilibrium's foremost advocates, notably Walras and the school of Arrow and Debreu,[13] which are widely accepted by economists as the 'standard' version of the theory.[14]

I will then show, in support of the claim that economics makes its choices esoterically and not exoterically, that in a series of major debates where the profession has been obliged to choose between a general equilibrium system (as mathematically defined below and regardless of the terminology introduced to describe it), and an alternative not subject to any of its limitations, it has in every case opted to choose the equilibrium variant. This is a general pattern. It establishes that faced with two generic alternative approaches, economics almost invariably opts for one of them. I will argue that the basis of this choice is not the exoteric properties of the variant adopted, but its esoteric properties, that is, the account of the social order which is concealed within it. [15]

[13] See Debreu (1959)

[14] See for example Eatwell, Milgate and Newman (1989)

[15] It has been argued that modern economics no longer uses the concept of equilibrium and that therefore, the conclusions of this paper regarding economics no longer hold. This is first of all disputable. We are concerned not just with systems that adopt the self-description 'equilibrium' but with all formally analogous systems such as rational expectations theory, which adopt the method outlined in our mathematical formalisation. Secondly economists do in fact repeatedly, in popular and pathbreaking modern works, very explicitly apply equilibrium theories as, for example, in New Trade Theory (see Fujita, Krugman and Venables 1999) and in Monopsony theories of wage determination (see Manning 2003). Thirdly, we are concerned with the history of economics. If its practice has changed in the last five years this is excellent if unexpected news, but this does not in any way

I will specify two generic types of system: an *equilibrium* or *simultaneous* system and a *temporal* system. These two systems, applied to more or less any body of economic ideas, provide different predictive paradigms yielding alternative quantitative predictions of reality.

Suppose some general dynamic system contains variables of two types: exogenous and endogenous. The endogenous variables are all those that the economist thinks of as intrinsic to the market – prices, quantities produced, labour inputs, profits, the interest rate, wages, and so on. Let the state vector of all these variables at time t be x_t.[16]

The exogenous variables are all the rest. In a marginalist or Walrasian framework these consist of consumer preferences and production functions. In a physicalist or Sraffian framework they consist of physical quantities of inputs and outputs. In a rational expectations framework they consist of agent predictions of the supply and demand for products. In general there is no specific limitation on what may be included. The critical mathematical property of an exogenous variable is simply that, in distinction from an endogenous variable, its value at one time is permitted to be dependent on its value at another time.

Let the state vector of all these variables at time t be a_t. Now write down a general dynamic equation for the system:

$$x_t = f(a_t; x_{t-1}) \qquad (1)$$

The function f constitutes the economists' theory: that is, it tells us in what state the economy will be at any given time, as a function of the present value of the exogenous variables, the past value of the endogenous variables. This is perfectly determinate for any f and a, given an initial condition at some time t=0. Such a system provides a *temporal* determination of the endogenous variables x_t given by the parameters a and the initial state of x.

There is a different approach which is, in fact, a special case of the temporal view. If we abstract from all effects resulting from changes in x_t we can assume that

$$x_t = x_{t-1}$$

This gives us a *fixed-point* equation

$$x_t^* = f(a_t; x_t^*) \qquad (2)$$

A very general theorem in mathematical topology tells us that for all parameters a and a very general variety of functions f,[17] a solution x_t^* exists to this equation.[18] Thus it solves the

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offset the evidence of two hundred years of previous evolution. Fourthly, the topic of this book is to assess the concept of equilibrium. If this concept has vanished from the present, it is hard to see what choice we have but to seek it in the past.

[16] x_t may contain differences or derivatives of its other components for example $x_t = \{p_t, p_{t-1}\}$ or $\{ p_t', p_{t-1}'\}$. This convention makes it easier to express dynamic relationships of order greater than 1.

[17] Specifically, f should be a convex mapping whose domain has an Euler Number of zero. This is wide-ranging but it should be noted is more restrictive than the condition for a temporal solution to exist.

