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The Pursuit of Coherence in Mainstream Macroeconomic Methodology

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Abstract

The coherence of mainstream macroeconomics is threatened by inconsistency between the core theoretical model and the empirically grounded models used for policy advice. The field has evolved in response to policy demands in the wake of the 2008 financial crisis. But this evolution has been constrained by the emphasis of the core theoretical approach on a particular representation of microfoundations. Yet the notion of internal consistency by which this microfoundations project is justified is challenged by a broader philosophical notion of consistency. The long-running expression of opposition in mainstream macroeconomics between logical and empirical coherence (or between rigor and realism) accordingly requires further examination of how real economic systems are understood and how knowledge about them is to be built and assessed. If mainstream macroeconomics is to continue to deviate from the core model by virtue of open-system ontology, then in order to ensure coherence, the characteristics of that system need to be articulated, and their implications for methodology worked out.

Keywords: macroeconomic theory, applied macroeconomics, microfoundations, methodology, epistemology, ontology.

Introduction

The field of macroeconomics provides an apt case study for current methodological discourse, much of which still revolves around the conflict between apriority and empiricism. Macroeconomics helps policy makers to explain and to predict outcomes in particular circumstances. It also poses particular challenges, in that it operates at a high level of aggregation, requiring analysis of the relationships between macro- and microlevels, as well as the intermediate mesolevel. Yet, arguably, the continuing emphasis on microfoundations has encouraged a conflation of macroeconomics with microeconomics, distracting methodologists' attention from the macroeconomic level (Hands 2015).

This relative lack of attention may also reflect methodologists' discomfort with what they see as the methodological compromises required of macroeconomists by policy makers' need for timely responses (Backhouse and Salanti 1999). These are compromises with respect to normative formalism when addressing the "messy" subject matter (Boumans 2021). While different views prevail as to the scope for quantitative macroeconomic forecasting, engagement in some form with macroeconomic data is a necessary aspect of policy advice, requiring some form of empiricism. As a result, methodological attention has tended to center on the relationship between theory and data, as well as the procedures for analyzing data using econometric methods. Yet scope for a methodological conflict with apriority is set up by the way in which the approach to microfoundations of the dominant dynamic stochastic general equilibrium (DSGE) approach narrows the methodological landscape.

Within mainstream economics itself, *methodology* normally refers to theory/model design and application, while *philosophy* is reserved for ontology and epistemology (a distinction drawn, for example, by Hoover [2001a], in discussing causality in macroeconomics). The purpose here is to discuss the connections between methodology and philosophy as a contribution to active debates within mainstream macroeconomics about whether to prioritize internal modeling consistency or external consistency with the data. The discussion is framed broadly in terms of a consideration of what might lend more coherence to the field. Apriority and empiricism both offer coherent guides to practice, but ones that have proved to be unworkable in their pure form. Alternative guides to practice are therefore considered here as the object of critical philosophical and methodological inquiry.

The discussion starts with a consideration of mainstream macroeconomic methodology in the conventional terms of the relationship between theory and methods. This methodology has not stood still. Empirical methods, theories, and the relationship between the two have evolved, as has the policy environment. But there is a deeper philosophical level at which mainstream methodology can be considered, which is the subject of the third section. How methodology itself is considered is colored by the ontology and epistemology that underpin it; this applies particularly to how the terms *coherence* and *consistency* are understood. Focusing on the role ascribed to formal modeling and the openness or closure of systems at different levels provides the basis for addressing the thorny issue of microfoundations.

The meaning of the term *microfoundations* itself depends on methodological approach. In the context of modern macroeconomics, it has come to refer to a modeling strategy whereby outcomes at the macrolevel are deduced formally from the rationality axioms enhanced by the rational expectations assumption. This is the meaning to be used in what follows, since it is the conventional meaning in modern mainstream macroeconomics. But

microfoundations can more generally mean that macroeconomics is to be regarded as secondary to microeconomics (Hoover 2006, 5). This understanding includes the view that some variables, such as expectations, cannot be fully endogenized within an axiomatic framework, such that the theory is broader than the formal model. This was the sense employed in much of mainstream macroeconomics before the adoption of rational expectations. Neo-Austrian economics is also microfounded in this sense but goes further in dropping any requirement for a formal axiomatic structure since it cannot capture such microfactors as creativity or mesofactors such as culture.

