

EQUILIBRIUM VERSUS PROCESS: A CONFRONTATION BETWEEN MAINSTREAM AND AUSTRIAN ONTOLOGY

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Equilibrium versus Process

A Confrontation between Mainstream and Austrian Ontology

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Summary

We confront mainstream and Austrian economics from a history of economic analysis point of view in order to identify the main reasons of their divergent interests on the concepts of, respectively, equilibrium and processes. The result of this confrontation attributes a decisive role to ontological considerations: mainstream central focus on equilibrium is the consequence of the adoption of specific mathematical tools. But the claim for a mathematical approach to economics is a doctrine that is independent from any study on the nature of the underlying economic system and real phenomena that are non-tractable are either reinterpreted in an amenable to reason form or are simply ignored. The choice of the tools determine the orthodox vision of the economic world as a closed system of interacting autonomous atoms. Austrians proceed exactly the other way round: ontological investigations are the starting point and as a consequence, they choose the relevant tools so to be coherent with their ontology where social reality is apprehended along an open processual view.

Keywords: Mainstream, mathematical formalism, Austrian school, social ontology, mathematical constructivism.

JEL classification: B13, B53, C18

Introduction

One reason why competing paradigms are hardly analytically commensurable is that they consider different questions as being scientifically relevant. The movement of celestial bodies was of no interest to Aristotelician scientists because they considered the supralunar area to be immutable whereas it was essential to copernician astronomers to their understanding of celestial mechanics. In other words, scientists with different conceptions of the reality they are investigating address different issues. In economics, equilibrium is the crux of the matter of mainstream theorising whereas some heterodox economists do not even attribute a benchmark role to this concept and focus rather on economic evolution and processes. In this paper, we confront mainstream and Austrian economics from a history of economic analysis point of view in order to identify the main reasons of their divergent interests on the concepts of equilibrium and processes.

The result of this confrontation attributes a decisive role to ontological considerations: a constant objective of mainstream economists is to transform economics into mathematical economics. This trend is identified by Lawson (2003, 2012) who considers it a form of ideology. Ideology is here understood as a set of relatively unchallenged underlying ideas. Mainstream economists adhere to this widespread cultural conviction that mathematics is fundamental to science and so, “[...] *all serious economics must take the form of mathematical modelling*” (Lawson, 2012, p. 9). In consequence, economic phenomena are interpreted in such a way to be tractable given the mathematical tools at disposal. To Lawson, tractability implies to rely on the existence of systematic correlations and thus to adhere to the deductivist doctrine according to which all explanations are expressed in terms of events regularities. Deductivism is no less than the core feature of what is called “neoclassical economics” (Lawson, 2013), in place of other substantive features such as the individualistic perspective, rationality axioms, focus on equilibrium states and so on. Deductivism is not coherent with an open processual view of social reality. On the contrary, the presupposed ontology is that the economy is a closed world of interacting isolated atoms. If we follow Lawson in this conclusion, we however put some shade on the idea of a strict correspondence between mathematical modelling without distinction and a worldview in terms of closed systems; not because, sensitive to the sirens of the dominant ideology we would want to save modelling to some extent but because we think that there are in mathematics, competing philosophical streams associated with distinct ontologies. So, rather than mathematics in general, we distinguish in what follows, between two kinds of mathematical tools – formalist and constructivist tools – and emphasise the correspondence between formalist tools and the deficient social ontology just described, leaving the door open to the possibility of a coherent constructivist treatment of an open-processual world.

Anyway, ideology here precedes ontological considerations. In other words, the claim for a

mathematical approach to economics is a doctrine that is independent from any study on the nature of the underlying economic system and real phenomena that are non-tractable are either reinterpreted in an amenable to reason form or are simply ignored. The choice of the tools determine the orthodox vision of the economic world.

Austrians proceed exactly the other way round: ontological investigations are the starting point and as a consequence, they choose the relevant tools so to be coherent with their ontology. More precisely, (part of) Austrians consider economics as a causal-genetic science and as a consequence, they reject mathematical functional tools. Again, we insist on the fact that only the dismissal of specific mathematical tools is justified by the Austrian ontology. It is a widespread error amongst Austrians to reject mathematics in block with no decisive argument: in theory, there may exist technical tools compatible with the nature of the economic system which, in Austrian terms, is an open process resulting from the interaction of individuals in a context of ignorance. For sure, formalist and axiomatic tools are not appropriated to the Austrian ontology, but there seems to be an adequacy between the Austrian view of economic reality and the tools of complexity, or, more generally, with constructivist tools and such possibility should at least be contemplated.

In the first section, we start from a confrontation of Menger and Walras on the role of mathematics. The resulting gap between the Austrian causal-genetic perspective and the marginalist mathematical approach is at the origins of a symptomatic misunderstanding. It concerns the meaning of the concept of competition and is central to the so-called planning debate that confronts Mises and Hayek with market socialists during the interwar period. According to the mathematical stance, the concept of competition is tantamount to an economic equilibrium state whereas in the Austrian logic, competition is a process.

Another step is reached in the 50s when mainstream begins to adopt a specific mathematical approach, namely formalism, a mathematical philosophy associated with the works of David Hilbert which develops from the 20s onwards and which is opposed to the constructivist position of Poincaré and Brouwer (section 2). The main consequences of the adoption of formalism in economics are to give the primacy to demonstrations of existence of economic equilibrium and to institutionalise the disconnection between theories and reality, between form and content.