[18] The theorem is colloquially known as the hairy ball theorem, because it proves that you cannot comb a ball covered in hair without leaving at least one hair sticking up. There may be more than one fixed point (many hairs may stand up); the equilibria may be stable (the hairs come to a point) or unstable (the hairs sprout) but at least one hair must stand straight up. See <http://tinyurl.com/qxm79> (accessed 23/03/2006) or a more light-hearted version on <http://tinyurl.com/8jb8k> (accessed 23/03.2006)

'quantitative' problem – it allows us to calculate the variables. It gives a prediction. This prediction is of course false, but can be treated like any prediction as an 'approximation' – as something to which reality is close, but from which for various reasons reality departs. This is in formal mathematical terms what economics really means when it uses the word 'equilibrium'.

In Galileo's terms the temporal and the equilibrium approaches are two different 'world systems'. This is the most important thing for any natural scientist to grasp, when grappling with what equilibrium in economics is really about. They produce different ways of thinking about the world, different ontological systems, both exoterically and esoterically. However the differences are not confined to meaning. They produce different and verifiable predictions; in excluding temporal approaches from consideration, therefore, economics ceases to be a science even in the narrow Popperian sense, because it excludes the possibility of that the equilibrium prediction may be falsified by comparing it with the temporal prediction.

In the actual translation of these two systems into practical economic paradigms, as noted above it is accepted that reality will deviate from the predictions of the model. Disputes between the two paradigms thus reduce to the meaning which is assigned to the deviation. For the temporal system, the model is generally considered to predict the *average* in some sense of the observed variable, so that observed reality can be modelled as:

$$\begin{aligned} \bar{x}_t &= f(a_t; \bar{x}_{t-1}) \\ x &= \bar{x}_t + \varepsilon_t \end{aligned} \qquad \text{(1a)}$$

for the equilibrium system, reality is modelled by

$$x_t^* = f(a_t; x_t^*)$$

$$x = x^* + \varepsilon_t^*$$

$\bar{x}_t$ is an exoteric observable, so all elements of any temporal paradigm are directly accessible to observation and measurement. x^* is an esoteric ideal, by definition not observable, since it represents a state that the system never occupies.

In equilibrium systems, this esoteric ideal is conceptually thought of being the same as the centre of gravity or time average and indeed, it is generally not accepted that the two may diverge. In fact they do, as it is mathematically easy to demonstrate. To be precise, the fixed point coincides with the time average only for a limited range of functions *f* and time-paths of the parameters *a*, and above all not when these show secular, that is, monotonic, variation. If such cases – as when, for example, *a* stands for technical productivity, which generally rises throughout the history of capitalism – the predictions of the two systems, for example their prediction of the average profit rate, simply diverge.

The major qualitative predictions of equilibrium systems definitely are therefore directly falsifiable in the Popperian sense: in particular they do not predict self-sustaining economic periodicity (crisis), secular growth in income polarisation, or prolonged periods of stagnation or high unemployment. Equilibrium theory, however, deals with this contradiction through

the meaning assigned to the error term ε_t which is, in effect, treated as a measure of deviation from perfection, as a consequence of non-market and external effects.

Thus in summary the temporal and equilibrium determination of quantitative results are not the same; they give rise to different predictions and are hence testable hypotheses, in the Popperian sense. Nevertheless, they give rise to two sets of meanings for all those variables which are endogenous to the system. $\bar{x}_t$ and x_t^* are not merely different numbers, they provide different ways of thinking about the objects to which they refer.

