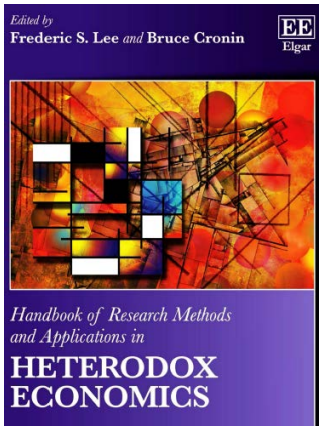

Critical realism, econometrics, and heterodox economics*

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11.1 INTRODUCTION

Econometrics, understood as the measurement of quantities relevant to economic analysis, has a long tradition in economics, which goes back at least to the authors that Joseph Schumpeter (1954 [1994], pp. 209–43) called the early 'econometricians', such as William Petty, Richard Cantillon, and François Quesnay. However, the approach adopted by those authors, who were the initiators of classical political economy, is very different from that of the contemporary econometricians. For classical political economists like Petty, Cantillon, and Quesnay, economic science was the study of the production and distribution of the surplus. To study this process, they developed arithmetical methods of measuring the surplus, taking into account quantities which can be objectively observed and measured, such as the quantity of land and quantity of labor time employed in the production process.

The classical surplus approach developed by those authors, which was continued by Smith, Ricardo, and Marx, was abandoned by the more influential schools of thought after the marginal revolution (and was already being abandoned after Ricardo). The introduction of differential calculus into economics played an important role here, as the emphasis was switched from the process of production and distribution of the surplus as a whole, focusing on aggregate quantities measured through arithmetic methods, towards marginal changes studied through differential calculus.

After the marginal revolution, the relationship between prices and quantities started to be studied in terms of marginal changes represented by supply and demand curves, and economics became increasingly concerned with the relation between the increment of a given quantity X and the increment of another quantity Y, while assuming everything else constant. Although this mode of reasoning emerged in the nineteenth century, it became more dominant than ever throughout the twentieth century, within neoclassical economics. In this context, econometrics emerged as an autonomous field within the mid-twentieth century, focusing on how changes in one variable affect another variable, while isolating the studied variables from everything else. The measurement of aggregate quantities taking into account the whole system, which was the method adopted by the classical authors, was relegated to the study of national accounts, and considered less scientific than the study of constant conjunctions of the form 'if event X then event Y'.

Critical realism in economics emerged as a critique of the use of methods which presuppose systems characterized by constant conjunctions of the form 'if event X then event Y', systems which are defined in critical realism as closed systems. In so doing, critical realism engaged in a critique of mainstream economics, including mainstream econometrics, due to its use of methods that presuppose closed systems. Critical realism

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both observes that constant conjunctions of the form 'if event X then event Y' are not ubiquitous, and indeed are rare, and also emphasizes that the socio-economic realm is an internally related open system in process.

But critical realism constitutes a philosophical perspective, and does not engage in substantive theorizing. Rather, it has been concerned with philosophically under-laboring for a more relevant economic theory and method, which does not presuppose a priori the existence of closed systems, and focuses on the reproduction of socio-economic structures as a whole, as the classical political economists and Marx had done. Critical realism advances a transformational conception of social activity, in which social structures are the condition of possibility of human agency, which in turn not only reproduces but also transforms social structures.

The set of substantive contributions that fall within the conception advocated by critical realism is the set of contributions often designated as 'heterodox economics'. The substantive theories developed within heterodox economics have been concerned with the reproduction of socio-economic structures as a whole, paying close attention to social provisioning in this context.

In so doing, heterodox economics engaged in a return to the surplus approach, since the study of the process of social provisioning is essentially a study of the distribution of the surplus, which was the central topic of the classical political economists who Schumpeter called the first 'econometricians'. The latter authors focused on the theory of value and price formation (a topic addressed today within what is called microeconomics), and when engaging in measurement focused on aggregate quantities in order to explain the production and distribution of the surplus (as heterodox macroeconomists have done since Kalecki and Keynes), rather than on correlations between increments in variable X and increments in variable Y, as mainstream economists and econometricians do while presupposing closed systems.

11.2 NEOCLASSICAL ECONOMICS AND MAINSTREAM ECONOMETRICS

As Schumpeter (1954 [1994], p. 209, fn. 2) notes, the term 'econometrics', coined by Ragnar Frisch, emerges in the mid-twentieth century in order to designate a research program which entails much more than mere measurement of observable quantities. The emergence of the field of econometrics in the twentieth century, together with the distinction between microeconomics and macroeconomics also stressed by Frisch, led to the structure of modern mainstream economics, typically divided into these three subfields: microeconomics, macroeconomics, and econometrics.

