Unification and Pluralism in Economics

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Abstract

Wade Hands has drawn attention to the explanatory pluralism present in Samuelson's *Foundations* alongside its derivational unification. The purpose here is to pursue this analysis in relation to the unificationist and pluralist discourses in economics. A consideration of Samuelson's philosophy of science suggests the presence of a degree of pluralism in other domains than explanation. But a broader discussion of the meanings of, and justifications for, both unification and pluralism indicates that derivational unification limits the admissibility of, and scope for, pluralism in other domains. This analysis is then applied to current debates over the future direction of mainstream macroeconomics.

Key words: unification, pluralism, Samuelson, macroeconomics, methodology

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Introduction

Wade Hands (2020) adds to his many important contributions to the philosophy and methodology of economics in an intriguing exploration of the concept of pluralism in relation to Paul Samuelson. He does so by identifying *both* unification and pluralism in Samuelson's classic work, *Foundations of Economics*. Samuelson's deliberate strategy was to promote unification at the derivational level in the form of mathematical structure while allowing pluralism at the explanatory level of theory. This explanatory plurality consists of the comparative statics of his microeconomics, based on constrained optimisation, and the dynamics of his macroeconomics. While Hands points out that this is a narrow form of pluralism, yet he sets out to argue that Samuelson was pluralist 'in spirit'. The purpose here is to take Hands's thought-provoking analysis as a starting-point for exploring further unification and pluralism in Samuelson's work, and in economics more generally.

There are multiple discourses on unification and pluralism, complicating any interpretation and discussion of a particular analysis. Unification refers to promoting unity while pluralism refers to promoting plurality. But then unity and plurality can apply to a range of levels, i.e. within a range of different domains. Further there may or may not be scope for interrelations between unity and/or plurality at the different levels (Dow 1997a, 2001). These levels are respectively:

1. ethics
2. ontology, the real subject matter of enquiry;
3. epistemology, or the scope, and procedure, for building knowledge about that subject matter;
4. methodology, or the range of methods of theorising and the basis for theory appraisal;
5. theory, or explanation.

There is further the matter of context in the form of philosophy of science, from which emerges the justification for particular forms of and domains for unification and pluralism. We begin therefore by exploring the nature and significance of Samuelson's philosophy of science, and then broaden the discussion out to consider different approaches to unification and pluralism. Hands completes his paper with some reflections on the departure of mainstream economics from Samuelson's framework. In the fourth section we build on these reflections to offer an account of pluralism in mainstream economics.

Samuelson's philosophy of science

Fortunately for our purposes Samuelson reflected on his own philosophy of science, giving us an insight into his own thinking, including notably in his debate with Friedman (Samuelson 1963) and also in a later reflective essay (Samuelson 1983). Of course there is scope for disparity between professed methodology and practice, an important component of the Samuelson-Friedman debate. Further, as with all important thinkers, Samuelson's views evolved over his career. But we can still learn about Samuelson's influences, his motivation and his mode of thought. In the process we examine whether Samuelson's pluralism extended beyond the domain of explanation.

Hands (2020) shows that Samuelson was heavily influenced by mathematical physics and especially by thermodynamics, 'the archetype of a successful scientific theory' (Samuelson

1983: 8-9).[1] It is therefore not surprising that Samuelson should take the physical sciences as his model for economics. In so doing he was following a tradition of aiming to make economics more scientific in the sense of being more like the physical sciences. Indeed Samuelson's substantial influence facilitated the agenda of moulding economics in the image of the physical sciences as it evolved in the twentieth century (Mirowski 1989). He did note the epistemological difference between economics and the physical sciences arising from our direct experience of economic subject matter: 'I abhor the sins of scientism' (Samuelson 1983: 8). But he carried over the unification goal, common in the physical sciences, in terms of developing a general formal mathematical framework. 'Central to Samuelson's book was the idea that there were common mathematical structures underlying different problems, both within economics and across disciplines' (Backhouse 2015: 347).

Samuelson (1983: 8) traced his philosophy of science to the father of logical positivism, Ernst Mach:

> Unpopular these days are the views of Ernst Mach and crude logical positivists, who deem good theories to be merely economical descriptions of the complex facts that tolerably well replicate those already-observed or still to-be-observed facts. Not for philosophical reasons but purely out of long experience in doing economics that other people will like and that I myself will like, I find myself in the minority who take the Machian view.

Machlup (1964) challenged this identification of explanation with description (see further Wong, 1973; Hands 2001, p. 63). In his reply to Machlup, Samuelson (1964) acknowledged that there were outstanding issues over the subjectivity involved in identifying facts, making reference to Kuhnian paradigms. He saw the issue as applying more to the social sciences than the physical sciences. Like Kuhn (1962) Samuelson saw the social sciences as immature, still evolving, allowing for contemporaneous paradigmatic differences. But these he classified as 'warts' on the surface of the 'face' (Samuelson 1983: 10); the latter was the proper focus of social science. Samuelson further reduced the significance of different perspectives on reality by referring to their source in psychological factors, rather than more fundamental epistemological factors. Indeed awareness of this type of plurality did not shake his emphasis on the primacy of facts over deductive reasoning. 'I am primarily a theorist. But my first and last allegiance is to the facts' (Samuelson 1983: 7).

Recognising the scope for plurality but only within limits is characteristic of Samuelson's philosophy of science; he could be said to subscribe to a form of inexactness.[2] Thus he regarded theory failings as marginal deviations from true descriptions/explanations: inaccuracies which could in principle be corrected (Samuelson 1964: 736-7). Later Samuelson (1983: 9-10) repeated his recognition of epistemological plurality, this time with respect to econometric

[1] A full account of this influence is provided by Backhouse (2015).

[2] See Hausman (1992: ch. 8) for a full discussion of inexactness.

analysis: ‘I do recognize that truth has many facets. Precision in deterministic facts or in their probability laws can at best be only partial and approximate’.

At the ontological level there are indications that Samuelson identified plurality in the subject matter beyond the micro-macro distinction. He justified different lines of enquiry (explanatory pluralism) thus: ‘I am an eclectic economist … only because experience has shown that Mother Nature is eclectic’ (Samuelson 1983: 9). But he had earlier asserted that ‘[n]ature seems to show an inexplicable simplicity’, and inferred that theoretical simplicity was therefore an appropriate appraisal criterion (Samuelson 1964: 739). So it seems that, for Samuelson, ontological eclecticism, like epistemological pluralism, is present but limited, holding no implications for methodology.

Finally Samuelson (1983: 6) also reveals some plurality with respect to ethics. He noted that his motivation to pursue economics, unlike other economists, was not an ethical motivation, yet his pursuit was guided by ethics: ‘Although positivistic analysis of what the actual world is like commands and constrains my every move as an economist, there is never far from my consciousness a concern for the ethics of the outcome’. Nevertheless he argued that rational argument combined with facts could resolve ethical differences, noting ‘the sad fact that our hearts do often contaminate our minds and eyes’. His example of ethical differences referred to views as to the appropriate relative roles for markets and for the state, something which was amenable to mainstream economic analysis. