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by

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Critical Realism and Econometrics*

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March, 2003

Abstract

In "Economics and Reality" (1997) Tony Lawson advocates a perspective on social reality labelled critical realism. Critical realism maintains that strict regularities between observable events are the exception rather than the rule in the social world. This is a negative argument for econometrics which is seen to rely on the identification of such regularities. By contrast, the notion of explanation sustained by critical realism does not depend on an abundance of strict event regularities. In this essay we examine whether econometrics is indeed incompatible with critical realism. This involves asking the following questions: Is Tony Lawson's characterization of econometrics accurate? In what sense, if any, could econometrics be useful for critical realist researchers? The discussion of econometrics is confined to the so-called LSE approach to econometric modelling of macroeconomic time series.

Keywords: Critical realism; Econometric methodology

JEL classification: B41, C50

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1 Introduction

> *Contemporary academic economics is not in a healthy state. Over many years now problems have regularly come to light which throw considerable doubt on the capacity of many of its strands to explain, or even address, real world events or to facilitate policy evaluation. Such problems especially beset the rather dominant 'mainstream' or 'orthodox' project, centering on econometrics and formalistic 'economic theory' (Lawson, 1997, p. 3).*

The quotation is taken from the introduction to "Economics and Reality" by Tony Lawson. According to Lawson the unhealthy state of mainstream economics can be attributed to "ontological neglect", that is, a neglect of explicit considerations of the nature of reality (Lawson, 1999, p. 274). This neglect is seen to be particularly evident in the literature on economic methodology. Most contributions to this literature, it is argued, have focused on epistemological issues and, moreover, have been influenced by the philosophies of Karl Popper. Lawson calls for a reorientation of economic methodology towards a greater emphasis on ontology. The perspective on social reality which he himself advocates is labelled *critical realism* and is strongly influenced by the transcendental realism of Roy Bhaskar (see e.g. Bhaskar, 1978).

Lawson's main criticism against econometrics is that it turns upon the identification of strict regularities between observable events. According to critical realism such regularities are the exception rather than the rule in the social world. This is a negative argument for econometrics, but not for critical realist research as the notion of explanation sustained by critical realism does not depend on an abundance of strict event regularities.

In this essay we examine whether econometrics is indeed incompatible with critical realism. This involves asking the following questions: Is Tony Lawson's characterization of econometrics accurate? In what sense, if any, could econometrics be useful for critical realist researchers? The discussion of econometrics will be confined to one particular approach to econometric modelling of macroeconomic time series, the so-called LSE methodology. However, we make no presumption that the LSE methodology offers the most relevant approach to empirical macroeconomics, or that other branches of econometrics, such as microeconometrics and financial econometrics, are less important.

The essay is organized as follows: Section 2 gives a brief account of critical realism as presented in Lawson (1994, 1997, 1999). This will be contrasted with the alternative approach of empiricism. Section 3 provides an overview of the main tenets of the LSE approach to econometric modelling. Section 4 then addresses Lawson's critique of econometrics. Section 5 concludes.

2 An outline of critical realism

Critical realism (CR) is an anti-*empiricist* philosophy of science. Hence, it is useful to contrast CR with empiricism. Following Smith (1998, ch. 3), we take empiricism to cover the *falsificationism* associated with Karl Popper, as well as the various brands of positivism such as the *logical positivism* of the Vienna Circle and the *standard positivism* associated with Carl Hempel. Despite their differences these approaches share a set of foundational assumptions that can be contrasted with those of CR.

2.1 Ontology

An important characteristic of CR is a strong emphasis on ontology, that is, the study of the nature of reality, the study of what really exists. CR distinguishes between three levels of reality; the *empirical*, the *actual* and the *deep* or *non-actual* (Lawson, 1994, p. 263). The empirical level refers to our experience, perception and impression of the actual. The actual level consists of events and states of affairs. The non-actual refers to the unobservable structures, mechanisms, powers and tendencies governing actual events. These structures and mechanisms exist independently of our experience of them.

Importantly, the three levels of reality are unsynchronized or "out of phase" with one another. A given event may be perceived differently by different people. Moreover, a single event is typically determined by multiple, possibly counteracting, mechanisms. Thus, the governing mechanisms cannot be "read straight off" the event. As an example of the lack of synchrony between events and mechanisms, Lawson uses a leaf falling from a tree. The falling leaf is always subject to gravity, but the law of gravity cannot be inferred directly from observing the leaf as the leaf is also subject to aerodynamic and thermal forces (Lawson, 1997, p. 22).

An alternative perspective is that reality consists merely of the objects of experience. This ontological position is referred to as *empirical realism*. Lawson (1997, p. 19) argues that empirical realism is implicit in the empiricist claim that all knowledge is grounded in experience. Empirical realism denies the existence of an unobservable deep or non-actual level of reality. Some empiricists conflate the empirical and the actual levels of reality and adopt what is referred to as a *flat* ontology (Smith, 1998, p. 298). By contrast, CR proposes a *multileveled* or *stratified* ontology.[1]

2.2 Empirical regularities and causal explanations

A common foundation of empiricist approaches is that an empirical regularity is both necessary and sufficient for establishing a causal law. Empirical regularities, or constant conjunction of events, consist of two or more events occurring together in similar conditions. For an empiricist the existence of such regularities justifies the claim to universal laws of the form "whenever event x then event y" (Smith, 1998).