But the requirement for microfoundations in any of these senses is by no means universal. There are other approaches that are not microfounded at all in that they do not privilege the microlevel, but rather consider it alongside other levels of analysis (King 2012). This represents a pluralist approach that fosters theory development by means of multiple strands of argument. Here too there are differences of approach with respect to the nature and role of analysis at the microlevel and its relation to macroeconomics.

The line of argument to be pursued here is that, while it might seem that significant change has taken place recently in mainstream methodology, continuity is more apparent in terms of what is regarded as the ideal approach to theorizing.¹ A central matter for debate is whether the requirement to build theory on logically consistent microfoundations in the first of the senses outlined above risks inconsistency with empirical models. Yet these models are an important tool for policy making. One option is to avoid this type of inconsistency by developing macroeconomics away from the standard deductivist approach. Hoover (2021) instead advocates retroduction (from empirical study to provisional theory in the form of models), a method that also avoids the pitfalls of pure inductivism. But what is to guide inference from evidence, that is, to lend coherence to retroduction? The discussion here will look further to the philosophical level in order to consider more broadly what could lend more coherence to mainstream macroeconomics. In particular, the scope for ontological consistency, as an alternative to internal logical consistency, is considered as a way to promote coherence in macroeconomics. The notion of logical consistency itself is explored with respect to different types of logic, focusing on classical logic and human logic.

The Evolution of Mainstream Macroeconomic Methodology

Methodological discussion within mainstream economics has focused primarily on the relations between theory and empirical analysis (e.g., Backhouse and Salanti 1999; Hoover 2001b). Macroeconomics in its modern form emerged in the 1930s out of twin developments: the pioneering building of large-scale datasets by the National Bureau of Economic Research (NBER) and Keynes's new analysis at the macroeconomic level, which had strong policy implications and data requirements. The neoclassical synthesis that then emerged developed within a methodological approach quite different from that of Keynes (Dow 2010). New structural macroeconomic models came to be synonymous with theory, replacing Keynes's narrower view of models as aids to thought, while empirical work developed within the new field of econometrics.

¹ The discussion thus updates earlier analyses of mainstream methodology along these lines, as in Dow (1996) and Jespersen (2009).

Further, neoclassical economists developed a growing sense of unease with theorizing solely at an aggregative level, which seemed to be inconsistent with theoretical propositions at the microlevel. A major spur to addressing the relations between the macro- and microlevels was Phelps et al.'s (1970) call for renewed attention to the formation of expectations. Macroeconomic theory became increasingly bound up with microeconomics, which was no longer seen as a separate field. But empirical testing was unable to settle debates in macroeconomics, as was evident in the monetarist-Keynesian debates of the 1970s.² Increasing emphasis was put on pure theory, understood to be testable in principle even if not in practice.

As Hahn (1981) argued, such testing was precluded by the inability to identify a real situation as corresponding to general equilibrium such that theoretical concepts lacked empirical counterparts. However, rational expectations theory justified empirical testing by defining all real situations as being in general equilibrium on the grounds that all agents continuously optimize on the basis of full information. Inconsistency between the abstract model and its empirical application was thus avoided. As Frydman and Phelps (2013) point out, this represented a marked change in the microfoundations project, endogenizing expectations logically within the formal structure. This became the standard understanding of microfoundations.

But, while it was a key feature of this approach that agents' expectations thus coincided with model forecasts, the large New Classical models developed in the 1970s and 1980s were not clearly successful predictors (see, e.g., Clements and Hendry 1995). New Keynesian macroeconomics therefore pursued an alternative modeling strategy based on DSGE models, which nevertheless retained the assumption of rational expectations on the part of a representative agent.³ The predictive failure of New Classical models presuming perfectly competitive markets was to be explained by a range of market imperfections, notably asymmetric information. The resulting New Consensus macroeconomics prevailed during the Great Moderation period up to the financial crisis. DSGE models thus provided the benchmark on which to build a response to the crisis, perpetuating what Haldane and Turrell (2018) describe as a monoculture within macroeconomics.

