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Deciding between alternative approaches in macroeconomics

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ABSTRACT

Macroeconomic time-series data are aggregated, inaccurate, non-stationary, collinear and rarely match theoretical concepts. Macroeconomic theories are incomplete, incorrect and changeable: location shifts invalidate the law of iterated expectations and 'rational expectations' are then systematically biased. Empirical macro-econometric models are non-constant and mis-specified in numerous ways, so economic policy often has unexpected effects, and macroeconomic forecasts go awry. In place of using just one of the four main methods of deciding between alternative models, theory, empirical evidence, policy relevance and forecasting, we propose nesting 'theory-driven' and 'data-driven' approaches, where theory-models' parameter estimates are unaffected by selection despite searching over rival candidate variables, longer lags, functional forms, and breaks. Thus, theory is retained, but not imposed, so can be simultaneously evaluated against a wide range of alternatives, and a better model discovered when the theory is incomplete.

1. Introduction

All macroeconomic theories are incomplete, incorrect and changeable; all macroeconomic time-series data are aggregated, inaccurate, non-stationary and rarely match theoretical concepts; all empirical macro-econometric models are non-constant, and mis-specified in numerous ways; macroeconomic forecasts often go awry: and economic policy often has unexpected effects different from prior analyses; so how should we decide between alternative approaches to modelling macroeconomies?

Historically, the main justification of empirical macro-econometric evidence has been conformity with conventionally-accepted macroeconomic theory: internal credibility as against verisimilitude. Yet in most sciences, theory consistency and verisimilitude both matter and neither can claim precedence: why is economics different? Part of the justification for a 'theory-driven' stance in economics is the manifest inadequacy of short, interdependent, non-stationary and heterogeneous time-series data, often subject to extensive revision. If data are unreliable, it could be argued that perhaps it is better to trust the theory. But macroeconomic theories are inevitably abstract, and usually ignore non-stationarity and aggregation over heterogeneous entities, so are bound to be incorrect and incomplete. Moreover, theories have evolved greatly, and many previous economic analyses have been abandoned, so it is self-contradictory to justify an empirical model purely by an invalid theory that will soon be altered. It is unclear why an incorrect and mutable theory is more reliable than data that can become more accurate over time.

The prevalence of the constellation of non-stationarity, endogeneity, potential lack of identification, inaccurate data and collinearity, have culminated in a belief that 'data-driven' is tantamount to 'data mining' and can produce almost any desired result—but unfortunately so can theory choice by claiming to match idiosyncratic choices of 'stylized facts', that are usually neither facts nor constant. The preference of theory over evidence may also be due to a mistaken conflation of economic-theory models of human behaviour with the data generation process (DGP): there

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is a huge gap between abstract theory and non-stationary evidence, inadequately finessed by simply asserting that the model is the mechanism—while *ceteris paribus* is easily assumed in theories, it is rarely achieved empirically (see Boumans, 1999). Indeed, Hendry and Mizon (2014) highlight fundamental failures in the mathematical basis of inter-temporal macroeconomic theory in wide-sense non-stationary economies, namely where the distributions of all economic variables are not the same at all points in time. Such shifts help explain the 'breakdown' of the Bank of England quarterly econometric model (BEQEM),[1] the empirical rejections of 'rational expectations' models in Castle, Doornik, Hendry, and Nymoen (2014), and the failures of economic forecasting discussed in Clements and Hendry (1998).