The logical positivists arrived at scientific laws by *inductive* reasoning, that is, by moving from the observation of particular instances to the formulation of general laws. Recognizing that scientists often proceed by first positing general laws and theories and then engaging in empirical research, the standard positivist and falsificationist approaches put greater emphasis on *deductive* reasoning. The hypothetico-deductive (H-D) model of explanation requires that the statement about what we are trying to explain (the *explanandum*) must be logically deducible from a statement expressing relevant initial conditions and at least one universal law (the *explanans*). As explaining an event according to the H-D model is the same as identifying universal law(s) under which the event can be subsumed, this model is also called the "covering

[1]As noted by Smith (1998, p. 299), *idealism* can also be said to commit to empirical realism. In contrast to most empiricists, however, idealists distinguish clearly between events and perceptions, that is, between the actual and the empirical domains.

law" model of explanation.[2] According to the H-D model there is a logical symmetry between prediction and explanation, a notion which is referred to as the *symmetry thesis* (Blaug, 1992, p. 5).

CR rejects the covering law model of scientific explanation. According to CR science does not depend upon identifying constant conjunctions of events. As formulated by Lawson:

> *The aim is not to cover a phenomenon under a generalization (...) but to identify a factor responsible for it, that helped produce, or at least facilitated, it. The goal is to posit a mechanism (typically at a different level to the phenomenon being explained) which, if it existed and acted in the postulated manner, could account for the phenomenon singled out for explanation (Lawson, 1997, p. 212).*

Thus, science and explanation should be concerned with uncovering the structures and mechanisms that govern events. In any given situation several mechanisms may be operative and these mechanisms may amplify each other or cancel each other out. If a particular structure is at work, an event may or may not be produced. Hence, an event regularity is neither necessary nor sufficient for a causal statement. Moreover, there is no logical symmetry between explanation and prediction.[3]

Given that the objective of science is to identify the "real" mechanisms underlying events, how should scientific investigation proceed according to CR? According to Lawson the appropriate "mode of inference" is *retroduction* (or *abduction*). Retroduction involves

> *(...) the movement from knowledge of some phenomenon existing at any one level of reality, to a knowledge of mechanisms, at a deeper level or strata of reality, which contributed to the generation of the original phenomenon of interest (Lawson, 1997, p. 26).*

However, Lawson is vague about the actual process of retroduction:

> *Not much can be said about this process of retroduction independent of context other than it is likely to operate under a logic of analogy or metaphor and to draw heavily on the investigator's perspective, beliefs and experience (Lawson, 1997, p. 212).*

In other words, there are no simple recipes for how to come up with hypotheses about causal mechanisms. Nor are there any simple rules for evaluating such hypotheses. Runde (1998) sets out broad conditions for testing causal explanations of events. He explicitly acknowledges, however, that these conditions are insufficient to identify the superior explanation in all situations.

2.3 Naturalism and its limits

If science requires the identification of empirical regularities, then a condition for science to be possible is that the requisite regularities are there to be found. CR argues that even in the natural world strict event regularities typically occur only in experimental situations. Lawson (1994, p. 261) refers to systems in which constant event conjunctions occur as *closed*

[2]The H-D model of explanation is attributed to Karl Popper, Carl Hempel, and Peter Oppenheim. As noted by Blaug (1992, p. 5), it was one of the model's critics who originally labelled it the "covering law model".

[3]According to Collier (1994, p. 58), evolutionary biology is an example of a scientific discipline with high explanatory power but low ability to predict specific outcomes or events.

systems. Experimental activity can thus be viewed as an attempt to *close* a system. Scientists conducting an experiment try to insulate a particular mechanism by focusing on a limited number of variables and excluding possible disturbing influences.

In the social world, critical realists argue, it is not generally possible to create experimental closures. Rather, the social world is fundamentally *open*. As formulated by Roy Bhaskar:

> *The chief epistemological limit on naturalism is not raised by the necessarily unperceivable character of social scientific inquiry, but rather that they only ever manifest themselves in open systems; that is, in systems where invariant empirical regularities do not obtain. For social systems are not spontaneously, and cannot be experimentally closed (Bhaskar, 1989, p. 45).*

The openness of the social world is closely related to the possibility of *real choice*. If human beings have real choice it means they could always have acted differently. A precondition for choice is that the world is open in that all events could have been different (Lawson, 1994, p. 269). Thus, open system analyses acknowledge that individuals are complex and internally structured and so may respond differently in similar situations at different occasions.

Accepting that the social world is inherently open and that strict event regularities are unlikely, how might we detect the mechanisms of the social world? Lawson (1997, p. 204) argues that even if we reject the possibility of strict event regularities occurring in the social world, we are not thereby forced to take the view that events occur randomly in a totally unsystematic fashion. Instead, regularities come in varying degrees of strictness. Occasionally certain mechanisms may dominate and produce so-called *demi-regularities* or *stylized facts*.[4] Such demi-regularities are useful for detecting the structures and mechanisms governing events as they allow at least partial access to the deep level of reality.

Notice that, like empiricism, CR commits to *naturalism*.[5] Both in the natural and social sciences explanation involves a reference to the mechanisms and structures of the non-actual level of reality, and in both cases the appropriate "mode of inference" is retroduction. However, it is recognized that structures and mechanisms in the social world differ from the structures and mechanisms operating in the natural world. For instance, social structures are likely to be only relatively enduring and to vary more over time and across space than the objects of natural science.

[4] A demi-regularity, according to Lawson (1997, p. 204), is a "(...) partial event regularity which *prima facie* indicates the occasional, but less than universal, actualization of a mechanism or tendency, over a definite region of time–space."

[5] Smith (1998, p. 347) defines naturalism as: "(...) any approach to knowledge construction which assumes that the methods and assumptions of the natural sciences can and should be applied to the objects of analysis in the social sciences." Although critical realists and empiricists are both committed to naturalism, they differ in their views on what are the appropriate methods and assumptions to use.