One route in responding to the crisis was to treat it as the result of a shock to a naturally equilibrating system. This approach allowed neoclassical versions of concepts central to Keynes's macroeconomics, such as *uncertainty* and *animal spirits*, to enter the analysis as a source of shocks (see, e.g., Bloom 2009; Farmer 2013).⁴ But why and how could deviations from equilibrium persist? There is now a substantial body of work on learning as a means of explaining within a rational expectations framework the delay in markets returning to equilibrium following a shock (see Eusepi and Preston 2018). Alternative routes pursue a more heterogeneous microlevel analysis of deviations from equilibrium, as in the agent-based modeling approach of Haldane and Turrell (2018) or a multiple-equilibria approach (Vines and Wills 2020).

² Keynes had had misgivings about the scope for reliable results from econometric analysis since that method relied on unchanging macroeconomic structure. See Garrone and Marchionatti (2009) on Keynes's debates with Tinbergen regarding these issues.

³ Hoover (2014) discusses the distance between the representative agent derived from aggregates and the agency of individuals implied by a microfoundations agenda.

⁴ Given the difference in methodological framework from that of Keynes, the meaning ascribed to these concepts also differed.

The focus has been to identify where standard DSGE models went wrong and therefore how they should be amended, drawing on aspects of reality from which they had abstracted. It is notable that this agenda has not included examination of the underlying structure of DSGE models with the rational expectations assumption. For example, since the dominant explanations for the crisis challenged the assumption of market efficiency, internal logic suggests that the crisis could be understood as the outcome of frictions that impeded or distorted market incentives. Since DSGE models had abstracted from financial institutions, the emphasis therefore moved on to endogenizing financial frictions themselves. This is a particular focus of New Monetarists like Wright (2018) who argue that it was this lack and a corresponding inadequate grounding of both financial behavior and institutions in rationality axioms that accounted for the failure to predict the crisis.⁵

The challenge posed by the crisis at the level of policy was for mainstream macroeconomics to engage more directly with the real economy. Blanchard (2017) and Wren-Lewis (2018) argue that different types of models that are not microfounded—structural econometric models (SEM)—are required in order to provide useful and timely policy advice informed by the data. But they do not question the value of improving the microfoundations of DSGE modeling as a long-term strategy, where DSGE models are the source of theory for application in SEMs:

We can think of an SEM as incorporating theory in a rough and ready way, but it is clearly better to incorporate it more rigorously. Internal consistency is a goal worth trying to achieve. That alone provides a rationale for the microfoundations project. (Wren-Lewis 2018, 67)

As Hoover (2006, 4) puts this view: “Macroeconomics reduces to microeconomics in principle but, because the reduction is difficult, we are not there yet.” In bringing their project’s discussions together, Vines and Wills (2020) argue for the simultaneous development of different types of macroeconomic models, including SEMs, to inform DSGE models. But the ultimate goal is still to develop a fuller synthetic DSGE model. It is never specified how such a synthesis is to be achieved. Confidence in such a resolution of the age-old struggle between rigor and realism can only be an expression of faith.

The increased championing of SEMs implies a shift in favor of empirically based macroeconomics. Backhouse and Cherrier (2017) confirm that there has been a substantial change in the relationship between theory and data in the twenty-first century literature, partly on account of policy requirements. This development includes greater attention to empirical issues and the increased prestige of applied economics relative to pure theory, where the term *applied* encompasses both empirical application of theory and greater policy engagement among empirical economists. Reflecting this development, such macroeconomic methodology discourse as there is has focused on modeling strategy with a view to empirical application and increasingly on substantive practical issues surrounding econometric methods and the relations between theory and data (see, e.g., Backhouse and Salanti 2000).

