Antiempiricism in economics: the case of neoclassical axiomatism

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Abstract

The advocates of neoclassical economics treat the axiomatic form of Neo-Walrasian general equilibrium theory as a glorious masterpiece of economic theory. The main aim of the paper is to examine those arguments which are used for giving preference to axiomatic method in general and particular in economics. It will be demonstrated that the alleged parallel between axiomatised part of physics and the neoclassical type of axiomatic form of one part of economics is based on various misunderstandings and not valid at all, and apart from the terminology there is not any connection between the behavioural concept of economics and neoclassical type of formalisation of behaviour.

The first part of the paper distinguishes two types of axiom systems in the field of empirical sciences. The first type of axiom systems has empirical meaningful contents, the axioms say something, albeit in an idealized nature, about the real world. The power of the axiomatic method is that it derives a large body of theory from a small number of assumptions. In building an axiomatised theory, for its empirical status and empirical applicability, it is necessary to give an operational method that permits us to examine the statements of the theory by means of observation. The derived theory can be applied if anything satisfies the axioms. Thus it is necessary to check only the validity of few axioms to decide about the applicability of the system. Euclid's axiom system of geometry, axiom system of mechanics and thermodynamics and axiom system of probability theory are successful and empirical meaningful results of the axiomatic method. In the case of the second type of axiom systems the axioms have nothing in common with reality, and therefore the axiom system is empirical empty. The concept of an axiom system as something divorced from reality is relatively recent phenomenon in mathematics. The arguments behind this way of theory buildings will be critically examined. The axiom system of Neo-Walrasian general equilibrium theory belongs to the second type of axiom systems. Its axioms are grounded not on empirics and reality, therefore its applicability and practical usefulness are at least questionable. Its negative practical consequences will be illustrated by the neoclassical recommendations for competition policy.

The second part of the paper gives a short outline of the interpretation of Neo-Walrasian system by contemporary methodologists, philosophers, writers of the history of economic thoughts and also touches upon its handbook presentation. The neoclassical interpretation of axiom system will be compared with the Misesian apriorism. The last one is treated by neoclassical methodologists as a dogmatic, antiempiricist method. It will be demonstrated that this criticism is valid to the neoclassical method.

Keywords: methodology of economics, methodological pluralism, neoclassical economics, axiomatism

Introduction

Empirical sciences deal with the objects of reality. Their laws, theories, models refer to reality and want to describe, explain or predict some type of observable and repeatable phenomena. The validity of a statement of an empirical science can be decided by the help of both the mind and observations. For an empirical status and empirical applicability of a theory, it is necessary to give an operational method that permits us to examine the statements of the theory by means of observation. Theory without operational method which enables us to make a correspondence between theory and empirics, is not part of empirical science.

An empirical theory can be criticized because of two distinctive components, namely its logical part and empirical part. In the first case there are some logical flaws between the various parts of theory. The second case can be divided further to two distinct problems. Firstly, there are contradictions between theoretical statements and observations, and secondly, there is not any correspondence between theory and empirics. This last problem means that the aim of the theory builder is to describe and explain one slice of reality, but in fact the theory does not have any empirical content. This way of reasoning is impossible in physics but can be observed in several theories of 'neoclassical economics'. This methodological or epistemological problem, the ignorance of empirics is the nearer topic of this paper.

The more concrete example of the paper will be the axiomatic form of Neo-Walrasian general equilibrium theory. This theory is treated by his advocates as a glorious, timeless masterpiece of economic theory, which contributed essentially to the methodological and theoretical development of economics. The mathematical "rigor" of the theory altered economics, making it a more formal and precise science and therefore economics achieves similar prestige among the sciences as mathematical physics. This is the positive extreme of the judgement of the merits of the theory. The absolute refusal can be found on the negative extreme, which is based on similar grounds as the positive opinions: it is not economics at all, but applied mathematics. It is a useless system of thought about nothing or detrimental concerning the economic theory and practice. Between these two extreme viewpoints lies moderate and slashing criticism also. Which viewpoint is more adequate can be judged by the examination of pros and cons.