Schumpeter (1954 [1994], pp. 209–43) argues, however, that if 'econometrics' means the measurement of quantities relevant to economic analysis, then econometrics is a field which goes back into the very emergence of classical political economy, when authors such as Petty, Cantillon, and Quesnay developed arithmetical methods for measuring objective and observable quantities relevant to economic analysis. But in so doing, Petty, Cantillon, and Quesnay adopted an integrated approach, rather than separating economic analysis into microeconomics, macroeconomics, and econometrics.

The approach of the early classical political economists was macroeconomic in the

sense that they focused on the study of the reproduction of the economy and society as a whole. The unit of analysis they used, which was also used by those who followed their approach such as Smith, Ricardo, and Marx, was the social class, rather than the isolated individual presupposed in mainstream microeconomics. The approach of those authors, designated by Marx as 'classical political economists', consisted of studying the production and distribution of the surplus throughout the various social classes.

For the classical political economists, the need to engage in economic measurement emerged initially in the context of a theoretical problem, concerning the definition of the surplus. In order to define the surplus, it is necessary to know how to value outputs and inputs in the production process, so that the surplus can be defined as the difference between the aggregate quantity of outputs and the aggregate quantity of inputs. The key production inputs considered by the classical authors were land and labor. Political arithmetic, to use the term employed by Petty, consisted thus in the measurement of value focusing on objective and observable entities such as quantity of labor time and quantity of land. Karl Marx (1867 [1999]) uses the term 'classical political economy' to designate the approach running from Petty to Ricardo, in order to distinguish it from the approach of Nassau William Senior and John Elliot Cairnes, in which subjective elements such as 'abstinence' and 'sacrifice' start to play a key role in the explanation of the cost of production.

The contribution of Menger, Jevons, and Walras constitutes for many a break with classical political economy, where subjective elements start to play a key role in the explanation of demand too. Marshall (1890 [1920]), however, argued that his approach was in continuity with classical political economy, which he interprets as an approach centered on supply and demand analysis, rather than on the reproduction and distribution of the surplus with value explained in objective terms. In Marshall's (1890 [1920]) framework, the cost of production includes subjective elements such as Senior's 'abstinence' (which Marshall prefers to call 'waiting') or Cairnes's 'sacrifice', which are represented through a supply curve. The demand curve, in turn, represents subjective marginal utility, in line with the marginalist authors. Marshall used supply and demand curves so construed in order to explain the mutual determination of prices and quantities.

Marshall faced a methodological problem when using supply and demand curves, namely the fact that those curves cannot move independently. Moving one curve triggers a sequence of events that leads to changes in the other curve, as Sraffa (1925, 1926) was later to show. Thus, in order to use supply and demand curves when determining prices and quantities, Marshall (1890 [1920]) assumed that everything else remains constant, for a time, in a pound called *ceteris paribus*.

Marshall (1919 [1923]) found a methodological justification for this procedure in Newton's and Leibniz's differential calculus, who noted that when looking at small changes, we can focus on the direct effect of a change in one variable X on another variable Y, while assuming that the indirect effects (the effect of a change on variable X on some variable Z which in turn influences variable Y) are negligible, since they will be a very small thing of a very small thing. This, of course, presupposes that changes are infinitesimally small, so that the product of an infinitesimally small quantity (the change in Z caused by a change in X) by another infinitesimally small quantity (the change in Y caused by a change in Z) can be neglected (so that we can focus on the direct effect that a change in X has on Y).

Marshall (1890 [1920]) explains that his use of differential calculus was influenced by Augustin Cournot and Johann Heinrich Von Thünen, who used differential calculus before the marginal revolution. The procedure Marshall adopts is, of course, highly problematic, since in economics we are not dealing with infinitesimally small changes, and so indirect effects cannot be ignored, as Sraffa saw early on; see Martins (2013, Ch. 2) for a discussion of this issue with reference to Sraffa's unpublished papers.

The Marshallian neoclassical method stands in stark contrast to the method adopted by the classical political economists from Petty to Ricardo, who focused instead on the reproduction of the economic system as a whole. While the classical authors relied merely on arithmetic while focusing on aggregate quantities, neoclassical economics drew heavily upon differential calculus in order to explain the direct effect of changes in a given variable X on another variable Y while assuming that indirect effects can be neglected, that is, everything else remains constant.