It is clear that mainstream macroeconomic methodology has evolved in the sense of methods of theory construction, its relations with data, and the empirical methods employed.

⁵ To incorporate money and a financial sector in DSGE models is in fact a challenging proposition. For example, Rogers (2021) identifies logical incoherence in mainstream macroeconomic modeling with respect to money.

But the debate continues regarding conflicts between deductivist theory and empirical application, which are often framed as a conflict between rigor and realism. The scope for conflict is evident in the aspiration to integrate microfounded DSGE models with SEMs, which, not being microfounded, are regarded as inconsistent.⁶ The discussion turns now to the philosophical level in order further to understand this situation. Can mainstream macroeconomics be coherent while accommodating this kind of inconsistency?

The Ontological and Epistemological Foundations of Mainstream Macroeconomic Methodology

The dominant philosophical grounding for mainstream macroeconomics, when professed by practitioners, is still logical positivist. There is only rare discussion of ontological and epistemological foundations, that is, statements regarding how the real economy is understood and therefore how knowledge about it should be built and how the status of this knowledge might be assessed (see, e.g., Hoover 2006).⁷ Since these philosophical foundations tend only to be implicit in economics practice, they generally need to be teased out. In engaging in such an exercise here, the starting point for the discussion will be the role of models in mainstream macroeconomics, not least because models are conventionally conflated with theories.⁸ How this attitude to mathematical modeling in macroeconomics implies a particular ontology and epistemology will be explored. In the process, discussions among macroeconomists themselves, such as the Oxford Rebuilding Macroeconomic Theory Project (Vines and Wills 2018, 2020), will be drawn upon.⁹

In the 1980s it was clear that the general equilibrium model had become the benchmark, providing a unifying framework for mainstream economics.¹⁰ In particular, this deductivist logical approach to modeling required derivation from axioms with respect to the optimizing behavior of a representative agent. Since then much has been made of the fragmentation of mainstream economics, including macroeconomics. Some go so far as to characterize this state of affairs as pluralistic (e.g., Colander 2000). But there is a critical difference between theoretical pluralism or pluralism of method within a common methodological approach and methodological pluralism. While there is a range of mainstream macroeconomic theories/models and methods of mathematical formalism, it is evidently understood that there is, or should be, one benchmark model. Any plurality is thus situated within an overarching methodological approach. This is evident from Kuorikoski and Lehtinen's (2018, 254) historical account:

⁶ There is further a potential conflict between regarding SEMs as incorporating theory on the one hand (Wren-Lewis 2018) and using them as a contributor to developing theory on the other, as discussed by Hoover (2021).

⁷ Considering ontology and epistemology as foundational does not preclude their evolution in the light of practice.

⁸ This conflation is evident in the postcrisis focus on replacing the old failed benchmark model with a new one (Lawson 2009). See Morgan and Morrison (1999) for an analysis of the history, nature, and use of economic models.

⁹ The Oxford project is not to be confused with the Economic and Social Research Council–funded Rebuilding Macroeconomics project based at the National Institute of Economic and Social Research in London (<https://www.rebuildingmacroeconomics.ac.uk>), whose research extends well beyond the mainstream approach.

¹⁰ See Weintraub (1985) for a full specification in Lakatosian terms.

There is a fundamental sense in which the core model has remained the same: what some call the “Ramsey model” of intertemporal optimization has been a key ingredient of all these models. The core model has thus been extensively supplemented with various components so as to obtain a better fit with the data.

The work that emerged from the Oxford Rebuilding Macroeconomic Theory Project in the 2018 issue of the *Oxford Review of Economic Policy* was addressed to perceived shortcomings with the DSGE model as the benchmark. A range of new developments was considered, from extending microfoundations in order to endogenize market frictions at one extreme to the parallel development of DSGE models and simpler policy-oriented models at the other. There was some difference of opinion as to how far DSGE models might develop sufficiently to obviate the need for different data-driven models. But Vines and Wills (2018) concluded that none of the developments under consideration would constitute a paradigm shift, that is, they should be discussed in terms of theoretical pluralism rather than methodological pluralism.