The Austrian revival of the 70s, part of which is explicitly critical towards the formalist philosophy, is built around the attempt of elaborating a theory of market processes based on an alternative methodological approach which is, it will be shown, compatible with constructivism (section 3).

Section 1 The rejection of mathematics as the symptom of a deeper rift

Menger is often presented in textbooks as one of the three leaders of the marginalist revolution whose originality would simply be in his firm rejection of the use of mathematics in economic analysis. The whole Austrian tradition is from that moment on characterised by this position regarding formalisation, as an inheritance from the scarce technical competences of its founding father.¹ This characteristic refusal of Austrians to use mathematics is often quoted as the essential element of distinction with mainstream economics. Since Jaffé (1976) however, this superficial interpretation only prevail for undergraduate simplifications and pedagogic stories. It is well-established that Menger develops economic theories that by many aspects, and not only the form, are distinct from the marginalist stance; modern Austrian economics develops precisely around this originality and can definitely not be reduced to a literary version of neoclassical economics. The rejection of mathematics, it will be argued, is only the symptom of deeper distinctions of both a methodological and ontological nature. From a methodological point of view, mathematical representation do not permit to *understand* complex economic phenomena; from an ontological point of view, the kind of mathematical tools available at Menger's times and used by his contemporaries were not adapted to his vision of economic reality, in the same way as today, formalism does not allow modern Austrians to provide an accurate representation of their ideas.

1.1. A causal-genetic approach

The scientific approach defended by Menger is purely analytical and consists in breaking down complex economic phenomena into their most simple elements, a logical decomposition in terms of relations of causality. On a methodological level, his objective is “[...] to reduce the complex phenomena of human economic activity to the simplest elements that can still be subjected to accurate observation, [...] to investigate the manner in which more complex phenomena evolve from their elements according to definite principles” (Menger, [1871] 1950, pp. 46-7).

Human behaviour seeking to satisfy needs is the simplest premise upon which everything may be built, thereby defining economics upon a strict subjectivist basis. Menger defines it as the principle of “economizing”.²

In his 1883 methodological work, Menger continues and goes deeper into the methodological

¹ Menger began to throw himself into self-taught mathematics in the 1890s. However, his son Karl, himself a great mathematician, ruthlessly declared : “I am afraid that he did not acquire an operative knowledge, let alone a critical insight into calculus” (K. Menger, 1973, p. 45).

² The term used by Menger ([1871] 1950, p. 116) is *Bedürfnissbefriedigung*, literally the satisfaction of needs and desires.

foundations which, in his opinion, should underlie any theoretical science and economics in particular. Essentialism and universalism, the two principles at the core of Menger's methodology which were already introduced in the *Grundsätze* of 1871, are here confirmed and justified. The scientific approach, whose aim is to acquire general knowledge of phenomena, consists in systematically researching ultimate causes which are the very essence of these phenomena, by establishing general laws having a universal character. Understanding an economic phenomenon means identifying the causal process which brings it into being, starting from its most elementary cause – economizing principle – to the most complex manifestation of the phenomenon under analysis.

Clearly, Menger's conception of economics clashes with marginalism. The opposition has been first made explicit by Hans Mayer. Mayer ([1932] 1995, p. 57) distinguishes between two types of theoretical approach to the question of how economic prices are formed: *causal-genetic theories* which, "[...] by explaining the formation of prices, aim to provide an understanding of price correlations via knowledge of the laws of their genesis", and *functional theories* which, "[...] by precisely determining the conditions of equilibrium, aim to describe the relation of correspondence between already existing prices in the equilibrium situation".

The adoption of a causal-genetic way of thinking in economics has a direct consequence as regards the use of mathematical tools. Indeed, according to Mayer (1932), Menger does not dogmatically reject any recourse to mathematics in economics, but he rejects mathematics in the form that was available at the end of the 19th century, that is functional mathematics which are not adapted to his conception of economic explanation.

Menger's position in this respect is straightforward and explicitly clashes with Walras whose objective is first of all to apply a Newtonian model of science to economics. In accordance with French post Enlightenment culture which puts Newton's scientific philosophy at the centre of the progress of the entire society (Cf. Ingrao and Israel, 1990, p. 36), the marginalist leader considers mathematics much more than just a mere demonstrative tool enabling him to give a simpler and more rigorous presentation than a literary equivalent. Mathematics is indeed a real investigative tool, a "research method" in itself.

For the non-mathematician it is natural to believe that mathematical form, where it can be used, conveys nothing more than ordinary language, and is only used to explain things to those who cannot understand them in any other form; however this assertion will bring a smile to the lips of anyone aware of services rendered by mathematics to all sciences to which they can be applied: mechanics, astronomy, physics, chemistry. (Letter by Walras, 16 January 1882)³

³ Our translation from French, from Antonelli (1953, p. 269, footnote n°3).

It is precisely here that the methodological rift between Walras and Menger lies.