Exoteric properties of the equilibrium paradigm

The exoteric failures of economics are part of everyday life. In the words of Paul Ormerod (1994):

> *"Economists from the International Monetary Fund and the World Bank preach salvation through the market to the Third World … Yet economic forecasts are the subject of open derision. Throughout the Western world, their accuracy is appalling. Within the past twelve months alone, as this book is being written, forecasters have failed to predict the Japanese recession, the strength of the American recovery, the depth of the collapse in the German economy, and the turmoil in the European ERM."*

Everyone makes mistakes. Thomas Watson, IBM's founder, is alleged to have said that the best way to double your rate of success is to double your rate of failure, a *nostrum* which appears to be the guiding principle of much international economic policy. What distinguishes science from dogma, however, is the mechanism – above all but not only when confronted with failure – which leads to changes in theory. What does economics actually do? I submit that, in virtually every school and every subject, faced with the choice between temporal and equilibrium paradigmatic variants, it either adopts the equilibrium variant immediately or gravitates rapidly towards it without testing the temporal variant; or even worse, having tested this variant it nevertheless excludes it from consideration. To take a few examples:[19]

1. The debate around Say's law. Keynes' well-known demolition of this law is accompanied by a mini-history which clearly shows how opposition to this absurd thesis was confined to a tiny minority of economists. Today, few explicitly defend Say's law as such following the experience of the Great Depression. Yet Say's fundamental conclusion is more or less standard orthodoxy and is expressed in the view that the cause of every crisis is, ultimately, governance. That is, it is an almost universal tenet of economic faith that a market economy cannot and does not produce either a general glut of products, nor a general shortage of jobs, from within itself.

2. Marginalism; the founders of marginalism themselves, such as Böhm-Bawerk, were temporalists. Böhm-Bawerk considered simultaneous (equilibrium) analysis 'a mortal sin

[19] A comprehensive list is provided in Freeman (2004)

against logic'. Yet today temporal marginalism – Austrian economics – is confined to the work of an isolated minority.[20]

3. Marx's determination of value is temporal through and through. In 1905 von Bortkiewicz first published a 'correction', replacing it by a system of simultaneous equations. Although this determination contains insoluble contradictions not present in Marx's own theory, and fails (unlike Marx's theory) to yield an explanation of the clearly-observable phenomenon of long-term declines in the profit rate, economists – not least, Marxist economists – have since Sweezy's (1942) endorsement of the Bortkiewicz interpretation almost universally accepted this as Marx's own view.[21]

4. Keynes: it is only within a non-equilibrium interpretation that it is possible unequivocally to explain the phenomenon of long-term and large-scale involuntary unemployment.[22] Indeed the whole point is that the assumption of full employment is itself an equilibrium condition. Yet within a few years of the publication of the *General Theory*, Hicks had already re-theorised it as an equilibrium model, and since then every generation of students is basically told that Keynes 'is' the ISLM interpretation proposed by Hicks.[23]

5. Real Business Cycle models: the field of economic dynamics is one of the few where it remains possible to test and compare the predictions of endogenous non-equilibrium models with those for which all cyclic phenomena are essentially the result of external shocks. Yet despite the generally very poor and limited practical validity of RBC models, which assume that cyclic behaviour is a disturbance of equilibrium propagated through time, they remain the dominant paradigm in the field.

6. Rational expectations: one of the principle instruments for inserting non-equilibrium analysis into Keynes' framework is the uncertainty of the future. Rational expectations puts this genie back in the bottle, by supposing that whatever agents believe about the future, is in fact what will actually happen.[24] Uncertainty, thereby, is eliminated by supposing it does not exist, a novel take on a hundred years of quantum mechanics. Equally startling is the evolution of 'non-equilibrium Walrasian' approaches which had a promising beginning and have virtually vanished from the intellectual scene. Five years ago I asked one of the founders why nothing more is being published in this school. 'because unless the words "Rational Expectations" are in the title, no-one will publish it' – came the answer.

7. Perhaps the only promising recent development has come in recent econometrics with a real recognition that time-series analysis on simultaneous equation lines introduced

[20] For a clear account of the difference between the Austrian and General Equilibrium view, together with an excellent account of the practical exoteric predictive differences between the two systems, see O'Driscoll and Rizzo (1985).

[21] See Freeman and Carchedi (1995) and Freeman, Kliman and Wells (2004), as well as the extensive papers to be found at <www.iwgvt.org> (accessed 22/02/2006) and <http://akliman.squarespace.com/> (accessed 22/02/06)

[22] Cf Patinkin (1965) for a clear statement of this point.

[23] See Davidson (1991)

[24] See O'Driscoll and Gorman (1991:213-220) for a clear discussion of this.

insurmountable problems of serial correlation. But this was known eighty years ago. 'Process theory' gave way to Haavelmo's simultaneous equation approach, which was standard until very recently.[25]

These 'choices' may be wrong, or they may be right. The point is that they were not dictated by observation or evidence. The triumph of the equilibrium paradigm is entirely due to its esoteric, and not its exoteric properties. We may view the history of economics as, in essence, a succession of 'large choices' of the Kuhnian type between broad paradigms in which, empirically, the choice made is always the equilibrium variant. Having made a large choice, economics may conduct a great deal of very practical work to explain ε, the deviation from prediction. This is scientifically objective and collects data, produces many regressions, tests many hypotheses, and turns out useful results. But it never returns to the basic theoretical question: does the esoteric ideal in fact correspond even mathematically to the exoteric average?

The critical point is the manner in which this question is avoided: by not even being posed. The temporal alternative is in every case excluded *a priori* not on the basis of evidence but 'logic'. Just as the catholic church banned the very admissibility of a Copernican solution, economics in practice rules out, and refuses to consider, the possibility of a temporal alternative. The exoteric significance and predictions of equilibrium economic theories do not determine whether or not the equilibrium paradigm is adopted. If, therefore, we wish to understand the true meaning of equilibrium we have to turn to a different logic, a logic which is not stated but in fact drives the process of theoretical selection – the esoteric significance of the concepts that it produces, and the system of logic concerning the social order to which this gives rise.

Religion without gods

It will not have escaped the reader that economics lacks one rather essential requirement for a religion: namely, a god. Are gods a necessary feature of religion?

We can get a handle on this by considering a much more modern example: the history of the theory of evolution. Why did this eventually catch on? Because it provided the essential missing element which the new contesting cosmology – economics – required to explain an altogether different social order, namely the survival of the fittest.

Darwinism facilitated a new unity between the world of nature and the world of humans. Without any divine intervention at all, competition between humans could be hypostasised as an expression of the natural order. Concepts such as 'competition', 'evolution' or 'natural' in economics carry an unacknowledged ideological load. Their exoteric meaning is a simple description of economic process. But the weight which they carry, within the minds of the policymakers and the people alike, arises from the simple unity of thought that results: we compete because we are animals; we can understand why firms live and die because it is in

[25] See Ekeland (2006)

their nature; unemployment and poverty are not the simple consequences of human decisions but the expression of a universal natural order.

From antiquity until the ownership of land and labour became generally alienable and hence monetised, aristocratic social power was rooted in the person of the aristocrat. This personal power is what had to be explained. This essential intellectual function was played by cosmology, because it explained why monarchs and aristocrats existed, and why they had power over others. With the rise of money and the commodity form, personal power fades and power arising from abstract wealth rises. Hence, it is the power of the owners of commodities, and above all money, that requires justification. it is no longer the monarch who obstructs the course of history but the financier, and the place of cosmological religion is taken by monetary religion, which provides just as absolute a justification for the actions of financiers as pre-Copernican cosmology did for the monarchy.

The esoteric core of the equilibrium paradigm is that it makes it impossible for the market to produce failure from within itself. Where, then, does failure come from? In mediaeval times, human misery was treated as an act of God. Humble nature was unacceptable as causal agency because this would remove the justification for feudal authority. Economics has reversed this concept of agency. The market itself – actually a uniquely human product – is explained as a product of exogenous forces. Its plagues and famines are still the outcome of exogenous forces but these are no longer divine. The new gods are the technical relations of production and the innate biological drives of agents, and the new sin is to stop them having their way with our markets.