The mathematization of economics advanced rapidly with the development of general equilibrium theory by Kenneth Arrow, Gérard Debreu, and Lionel McKenzie, and the development of game theory by John Von Neumann, Oskar Morgenstern, and John Nash. At this stage, fixed point theorems play a key role in the development of general equilibrium theory and game theory. But the use of differential calculus plays a central role in the development of mainstream economics at this stage too, so much so that Paul Samuelson (1970) focuses on the 'maximum principle' in his Memorial Nobel Prize Lecture. In his lecture, Samuelson refers also to the importance that differential calculus had to Marshall's *Principles of Economics*, which Samuelson describes as the dominant economics treatise in the 40 years following its publication (and was replaced by Samuelson's own textbook as the dominating economics treatise), while referring also to Cournot's pioneering contribution to differential calculus.

The program known as 'econometrics', led by authors such as Ragnar Frisch and Jan Tinbergen, is part of this increasing mathematization of economics in the mid-twentieth century, where differential calculus plays a central role. The research program of mainstream econometrics is centered on the formulation of an econometric model in which a given variable (or set of variables) X influences a given variable (or set of variables) Y. The econometric model focuses only on the direct effects of X on Y, which are expressed in terms of the regression coefficients associated with each variable X, leaving other aspects as part of a residual term.

In order to estimate the regression coefficients various methods are used, such as the least squares method, the method of maximum likelihood, or the generalized method of moments. All these methods consist of an optimization procedure drawing upon differential calculus, focusing on the variables which are selected, while assuming that everything else remains constant (or constitutes a mere residual which has a negligible influence on the econometric model).

The methodology employed in econometrics was criticized early on by John Maynard Keynes, who noted how it presupposes atomism; that is, presupposes that we can focus on the effect of a given variable on another variable while assuming it to be isolated from everything else. Keynes's critique of econometrics is part of his critical approach to symbolic mathematics in general, which can be seen for example in his critique of the use of differential calculus by Marshall and Pigou. According to Keynes econometrics, like differential calculus, presupposes strict independence between the various factors involved,

and loses all its applicability if there is no strict independence between the variables being analyzed and the rest of reality; see, for example, Keynes's (1936, pp. 297–8) discussion of symbolic mathematics.

The problem at stake here is connected to the use of differential calculus, which led Marshall and neoclassical economics to focus on the effect of an increment in a given variable X on another variable Y while assuming everything else constant, in contrast with the classical method which focused instead on the arithmetic analysis of aggregate quantities. Keynes's (1936) own approach consists of a return to the study of macroeconomic aggregate quantities, which can be studied through basic arithmetic. Thus, Keynes's perspective can be seen as a return to the classical method of focusing on macroeconomic aggregate quantities.

Keynes's approach is quite compatible not only with the classical method, but also with classical theory. Keynes seems to have taken seriously Marshall's claim to be in continuity with classical political economy. Thus, when Keynes claims he is criticizing 'classical' theory, he is in truth criticizing the 'neoclassical' theory, as developed by Marshall and Pigou. But once we distinguish between classical political economy and vulgar economy, as Marx did, we see quite clearly that Keynes's theory is quite compatible with classical political economy, understood as a study of the circular process of reproduction while focusing on macroeconomic aggregate quantities; see Martins (2013, Ch. 4) for a discussion.

11.3 CRITICAL REALISM IN ECONOMICS

Critical realism in economics engaged in a critique of mainstream economics, including mainstream econometrics. Lawson's contribution, which is central to the development of critical realism within economics, was inspired by Keynes's methodological critique of the use of mathematical methods that presuppose atomism, as well as by the contributions of many other heterodox economists. The philosophy of critical realism, led by Roy Bhaskar, helped in systematizing the contributions of those various heterodox economists.

The conception reached within critical realism in economics is one in which human agents and social structures are in a continuous process of reproduction and transformation. The focus on the reproduction and transformation of social structures in critical realism goes back to Marx's contribution, which is explicitly acknowledged by Bhaskar and Lawson. Bhaskar's critical realism was especially influenced by the way in which Louis Althusser developed Marx's perspective, while Lawson's approach is influenced by other heterodox economists who also focused on social reality as a whole; see Martins (2013, Ch. 7).