The main aim of the paper is to discuss the properties of axiom systems in general and from the point of view of Neo-Walrasian general Equilibrium theory (further shortly:

NWGE). The discussion proves hopefully that the alleged parallel between axiomatization of some part of natural sciences and NWGE is not valid. The paper will be organized as follows. Firstly, the general properties of an axiom system are discussed. The second section is about the use of axiom systems in various branches of science. Thirdly, the axioms and assumptions of NWGE are presented. Fourthly, axiomatization in natural sciences and axiomatization of NWGE will be compared. In the last section some arguments in favor of NWGE will be discussed.

General properties of axioms and axiom systems

In this paper the word 'axiom' is used as a basic statement which validity and truth cannot be deduced inside the theoretical system. An axiom cannot be defined itself, it is interpretable only in the frame of a system of axioms. Axioms are supplemented with some basic definitions or undefined primitive terms. Definitions can be given in an indirect way in the introduction of axioms. Axioms must be independent and consistent, that is, they do not contradict themselves. Starting from contradictory axioms anything can be proved. In the field of pure mathematics there is a rather esoteric debate about the consistency of the axiom systems. If contradictory statements can be derived from the axioms, then the axiom system is inconsistent. Till this day we do not know of any case where two contradictory and practically important statements were deduced in an axiom system.

Axioms can be originated as a self evident truth, as a very general empirical statement derived from innumerable empirical observations or it can be arbitrary and without any empirical content. Axioms can originate from anywhere, the important thing is that axioms are not true in absolute sense. They can be true of something. For example, parallel axiom of Euclidean geometry is true in a plane but not true in spheres. The empirical truth of an axiom can be decided by experiments also.

The power of the axiomatic method is that it derives a large body of theory from a small number of assumptions. The axiomatic method itself is no guarantee against error, but it has the virtue that it allows the structure of the theory and the logical connections between the various statements to be understood and any mistake to be easily identified and removed. The derived theory can be applied if anything satisfies the axioms. Thus it is necessary to check only the validity of a few axioms to decide about the applicability of the system. This process works in the opposite direction also: if there is a contradiction between the observations and a corollary statement of the axioms then the axioms may be false for the concerning real world situation.

The word axiom has many other shades of meaning. For our investigations it is only important to preclude the using of axiom for basic or fundamental principles and not necessary to define further. Instead of using the word axiom the word postulates are used in exactly the same meaning.

Use of axiom systems in various branches of science

Axiom systems have the same formal requirements, namely consistency and independence of axioms. However, the role of various axiom systems in scientific research is different. Countless axiom systems can be called into existence which does not have any practical usefulness, in the sense that it cannot be applied to any known real world situation. There are axiom systems which are a relative distant from any important practical application also. The concept of an axiom system divorced from reality is a relatively recent phenomenon in mathematics. Divorced from reality is a matter of mathematics, but as regards the empirical science, the connection between axioms and reality is a fundamental issue.

I focus only on important and empirically meaningful successful examples of axiom systems. The examples will be Euclidean geometry, classical mechanics and probability theory. The aim of this presentation will be the demonstration of the crucial difference between the axiomatization based on empirics and the set theoretical axiomatization of general equilibrium theory. Laying down of empirically meaningful axioms are a result of a long process of problem solving and knowledge accumulating in the history of sciences. The maturity of the field is a prerequisite of the axiomatization. The axiomatized theories became a closed system, which may be empirically valid or invalid, but intermediate situation is not possible. Therefore the correction of an axiom system cannot take place with small steps, with minor modifications. If something contradictory is discovered and corroborated then the whole system has to be rebuilt. (Heisenberg, 1967, p. 231-232) Therefore problematic, contradictory, inconsistent or conflicting elements should never be the content of an axiom system which wants to say something about reality. One can solve scientific problems with the help of unproblematic axioms.

The prototype of every axiom systems is the Euclidean geometry. The axioms of Euclidean geometry are not arbitrary, but originate from the everyday experience and intuition and express it in an idealized nature. Its axioms fit our elementary spatial experience. Hilbert compared the geometry and natural science from the point of view of axiomatization in the following manner: “Geometry also [like mechanics] emerges from the observation of nature, from experience. To this extent, it is an experimental science. … But its experimental foundations are so irrefutably and so generally acknowledged, they have been conformed to such a degree, that no further proof of them is deemed necessary. Moreover, all that is needed is to derive these foundations from a minimal set of independent axioms and thus to construct the whole edifice of geometry by purely logical means.” (Corry cites Hilbert, p. 108) The important difference between Euclidean geometry and natural sciences is that the axioms of the former one is not subject to a change. However, in the case of physical sciences it is conceivable, that its axioms change thanks to the new discoveries.

It is contented sometimes that with the non-Euclidean axiom systems and geometries the Euclidean geometry is not valid yet. This is a misunderstanding. The Euclidean geometry is invariably valid in plane, its practical usefulness is an everyday experience in the work of architects. Non-Euclidean geometries can be used in several other practical spheres: in GPS location, in navigation of pilots and ship captains on the earth, in space travels, in understanding possible real and artificial crystal structures and they have countless other indirect and not obvious practical use.

Turning to the classical mechanics, Newton’s three laws play the same role as axioms in geometry. These laws are called sometimes basic laws, sometimes axioms and sometimes basic rules. Newton’s first law of motion says that in the absence of external forces, a body will execute motion along a straight line with a constant velocity. Since the force-free motion is unproblematic, it can become one pillar of the mechanics, together with the other two laws. What is the cause or explanation of these three laws? This question belongs not to the domain of natural science but to the philosophy or religion. The discovery of Newton’s three laws was owing to previous discoveries and experiments of mechanics and gave explanation for several phenomena, which were unexplained or explained in a wrong way before Newton’s reformulation of mechanics.

After the ascendance of modern physics and quantum mechanics, it is asserted occasionally, that Newtonian physics is invalid, wrong or unacceptable. However, in that scale, where the definitions and notions of Newtonian physics can be interpreted, the classical physics give us a valid description of phenomena. Despite the fact, that the Newtonian notions do not have meaning at subatomic level, the theory remains valid in the field of macroscopic phenomena. (Heisenberg, 1967, pp. 232-233)

The last example is the measure theoretical axiomatic foundation of probability calculus. The three axioms by Kolmogorov seem astonishingly trivial that one may wonder why it was formulated only in 1933. In theoretical sense the axiomatization of probability is a successful research area with many important adequate applications where repeatable mass phenomena occur. These applications can be found in theoretical and applied sciences: meteorology, insurance, medicine, genetic, quantum mechanics, quality control, resource management and so on. However, the danger of the axiom systems which are detached from empirics can be illustrated also with the axiomatization of probability by Kolmogorov: the inadequate adoption of the theory in the field of non-repeateble, unique phenomena. This is the basic problem of econometrics also. The problems of probability theory do not concern the axioms (apart from the polemics between measure theoretical approach and frequency approach by Richard von Mises); they are generally about the adequate application of the mathematical theory to an observed phenomenon.

The axioms and assumptions of NWGE

The paradigmatic evolving of NWGE is attributed mostly to the works of Arrow and Debreu in the 1950's. In this section this form of the theory is discussed, based on "Theory of value" by Debreu. There are two types of axioms and assumptions of NWGE. Firstly, pure mathematical assumptions, like the axiom of completeness, compactness, the maximum-minimum theorem, the separating hyperplane theorems, the Kakutani fixed point theorems and others.[1] I pass over the listing of the complete set of abundant mathematical assumptions and definitions this can be found in the first 27 pages of "Theory and value". Choosing these assumptions is not anchored in economic theory. In the next section I will revert to some aspects of these mathematical tools.

Secondly, the theory employs redefinitions of economic terminology[2], essential economical assumptions and disregards vital issues also. The following enumeration is arranged in groups by topics. Overlappings may be in the list inside the groups and between the groups also.

Money:

1. Economy operates without money.

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[1] About some problems of this mathematical theorems see Velupillai (2005).

[2] "The dual concepts of commodity and price are introduced in this chapter. The meaning of these terms, somewhat different from current usage, will be made precise in the next sections." (Debreu, 1959, p. 28.)

Price:

2. Price is a general term which “covers a great variety of terms in current usage: prices proper, wages, salaries, rents, fares, fees, charges, royalties…” (Debreu, 1959, p. 32.)

3. All prices are given parametrically to all agents, the issue of formation of prices is not part of the theory.

4. Prices constitute the sole kind of information on which “decision” are based (decisions do not occur in the original and everyday sense of the word because of full information; see later).

5. Prices can be positive (for scarce commodity) zero (for free commodity) and negative (for noxious commodity).

Commodities:

6. Commodity is a general term which covers goods, services, labor and transportation.

7. Commodities are perfectly divisible.

8. Economy operates without material reserves.

9. Factors of production, capital and consumer goods are not specified separately.

Production:

10. The producer is an economic agent who optimizes the production plan on the basis of the given prices.

11. Production occurs at constant returns to scale.

Markets and trade:

12. There is not trade and trading costs.

13. There are demands and supplies, but there are no markets.

14. There is not communication between economic agents.

Time:

15. The analysis is static and atemporal.

16. The analysis starts from a predetermined instant position.

17. Economic agents make a decision about the production and consumption at a single date, in the beginning of an unspecified length of time (one day? ten years?). There is not possibility to change the behaviour.

18. Length of elementary time interval is the same for every activity.

19. There is not interest.

20. There is no possibility to learn, invention, research and development.

21. There is not historical time.

Space:

22. There are elementary locations. The set of location is partitioned into nations.

23. The prices are uniform for all the locations of a nation.

Institutional, legal and social factors:

24. There are not social and cultural factors.

25. There are no state, law and institutions.

26. There are no taxes.

27. There are no legal or mental barriers in doing business.

Information:

28. Economic agents are perfectly informed and they have perfect foresight.

29. There is no possibility of error and imperfect decisions.

30. There is no advertising.

Externalities:

31. There are no externalities.

This is not a comprehensive survey for two reasons. Firstly, the assumptions concerning consumer behaviour are left out, because they are well-known from the theory of perfect competition. Several topics were omitted which are not mentioned directly in NWGE: lack of credit, employment and unemployment, business cycles and so on. Secondly, there are many other papers about the topic with slightly different formulation. There can be contradictions, undefined phrases and omitted definitions inside the same publication also. It is strange from authors who claim to hold to high standards of analytical rigor that their verbal presentation can be superficial and verbal definitions are sometimes unclear. For example, Debreu stated on page 28 the lack of money. Five pages later is written: "Imagine that a certain good circulates as money at location s, at date t, and let k be the index of the commodity thus defined." (Debreu, 1959, p. 33) The subsequent explication can hardly be followed, similarly to some other verbal parts of the book. Treatment of space is inconsistent also: firstly many locations are introduced, and goods are specified physically, temporally, and spatially. "A good at a certain location and the same good at another location are different economic objects, and the specification of the location at which it will be available is essential." (Debreu, 1959, p. 29-30) This is a correct definition. However, five pages later can be read, that the set of location is partitioned into nations and the prices are uniform for all the locations of a nation. It is not clear, how can be prices of different goods (if different location means different goods) uniform.

Comparison of the axiomatization with empirical content and NWGE axiomatization

In the case of formerly presented examples of axiom systems either axioms have direct and controllable empirical contents (Euclidean geometry and classical mechanics) or there are real world phenomena where the deductions of the system are applicable in an adequate way (Kolmogorov probability). This axiom systems have a direct and unambiguous connection with real world phenomena, thus the axiom system gives information about the real world, albeit in an idealized nature. The deductions of the axiom system are detached from intuition and direct experience for the sake of mathematical rigor. But only the deduction and not the origins of axioms are detached from empirics. Axiomatization of NWGE represents a third type of axiom systems, namely pure mathematical system without any possible real world application or interpretation. Not only theorems deriving from axioms are detached form the intuition but choosing axioms and assumptions too. This is a conclusive different. The impressive success and development of natural sciences, indeed the western civilization was based on the amalgamation of theoretical and practical-empirical viewpoint in the scientific discovery. This mentality is a missing element from NWGE.