2.4 Lawson's critique of econometrics

According to Tony Lawson econometrics involves searching for covering laws or universal event regularities in a probabilistic form. More precisely, he argues, econometricians are implicitly committed to a thesis called *regularity stochasticism*:[6]

> *(...) for any (measurable) economic event y a stable and recoverable relationship between a set of conditions* $x_1, x_2, \ldots, x_n$ *and the average or expected value of y (conditional upon* $x_1, x_2, \ldots, x_n$*), or some such, is postulated (Lawson, 1997, p. 76).*

It is clear that once we accept the critical realist view of the social world as inherently open, we expect a stable and recoverable relationship between economic events to be the exception rather than the rule. Lawson (1997) identifies three strict conditions that must be satisfied for a stable empirical relationship to obtain, namely the *extrinsic closure condition*, the *intrinsic closure condition* and, if the relationship involves aggregate or macro-level variables, an *aggregational condition* for (aggregate) closure. We consider these in turn.

The extrinsic closure condition is satisfied when the phenomena under study can be isolated from disturbing external influences. That is, any variable omitted from the econometric model should be uncorrelated with the variables already included.

The individuals of analysis may have more than one internal state (for example, a person could be sad or happy) and may behave differently depending on the internal state. Hence the need for a condition for intrinsic closure. The intrinsic closure condition can be understood as implying that a cause always produces the same effect (Downward et al., 2002, p. 482). It will be satisfied if every possible intrinsic state of the unit of analysis is specified, and only one outcome is possible for each state given the specific conditions.[7]

There can be no general presumption that the individual units in a population are identical. Instead, populations are typically heterogeneous. This implies that the extrinsic and intrinsic closure conditions are not sufficient when the postulated relationship involves aggregate or macro-level variables. Aggregate closure requires either that restrictions are imposed on the individual units so that stability obtains in the aggregate despite the heterogeneity, or that explicit account of the heterogeneity is taken in the model specification.[8]

Thus econometrics, Lawson (1997) argues, involves making closure assumptions. He points out that a common response to the breakdown of econometric models is to suggest that closure has not yet been achieved. Faced with instability in estimated relationships, econometricians suggest that a variable has been erroneously omitted from the model specification (extrinsic closure has not been achieved), or else that the model is not formulated at a sufficiently disaggregate level (the intrinsic and/or the aggregational closure conditions are not satisfied). From a critical realist perspective, however, the presumption that closure is achievable is a fallacy, thus attempts to create closures are likely to fail. This follows from a recognition that

[6] Mainstream theoretical economics, it is argued, is committed to a special case of regularity stochasticism, namely *regularity determinism* (Lawson, 1997, p. 98).

[7] To illustrate; in neoclassical consumer theory intrinsic closure is achieved by assuming that individuals are utility maximizers (they have only one intrinsic state), and a unique utility maximum exists (there is only one possible outcome for each internal state).

[8] Neoclassical consumer theory imposes restrictions on individuals' utility functions to ensure that the representative consumer model holds, that is, that aggregate behaviour looks as if it was generated by a single "representative" consumer with income equal to aggregate income. A necessary and sufficient condition for the representative consumer model to hold is that individual utility functions have the so-called Gorman form. See e.g. Varian (1992, p. 153–154).

the social world is fundamentally open. Econometrics, characterized as engaged in the search for strict event regularities, is incompatible with critical realism.

Finally, note that Lawson does not dismiss the use of quantitative and statistical methods in economics entirely. In particular, he acknowledges that summary statistics such as means and growth rates could have a role to play in critical realist arguments (Lawson, 1997, p. 69).

3 The LSE approach to econometric modelling

> *Once upon a time there was consensus on both the theoretical foundations of macroeconomics and the correct approach to macroeconometric modelling (Favero, 2001, p. 1).*

The consensus on macroeconometric modelling which Favero is referring to is the "traditional" or "textbook" approach that emerged in the decades following the foundation of the Econometric Society in 1930. The main objective of the Econometric Society was to promote a unification of theoretical and statistical approaches in economics (Frisch, 1933, p. 1). In a strict (and caricatured) version of the traditional approach economic theory provided the model, and the task of the econometrician was simply to estimate the parameters in that model. The theory could then be tested by looking at the statistical significance and sign of the coefficient estimates. In more pragmatic applications auxiliary assumptions were made about adjustment processes, functional forms and conditioning variables to take account of departures from the theoretical model (Pesaran & Smith, 1995, p. 64).

During the 1970s the traditional strategy came under attack from both practitioners and theorists. First, there was widespread evidence of forecast failure. In face of the large supply shocks that hit the world economy, well established empirical relationships such as the Phillips curve "broke down" and were even outperformed by simple univariate time series models in terms of forecast accuracy. Second, Lucas (1976) criticized the use of econometric models for purposes of policy analysis. Lucas' famous argument can be stated roughly as follows: The traditional approach estimates the parameters of derived decision rules of economic agents. If agents base their decisions on expectations of future outcomes of economic variables then, in general, the estimated parameters will be combinations of the parameters of the agents' objective functions and the parameters of the government's policy rule. Hence, the parameters of agents' decision rules will not be constant in the face of changes in government policy, and thus it will not be appropriate to use the estimated decision rules to examine the effects of such changes.

Since the late 1970s a number of different approaches to empirical macroeconomic modelling have emerged. In the following we focus on the so-called "LSE methodology" which was originally developed by a group of researchers associated with the London School of Economics in the 1960s and 1970s.[9]

It is beyond the scope of this essay to give a comprehensive survey of the LSE methodology. Instead we focus on two aspects that are considered important in the current context, namely the identification of structure and the status of empirical models. In addition, we give a brief

[9] The LSE methodology is sometimes referred to as the "Hendry methodology" owing to the substantial contributions of David F. Hendry.

mention of recent results on economic forecasting originating in the joint work of David F. Hendry and Michael P. Clements. The exposition draws on Hendry (1995a) and Ericsson et al. (1990).