A central notion in critical realism is the notion of 'internal relation', which can be defined as a relation which is constitutive of its parts. The notion of internal relation is present in Marx's philosophy, and is connected to the influence of Friedrich Hegel on Marx. Even if we accept Althusser's (1965 [2005]) thesis that there is an epistemological break in Marx's thinking after which Hegelianism is dropped, the notion of internal relation remains central to Marx's mature thinking.

However, if everything is internally related, we cannot have complete knowledge by

focusing on a given part. If we focus only on a given part, we are missing the other parts, in a context where the relations to those parts are constitutive of the part we want to study. Drawing upon Bertell Ollman's (1993) interpretation of Marx's method, Lawson (1997) makes a distinction between abstraction and isolation in order to address this problem (which is the same problem faced by Marshall, and which Keynes pointed out when criticizing mainstream econometrics and the use of differential calculus). To abstract means to focus on a given part without supposing that the part is independent from the other parts we are abstracting from. This means that when looking at a given part, there is always uncertainty due to the existence of other parts we are abstracting from. To isolate, in contrast, means to focus on a given part while assuming that the part is not related to the other parts we are isolating it from.

Like Marx, Marshall was also influenced by Hegel and perceived the problem of internal relations early on. Marshall's use of differential calculus was a way to avoid the problem raised by internal relations, in order to focus on a given part of reality. Marshall acknowledged the existence of internal relations, but assumed that we could focus on direct effects only in order to study the conditions for partial equilibrium, while assuming indirect effects to be negligible.

Marshall's assumption that indirect effects are negligible, for a given time at least, was an attempt to avoid the uncertainty that occurs when abstracting. Bertrand Russell was so troubled by this uncertainty that he adopted the method of isolation instead, since only isolation guarantees that knowledge of a given part is not disturbed by other parts of reality. But isolation presupposes that each part is a self-sufficient atom, in the sense that it remains undisturbed by other parts of reality. Thus, Russell embraced atomism, breaking with the Cambridge philosophical tradition where internal relations were always a central notion.

In short, abstracting and isolating are two different procedures, which lead us to focus on a given part of reality. If we abstract from other parts which are internally related to the part we are focusing on, we reach knowledge of a given part which comes to us under a given degree of uncertainty and vagueness. This is why Keynes (1936, pp. 297–8) argues that ordinary discourse is a more appropriate method for describing reality than symbolic mathematics. Keynes (1936, pp. 297–8) notes that when engaging in ordinary discourse, we are using words which are part of a broader semantic context, and so we can keep at the 'back of our heads' the necessary qualifications related to the other parts we are abstracting from, taking into account internal relations. Mathematical symbols, in contrast, indicate exact rules which must not contain any uncertainty or vagueness, and presuppose that the part of reality we are focusing on is isolated from everything else.

The positivist attempt to find laws of the form 'if X then Y' is an attempt to find the connections between isolated parts, while ignoring other interactions that X and Y may have with other entities Z. Lawson (1997, 2003) defines closed systems as systems characterized by constant conjunctions of the form 'if event X then event Y', while open systems are systems in which those constant conjunctions need not occur. Lawson (1997, 2003) defines deductivism as a form of explanation which presupposes closed systems, that is, it presupposes constant conjunctions of the form 'if event X then event Y'. Critical realists criticize mainstream economics, including mainstream econometrics, due to its ubiquitous use of mathematico-deductivist methods; that is, methods that presuppose closed systems.

Mathematical methods were applied successfully in natural sciences such as physics. However, this is because closed systems are created artificially under controlled laboratory conditions, so that exact regularities are sometimes obtained, and mathematical methods can be applied successfully. Of course, in fields such as astronomy, exact regularities can be found without laboratorial manipulation. In fact, Newton developed differential calculus (which he called the 'method of fluxions') at the same time as he was studying celestial mechanics. Gauss developed regression analysis in order to study celestial mechanics too.

Techniques widely used in mainstream economics, such as differential calculus and regression analysis, proved to be very useful when applied to closed systems, be it celestial mechanics, or the systems artificially generated in the laboratory. The use of those methods indeed presupposes closed systems. Thus, if we apply those methods to social reality we are presupposing, a priori, that social reality must be characterized by closed systems, or atoms, as Keynes noted early on in his critique of econometrics.