The object of my research is to reduce complex economic phenomena to their true causes, and to seek out laws according to which these complex phenomena of political economy are repeated. The results of my research may be represented by mathematical formulae. Mathematical representations may help with the demonstrations: however, the mathematical method of representation is in no way the essential part of the task I have undertaken. (Letter by Menger, 1 June 1883)⁴

The mathematical method used by Walras seems far from appropriate to Menger's objective, i.e. knowing how to determine the essence of complex economic phenomena.⁵ As soon as the aim of the theorist is to understand the process of emergence of a phenomenon through causal decomposition into its primary elements, formalisation in the form of a system of simultaneous equations is inappropriate since it turns a blind eye to the sequence leading to the formation of the phenomenon, focusing exclusively upon the ultimate outcome of the process.

1.2. Two competing ontologies

From a more substantial point of view, the comparison between the Austrian and the marginalist theory of value reveals the ontological divide between the two traditions, the attitude towards the use of mathematics being only the symptom of this divide. At a first superficial sight, it seems that Menger shares with marginalists a subjective theory of value. However, the nature of their respective conception of subjectivism is different. Menger introduces the elements for a dynamic conception of subjectivism where the passing of time changes individuals' perceptions of their environment, where agents keep on gathering informations and continuously modify in unexpected ways their plans; whereas marginalist subjectivism, of a static nature, manifests itself through the definition, for each economic agent, of a stable continuous utility function. The marginalist *homo economicus* is once and for all defined through it and from this moment on, his actions are

⁴ Our translation from French, from Antonelli (1953, p. 272).

⁵ "My opinion is actually that the method that should be adopted within pure economics cannot be simply called *mathematical* or *rational*. We should not only investigate relations between magnitudes but also the *essence* of economic phenomena. But how could we know this essence, for instance, the essence of value, of entrepreneurial profit, of labour distribution, of bimetallism, etc. in a mathematical way? Even if the mathematical method was purely and simply justified, in any case, it would not fit with the solution of the mentioned part of the economic problem.

However, I cannot accept the mathematical method at all, even for the determination of the laws of economic phenomena [...] it is at the same time clear that the purpose of your investigations will never be reached through the mathematical method. It is rather necessary that we come back to the simplest elements of phenomena which are generally very complex -therefore that we determine *analytically* the last constitutive factors of phenomena [...].

Let us consider the theory of prices. If we want to have access to the knowledge of the laws which rule goods exchange, it is first necessary to come back to the motives which lead men to act within exchanges, to the facts which do not depend on the will of traders, which have a causal relation with goods exchange.

We should come back to the needs of men, to the importance they give to the satisfaction of needs, to the quantities of different goods which different economic agents own, to the subjective importance (subjective value) that different economic agents confer to given quantities of goods and so on". (Letter from Menger, translated from Antonelli, 1953, pp. 279-81)

completely predictable. The reality formalised by Walras and marginalists is a world where economic configurations are the outcome of the interaction of automata with predetermined behaviour in an environment with no perturbing factors, i.e. a closed world of interacting autonomous atoms. On the contrary, Menger insists on the creative dimension of individual economic actors, not reducible to mere reactors: Mengerian agents are engaged in a process of acquisition of knowledge (knowledge of how to produce goods, of the needs of other agents, of the goods that may satisfy these wants and so on) leading to continuously modify and improve their plans of action; the Mengerian agent lives in a world of uncertainty where occurrence of errors is indeed possible; decisions should be based upon expectations agents make about an unknown future, leaving a room for their creative abilities. Jaffé describes the Mengerian Homo Economicus as follows:

« Man, as Menger saw him, far from being a “lightning calculator”, is a bumbling, erring, ill-informed creature, plagued with uncertainty, forever hovering between alluring hopes and haunting fears, and congenitally incapable of making finely calibrated decisions in pursuit of satisfactions. Hence Menger’s scales of the declining importance of satisfactions are represented by discrete integers. In Menger’s scheme of thought, positive first derivatives and negative second derivatives of utility with respect to quality had no place; nothing is differentiable » (Jaffé, 1976, p. 521).

Menger makes no concessions to his conception of social reality as an open-processual kind; decision making takes into account the creative activity of the human mind in a continuously moving environment and becomes a process hardly tractable in terms of functional mathematics. Rejection of mathematical formalisation by Austrians is thus justified because there exists a direct correspondence between the mathematical tools used by Walras and later on by neoclassicals (mainly functional relationships, derivative and systems of simultaneous equations, topology and fix point theorem) and the functional approach defined by Mayer. Menger’s refusal of functional mathematics should ultimately be analysed as a reflective rejection, rather than the evidence of his weakness in mathematic techniques, a rejection based on a double circumstance: an awareness of the ontological specificity of his approach and the (coherent) adoption of a causal-genetic thinking.

1.3. The planing debate: misunderstandings and cross purposes

A few decades later, Austrians and neoclassicals clashes on the question of the possibility of economic planning. This controversy is interesting for our purpose to the extent that it is the expression of the confrontation between the mainstream static equilibrium point of view and a heterodox market process perspective.

The debate is rather confused, the two schools being clearly not on the same wave-length: they

seem to use the same terms with different meanings, in particular, the term of competition and, within its own logic, each school claims to come out a winner (Cf. Don Lavoie, 1985). The objective here is not to describe the details of the controversy but rather to show that the oppositions and misunderstandings are a consequence of their respective methodological orientation and ontology.