Yet by the 2020 issue of the *Oxford Review of Economic Policy*, Vines and Wills (2020) anticipate what they depict as a paradigm shift. This involves advocating for a multiple-equilibria approach whereby analysis of paths to different possible equilibria are explored in small DSGE models as inputs to a large synthetic DSGE model. They also place increased emphasis on the scope for integrating this exercise with input from SEMs. DSGE models are demoted from being at the core to being “toy models.” But the methodological issues remain: the goal is still to arrive at a comprehensive DSGE model with empirical inputs from SEMs. But there would be scope for microfoundations inconsistency, in the short term at least, between the small and large DSGE models as well as between the DSGE models and the SEMs. In terms of methodological approach, this seems to fall short of a paradigm shift. At the same time, accepting inconsistency within a deductivist theoretical structure seems to risk incoherence. In order to consider further whether a core methodological approach is being perpetuated, the following discussion seeks to identify what the discourse on DSGE models implies both about ontology and about epistemology. This analysis will draw on the conceptual framework of closed and open systems as set out by Dow (2002), Chick (2004), and Chick and Dow (2005).¹¹

Any formal mathematical model is a closed system, so if theory and model coincide then the theoretical system is inevitably closed. The conditions for the closure of a theoretical system are as follows: all the relevant variables can be identified; the system boundaries are specified such that these variables can be classified dualistically as endogenous or exogenous; and structures and relationships within the system are either knowable or known to be stochastic.¹² A mainstream theoretical system couched in terms of general equilibrium fits this template well. It is constructed along deductivist lines that prioritize internal consistency in terms both of classical logic¹³ and of the core role of equilibrium as a basis for identifying model outcomes. Weintraub (1985) identified this role as a positive heuristic of mainstream theory, something that still persists even if it has evolved to encompass multiple equilibria and deviations from equilibrium. To the extent that mainstream macroeconomic theory is

¹¹ Alternative conceptualizations are set out by Lawson (1997) and Cartwright (1999).

¹² A more detailed specification of the conditions is set out in Chick and Dow (2005).

¹³ An alternative form of logic will be explored below.

characterized by DSGE models it is therefore a closed theoretical system that in turn entails a closed-system ontology (Lawson 1997). The implication is that a naturally ordered understanding of real social systems (as of natural systems) is implicit in the mainstream approach.¹⁴

The meaning and significance of system closure at the ontological and epistemological levels may be clarified by considering those alternative approaches to macroeconomics that are instead explicitly based on open systems at both levels. There is scope for a range of open theoretical systems. Only one of the conditions for closure must not be met for the system to be open. Since there is scope for multiple combinations of conditions for closure not being met, there is scope for a range of nonmainstream schools of thought. Each is identified by its own sources of openness that follow from its particular open-system ontology. Chick and Dow (2005, 366) set out a list of *possible* sources of real-world openness that would be inconsistent with the microfoundations project as it is understood in modern mainstream macroeconomics:

1. The system is not atomistic; therefore at least one of the following holds:
 - a. outcomes of actions cannot be inferred from individual actions (because of interactions); or
 - b. agents and their interactions may change (for example agents may learn).
2. Structure and agency are interdependent.
3. Boundaries around and within the social or economic system are mutable for at least one of the following reasons:
 - a. social structures may evolve;
 - b. connections between structures may change; or
 - c. the structure-agent relation may change.
4. Identifiable social structures are embedded in larger structures; these may mutually interact, for the boundaries of a social system are in general partial or semipermeable.

Post-Keynesian macroeconomics, which is a leading alternative to the mainstream approach in macroeconomics, is built on a particular open-system ontology and consequent open-system epistemology (Dow 2019). A pluralistic approach to reasoning is employed whereby formal mathematical models constitute only partial arguments. Models are combined with other (incommensurate) forms of reasoning within an open theoretical system in order to arrive at a considered conclusion. Incommensurability is enhanced by the understanding of conceptualization itself as an open system (Cartwright 1999). Models are aids to thought for the purpose of identifying causal tendencies rather than generating concrete predictions; this includes empirical application as a means of identifying stylized facts as an input to a broader analysis.