3.1 The identification of structure

According to Hendry (1995b)

> *(...) economics need those [models] which are useful for understanding economic behaviour, for testing economic theories, for forecasting, and for analysing economic policy. All four objectives involve discovering sustainable empirical relationships between observed economic magnitudes, and rejecting models which lack desirable characteristics (Hendry, 1995b, p. 1623).*

The discovery of sustainable empirical relationships is related to the discovery of *structure*. Recognizing that structure does not have a unique meaning in econometrics, Hendry (1995a, p. 33) defines it as "the set of basic, permanent features of the economic mechanism". Necessary, but not sufficient, conditions for a set of parameters to define a structure are that they are invariant with respect to extensions of (a) the sample period, (b) the information set and (c) regime shifts.

The necessary conditions for structure are, in a limited sense at least, open to empirical evaluation. Tests of parameter constancy can be used to assess whether parameters are invariant to extensions of the sample period. Omitted-variables tests can reveal whether the parameters are invariant to extensions of the information set. Finally, tests of *parameter invariance* help establish whether a parameter vector is invariant to regime shifts.

Formally, parameter invariance is defined relative to a *class of interventions* affecting the economy. The interventions could be changes in monetary or fiscal policy regimes, institutional changes or technological innovations as well as political disturbances. A parameter vector is invariant to a class of interventions if it remains constant despite the interventions (see e.g. Ericsson et al., 1998, p. 373).[10] The claim that a parameter is invariant to a given intervention, e.g., a change in the exchange rate regime, is refutable by showing that the parameter is non-constant over the intervention. A failure to reject invariance is evidence against the empirical relevance of the Lucas critique in a given model.[11]

Whether invariant features of the economy do in fact exist is an unresolved issue. However, Hendry (1995b) argues that it is unlikely that empirical econometric models will be invariant to all kinds of regime shifts occurring in the the economy.

3.2 The status of empirical models

The LSE approach views empirical models as approximations to an unknown *data generation process* (DGP). The DGP is the joint outcome of the activities of all economic agents *and* a measurement system (Ericsson et al., 1990, p. 10). The DGP can be described as the joint probability distribution of the observed variables. Let $\mathbf{w}_t$ denote the vector of observations on

[10] Eitrheim & Nymoen (1988) maintain that this notion of invariance is related to the notion of *causality* in the LSE methodology.

[11] See e.g. Favero & Hendry (1992) on testing the empirical relevance of the Lucas critique.

all economic variables in period t. The joint probability distribution can be written as:

$$D_W\left(\mathbf{w}_1 \ldots \mathbf{w}_T | \mathbf{W}_0; \boldsymbol{\theta}\right), \tag{1}$$

where $D_W(\cdot)$ denotes the probability density function, $\mathbf{W}_0$ are the initial conditions, $\boldsymbol{\theta}$ is a vector of parameters and T is the number of observations on $\mathbf{w}$. In general the DGP is a complex function of high dimensionality. For instance, we make no presumption that the DGP is linear and/or constant over time.

Hendry (1995a, ch. 9) identifies eleven steps in the *reduction process* from the DGP to an empirical model.[12] One crucial step is the *marginalization* of the DGP with respect to (i.e., the elimination of) variables that are considered irrelevant to the determination of the variables of interest. To see this formally, we transform $\mathbf{w}_t$ into $(\mathbf{z}_t\prime, \mathbf{v}_t\prime)$ where $\mathbf{v}_t$ identifies the variables that are judged irrelevant. Marginalizing the joint density with respect to the elements of $\mathbf{v}_t$ involves factorizing (1) into

$$D_W\left(\mathbf{w}_1 \ldots \mathbf{w}_T | \mathbf{W}_0; \boldsymbol{\theta}\right) = D_{V|Z}\left(\mathbf{v}_1 \ldots \mathbf{v}_T | \mathbf{z}_1 \ldots \mathbf{z}_T, \mathbf{W}_0; \boldsymbol{\lambda}\right) \times D_Z\left(\mathbf{z}_1 \ldots \mathbf{z}_T | \mathbf{W}_0; \boldsymbol{\phi}\right) \tag{2}$$

Eliminating the variables in $\mathbf{v}_t$ now means discarding the conditional density $D_{V|Z}(\cdot|\cdot)$ and retaining the marginal density $D_Z(\cdot|\cdot)$. Clearly, this involves a loss of information unless the parameters of interest ($\boldsymbol{\mu}$ say) are a function of the parameters of the marginal density alone (i.e., $\boldsymbol{\mu} = f(\boldsymbol{\phi})$ alone). Note that in practice the marginal density in (2) is the most general density under consideration.