As regards the arguments for favoring mathematical expression, Debreu and his followers state that the theory "is logically entirely disconnected from its interpretations." (Debreu, 1959, p. VIII.) However, this is the case with every other theory and with the three examples also. The key difference is that in the examples not only the theory is given that there also exist operational method and tools for measuring variables used in the mathematical formulation of theories. Indeed, mathematical formulation suppresses the fact that mathematical symbols want to refer to ambiguous, unclear, vague and unmeasurable economic and social phenomena. Therefore in this case mathematical expression is able to provide only the illusion of exactness of economic concepts. It would be also a rather strange idea that murky ideas expressed in natural language have an exact, precise meaning translated to the language of mathematics. Debreu does not deal with the interpretation of the theory thus he solves this translation problem in that way. Otherwise, this solving is inconsistent with his intensive use of economic terminology. Words such as "commodity", "price", "production" are employed in NWGE theory without any economical ethos behind these words. Moreover, the basic mathematical concepts of the theory have been chosen because of their mathematical convenience in generating theorems and may contradict to our elementary knowledge about the functioning of economy. Constant return of scale or perfect divisibility of goods are a rather unfamiliar assumptions which are not negligible when someone try to use the theory to real problems.[3]

Arguments in favor of NWGE

In this section some moderate argument in favor of NWGE will be discussed. As I mentioned in the introduction the opinions about the scientific merit of NWGE ranges from the devout admiration[4] to absolute rejection as pseudo science[5]. According to one interpretation NWGE proofs the existence of general equilibrium of a competitive market economy. A restrained opinion says that NWGE demonstrates that conditions under which general equilibrium imaginable. For example it shows, that in the absence of time, externalities, institutions, taxes, trading costs, constant returns to scale and so on, and in the presence of perfect information, perfect foresight a fully competitive general equilibrium allocation exists and Pareto-efficient.

One of the basic arguments in favor of NGWE is that it serves a useful starting point to analyze the real effect of factors which are disregarded in the models. Thus, for example, the abolition of time enables to grasp the essential points of time during the development of a temporal theory. Or suppose commodities are distinguished by their location then the theory can be developed into a spatial model. And so on, similar with all other restrictive assumptions. The problem of this view is that too much unreal assumptions remain after resolving only one and we know nothing about their complex interactions and biasing effects.

According to an other argument, although NGWE is unrealistic and unusable in everyday problems but it is still useful as a simplified guide as to how a real economies function. "[The rigor of contemporary school of mathematics] leads to a deeper understanding of the problems

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[3] Karl Menger presented many examples which showed that mathematical presentation in economics is not more precise than use of natural language and he demonstrated the problems of tacit assumptions of mathematical economics. (Menger, 1973) See Lawson (1987) and Vilks (2007) also.

[4] Only one example: "As he rightly emphasized, the general equilibrium approach encompasses a theory of market allocation across space, time and states of nature. As such it unifies and extends location theory, capital theory, and theories of behavior under uncertainty. It provides a positive theory of social behavior in these environments, but perhaps more importantly, it describes a normative standards against which other allocative mechanism can be compared." (Varian, 1984, p. 11)

[5] "Strictly interpreted, neo-Walrasian theory is descriptive only of a fairy-tale world of notional economic activities that bears not the slightest resemblance to any economy of record, past, present, or future. It is a science fiction…" (Clower, 1986, p. 195)

to which it is applied, and this has not failed to happen in the present case.” (Debreu, 1959, p. VIII)

Conclusions

Axiomatization of a set of theory can be extremely efficient and progressive if the axiom system has a real contact with the phenomena aimed to explain. There are many examples for sound axiomatization in the field of empirical sciences. NGWE does not belong to these examples. It seems that NGWE interprets peculiarly the axiomatization and its axiom system does not have any contact with reality. “The axioms of equilibrium theory were originally chosen in order to secure the desired result, in other words, the assumptions required for proving the existence of a unique and possibly stable general equilibrium. (…) Since Walras first wrote down his system of equations over 100 years ago, progress has definitely been backwards not forwards in the sense that those of the present set of axioms are far more restrictive than those of the original Walrasian model. The ship is no nearer to the shore, but considerably farther off, though in a logical, mathematical sense, the present system of derived tautologies is enormously superior to Walras’s original effort.” (Kaldor, p. 1985, p. 13)

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