Thus, for example, Minsky (1976, 1986) developed a formal macroeconomic model that depicted some key features of his financial instability hypothesis at an aggregative level; the model has been applied in empirical attempts to establish relevant stylized facts, such as cyclical patterns of debt. The model involves abstraction in the form of simplification that can

¹⁴ The degree to which the natural world is ordered or closed is a matter for debate, particularly in the context of climate science (Dow 2020).

be removed in broader analysis rather than in the form of fictions that cannot be removed. The model is deliberately designed for application, not alone but in combination with other strands of reasoning and types of evidence.

Like Keynes, Minsky chose not to encapsulate his hypothesis in a comprehensive formal model because of his open-system ontology. Financial relationships evolve over the cycle due to financial innovation, and market psychology may shift discretely and unpredictably, sometimes in response to the exercise of agency (e.g., a high-profile speech pointing to a particular source of market vulnerability). The economic system is thus open due to developments at the meso- and microlevels that are not determinate, such as new financial innovations and changes in market sentiment. But knowledge about these developments can nevertheless be gathered using a range of methods other than formal modeling. Minsky's hypothesis points to the systemic cyclical forces that create market vulnerability but cannot predict exactly what will puncture confidence or when it will happen as the system becomes increasingly fragile. The theory was thus developed in a way that derived from a multilevel structured ontology: the microlevel of agency, the mesolevel of institutions and conventions, and the macrolevel of markets. Privileging one level, as in insisting on microfoundations, does not make sense in light of such an ontology. This applies particularly to the strict modern mainstream form of microfoundations. Evolution and multilevel complexity preclude the scope for formal microfoundations and thus for capturing the theory in a deductivist formal model.

In contrast, formal microfoundations lie at the heart of theorizing within modern mainstream macroeconomics in the form of DSGE models. Logical consistency in a closed-system methodological approach requires that macroeconomic relations and structures be specified with respect to atomistic agents. Therefore, from this perspective, model-specification shortcuts that sidestep microfoundations are only deemed acceptable (if at all) for pragmatic reasons of providing timely policy advice pending the satisfactory completion of the microfoundations project. Whether that project can actually be completed remains in doubt (Rogers 2021). But is such an inconsistency methodologically coherent?

This is an area of discussion in mainstream macroeconomics that suffers particularly from inattention to ontology and epistemology. The microfoundations imperative requires explicit justification in terms of consistency in classical logic, a form of logic appropriate for closed systems. This approach to logic is reductionist, facilitating the building of a theoretical structure on *foundations* at the microlevel; this accords with the characteristics of closed systems. But there are other types of consistency, notably human-logical consistency and philosophical consistency (King 2012; Dow 2016).

If the economy is understood to be open due to intrinsic evolving social interaction (and indeed identity), which does not arise from independent atomistic agency, then methodological individualism would be inconsistent with that ontology (Hoover 2001b, 2009). One alternative to classical logic that starts from the inability to demonstrate the truth-value of axioms with respect to an open-system ontology is "human logic" (see, e.g., Gerrard 1992). This logic supports multiple strands of reasoning as the most robust way of building (uncertain) knowledge. Each internally consistent strand contributes to an overall theory, but each may take a different starting point and is thus inconsistent in the classical-logic sense. There is no requirement of mathematical formalism, so the different strands of reasoning tend

to be incommensurate yet still serve to build up a way of understanding the subject matter.¹⁵ The different open-system ontologies that underpin different schools of thought provide the grounding for each school's conceptualizations, choices of method, mode of theorizing, and so on. This grounding provides each approach with its own coherence. Open-system ontologies more generally justify the use of human, rather than classical, logic.