The mathematical orientation of mainstream economists lead them to deepen the intuition of Barone who notices in a famous paper of 1908 the formal similarity that exists between the competitive walrassian model and a model of a planned economy. The equations and the resolution are identical, only the institutional context changes, the auctioneer is replaced by the central planer but the logic of the model remains the same. The possibility of planning amounts to the possibility of replicating the walrasian equilibrium solution.

Within the competitive solution (Lange and Lerner), prices are mere accounting tools. Whether they are the product of competitive market or of a central planner does not matter. The issue at stake is rather to find the good prices so that the managers of public firms may take efficient economic decisions. Prices are determined by a procedure of trial and error centralised by the State. Walrasian theory is totally determinist in the sense that the equilibrium configuration only depends on the given conditions of the economy in terms of technology, endowments and individual preferences. In this light, the role of planning is to gather the necessary data and to provide a procedure enabling the corresponding optimal configuration to be replicated.

Austrians cannot agree with this solution which contradicts their ontology: economic reality is characterised by continuous changes in data which render obsolete even before it is reached any configuration of competitive equilibrium. Understanding the economic reality means identifying the mechanism that allows for the spontaneous coordination of decentralised individual agents.

Despite a series of arguments on the practical impossibility of collecting the information necessary for the setting-up of a centralised allowance procedure, it may be theoretically possible to reproduce an economic equilibrium state. It is not possible however to duplicate the coordination mechanism through planning. To Mises and Hayek, the fundamental question facing economics is that of coordinating the plans of individual actors in a world of continuous change. Acquisition of knowledge represents the major source of evolution of the system by perpetually modifying agents' plans. The question is to understand the occurrence of inter-temporal adjustments in agents' plans whereas for neoclassical authors, the problem consists in determining a theoretically optimal configuration, with no regard for the dynamic forces leading up to this final state.

The definition of competition as a process of knowledge discovery is the Austrians' definitive answer to the debate on planning. It summarises the overall argumentation of Mises and Hayek. Competition is a dynamic process of knowledge discovery which can only be envisaged in a world

of ignorance and uncertainty where there is interaction between agents capable of modifying their plans. From the moment competition is described as “[...] a voyage of exploration into the unknown, an attempt to discover new ways of doing things better than they have been done before” (Hayek, [1946] 1949, p. 101), then, any attempt at planning can only lead, according to Austrians, to failure; indeed, “[...] it is only through the process of competition that the facts will be discovered. This appears to me one of the most important of the points where the starting-point of the theory of competitive equilibrium assumes away the main task which only the process of competition can solve” (Hayek, [1946] 1949, p. 96).

Section 2 Formalism and the formalist revolution in economics

In the following decades, the growing sophistication of mathematical tools available strengthens mainstream in its static perspective with special emphasis on the final state of rest of the economy. A decisive step is reached in the 50s when mainstream economists come to adopt the standards of *mathematical formalism*. At this stage, the form of theories definitely gets over their empirical content and the quest for equilibrium existence becomes the *raison d'être* for a generation of authors. In the next section, we define the mathematical philosophy of formalism, describe its adoption by the mainstream and identify the consequences on the practices of economists. Of course, Menger's followers keep aside from this methodological revolution, also because until the 70s, these are years of a dry academic period for the Austrian tradition, as it is overcome by the success of Keynesianism and discredited by the political writings of Mises and Hayek.

2.1. The formalist program

The formalist program, associated with the name of David Hilbert and – for its extreme version – of Bourbaki, emerges as an answer to the debate on the foundations of mathematics. Mathematics was built on the model of the traditional Euclidean axiomatic method which consists in accepting without demonstration a reduced set of postulates, the axioms, and deducing from it a set of theorems. For a long time, the empirical obviousness of axioms seemed to guarantee the truth of the theorems which it was possible to deduce from them. But by the end of the 19th century, the discovery of logical antinomies by Russell questioned the statute of mathematics as a set of eternal truths. A logical antinomy is found when a contradiction emerges between theorems that are deduced from the same set of axioms. This brought to the foreground the question of the consistency of formal systems which interested mathematicians and logicians for decades. It was essential for scientists to discover a way to get back the certainty they lost in the purity of mathematics, otherwise their practice would be forever prone to the possibility that an inconsistency

appears.

Hilbert's formalist solution consists in reducing mathematics to a pure symbolic language with no *a priori* meaning. More precisely: a 'formal system' is composed of (1) a set of symbols, (2) a set of rules for transforming these symbols into formulae, (3) a set of rules for transforming the formulae, and (4) a reduced number of formulae representing the axioms of the system to be observed. By construction, a formal system has no semantic content and may take on different interpretations. A "model" is an interpretation that is given to a formal system. The clear-cut separation between syntax and semantics – between the formal aspects of the system and its various interpretations – is one of the most salient characteristics of modern axiomatics. To formalise a theory in the sense of Hilbert, means indeed emptying it from all of its semantic content and giving an abstract representation of it – the formal system – in the form of symbols, formulae (among them axioms) and sequences of formulae having no more obvious bond with the theory of departure. The formal system thus formed is like an abstract box, deprived of any significance, on which the mathematician works in order to draw theorems. At this stage, the question of the realism of the axioms is completely irrelevant. But it would be erroneous to say that in axiomatics reality does not matter at all, for in the next stage of the axiomatisation process, the objective is precisely to assign models to each formal system, that is, to find an interpretation in terms of real phenomena for the formal system.¹² In a model, every symbol is given a specific meaning, and the same abstract box may be associated with different models, that is, it may receive various interpretations. The initial theory which inspired the formal system constitutes one model among others.