This removes purely human agency from the field just as effectively as divine intervention. Interference with the market becomes a crime against nature, a distortion of its innate perfection. Consequently all private benefit received from the market is the outcome of natural forces: capitalists are rich because nature intended them to be. Take their riches from them, and things can only get worse. Poverty, destitution, famine: these are sad but inevitable consequences of nature. Any policy designed to offset or overcome them is misguided. Nature, in a word, has been enthroned as a God, by excluding humans from Nature.

If it were to be accepted that the market is merely a dynamic system, which may or may not succeed, it would also be accepted that the market is merely one among many possible human creations. We may choose to allow prices and the movement of capital to allocate each human being her or his ‘allotted’ share of society’s products, or we may decide that we don’t like what the market give us and seek to change it, overriding those laws of property and exchange which permit the market to work. In so doing, however, we override the distribution of products and social functions to which the market gives rise. We transfer incomes and wealth from one class to another. In particular, we are likely to take both power and wealth away from social classes, such as those that own capital or those that dominate the wealthier countries, and give it to others. This is a threat to them. It undermines their status and in extreme circumstances their existence.

The most important formal property of the equilibrium system is thus that it eliminates the ideological and social threat posed by accepting the market as a mere system of organisation

among others. Finally, however, it possesses a further formal property, which explains its selection mechanism. Equilibrium theory sustains, justifies and codifies a private interest – classes with money. It expresses, as if it were a law of nature, the reasoning behind measures which, were they put directly and explicitly to people, would be rejected because of their partisan and hence unjust consequences.

The exoteric language of economics has immense social power. At the time when Argentina's currency collapsed, when almost no politician retained anything approaching sufficient support to govern, the economist Rudiger Dornbusch proposed that Argentina's economy should be handed over to a committee of economists – a proposal not far from handing over the fire brigade to the arsonists. Nevertheless, the very same people who refused to allow three successive presidents to assume their functions, were shown by opinion polls to support the Dornbusch proposal by between 50 and 60 percent.

This is characteristic of a relation between society and the esoteric classes which is remarkably similar to that society had to the clerical and monastic classes in feudal times. Notwithstanding the substantial and transparent grievances of many of the common people, often arising from private abuse by clerics and monarchs alike,[26] people considered the *system* of monarchic rule and canon law to be entirely right. In purely material terms this reflected the insufficiently-developed state of a realistic alternative. But in ideological terms what is striking is the immense symbolic and ideological power, in the minds of men and women, of the primary concepts of divine authority.

This spells out the conditions for reform. It is at the precise point when ordinary people begin to doubt the social order that a thirst arises for different economic explanations. The ethical economist, therefore, has a duty not to offer a new 'authority' – a new heterodox orthodoxy – but a genuine pluralism, genuine access to the full range of options. What is required from equilibrium theory – which it almost never concedes – is a statute of toleration, an acceptance that the public has the right of access to the full range of alternatives: in short, genuine pluralism.

[26] See for example Chamberlain (2003)

Appendix: temporality, equilibrium, endogeneity and exogeneity, in physics and economics

This short appendix illustrates the main disputed mathematical issues covered in this article, with some repetition, but placing all the key arguments together in what I hope is an accessible form.

The reader does not have to follow them to understand the argument except perhaps to follow what is meant by *endogenous* and *exogenous* cause. They are also necessary, however, to re-enforce a basic point which is so frequently ignored or wilfully denied by economists,[27] that it needs to be explained and asserted in such a way that criticism ceases to be merely ignorant. The temporal approach is neither esoteric, nor unusual, nor logically challengeable or challenged, but an absolutely standard procedure which is part of the basic training of every undergraduate natural scientist. It should not be necessary to say so: sadly, it is.