11.4 REALISM, INSTRUMENTALISM, AND CAUSATION

Trygve Haavelmo tried to address the implications of the problems raised by Keynes, and pointed out the need of using joint probability density functions, to take into account that reality is deeply interconnected, as Keynes argued it is. David Hendry (2000) developed a methodology in which one starts from such an assumption, and then one tries to find reduced-form models where we can identify a given variable (or set of variables) X as an exogenous or independent variable. After this is done, one can then follow the usual procedure undertaken within mainstream econometrics, which is to assume that a given variable (or set of variables) Y is a dependent or endogenous variable, in the sense that it is explained in terms of the variable (or set of variables) X, which is typically taken to be independent or exogenous. But the variable which is supposed to be independent or exogenous is often actually endogenous too, and correlated with the error term, leading to inconsistent estimates.

There are, of course, various attempts within mainstream econometrics to circumvent these problems. One is the use of the method of instrumental variables, which can be interpreted also as a least squares method undertaken in two steps. In the first step, we find a variable Z which is not correlated with the error term, but is correlated with the variable X. We can then estimate X using Z, and afterwards use the estimates of X which do not suffer from endogeneity since we are actually using a linear combination of Z which is not endogenous.

The use of instrumental variables implies, of course, the use of variables which may have no theoretical connection to the variables we intend to explain. This is why the former are called 'instrumental' variables. In mainstream econometrics, the aim is often to find some correlation regardless of theory. The Cowles Commission, which contributed much to the establishment of mainstream econometrics, stressed the need to combine measurement with theory. But given the difficulties of engaging in measurement in the context of open systems, a tendency emerged where the aim is simply to find correlations.

This is clear in the widespread use of the method of instrumental variables, but it is also clear in the methodological position adopted by Milton Friedman (1953 [1970]),

often designated as 'instrumentalism'. According to Friedman's position, economic models need have no connection to reality, as long as they predict. Friedman's position was challenged by mainstream economists such as Paul Samuelson (1963), who argued that models must be used to find an underlying structure. But whatever methodological position is explicitly supported, mainstream economics is characterized by the use of a deductivist methodology which presupposes implicitly that reality is constituted by closed systems. Friedman's instrumentalism is a more honest rendering of what is actually being done in mainstream economics, and the use of instrumental variables is often a way to simply find a correlation, even if the proposed aim of the instrumental variable method is to avoid problems of endogeneity in the explanatory variables.

The 'endogeneity' of the explanatory variables, which should be exogenous instead in order to avoid inconsistent estimators, is simply a consequence of the fact that the data generating process – that is, social reality – is an internally related open system, and so it becomes impossible to find constant conjunctions of the form 'if X then Y', and X cannot be seen as an independent and exogenous variable. In order to avoid this problem, Christopher Sims adopted a methodology which consists simply in assuming that all variables are endogenous, and correlating a vector of such variables with themselves at different time periods, leading to a methodology known as a VAR (vector auto regression) model. The VAR methodology is supposed to be completely atheoretical, since we are only searching for correlations, without any regard for the underlying theory.

Without an underlying theory, we are faced with the problem of causal explanation. As critical realists explain, natural scientists identify causal mechanisms because different experiments are conducted, in order to find the conditions under which causal mechanisms are triggered. If the social realm is an open system which cannot be subject to experimental control in the same way as the natural realm, we cannot identify causal mechanisms in the same way as in the natural realm. For this reason, Lawson (2003, Ch. 4) develops a methodological procedure termed 'contrast explanation', where instead of producing a given outcome in a closed system, we must wait until scientifically interesting surprising contrasts appear in socio-economic reality. While a laboratory experimental activity is forward-looking, since it deliberately produces situations where surprising contrasts become manifest and causal powers and structures are identified, contrast explanation is backward-looking, since in contrast explanation we typically look at historical data or case studies and try to find surprising contrasts that may arise in an open system.

If the social realm were a closed system, as presupposed in mainstream economics, we could find constant conjunctions of the form 'if X then Y'. However, without being able to artificially construct several experimental arrangements in order to identify the conditions which trigger specific causal mechanisms, we would be unable to find what causes what. Causes are identified when contrasting situations are observed, where in some situations causal powers are triggered, and in other situations causal powers are not triggered.

This shows that Friedman's (1953 [1970]) instrumentalist methodology is much more consistent with the deductivist methods used in mainstream economics, which presupposed closed systems. If the world is a closed system, we simply observe correlations, without being able to identify causality, since we cannot identify contrasting situations in order to find which underlying conditions trigger causal powers. All that we would be

able to achieve is prediction of events based on our model, without being able to explain the real underlying causes.