Formalism as a philosophy of mathematics is attached at this level with Plato's realism supporting the thesis that mathematics does not create anything, does not invent objects, rather, discovers pre-existent objects in the intellect. The power of axiomatisation is due precisely to the fact that the discovery of an abstract box, of a formal system, makes it possible to explain several real phenomena, and rests on the belief of a preset adequacy between the structure of mathematics and reality. Mathematics is considered as a storehouse of abstract form, "the mathematical structures" in Bourbakists terms, "[...] and so it happens without our knowing how that certain aspects of empirical reality fit themselves into these forms, as if through a kind of preadaptation" (Bourbaki, 1950, p. 231).

2.2. *The formalist revolution in economics*

If there were an ontological neoclassical discourse, coherent with their practices, it would consist then in asserting that this pre-established harmony between mathematics and physical reality, also concerns social reality. This is exactly what Debreu, the champion of formalism in economics suggests: (2008, our italics), "...in a global historical view, the *perfect fit* between the mathematical

concept of a fixed point and the social science concept of an equilibrium stands out”, in other words, economics offers a new semantic field of development to pre-existing conceptual structures. More precisely,

[a]n axiomatized theory first selects its primitive concepts and represents each one of them by a mathematical object...Next, assumptions on the objects representing the primitive concepts are specified, and consequences are mathematically deduced from them. The economic interpretation of the theorems so obtained is the last step of the analysis. According to this schema, an axiomatized theory has a mathematical form that is completely separated from its economic content. If one removes the economic interpretation of the primitive concepts, of the assumptions and of the conclusions of the model, its bare mathematical structure must still stand. (Debreu, 2008)

Such harmony makes it possible to conceive mathematics as the base of all exact scientific knowledge in economics. In adopting formalism, neoclassicals follow Hilbert's belief that the mathematical analogy, understood as the systematic adoption of the modern axiomatic approach, represents the good scientific practice and this is so, whatever the scientific field considered, and economics in particular.

I believe: anything at all that can be the object of scientific thought becomes dependent on the axiomatic method, and thereby indirectly on mathematics, as soon as it is ripe for the formation of a theory. By pushing ahead to ever deeper layers of axioms . . . we also win ever-deeper insights into the essence of scientific thought itself, and we become ever more conscious of the unity of our knowledge. In the sign of the axiomatic method, mathematics is summoned to a leading role in science. (Speech by Hilbert 1918, in Ewald, 1996 and Weintraub, 1998)

Mainstream ideology that good economics is mathematical economics is by then made more precise: good economics is axiomatic economics. “Allegiance to rigor dictates the axiomatic form of the analysis [...]” (Debreu 1959, p. x).⁶ Standards of proof, of rigour, of truth in modern economics flow from the adoption of this conception of mathematics by economists since the 50s onwards, what Blaug (1999, 2003) describes as the “formalist revolution” in economics. This dramatic evolution in the practices of economists is centred around the works of Arrow (1951), Arrow and Debreu (1954), Patinkin (1956), Solow (1957), Koopmans (1957), Dorfman, Solow and Samuleson (1958), Debreu (1959) and around three main institutions, Karl Menger’s mathematical Colloquium

⁶In his foreword to *Theory of Value*, Debreu (1959) gives a cristal clear description of the formalist method. The quotation continues as follows:

[...] where the theory, in the strict sense, is logically entirely disconnected from its interpretations. In order to bring out fully this disconnectedness, all definitions, all the hypotheses, and the main results of the theory, in the strict sense, are distinguished by italics; moreover, the transition from the informal discussion of interpretations to the formal construction of the theory is often marked by one of the expressions : « in the langage of the theory », « for the sake of the theory », « formally ». Such a dichotomy reveals all the assumptions and the logical structure of the analysis. It also makes possible immediate extensions of that analysis without modification of the theory by simple reinterpretation of the concepts.

in Vienna, where the first demonstrations of the existence of an economic equilibrium were provided during the interwar period (Wald, 1935 and Von Neumann, 1945/46), the Cowles Commission where members of the Vienna Circle migrated in the 40s and Princeton University, where Bourbakist economists could develop their works.

2.3. formalism and economists' practices

The adoption and generalisation of the formalist approach in economics was supposed to bring ever more generality, rigour and simplicity. The separation between syntax and semantic would lead to the discovery of new theories simply from the mere reinterpretation of a pre-established formal system⁷; economics could in this sense become ideologically free since a formal system is supposed to convey no specific vision of the world before the interpretative step; the axiomatic approach aims at eliminating the possibility of inconsistencies by rigorously making explicit the primitive concepts and the chains of deduction leading to theorems so that if a contradiction was to emerge, it would be easier to identify with precision its origin in order to eliminate it.⁸