Suppose some general dynamic system contains variables of two types: exogenous and endogenous. The endogenous variables are all those that the economist thinks of as intrinsic to the market – prices, quantities produced, labour inputs, profits, the interest rate, wages, and so on. Let the state vector of all these variables[28] at time t be

$$x_t = \{x_1^t, x_2^t, \ldots. x_n^t\} \qquad (1)$$

The x_t vary according to the specific problem to be studied, and the natural scientist normally begins by asking how the system might move from one point in time to the next. This is the temporal approach. Examples are the laws of gravity, Newton's Laws of Motion, or the laws of Thermodynamics to which Samuelson refers in our opening quote. In economics, examples would be Kalecki's price equations, accelerator- multiplier systems, Harrodian growth equations, Marx's equations governing the formation of value, or the non-linear cyclic models which Richard Goodwin introduced to economics in general and to Schumpeter and Samuelson in particular.

The exogenous variables are all the rest. In a marginalist or Walrasian framework these consist of consumer preferences and production functions. In a physicalist or Sraffian framework they consist of physical quantities of inputs and outputs. In a rational expectations framework they consist of agent predictions of the supply and demand for products. In general there is no specific limitation on what may be included. The critical mathematical property of an exogenous variable is simply that, in distinction from an endogenous variable, its value at one time is permitted to be dependent on its value at another time.

Let the state vector of all these exogenous variables at time t be

$$a_t = = \{a_1^t, a_2^t, \ldots. a_n^t\} \qquad (2)$$

The temporalist now writes down a general dynamic equation for the system:

$$x_t = f(a_t; x_{t-1}) \qquad (3)$$

[27] See for example the discussions in Kliman, A. and Potts (2015)

[28] x_t may contain differences or derivatives of its other components for example $x_t = \{p_t, p_{t-1}\}$ or $\{ p_t', p_{t-1}'\}$. This convention makes it easier to express dynamic relationships of order greater than 1.

This is a difference equation, connecting the state of the endogenous variables at time *t* to those at a prior time, *t*-1. If the time interval is considered to become infinitesimally small, so that we are dealing with *continuous* time instead of discrete time we arrive at a differential equation

$$\frac{dx}{dt} = f(a_t, x) \tag{4}$$

The main properties distinguishing the temporal from the equilibrium concept can be studied in the difference equation form, but the continuous time formulation is more general, which is why in Freeman (1996) I opted to study the Okishio theorem in its continuous form. This deals with a number of issues that other writers have found problematic such as turnover time.

In a *temporal* system as noted, models are considered to predict the *average* in some sense of the observed variables, so that exoteric reality can be modelled as:

$$\begin{aligned} \bar{x}_t &= f(a_t; \bar{x}_{t-1}) \\ x &= \bar{x}_t + \varepsilon_t \end{aligned} \tag{5}$$

Where ε is a residual or error term accounting for the difference between this observed value and the predicted average, essentially representing those factors that our model (which is necessarily incomplete as are all models) has not included. For the equilibrium system, reality is modelled by

$$x_t^* = f(a_t; x_t^*) \tag{6}$$

$$x = x^* + \varepsilon_t^* \tag{7}$$

In this system, *x is assumed not to change* and this is the critical assumption. In equation (6), the time variable is the same on the lefthand and righthand. If the endogenous variables are not allowed to change in a dynamic system, then the *only* possible cause of change is an external change, to the exogenous variables. No movement of the system arising from its endogenous properties can arise, because the equations are solved on the presupposition that the endogenous variables do not change, that is, that the market is perfect.

Esoteric and Exoteric descriptions of reality are now definable mathematically. $\bar{x}_t$ is an exoteric observable, so all elements of any temporal paradigm are directly accessible to observation and measurement. x^* is an esoteric ideal, by definition not observable, since it represents a state that the system never occupies. To the discrete time system, Marshall and Bortkiewicz apply the term 'successivist'.[29]

The equations (6) give at least one solution. There may be more than one, which was one of the important contributions of writers such as Nash. Space does not allow us to go into this point, however on the whole it is a distraction, in that it is an attempt to explain why the system does not attain the most desirable state of perfection, which does not deal with the fundamental point that there is no point of perfection at all. In religious terms, the result is a kind of polytheistic theory, so the strife among the Gods becomes the explanation for chaos on earth.