The second step in the reduction process is *conditioning.* This step involves dividing the variables $\mathbf{z}_t$ into endogenous variables ($\mathbf{y}_t$) and non-modelled variables ($\mathbf{x}_t$), and then explaining $\mathbf{y}_t$ while treating $\mathbf{x}_t$ as given. First, note that, without loss of generality, the marginal density $D_Z(\cdot|\cdot)$ can be sequentially factorized into:

$$D_Z\left(\mathbf{z}_1 \ldots \mathbf{z}_T | \mathbf{W}_0; \boldsymbol{\phi}\right) = \prod_{t=1}^{T} D_z\left(\mathbf{z}_t | \mathbf{z}_1 \ldots \mathbf{z}_{t-1}, \mathbf{W}_0; \boldsymbol{\gamma}\right). \tag{3}$$

This factorization generates an error $\boldsymbol{\varepsilon}_t \equiv \mathbf{z}_t - E[\mathbf{z}_t | \mathbf{z}_1 \ldots \mathbf{z}_{t-1}]$ which is a mean-innovation process with respect to $\mathbf{z}_1 \ldots \mathbf{z}_{t-1}$.[13] Next, we factorize the density for $\mathbf{z}_t$ into a conditional density for $\mathbf{y}_t$ given $\mathbf{x}_t$, and a marginal density for $\mathbf{x}_t$:

$$D_z\left(\mathbf{z}_t | \mathbf{z}_1 \ldots \mathbf{z}_{t-1}, \mathbf{W}_0; \boldsymbol{\gamma}\right) = D_{y|x}\left(\mathbf{y}_t | \mathbf{x}_t, \mathbf{z}_1 \ldots \mathbf{z}_{t-1}, \mathbf{W}_0; \boldsymbol{\delta}\right) \times D_x\left(\mathbf{x}_t | \mathbf{z}_1 \ldots \mathbf{z}_{t-1}, \mathbf{W}_0; \boldsymbol{\omega}\right). \tag{4}$$

Ignoring the marginal density for $\mathbf{x}_t$, and modelling only the conditional density for $\mathbf{y}_t$ given $\mathbf{x}_t$, potentially involves a loss of information. The conditions under which ignoring the marginal density does *not* involve a loss of information depend on the purpose for which the model is intended. For the purposes of *estimation* and *testing* the relevant condition is that of *weak exogeneity.* The variables in $\mathbf{z}_t$ are weakly exogenous for the parameters of interest $\boldsymbol{\mu}$ if the latter are a function of the parameters of the conditional density $D_{y|x}(\cdot|\cdot)$ only (i.e., $\boldsymbol{\mu} = f(\boldsymbol{\delta})$

[12]The theory of reduction was outlined in Hendry & Richard (1982) and Hendry (1983).

[13]That $\boldsymbol{\varepsilon}_t$ is a mean-innovation process with respect to $\mathbf{z}_1 \ldots \mathbf{z}_{t-1}$ means that $E[\boldsymbol{\varepsilon}_t | \mathbf{z}_1 \ldots \mathbf{z}_{t-1}] = 0$ and so $\boldsymbol{\varepsilon}_t$ cannot be predicted (in mean) from past values of $\mathbf{z}$. See Hendry (1995a, p. 59).

alone).[14]

If the purpose is conditional *prediction* an additional restriction is required, namely that $\mathbf{y}_t$ should not *Granger cause* $\mathbf{x}_t$, that is, lagged values of the endogenous variables $\mathbf{y}_t$ should not enter the marginal distribution for $\mathbf{x}_t$. The joint assumptions of weak exogeneity and Granger non-causality correspond to the condition of *strong exogeneity.* Finally, *policy analysis* typically involves analysing the effects on $\mathbf{y}_t$ from changing the marginal distribution for $\mathbf{x}_t$ (i.e., changing $\boldsymbol{\omega}$). For valid policy analysis using the conditional model *super exogeneity* is required. The conditions for super exogeneity are that $\mathbf{x}_t$ is weakly exogenous for the parameters of interest, and that the parameters in the conditional model are invariant to a class of interventions.

The reduction process also involves making assumptions about the *constancy* of parameters over time, as well as assumptions about functional form, distributional properties and lag length. Under assumptions of constant parameters and linear conditional normality, the conditional model $D_{y|x}(\cdot|\cdot)$ can be written as a vector autoregressive-distributed lag model

$$\mathbf{A}(\mathbf{L})\mathbf{y}_t = \mathbf{B}(\mathbf{L})\mathbf{x}_t + \varepsilon_t, \qquad \varepsilon_t \sim N(\mathbf{0}, \mathbf{\Omega}) \tag{5}$$

where $\boldsymbol{\varepsilon}_t$ is a vector of error terms, and $\mathbf{A}(\mathbf{L})$ and $\mathbf{B}(\mathbf{L})$ are polynomial matrices in the lag operator.[15] A formulation such as (5) is commonly used in econometric modelling exercises. Moreover, several model classes (e.g. static regressions, univariate time series models) arise as special cases of this general model.

The empirical model (5) has status as a *derived* model. It follows that the error process $\boldsymbol{\varepsilon}_t = \mathbf{A}(\mathbf{L})\mathbf{y}_t - \mathbf{B}(\mathbf{L})\mathbf{x}_t$ is also a derived process, representing "everything not elsewhere specified" (Ericsson et al., 1990, p. 11). Specifically, (5) is derived from the DGP through a number of simplifications or reductions. Hence, a model like (5) can only be sustained if these reductions are valid. The LSE approach emphasizes the importance of testing the validity of the reductions implicit in the empirical model. Such tests correspond to tests for no loss of information occurring in the reduction process, and includes tests for the null hypotheses of innovation errors (e.g. absence of autocorrelation, homoscedasticity), no omitted variables, parameter constancy, normality, linearity and valid conditioning.

[14] In addition, weak exogeneity requires that the parameters $\boldsymbol{\delta}$ and $\boldsymbol{\omega}$ are *variation free*. See Ericsson et al. (1990, p. 17).