As a consequence of the adoption of formalism, the nature of the work of theoretical economists evolves, becomes more and more abstract, directed by “[...] the quest for the most direct link between the assumptions and the conclusions of a theorem. Strongly motivated by aesthetic appeal, this quest is responsible for more transparent proofs in which logical flaws cannot remain hidden, and which are more easily communicated” (Debreu, 2008). Progress in the formalist sense means elaborating consistent formal systems based upon less and less primitive concepts and assumptions. Starting from the walrasian formalist reformulation taken as a benchmark, mathematical economists search for ever weaker assumptions, refinements and extensions that still permit the existence proof, modifying one part of the original formal system in order to find new models, ending up with a pile of models that stand more and more distant from economic reality. Walras’ applied problem of the

⁷ I argue elsewhere (2010) that von Neumann’s growth model is a reinterpretation, in the realm of economics, of a formal system he first elaborated in 1928 in game theory; another direct example is given by Debreu (2008) and concerns economic theory of uncertainty: Arrow in 1953 without modifying the formal structure of the model, just added the state of the world in the traditional characteristics of a commodity.

⁸ The position of the Bourbakist programme is for this reason evocative: the objective of this radical version of formalism is not to found mathematics any more, rather, to clarify, through the linking of formal systems with one another, the architecture and unity of mathematics. The mathematician must face contradictions, if they emerge, on a case-by-case basis.

Absence of contradiction, in mathematics as a whole or in any given branch of it, thus appears as an empirical fact, rather than as a metaphysical principle. The more a given branch has been developed, the less likely it becomes that contradictions may be met with in its further development. [...] What will be the working mathematician's attitude when confronted with such dilemmas? It need not, I believe, be other than strictly empirical. We cannot hope to prove that every definition, every symbol, every abbreviation that we introduce is free from potential ambiguities, that it does not bring about the possibility of a contradiction that might not otherwise have been present. Let the rules be so formulated, the definitions so laid out, that every contradiction may most easily be traced back to its cause, and the latter either removed or so surrounded by warning signs as to prevent serious trouble. This, to the mathematician, ought to be sufficient; (Bourbaki, 1949, p. 3)

possibility of a multi-market equilibrium in a real economy transformed into a mathematical problem to be solved with the standard of rigour of formalism. In his famous 1972 article, Kaldor (p. 1238-9), referring to the axiomatic approach, already warns against the consequences of this practice: “In terms of gradually converting an “intellectual experiment” (to use Professor Kornai’s phrase) into a scientific theory – in other words, into a set of theorems directly related to observable phenomena – the development of theoretical economics was one of continual *degress*, not *progress*”. Indeed, the “relevant” assumptions are relevant in relation to the capacity of the related formal system to exhibit a rigorous existence proof and not in relation to the realism of the related model flowing from this formal system. The risk is, as Debreu (2008) himself self-consciously conceded, that mathematical economists may be tempted to concentrate on the form to the detriment of the content, excluding from their analysis those economic phenomena not readily amenable to this form of mathematisation. Mathematical tractability overtakes the degree of realism of the modelling activity. Ideology over ontology.

The importance of the demonstrations of existence of equilibrium that has been at the centre of interests of mathematical economists for decades is another salient consequence of the adoption of formalism. The obsession of formalists is to provide consistent formal systems. Proving the consistency of a formal system means it is free from any contradiction. Logical necessity is at the heart of the formalist conception of proof that economists have endorsed since the 50s: equilibrium exists because otherwise a contradiction would emerge from the formal system. Existence proofs based on the fix-point theorem are negative demonstrations in the sense that they insist on the logical necessity of the existence of equilibrium. Equilibrium exists not because the theory gives an explanation of how it is possibly reached but because it is a logical necessity.

This kind of non-constructive proof (or negative proof) allows a direct jump from the axioms of the model to its final outcome and accounts for the neglect of mainstream economists in the analysis of the economic process that possibly leads to equilibrium. As far as stability is concerned, the relatively poor results neoclassical economists reach and the nature of the difficulties they face – totally irrelevant conditions of gross substitution for instance – are the symptoms of the inappropriate nature of the mathematical tools with some aspects of economic reality. This seems a sophistication of what Mayer's called functional theories. As Blaug explains (2003, p. 146), “[t]he Formalist Revolution made the existence and determinacy of equilibrium the be all and end all of economic analysis”, with no need or incentive to investigate in the process of prices determination.

Section 3 The Austrian theory of market processes

On the contrary, the economic process is the central object of investigation of modern Austrian economists, none of them being committed with formalism. As we all well know however, it is difficult to describe the Austrian school as a unified paradigm. We argued elsewhere (Gloria-Palermo, 1999a) that within the diversity of the Austrian revival of the 70s, the stream led by Lachmann, the radical subjectivist stream, is certainly the most faithful to the Mengerian causal-genetic perspective. It also incorporates the essential Misesian and Hayekians insights of, respectively, human action and the dispersed nature of knowledge.

3.1. Market processes and institutional order

Lachmann (1977, p. 34) develops a sharp criticism of mainstream functionalist theories which fall under the category of what he calls “late classical formalism” and proposes a theory of market processes, hardly tractable with the canons of formalism but which is, according to us, compatible with an alternative mathematical conception, namely constructivism.

From an ontological perspective, radical subjectivists insist on the non deterministic nature of market processes. They give up any reference to equilibrium as a possible final state of rest; they rely on Shackle's view of economic reality as a “kaleidic” world, that is, a world characterised by the continuous occurrence of unexpected changes which disrupt pre-existing decision-making patterns. According to this conception of economic reality, the future is open in the sense that it is not pre-determined by a set of data on which agents can base their decisions. Future is unknown but it is not unimaginable and decision-making is based on agent's subjective (and divergent) anticipations of how the situation will evolve.