[29] For the theory of value, the continuous case is covered in Freeman (1996)

Returning to the question of existence, the key point is that this is mathematically guaranteed, which is what gives the method its universal character and allows it, mathematically, to play the role of a general metaphysics for economics instead of the mere property of one particular school of thought.

Some elementary theorems prove that under quite general conditions, there is a unique solution to (2) and (3) depending on the functions f and g and the initial values x_0 at some time $t=0$ in the past, usually termed the 'boundary conditions'.[30]

Equilibrium when shorn of its ideological trappings can now be seen as just a particular, restricted solution to a temporal equation giving a hypothetical 'stationary state', in which x does not change over time.

This also exists under a wide range of conditions, as a result of a different set of theorems of which the most general is the Brouwer fixed-point theorem. Note that x^{*t} will vary over time, but only because of changes in a, given by equation (2), sometimes termed 'structural' changes. In contrast, in the more general temporal solution (5), x^t will have a more or less complex trajectory depending on the transition function $f()$.

The theory of Competitive General Equilibrium (CGE), in its most elementary form, amounts to the claim that

$$x^t = x^{*t} \qquad (9)$$

That is to say, given equation (2) the solution to equation (1) is the same as the solution to equation (3). In general, this is not true. CGE proponents, therefore, generally make the more relaxed claim that x^t is sufficiently 'close' to x^{*t}, in some sense which varies from writer to writer, that we may effectively ignore the differences. A further complication thereby arises because the defenders of equilibrium allege, in effect, that the equilibrium solution x_t is a 'centre of gravity' around which the real x oscillate, in the manner of a pendulum. Of this more shortly.

This is extensively discussed in the exchange between Freeman and Mongiovi (see Freeman 2011). The problem is that the 'centre of gravity' is a rhetorical fiction, which cannot describe any but a very restricted range of motions. It is in a certain sense the 'last refuge of equilibrium' – it is offered as a dismissal of the temporal method without the slightest attention to the underlying issues of logic. To say, to cite just one problem, that the sun is the centre of gravity of the solar system and therefore, the motion of the planets may be considered, as a first approximation, to be stasis, is to treat the solar system as if all planets were at the centre of the sun. Moreover, since the actual motion of the planets is elliptical or in general conic, and not simply circular, the sun is not even the hypothetical centre of their motion, but is located at one or other focus of the conic.

[30] The neo-Ricardian literature obfuscates this issue by referring only to quite special variants of fixed-point theory such as the Perron-Frobenius theorem which states that there is a fixed point solution when f takes the form of a linear system, and that provided the coefficients of this linear system satisfy some 'reasonable' property indicating that the system appears economically and in principle capable of self-reproduction, then there is a particular state of the system in which it does not change, which provides a solution defining values or, in the price system, the profit rate and prices of production, uniquely. The obfuscation consists in the implication that only people with specialist knowledge of linear matrix theory can understand why the theory works. Actually, the whole of linear systems theory is a rather restricted special case of the much more general case which, as always, is much simpler. The fixed point exists for the same reason that a ball can be always be placed on a convex surface in such a way that it does not move. Its position may be stable (if it is in a hollow) or unstable (if it is on a hump) but given certain very general conditions, some stable position may always be found.

Nevertheless we can make an approximate categorization of the various possible theories linking motion and equilibrium, many of which have in fact appeared. They should be considered more akin to the pre-Galilean attempts to 'save the appearances' of the terracentric view, than as useful descriptions of reality. That is, these are categories of esoteric reasoning, not exoteric or inductive description.