Finally, there is a false belief that data-based model selection is a subterfuge of scoundrels—rather than the key to understanding the complexities of macroeconomies. All decisions about a theory formulation, its evidential database, its empirical implementation and its evaluation involve selection, though such decisions are often either ignored or camouflaged: **selection is unavoidable and ubiquitous**. Building on that insight, a replacement approach is proposed in Hendry and Doornik (2014) and Hendry and Johansen (2015) that retains theories while selecting across a large range of alternatives, including any number of shifts of unknown magnitudes and signs at unknown times. Thus, instead of simply adopting one of the four conventional methods of deciding between alternative models, namely macroeconomic theory, empirical evidence, policy relevance and forecasting, all of which transpire to be inadequate individually in the face of the complexities of macroeconomies observed through their resulting aggregate time series, we propose an extension of encompassing (see Mizon and Richard, 1986) that nests 'theory-driven' and 'data-driven' approaches, as in Hendry and Johansen (2015). Theory insights can be retained **unaffected** by data-based model selection even when searching over many rival candidate variables, longer lags, non-linear functional forms, and structural breaks. Despite commencing from very general specifications, possibly with more variables, N, than observations T, multi-path search algorithms such as *Autometrics* (see Doornik, 2009) can control retention rates of irrelevant variables at low levels using stringent critical values, yet automatically retain all theory-based variables, irrespective of their significance. When the embedded theory is correct and complete, the distributions of its estimated parameters are *identical* to those obtained by directly fitting it to data. Conversely, because the theory model is retained but not imposed, when it is incorrect or incomplete, this encompassing approach can lead to the *discovery* of a better empirical model that retains any subset of valid theory insights together with a set of variables that are substantively relevant empirically. Selection is essentially costless if not needed, and beneficial otherwise, the opposite of current beliefs.

The paper seeks to overview strategic issues influencing 'model choice' in macroeconomics. Its structure is as follows. Section 2 discusses the main criteria by which models are currently selected in macroeconomics, specifically economic theory with its subset of policy relevance, and empirical evidence with its subset of forecast accuracy. Section 3 reviews the foundations of econometrics initiated by Trygve Haavelmo, how various aspects have developed since, and the relationship between his concept of 'design of experiments' and the theory of reduction that determines the target for model selection. Section 4 considers whether empirical evidence alone can decide the choice of model, and concludes not. Section 5 highlights some major issues confronting inter-temporal macroeconomic theory: Section 5.1 considers the interlinked roles of theory and evidence, illustrated in Section 5.2 by a 'Phillips curve' example; Section 5.3 describes the consequences of unanticipated shifts of distributions, where Section 5.4 focuses on the resulting difficulties for theories of expectations formation, and Section 5.5 on the closely linked failures of the law of iterated expectations when distributions shift over time. The conclusion is that theory alone is an inadequate basis for model choice even when a theory model is the objective of an analysis, and is stringently tested, as discussed in Section 5.6. Section 6 shows that forecasting performance cannot distinguish reliably between good and bad models. Consequently, Section 7 then proposes embedding theory-driven and data-driven approaches during model selection while retaining economic theory insights. Section 7.1 explains the formulation of the initial general unrestricted model (GUM); Section 7.2 describes selecting empirical models therefrom, and outlines automatic empirical model discovery while also tackling multiple location shifts, namely sudden, often unanticipated, changes in the levels of the data processes. This provides the basis for the proposal in Section 7.3 for retaining (but not imposing) economic theory models, unaffected by selecting over many contending alternatives, while checking for location shifts of any magnitudes and signs anywhere in the sample, extended in Section 7.4 to working with an incomplete, or invalid, theory model. Section 8 discusses the implications for evaluating policy models, and Section 9 considers how the overall analysis might help clarify approaches to nowcasting and flash estimates. Section 10 concludes.

2. Criteria for deciding between alternative approaches

Many criteria have been used to select models in macroeconomics, including: theory generality, internal consistency, insights, invariance, novelty, excess content, policy relevance, identification, and consistency with evidence; empirical goodness-of-fit, congruence, constancy, parsimony, encompassing, consistency with theory, and forecast accuracy; as well as elegance, relevance, telling a story, and making money, *inter alia*. An obvious solution to resolve the dilemma as to which criteria should be used is to match them all. Unfortunately, some criteria conflict (e.g., generality versus parsimony; elegance versus congruence, etc.), human knowledge is limited, and economies

[1] See Harrison et al. (2005), to be replaced by the new dynamic stochastic general equilibrium (DSGE) model in Burgess et al. (2013), called COMPASS (Central Organising Model for Projection Analysis and Scenario Simulation). http://bankunderground.co.uk/2015/11/20/how-did-the-banks-forecasts-perform-before-during-and-after-the-crisis/ provides an honest appraisal of the failures of the Bank's new model even on past data.

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