The resulting analysis of market processes may be synthesised as follows: the thrust of market processes result from the interaction of a multitude of individual plans, which, while coherent individually and reflecting the individual equilibrium, are incoherent as a group. When incompatibilities between plans emerge, that is when plans are not well coordinated, it means that some individuals failed to reach their objectives; they will be led to modify their original plans; individual plans are, in the radical subjectivist perspective, products of mental activity oriented both to an experienced past and to an imagined future. Plans are thus systematically divergent because subjective expectations are based on the image agents form about an unknown future.⁴ Competition might, in Hayek's view, conduce to the diffusion of relevant knowledge, but good expectations cannot be diffused by any ways, for once they revealed themselves relevant they are already obsolete and need to be revised; no *ex ante* criterion of success exists. Inconsistency of plans challenges the traditional view of a tendency toward equilibrium. Market is ultimately described as a never ending process resulting from the interaction of stabilising and destabilising forces whose

combination is a priori non predictable.⁹ This result leads critics to present radical subjectivists as nihilists or pseudo-scientists. Indeed, this conception of the market process is non tractable with classical systems of differential equations and clearly does not meet the standards of theorising. Now, for scientists not committed with mainstream ideology, that is with a distinct definition of scientific explanation, rigour and proof, this analysis of the market process may be welcome as an interesting theory. Science do not stop at the gates of the formalist heaven. Nor does radical subjectivists stop their investigations at this point: Lachmann proposes a way to theoretically deepen this analysis, in terms of ideal-types rather than differential equations.

The solution consists in introducing and analysing the role of institutions in the process of formulation of individual plans. This allows to take into account the implications of individual free will and disequilibrium forces without losing any idea of order and without incurring nihilist conclusions. The concept of equilibrium, irrelevant in such an open-processual analysis, is replaced by the notion of order, compatible with the underlying conception of social reality.

More precisely, institutions are here defined as the set of rules of conduct and behavioural norms guiding agents in a world of radical uncertainty. Lachmann (1970, p. 13) focuses on “[...] the contrast between the necessarily durable nature of the institutional order as a whole and the requisite flexibility of the individual institution’: on the one hand, institutions should make up a stable framework of reference allowing individuals to make their decisions without knowing the detailed plans of all other actors beforehand; on the other hand, however, they should also constitute a relatively flexible setting enabling painless adaptation to unexpected changes in a kaleidic society. The issue at stake is not to examine the conditions for finding out an “optimal” set of institutions but to understand the nature of the market process, its origins and unfolding, in relation with the specific institutional environment from which it emerges. Stability and flexibility are two necessary features for a coherent institutional order from which market processes develop. The institutional order is thus built on two principles according to Lachmann (1970, p. 90): the first is based on the existence “[...] of frequently mutable [internal] institutions in a definite sphere of actions [...] so that to ensure to each individual [...] a wide sphere of contractual freedom”; the second is based on the existence of fundamental (external) institutions, “[...] not mutable at all [...] [which] must provide a firm outer structure in the interstices of which the sediments of individual efforts in the "free and mutable" sphere can accumulate”.

It is possible, we think, without violating the Austrian ontology, to extend this analysis along a constructivist perspective.¹⁰

⁹See Sandye Gloria-Palermo (1999c) for a more detailed representation of the Austrian theory of the market process.

¹⁰Lachmann ([1988] 1994) suggested a distinct orientation: to develop his view along an ideal-type approach à la Weber consisting in providing different analysis of market processes rather than one single theory of the market process, according to the diversity of the institutional contexts in which interaction takes place. Other radical subjectivists, in

3.2. *The constructivist alternative*

Constructivism is here understood as an alternative to the formalist philosophy. Let's go back to the debate on the foundations of mathematics. Intuitionists like Poincaré and Brouwer, give a distinct answer than formalists to the question of the consistency of formal systems. They place the authority of the perception and of the intuition of the mathematician above that of the logical principles and inference rules whose historical and cultural relativity are underlined. Intuitionism is one form of constructivist mathematics; the various constructivist streams distinguish themselves relatively to the type of deductive rules and mathematical objects that are accepted as valid. Indeed, constructivists consider that there is no such a thing as a universally valid set of deductive arguments, but rather aesthetically and epistemologically valid deductive arguments, historically and culturally determined. For instance, intuitionists reject the relevance of the principle of excluded middle in elaborating their proofs whilst finitists, the extremist constructivist stream led by Kronecker, consider that a mathematical object exists only if it is possible to construct it by elaborating a finite process that starts only from natural numbers.¹¹ More generally, constructivists all agree on the idea that understanding a mathematical object means being able to construct it, that is, to provide an accepted method (a finite method, or a method based on intuitionist logic i.e. without the excluded middle principle or the axiom choice and so on...) for creating it, using a set of approved deductive arguments. This is the proof of its consistency.