Comparing the exercise of human logic with the classical logic of mainstream macroeconomic theory, Chick and Dow (2005, 369–70) point out:

The key is how far the theoretical system is identified with its models. Within an open theoretical system, there is scope for changing the assumptions, boundaries or *ceteris paribus* conditions to suit the theorist's immediate purpose, as for example assuming that long-term expectations are fixed in one model but not in another. Discussion surrounding these models extends beyond the models in order to take account of what has been "kept at the back of one's head." A closed theoretical system on the other hand tends to be identified with its models.

Using human logic, theory and application are not dichotomized but are rather complements with respect to a common ontology. On realist grounds, theory is designed for application. Rigor refers to robust capacity to address the real subject matter rather than internal classical-logic consistency. The rigor-realism dichotomy that has dogged mainstream macroeconomics does not apply in the same way to an open-system epistemology. Therefore, combining different strands of reasoning according to human logic is not the same as an eclectic approach that retains deductivist theory alongside structural econometric models. The closed-system ontology implied by pure deductive theory requires consistency between models in the classical-logic sense, that is, complete compatibility within a formal deductive structure. But it does so at the cost of inconsistency with the type of modeling that is feasible for empirical application.

Nevertheless, realism has played a part in the evolution of mainstream macroeconomics in recent decades. Concern over inconsistency between models and experience (including experimental evidence with respect to rationality) has encouraged consideration of various features of the real world that might account for shortcomings with particular modeling strategies (see, e.g., Stiglitz 2018). Each of these features can be identified with one or another sources of real-world openness listed by Chick and Dow (2005).

New Keynesian macroeconomic theory has developed by paying particular attention to the market frictions caused by asymmetric information, notably in the credit market. A second development addresses the challenge of modeling social interactions, reflecting the evident issues of trust and herd behavior arising from the crisis. Further modifications to mainstream models have drawn on psychology to explore cognitive limitations that limit rationality. Akerlof (2002) has extended new behavioral economics into macroeconomics by considering a range of ways in which the standard rationality framework does not apply in practice. He notes how behavioral macroeconomics incorporates "realistic assumptions grounded in psychological and sociological observation" and presents it as "rebuilding the microfoundations that were sacked by the New Classical economics" (413; see further Stiglitz

¹⁵ This logic shares characteristics with Feynman's (1965) account of Babylonian mathematics.

2018). The term *microfoundations* is being used here in the more general sense of privileging the microlevel but without requiring all of theory to be developed within an axiomatic structure, implying an open-system epistemology and ontology (see Akerlof's [2020] methodological analysis).

But the deductivist microfoundations imperative has continued to be more generally evident in the criticism of DSGE modeling that it has adapted to crisis circumstances by a series of ad hoc adjustments that take it further away from a coherent deductivist model. Kuorikoski and Lehtinen (2018, 255) point out that:

Many of the most central assumptions, such as intertemporal optimization, never change in DSGE models: even if the modifications concern the behavioural assumptions, the core optimization model is never abandoned. In other words, altering this assumption to make it more realistic is only possible if the whole DSGE framework is abandoned.

Thus for example the core rational-optimizing framework persists in the depiction of other-regarding behavior as being atomistically rational with respect to expectations of reciprocity. Evidence of the limits to which interpersonal preferences can be incorporated in the mainstream framework is also found for example in Ashraf, Camerer, and Loewenstein's (2005) discussion of Adam Smith's impartial spectator. Where for Smith the impartial spectator was the voice of conscience, for the behavioral economist the impartial spectator is instead the voice of classical reason.

Indeed some new behavioral economists explicitly espouse the deductivist approach to theory. For example, Camerer, Loewenstein, and Rabin (2004, 1) introduce their substantial behavioral-economics reader as follows:

At the core of behavioral economics is the conviction that increasing the realism of the psychology underlying economic analysis will improve the field of economics *on its own terms*—generating theoretical insights, making better predictions of field phenomena, and suggesting better policy. This conviction does not imply a wholesale rejection of the neoclassical approach to economics based on utility maximization, equilibrium, and efficiency. The neoclassical approach is useful because it provides economists with a theoretical framework that can be applied to almost any form of economic (and even noneconomic) behavior, and it makes refutable predictions. (Emphasis in original)