[15] $\mathbf{A}(\mathbf{L}) = \mathbf{A}_0 - \mathbf{A}_1 L - \mathbf{A}_2 L^2 - \cdots - \mathbf{A}_q L^q$ and $\mathbf{B}(\mathbf{L}) = \mathbf{B}_0 + \mathbf{B}_1 L + \mathbf{B}_2 L^2 + \cdots + \mathbf{B}_q L^q$. L is the lag operator ($L^h s_t = s_{t-h}$), and q denotes the number of lags on each variable. If the number of variables in $\mathbf{y}_t$ is n_1, and the number of variables in $\mathbf{x}_t$ is n_2, then $\mathbf{A}_0 \ldots \mathbf{A}_q$ and $\mathbf{B}_0 \ldots \mathbf{B}_q$ are $n_1 \times n_1$ and $n_2 \times n_2$ matrices of coefficients respectively.

From the theory of reduction it follows that all models will only be approximations to the underlying DGP. Since such approximations are inevitably false, empirical models cannot be judged according to their veracity. Other criteria for accepting a model are needed. Hendry (1995a, p. 365) lists six criteria that any acceptable approximation or model must satisfy:[16]

1. The model's predictions satisfy all data constraints (e.g., non-negativity constraints).
2. The conditioning variables are weakly exogenous for the parameters of interest.
3. The model explains the results of rival models, i.e, it *encompasses* rival models.
4. The model is consistent with economic theory.
5. The errors are innovation processes.
6. The parameters in the model are constant.

The LSE approach makes a distinction between the context of discovery and context of justification. The criteria listed above play a crucial role in the evaluation of models, that is, in the context of model justification. In the context of model discovery the LSE approach acknowledges that there is no unique route to a good or correct model specification. Still, a main tenet of the LSE methodology is a general-to-specific modelling strategy.

The general-to-specific procedure seeks to mimic the reduction process described above (Hendry, 1995a, p. 361). The first step is to formulate a general unrestricted model (GUM), making sure that it satisfies the model acceptance criteria above. Economic theory plays a role in suggesting which variables should be included in the GUM. The next step is to simplify the GUM by imposing statistically acceptable restrictions on the model in order to derive a simpler model with coefficients that are easier to interpret. The final model should then be evaluated using the model acceptance criteria.[17]

3.3 Sources and implications of forecast failure

In two recent books, Clements & Hendry (1998, 1999), David Hendry and Michael Clements outline a theory of macroeconomic forecasting based on empirical econometric models. As we have seen, one reason why economists and policy makers started questioning macroeconometric models in the 1970s was the repeated occurrence of forecast failure. A principal aim of Clements & Hendry (1998, 1999) is to develop an understanding of the sources and implications of such failure.

Clements and Hendry emphasize that the success of forecasting depends both on characteristics of the economic system and the forecasting method. Successful forecasting requires that there are regularities in the economy, and that these are informative about the future. The forecasting method should capture these regularities and exclude non-regularities (Clements & Hendry, 1998, p. 12). The first condition relates to the notion of *predictability*. An event is seen to be unpredictable relative to an information set if knowledge of that information set

[16]See also Hendry & Richard (1982) and Gilbert (1990).

[17]Recently, a software program (PcGets) allowing computer-automation of the simplification process has been developed. See Hendry & Krolzig (2001).

does not help in the prediction of the event.[18] Furthermore, forecast failure is to be distinguished from poor forecasting. The latter relates to the absolute precision or accuracy of our forecasts. Poor forecasts could owe to a "bad" forecasting model or to events being inherently unpredictable. Forecast failure is defined as "significant mis-forecasting relative to the previous record" (Clements & Hendry, 1999, p. 37) and so involves a deterioration in forecasting performance.

Clements & Hendry (1999) focus on a situation where the DGP is non-constant, the empirical model does not coincide with the DGP, and the parameters of the model must be estimated. An interesting result derived in this set-up is that models incorporating causal information may be dominated in terms of forecast accuracy by models that do not incorporate such information. The authors identify structural breaks in the forecast period as the most important source of forecast failure. Model misspecification, estimation uncertainty and other potential sources of forecast failure are found to be less important. Structural breaks are seen to derive from institutional, political and technological changes in the economy which manifest themselves as shifts in deterministic terms such as means and growth rates of economic variables.

Unanticipated deterministic shifts in the forecast period will cause any econometric model to mis-forecast in the period when the break occurs. However, some models are more robust to breaks than others in the sense that they forecast relatively better after the break has occurred. The most robust models are not necessarily the best models for other purposes. An important methodological implication is that forecast failure alone does not justify the rejection of a theory on which an econometric model is based (Clements & Hendry, 1999, p. 308).

4 Addressing the critique

Is Lawson's characterization of econometrics as engaged in a search for universal event regularities accurate? Could econometrics have a role in the explanatory project outlined by critical realism? These are the questions we try to answer in this section, drawing on the outlines of critical realism and the LSE approach to econometric modelling above.

First, however, a brief comment on Lawson's claim that econometrics fails the tasks it sets itself seems warranted. Lawson substantiates his claim by pointing to the apparent inability of economic forecasters to forecast economic events accurately. As we have seen, however, econometric models serve other purposes besides forecasting. What is more, the best forecasting model is not necessarily the best model for purposes of policy analysis, testing of theories, or, more generally, for acquiring knowledge about the workings of the economy. Thus, the "success" of an econometric model cannot be established on the basis of forecasting performance alone. Moreover, the claim that empirical econometric models have had no success at forecasting is itself contentious. Econometric models that forecast fairly well over periods of time are indeed in evidence. This is witnessed by the fact that econometric models continue to be used by forecasting agencies and policymakers.

[18]Formally, the stochastic variable y_t is unpredictable with respect to the information set Ω_{t-1} if $D_{y_t}(y_t|\Omega_{t-1}) = D_{y_t}(y_t)$ (Clements & Hendry, 1998, p. 35).