11.5 THE MAINSTREAM ECONOMETRICIANS' CRITIQUE OF CRITICAL REALISM

Clive Granger developed a notion of causality which shows what causality means in a context of closed systems. 'Granger causality' is a conception where causality means merely whether one variable is useful for forecasting another model in the context of an econometric model. Granger (2004) criticizes critical realism for failing to note that many statistical tools developed within contemporary econometrics address the problems raised by critical realism, focusing for example on time-varying parameters, and argues that there are some examples of successful prediction in econometrics, such as that undertaken in Ramanathan et al. (1997).

As Lawson (2003) notes, his critique does not imply that closures never occur, but merely that they do not always occur, and so the insistence on always using methods that presuppose closed systems leads to a great waste of energy and effort. The problem identified in critical realism is not the use of mathematics, but rather the belief that the use of mathematico-deductivist methods is the only scientific way to undertake valuable economic research. Scientifically interesting closures are rare, and so the insistence on the use of methods that presuppose them is misplaced. Concerning time-varying parameters, which is another point raised by Granger, Lawson (2003) notes that those parameters are often described in terms of other mathematical constants, and thus the assumption of exact closure appears at another level.

Hendry (1983) criticized Lawson (1981) for failing to note that many econometricians do take into account the issues raised by Lawson; see Stephen Pratten (2005) on the debate between Hendry and Lawson. Hendry, like other econometricians such as Robert Engle, has been much concerned with the problem of endogeneity. Hendry, like Haavelmo, notes that we must start from a joint probability density function, in order to take into account the fact that reality is interconnected, and so we cannot take for granted the exonegeity and independence of the explanatory variables.

However, even if we start from a joint probability density function, we still must know which probability density function we should choose in order to describe the data generating process. The central limit theorem is sometimes pointed out as a justification for the use of normal (or Gaussian) probability functions. The central limit theorem states that the arithmetic mean of a sufficiently large number of independent and identically distributed random variables will follow approximately the normal distribution. But the central limit theorem, as usually formulated in most statistics and econometrics textbooks, presupposes independence between the various variables, which means that it presupposes isolation again. Even if dependence concepts are developed, so that the central theorem can be applied to cases where dependence exists, it must presuppose constants at some level, as all mathematics does.

Of course, other probability functions can be tested, until we find the correct one. The problem is that all probability functions must presuppose constants at some level, and the only thing which is constant in economic reality is change. The data we may want

to analyze are typically not stationary, nor even ergodic, which means that we cannot assume that the study of a given time period gives us any guidance to understanding other time periods. That is, even basic concepts such as the mean, variance, or covariance may not be constants; see Paul Davidson (1994) on how Keynes's critique applies to all approaches that presuppose ergodicity. As Granger (2004) argues when criticizing critical realism, contemporary econometrics allows for time-varying parameters. But constants, and thus closure, must be found at some level so that mathematico-deductivist tools can be successfully employed.

Edward Leamer (1985) recognized the need for robust relations between variables if econometric methods are to be of any use. Thus, he developed a procedure of sensitivity analysis, often called 'extreme bounds analysis', which consists in, when studying the relationship between variables X and Y, changing a set of variables Z, and see how the relationship under study (between X and Y) is affected by those changes in variables Z. The relationship between variables X and Y is said to be robust if it is not significantly affected by the changes in Z. If the coefficients of a regression of Y on X do not remain sufficiently stable when changes in another set of variables Z occur, we may wonder why we are trying to measure with precision something which is not precise at all. The same can be said of other mathematical constants we may want to find in order to describe time-varying parameters.

The point can be illustrated by imagining a graph which shows the relationship between two variables X and Y. The points in the graph, which represent each observation, may be disposed across an exact straight line, or may be led to do so after appropriate transformations (for example logaritmization, or taking differences) are performed. In that case, we are clearly in the presence of a closed system, and it becomes important to measure exactly the slope of the line, and its intercept with the Y axis, measured by the regression coefficients.

But it may also happen that the points in the graph show no exact line, or no line at all, even if they appear to indicate a more or less vague positive or negative correlation between X and Y. Under such a situation, it often happens that adding a new observation, or removing one, significantly changes the coefficients of any regression analysis that we may perform. Under such a situation, do we gain anything by adding a regression line to the set of points represented in the graph? The coefficients we obtain under those situations are highly fragile, as Leamer (1985) points out, and the regression line only gives a false sense of precision. Probably graphical inspection of the dots on the graph, with no regression curve added, gives us a better description of the situation, since it gives us a sense of the various tendencies at stake, and of how uncertain the situation is.