By an '*attractor'* theory we mean a dynamic theory which claims that the x^t is regular in some sense, in that it repeats at semi-regular intervals, and fluctuates around a point or neighbourhood. An example would be Goodwin's 'employment-wage' oscillator. An attractor theory is the closest an equilibrium theory can get to a genuine temporal account, because in fact it borrows, as a kind of metaphor, a result from temporal mechanics.

Actually the attractor when introduced temporally does not have to be an equilibrium, a point that equilibrium theory simply ignores. Thus the sun is an attractor of Halley's comet, but is definitely not at the centre of its orbit. An attractor also need not be stable; not only can it move over time, but the system can simply cease orbiting it, and fly off in a new direction. Chaos theory is largely devoted to studying such bifurcations or catastrophes. Attractor theories are the most general cyclic theories and most resistant to ideological interpretation, though of course no theory is endowed with natural immunity in this respect.

By a *'gravitational'* theory we mean an equilibrium theory which claims that x^t 'moves around' x^{*t} in some sense, generally not clarified. This is essentially a metaphor rather than a logical step: insofar as there is a physical analogy, it would be either that of a pendulum oscillating backwards and forwards over its lowest point, or a planetary body orbiting the sun. Gravitational theories can be thought of as combining two claims: that the fixed point is the attractor of the system, and that it is also the centre or time average of the system. This is true of a very simple type of system called a *harmonic oscillator* which describes many frequently-observed oscillatory phenomena such as a pendulum, water waves, musical instruments, and so on. Harmonic oscillations occur only under quite restricted circumstances, for example when the system (1) is *linear*, which means that x^t is made up of simple multiples of the variables in the vector x^{t-1}.

The archetypal gravitational theory is that of Schumpeter (see Freeman 2014) for whom equilibrium is *defined* to be the point around which the economy oscillates. To reach this conclusion he extends the concept of business cycle, developed by Marx and Juglar, to the famous notion of 'Long Waves' introduced by Kondratieff; the essence of this view is the concept of *self-restoration;* that no matter how far or protracted is the movement of the economy from its putative, hypothetical equilibrium, there are purely economic (that is to say, endogenous) forces at work which will bring it toward recovery and even boom, unaided by government intervention.

The issue of *stability* then becomes central, as follows: *if* x^{*t} is a stable equilibrium, the equations governing x^t will approximate to a harmonic oscillator in some neighbourhood sufficiently close to x^{*t} that non-linearities can be ignored. No such result applies if x^{*t} is not stable, obviously, since then there is no reason that x^t should have anything to do with it. Thus although technically a jetliner can balance on a steeple, aviators attempting this feat would in all probability fall off; aircraft are in consequence more often found tending away from tall buildings than towards them.

Theories of self-restoration hinge on what is treated as *exogenous*; that is, which variables are assigned the status of the parameters a, which have no functional dependence on the endogenous variables x. An example on which most would agree would be sunspots or daylight hours. But in debates around self-restoration, it matters whether we think that, for

example, the government or for that matter, the people, act 'of their own free will' and change the tax rate or otherwise 'intervene' in the economy, this will clearly affect x in subsequent periods. But the converse (for such a theory) is not true: the government and people act autonomously and exercise choice, and there is no rule which tells us it will always respond to a given level or movement of x with a definite action.

Endogenising theories assert that some or all of the exogenous parameters a are in fact endogenous, which amounts to saying that they really belong in x. Schumpeter, for example, asserts that innovation is an 'internal' factor – it is in some sense 'brought forth' by what is going on in the economy. Examples example of highly endogenised systems are offered by the French positivist theories of the early 19th Century, in which movement becomes mechanical and pre-ordained. Marx's political economy at first sight appears wholly endogenised, but there is one vital difference: human free will, our capacity for conscious action, leaves us 'free to shape our history, but not under circumstances of our choosing'.

Self-restoration is the claim that the trajectory of the endogenous variables is *temporally stable*: that there are limits beyond which they do not go (in the absence of an external catastrophe, a critical change in the parameters a) and that they have an attractor.

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