4.1 The aims and possibilities of econometrics

According to Hendry the objectives of empirical modelling involve "discovering sustainable empirical relationships between observed economic magnitudes". This apparently fits nicely with Lawson's characterization of econometrics as engaged in a search for covering laws. I would argue, however, that the sustainable relationships Hendry refer to are less strict and less universal in scope than the "exceptionless" regularities required for a covering law according to Lawson.

After reading several early contributions to econometrics, Kevin Hoover concludes that

> *Yes, they [the early econometricians] sought robust regularities, but they expected neither the precision nor the freedom from context and precision that is implied in Lawson's covering law characterization (Hoover, 1998, p. 7).*[19]

This characterization applies equally well to the LSE econometricians. Although they search for invariant relationships, it is clear that they do not expect to find relationships that are invariant to any kind of shock that may hit the economy. It is recognized that, occasionally, economies are subject to abrupt changes that may well cause statistically well-specified and theory-related econometric models to "break down" in the sense of producing systematic forecast failure. Furthermore, it is recognized that some events could be inherently unpredictable.

The LSE approach clearly acknowledges the complexity of the economy and the problems involved in measuring economic magnitudes. This is evidenced in the following quotation:

> *Modern economies are complicated, dynamic, non-linear, simultaneous, high-dimensional, and evolving entities; social systems alter over time, laws change; and technological innovations occur. The resulting time-series data samples are heterogeneous, non-stationary, time-dependent and inter-dependent. Economic magnitudes are inaccurately measured, subject to revision and important variables are not observable: worse still, available samples are relatively short and highly aggregated (Hendry & Krolzig, 2001, p. 101).*

Moreover, the LSE methodology recognizes the difficulties involved in isolating sustainable relationships between economic variables. An empirical model is seen to be derived from the underlying DGP through a series of reductions. Interestingly, the conditions for the reductions to be valid, that is, to involve no loss of information, relate to the closure conditions identified by Lawson. Valid marginalization with respect to variables that are excluded from the analysis corresponds to satisfaction of the extrinsic closure condition. The requirement of parameter constancy relates to the intrinsic closure condition as well as the condition for aggregate closure. The LSE approach emphasizes that the validity of the implied reductions should be evaluated through extensive testing of the empirical model. We can interpret this as saying that closure, to some extent at least, can be justified by statistical criteria. Tests for omitted variables and tests for parameter instability could help establish whether closure, at least locally, has been achieved. Tests of super exogeneity can be used to evaluate whether the Lucas critique applies

[19] Similarly, on the subject of covering law notions in economic theory, Hausman (1999, p. 287) argues that "The dominant view of economic theory since the early nineteenth century is that it captures only some of the relevant factors and that consequently its empirical implications will be inexact and sometimes badly off the mark. (...) As economic methodologists have long understood, a *ceteris paribus* law implies no strict regularity among the properties it explicitly mentions".

to the model at hand. Interestingly, there seems to be little evidence for the empirical relevance of the Lucas critique (Ericsson et al., 1998, p. 376).

Accepting the view that econometrics is about discovering "robust" regularities, we must make probable that the requisite regularities are indeed to be found. According to Lawson so-called demi-regularities may occasionally turn up even in the social realm, reflecting that certain mechanisms come to dominate over limited regions of time and space. These demi-regularities are insufficient to the requirements of econometrics as defined by Lawson, but are perhaps more like the robust regularities required for a less "ambitious" econometric project.

Moreover, there are different views on the degree of openness of the social world within the critical realist camp itself. Drawing on insights from institutional and behavioural economics, Downward et al. (2002) argue for a modified realist ontological position. Their argument is that although the social world is potentially, or logically, a purely open system, in practice it is characterized by "quasi-closures" which may manifest themselves in stable patterns of events. Situations of quasi-closure come about because social agents seek "ontological security" in an open and complex social world. Faced with the challenge of making decisions in complex situations, agents are inclined to develop habits, conventions and routines. Such habit and routine behaviour will be reflected in social institutions which may prove to be stable over periods of time.

4.2 Could econometrics be useful for critical realists?

According to CR the aim of science is to uncover the mechanisms and structures of the deep level of reality, and these need not manifest themselves in regularities at the empirical level. This implies that, even if we accept that econometrics relies only on "robust" regularities and that such regularities do in fact obtain in the social world, we have yet to demonstrate that econometrics could be useful for critical realist researchers. The relevant question is whether econometrics could help produce explanations in terms of mechanisms.

As noted by Downward et al. (2002), the implications of critical realism for empirical research methods (which, of course, are not exhausted by econometrics) are not entirely clear. Lawson dismisses econometrics as incompatible with critical realism, but nevertheless insists that his explanatory project contains a "significant empirical component" (Lawson, 1997, p. 221). Activities such as the computation, graphing and tabulation of summary statistics about the economy are all regarded as informative. As argued by Hoover (1998, p. 16), much of econometrics is just sophisticated versions of these "legitimate" activities. In fact, one of the main purposes of empirical econometric models according to Hendry (1995a) is to provide data summaries.

The extent to which econometrics could be useful in critical realist research is related to the role played by demi-regularities in this research. Lawson admits a role for demi-regularities at two stages in a realist research project. First, demi-regularities have a role in the context of discovery. Demi-regularities help direct the research process and contribute to the generation of hypotheses about causal mechanisms. Second, demi-regularities could have a role in the assessment of causal explanations.

Econometric models potentially have the capacity to reveal non-spurious and non-obvious (demi-) regularities. In a sense this will be particularly true of an approach to econometrics which takes the relationship between the unknown data generating process and the empirical model seriously, such as the LSE approach. We argue that the capacity to reveal unobvious and robust regularities makes econometric models useful for critical realist researchers. This view gets some support from Downward et al. (2002) who, in line with their view that the social world is characterized by situations of "quasi-closure", admit a greater role for econometrics in realist research than does Lawson.