Constructivist tools offer a generativist understanding of phenomena which echoes back Menger's theoretical objective to focus on the process of emergence of economic phenomena, "the organic institutions", taking the economizing principle as point of departure for the explanation. As Epstein (2006, p. 1587) sums up, "if you don't grow it, you didn't explain it": understanding a phenomenon means to constructivists, being able to generate it starting from local interactions of heterogeneous agents with bounded rationality.

Despite some isolated attempts to engage Austrian economics with the use of constructive tools (Oprea and Wagner 2003, Vaughn 1999, Lavoie and Al. 1990) and more specifically with agent-based modelling (Holian and Graham 2011, Seagren 2011, Nell 2010, Vriend 2002), one cannot but notice that modern Austrians have been committing themselves in that direction rather gingerly, most papers being optimistic methodological discussions rather than modelling proper. Given the apparent perfect fit that exists between Austrian ontology and the tools of complexity, this may appear as a real conundrum. Remember that, as Tesfatsion defines it (2006, p 7), a complex system

particular Lavoie (1991), suggest an interpretative turn consisting in considering economics as the hermeneutics of human action : understanding an economic phenomena means understanding it as a manifestation of individual purposefulness.

¹¹ According to Kronecker famous motto, « God created the natural numbers, all else is the work of men ».

is characterised by two elements: it is composed of interactive units and exhibits emergent properties that is, properties distinct from those of the interactive units, in the sense that what goes out is more than the sum of what goes in. The Hayekian concept of spontaneous order, resulting from the interaction of individual agents in a context of dispersed and tacit knowledge enters this category and agent-based modelling may be useful for analysing the emergence of this decentralised arrangement.

There is a rapid and simple answer to that paradox. The Hayekian concept of spontaneous order conveys a narrower meaning than that of emergence, which may hamper the use of these techniques by Austrian economists. Contrary to the more general idea of emergent properties, a spontaneous order conveys implicit welfare properties. Yet the whole Austrian edifice is oriented towards the normative objective of assessing the qualities of decentralised market processes – ideology in a distinct sense than that we use to describe mainstream attachment to modellisation – whereas multi-agent modelling of market processes has no a priori reason to end up with efficient regularities. Simulations may display back and forth between coordination patterns and uncoordinated situations, with the possible occurrence of numerous catastrophes. In other words, agent-based modelling and other complexity tools do not guarantee the free market point of view.¹²

Conclusion

The object of this paper has been to assert the implications, in terms of practices of the community of economists and constraints for their analysis, of the adoption of specific mathematical tools. Our thesis is opposite to the position of Samuelson (1952) who claims the neutrality of mathematics in economic analysis, in the sense that there is, according to him, a strict equivalence between the mathematical language, of any kind, and prose, the former simply allowing for simplest handling of long chain of reasoning. Mathematics is reduced to a mere medium of expression strictly identical to literary exposition “There is no place you can go by railroad that you cannot go afoot and I might add, vice-versa” (Samuelson, 1952, p. 56). The author examines the odd position of Menger with

¹² At least two other reasons may be put to the fore to explain the Austrian reluctance: a first obstacle is the anti-constructivist stance of Hayek who in the 40s criticises the scientist point of view consisting in adopting the same investigation methods in both natural and social sciences (Hayek 1942). The position of the author has however evolved later on when, in *The Sensory Order* he adopts a distinct classification between sciences, those which concentrate on complex phenomena and those which concentrate on non complex phenomena (see Caldwell 2004). A second obstacle may emerge from the strict methodological individualism of Austrians that is only apparently in phase with agent-based modelling where by “agent” is meant not only cognitive agents but also organisations, institutions and so on. Agent-based modelling allows to understand the emergence of institutions – a very Austrian issue indeed since Menger’s analysis of the emergence of money – but also the influence of institutions on economic individual decisions – much more difficult to integrate in an Austrian framework (see Gloria-Palermo 1999b for a discussion of these difficulties).

respect to Jevons and Walras, but he simply concludes that, of the three marginalists, Menger was probably the less interesting given his focus on qualitative features of economic phenomena and his search for the identification of the essence of these phenomena. The thesis here defended is that Menger could not engage in his research program given the nature of the mathematical tools then available. Nor could modern Austrians investigate the nature of the market process with the help of formalist tools. Constructivist tools, with their associated distinct conception of explanation, may provide an interesting alternative.

Ultimately, the view defended here is that mathematics matters, it matters to the extent that one could, like Giocoli (2003), use it as demarcation line in order to classify theories instead of or in addition to the traditional considerations concerning the nature of assumptions. On one side formalists theories, characterised by “[...] non-descriptive content, the adoption of topological tools, the faith in non-constructive existence proofs” (Giocoli, 2003, p. 33), on the other side, constructivist theories, characterised by realist starting points, simulation tools, generative explanations.

Criticisms of mainstream economics are not new, but they may have a major impact today simply because, as soon as one realises that many of its limits are the direct consequence of the use of specific mathematical tools, the very existence of alternative techniques may help to overcome the lock-in in which our discipline has been engaged for decades.

Being aware of the non neutrality of mathematics is necessary. « ...[A]s economic analysts we are directed by, if not *prisoners* of, the mathematical tools that we possess » (Sargent 1987, p. xix, italics added). But it is not sufficient. As we have stressed in this paper, an ontological investigation on the nature of economic phenomena would allow for a deliberate choice of the most appropriate tools and methods rather than using by inertia the tools imposed by mainstream ideology.

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