A similar case occurs with supply and demand curves. As Pierangelo Garegnani (1998) explains, the classical economists did not resort to supply and demand curves in order to explain prices. For the classical authors, the gravitation of the market price around the natural price was a vague process, which is best described by a series of points in a graph which conveys the vague character of the process, as Garegnani (1998) does when representing gravitation graphically, rather than by supply and demand curves which give a false idea of precision. As Aristotle argued, we cannot aim at more precision than the precision that the subject matter allows for. If we are analyzing a closed system, mathematical methods that presuppose such systems are most appropriate. If we are analyzing

an open system, a description of the system that does not presuppose closure is more appropriate.

11.6 HETERODOX ECONOMICS AND THE SOCIAL SURPLUS APPROACH

Since scientifically interesting closures are not found easily, we often find mainstream econometricians torturing the data until the data fit into the model, leading Leamer (1983, p. 37) to point out that in mainstream econometrics 'hardly anyone takes anyone else's data analysis seriously', as Lawson (2003, p. 11) also notes.

The problem faced by mainstream econometrics is that it engages in what Lawson (1997) calls 'isolation', by focusing on models that attempt to establish correlations between variables while assuming everything else remains constant. Lawson argues that while mainstream economics is characterized by the use of mathematico-deductivist methods that presuppose an ontology of closed systems, heterodox economics is best defined in terms of a concern with a social reality understood as an internally related open system in process. In the latter situation, the best methodological procedure available is a combination of abstraction and contrast explanation, which requires using words in the context of a narrative, rather than mathematico-deductivist methods, and thinking dialectically.

Mary Morgan (2002) suggests combining models with narrative stories when explaining reality. The question is whether the model adds anything to the narrative. When facing partial regularities represented in a graph showing several dots that do not follow an exact pattern, do we gain anything by adding a regression equation, whose coefficients are fragile enough to change significantly as new data arises? Most econometricians would argue that any good econometrician would not do so. But as Leamer (1983) and Hendry (2000) acknowledge, this is often done in fact. And the reason it is done is because whatever is perceived as mathematical complexity is immediately if erroneously equated with science. Thus, unrealistic econometric models are developed even when they bring little added value, in order to conform to what is perceived as 'proper practice' or science.

In order to engage in abstraction, rather than in isolation, the most useful mathematics is the mathematics that can be more easily explained in words, which enables us to keep in mind the various tendencies at play. And the mathematics that can be more easily explained in words is a simpler type of mathematics, rather than a too-complex analysis which presupposes closed systems while making us lose sight of the fact that an isolation, rather than an abstraction, is being made. Words are a better tool for engaging in abstraction since, as Keynes (1936, pp. 297–8) notes, when using words we can keep in mind the connections of the objects we are focusing on to the rest of reality, in a way that we cannot when using differential calculus.

The tendency to admire the mathematical tools developed within advanced physics often leads economists to forget that science is characterized not by a specific method, but rather by a concern with underlying structures and mechanisms, and with using the best methods to identify them under each context. Even in physics, the use of mathematical methods often fails to take uncertainty into account; I discuss this issue together with

a physicist colleague in Rodrigues and Martins (2014). The best methods, which bring more insight into underlying structures, are not necessarily the most complicated ones, but the ones which are more appropriate given the nature of reality.

Paul Downward and Andrew Mearman (2009) suggest the use of a wider range of mathematical techniques in combination with the critical realist methodology; see Lawson (2009) for a reply. Consideration of different methods is indeed important, as Downward and Mearman (2009) argue, but the key issue at stake concerns the appropriateness of those methods used given the nature of reality. When criticizing Lawson's (1997) critique of econometrics, Kevin Hoover (2002) provides various examples that he identifies as useful econometrics. Quite significantly, the examples he points out refer to quite elementary procedures of data analysis, which Hoover (2002, p. 166) names 'primitive econometrics'. When using more elementary procedures, the underlying presuppositions can be taken into account more easily, and it becomes easier to engage in abstraction rather than in isolation.

John Finch and Robert McMaster (2002) advocate the use of categorical variables and non-parametric techniques, and suggest also an important distinction between 'econometrics mainly-as-regression' and 'econometrics-as-measurement'. If econometrics consists mainly in regression analysis, then 'econometrics' consists in the mainstream project that emerged in the mid-twentieth century, developed by authors such as Ragnar Frisch and Jan Tinbergen. If econometrics consists mainly in measurement, then it goes back to Petty, Cantillon, and Quesnay, as Schumpeter argues. Within heterodox economics, econometrics can be best interpreted as an attempt to measure quantities which are relevant to economic analysis, as was the case for the classical economists.