Thus, we agree with Hoover (1998) that econometrics is compatible with critical realism. Econometric models potentially contribute to causal explanations by summarizing data and by revealing interesting demi-regularities. However, as emphasized by Sayer (2000, p. 22), statistical explanations are not explanations in terms of mechanisms, and so, from a critical realist perspective, the explanatory power of the econometric models themselves could be limited. In order to uncover the sought-after structures and mechanisms of the non-actual level of reality, critical realists would use econometrics as a supplement to other research methods.

5 Concluding remarks

In "Economics and Reality" Tony Lawson advocates an open-systems ontology for the social sciences. Econometrics, it is argued, supposes that closures are widespread in the social world. Defining econometrics as a search for exceptionless regularities, econometrics is incompatible with critical realism. Examining the writings of David Hendry and his coauthors, however, it seems that econometrics is better characterized as a search for robust, but not necessarily strict, event regularities. The LSE approach also emphasizes the importance of testing the validity of the reductions or closure assumptions implicit in the empirical model.

By revealing interesting and non-obvious partial regularities, econometric models could contribute to causal explanations in the critical realist sense. Hence, econometrics is useful for critical realists, at least as a supplement to other research techniques. What is more, by highlighting the conditions under which stable empirical regularities obtain in the social world, critical realism could contribute to a better understanding of the potential and the limitations of econometrics.

References

Bhaskar, R. (1978). *A Realist Theory of Science*. Hassocks: Harvester Press, 2nd edition.

Bhaskar, R. (1989). *The Possibility of Naturalism: A Philosophical Critique of the Contemporary Human Sciences*. New York: Harvester Wheatsheaf, 2nd edition.

Blaug, M. (1992). *The Methodology of Economics: Or How Economists Explain*. New York: Cambridge University Press, 2nd edition.

Clements, M. P. & Hendry, D. F. (1998). *Forecasting Economic Time Series*. Cambridge: Cambridge University Press.

Clements, M. P. & Hendry, D. F. (1999). *Forecasting Non-stationary Economic Time Series*. Cambridge, Massachusetts: The MIT Press.

Collier, A. (1994). *Critical Realism. An Introduction to Roy Bhaskar's Philosophy*. London: Verso.

Downward, P., Finch, J. H., & Ramsay, J. (2002). Critical realism, empirical methods and inference: A critical discussion. *Cambridge Journal of Economics*, 26, 481–500.

Eitrheim, Ø. & Nymoen, R. (1988). *LSE-skolen i økonometri [The LSE School in Econometrics]*. Arbeidsnotat 1988/11, Norges Bank.

Ericsson, N. R., Campos, J., & Tran, H.-A. (1990). Pc-give and david hendry's econometric methodology. *Revista de Econometria*, 10, 7–117.

Ericsson, N. R., Hendry, D. F., & Mizon, G. E. (1998). Exogeneity, cointegration, and economic policy analysis. *Journal of Business and Economic Statistics*, 16(4), 370–387.

Favero, C. & Hendry, D. F. (1992). Testing the Lucas critique: A review. *Econometric Reviews*, 11, 265–306.

Favero, C. A. (2001). *Applied Macroeconometrics*. Oxford: Oxford University Press.

Frisch, R. (1933). Editor's note. *Econometrica*, 1, 1–4.

Gilbert, C. L. (1990). Professor Hendry's econometric methodology. In C. W. J. Granger (Ed.), *Modelling Economic Series* (pp. 279–303). Oxford: Oxford University Press.

Hausman, D. M. (1999). Ontology and methodology in economics. *Economics and Philosophy*, 15, 283–288.

Hendry, D. F. (1983). Econometric modelling: The 'consumption function' in retrospect. *Scottish Journal of Political Economy*, 30, 193–220.

Hendry, D. F. (1995a). *Dynamic Econometrics*. Oxford: Oxford University Press.

Hendry, D. F. (1995b). Econometrics and business cycle empirics. *The Economic Journal*, 105, 1622–1636.

Hendry, D. F. & Krolzig, H.-M. (2001). *Automatic Econometric Model Selection Using PcGets 1.0*. London: Timberlake Consultants Ltd.

Hendry, D. F. & Richard, J.-F. (1982). On the formulation of empirical models in dynamic econometrics. *Journal of Econometrics*, 20, 3–33.

Hoover, K. D. (1998). Econometrics and reality. Unpublished manuscript, University of California, Davis.

Lawson, T. (1994). A realist theory for economics. In R. E. Backhouse (Ed.), *New Perspectives on Economic Methodology* (pp. 257–285). London: Routledge.

Lawson, T. (1997). *Economics and Reality*. London: Routledge.

Lawson, T. (1999). What has realism got to do with it? *Economics and Philosophy*, 15, 269–282.

Lucas, R. E. (1976). Econometric policy evaluation: A critique. In K. Brunner & A. H. Meltzer (Eds.), *The Philips Curve and Labor Markets, Vol 1 of Carnegie-Rochester Conference Series on Public Policy* (pp. 19–46). Amsterdam: North-Holland Publishing Company.

Pesaran, M. H. & Smith, R. (1995). The role of theory in econometrics. *Journal of Econometrics*, 67, 61–79.

Runde, J. (1998). Assessing causal economic explanations. *Oxford Economic Papers*, 50, 151–172.

Sayer, A. (2000). *Realism and Social Science*. London: SAGE Publications Ltd.

Smith, M. J. (1998). *Social Science in Question*. London: SAGE Publications Ltd.

Varian, H. R. (1992). *Microeconomic Analysis*. New York: W. W. Norton and Company, Inc., 3rd edition.

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