Similarly Hong and Stein (2007, 126) spell out the pressure for behavioral finance to fit into the standard mainstream approach as follows:

The enduring appeal of classical asset-pricing theory over the last several decades owes much to its success in forging a consensus around a foundational modelling platform. This platform consists of a core set of assumptions that have been widely-accepted by researchers working in the field as reasonable first-order descriptions of investor behaviour, and that—just as importantly—lend themselves to elegant, powerful, and tractable theorizing. If behavioural finance is ever to approach the stature of classical asset pricing, it will have to

move beyond a large collection of empirical facts and competing one-off models, and ultimately reach a similar sort of consensus.

The critical issue for mainstream macroeconomics then is whether to persist in aiming for such a consensus by ensuring that empirical applications have microfoundations consistent with the core DSGE model. One possible explanation that this has so far proved to be unworkable is that application confronts an open-system reality at odds with the ontology implicit in DSGE models. One alternative is to confirm the closure of the economic system and address head on the classical-logical inconsistencies that persist between mainstream macroeconomic theory and its application. Alternatively, applied macroeconomics needs to follow its own methodological path based on some form of open-system ontology. But then the nature of that system needs to be articulated in order to guide choice of methods and mode of theorizing. Open-system mainstream macroeconomics that retains microfoundations in the sense of privileging the microlevel implies a very different ontology from Post-Keynesian economics.

This is not an argument favoring one side of the theory-applied divide over the other. Nor is it an argument for pure deductivist theory (implying a closed-system ontology) proceeding alongside applied macroeconomics (implying an open-system ontology) in an eclectic fashion. It is an argument for specifying an ontology and following its implications through to epistemology and methodology.

Conclusion

We have traced here the evolution of mainstream macroeconomics as a struggle between theoretical and empirical coherence. While external policy demands have kept empirical application to the fore, the pressures on theorizing have been mostly internal, consistent with the requirements of closed deductivist systems. Such systems in turn imply an understanding of social systems themselves as being closed. This theoretical framework continues to provide the benchmark for both empirical modeling and for policy application.

The strict rational-expectations form of the microfoundational imperative follows from the internal consistency requirements of exclusively formal deductivist theory. Yet these requirements can conflict with other, philosophical, consistency requirements, which are hard to ignore when it comes to real-world application. There are alternatives to classical logic, notably human logic, which facilitate philosophical consistency. By acknowledging the uncertainty conditioning any knowledge of complex and evolving systems, human logic replaces reliance on one deductive structure (as in the benchmark model) with a plurality of strands of reasoning drawing out different aspects of the real subject matter, all put together by the exercise of judgment. Rather than being eclectic, the exercise is made coherent by its ontological foundations, with each approach to macroeconomics associated with a particular open-system ontology.

Open socioeconomic systems in general are judged to be built on an evolving complex of identities, interrelations, institutions, and agency. *Some* strands of theoretical argument may start with the microlevel. But there is no necessity for that level to be treated as foundational to the whole; it depends on the particular ontology being employed. For modern mainstream macroeconomics, the implicit ontology takes agents to be narrowly rational, optimizing, and atomistic beings, facilitating formal deductivist expression. This justifies the strict form of

microfoundations as separable and unidirectionally causal. Yet the confrontation of the resulting (closed-system) macroeconomic theory with the (open-system) context of its application opens mainstream macroeconomics to the charge of incoherence; (classical) logical consistency conflicts with philosophical consistency. An alternative basis for coherence considered here is an approach to theorizing that does not create a divide between theory and application but rather aims to address and explain the features of real economic systems encountered by applied macroeconomists. Consistency with respect to human logic can be maintained on the basis of philosophical consistency within a coherent structure.

The first step in promoting coherence within mainstream macroeconomics is therefore to examine its philosophical foundations. The second step is to consider the implications of these foundations, not only for philosophical consistency but also for the type of logic appropriate to the subject matter and to our scope for knowledge about it.

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