The quantities which are relevant for heterodox economists are the aggregate quantities that help us to explain the process of social provisioning, and those quantities help us to explain the production and distribution of the surplus, which were also studied by the early classical political economists. But the more adequate method to employ when studying those magnitudes is a method which provides a description of those magnitudes that can be used when formulating an economic theory, rather than a method that attempts to predict events while presupposing closed systems.

The approach of the classical political economists, the early 'econometricians', consisted of very elementary arithmetic. But it was an approach that enabled them to develop a theory of the process of production and distribution of the surplus as a whole, unlike the contemporary mainstream models, which by presupposing isolation rather than abstraction, end up distracting from (or indeed preventing) the development of a theory of the production and distribution of the surplus, and of the process of social provisioning.

As noted above, the classical authors focused on the description of aggregate quantities through arithmetic in order to study the economy as a whole, rather than focusing on marginal changes in a given a part of reality which is assumed to be isolated from everything else. The central core of economic reality, for the classical economists, was the process of production and distribution of the surplus. But even the description of such a core was conducted using a narrative that takes into account the connections of such an abstract core to the remaining aspects of reality.

The emphasis on the surplus is also a central concern of heterodox economists today. Heterodox economists have been concerned with the process of social provisioning; see

Lee (2009). When focusing on such a process, the central aspect to be addressed is the surplus, and the way in which it is distributed; see Lee (2012) and Lee and Jo (2011). The distribution of the surplus through social provisioning is, of course, a process which cannot be described only in mathematical terms, much less predicted through econometric analysis. The distribution of the surplus through social provisioning must be explained using a narrative that integrates ethical and political aspects. The Cambridge controversies in the theory of capital were an important refutation of the attempt to reduce distribution to a mathematical exercise; see Martins (2013, Ch. 2). And even when a model is provided, it must be a model grounded on empirical facts, driven by a concern with reality, rather than with modeling per se; see the contribution by Lee, Chapter 14 in this *Handbook*.

11.7 CONCLUDING REMARKS

According to critical realism in economics, the social realm is an internally related open system, where scientifically interesting closures are rare. Thus, the best methodological procedure available is abstraction aimed at reaching a theory of the reproduction of the socio-economic system, rather than isolation aimed at reaching a model while assuming everything else remains constant.

If we are in the presence of a closed system, there are constant conjunctions of the form 'if X then Y' to be found, and mathematico-deductivist techniques can be most useful. If we are in the presence of an open system, where events are co-produced by a multiplicity of structures, powers, mechanisms, and tendencies, the best methodological procedure for identifying causal factors consists in the identification of surprising contrasts that reveal causal powers at play. But those contrasts become manifest in partial and inexact regularities, rather than in exact regularities such as the one we find in celestial mechanics or laboratory situations.

When studying partial and inexact regularities, simple descriptive mathematics usually provides a more adequate guidance for causal explanation, which can be more easily combined with ordinary discourse which, in turn, is a more adequate language for engaging in abstraction while taking into account internal relations. Those were the methods used by the classical political economists, which enabled them to engage in the first systematic and objective analysis of the production and distribution of the surplus. Such an analysis of the production and distribution of the surplus is essential in order to study the process of social provisioning, which is the central aspect studied by heterodox economists.

As critical realists point out, human knowledge is a permanently reproduced means for further knowledge, and scientists are permanently under a given theoretical and methodological paradigm. Mainstream economics is a paradigm that can be best defined methodologically, as an insistence on the use of mathematico-deductivist methods. Heterodox economics, in contrast, can be best defined ontologically, in terms of a concern with the nature of reality, and the methods used are seen as more or less appropriate depending on the nature of reality.

The term 'econometrics' constitutes a philological error too, since '*nomos*' should not be separated, and so it ought to have been either suppressed so that it reads 'ecometrics', or maintained so that it reads 'economometrics'. Just as the name 'econometrics' shows

a lack of concern with its classical linguistic roots, so does the research program it designates show a lack of concern with the method followed by the classical authors who Schumpeter named the first 'econometricians', and were not the precursors of mainstream economics and its reliance on methods that presuppose closed systems, but rather the precursors of those who focus on the production and distribution of the surplus in the context of social provisioning, that is, heterodox economists.

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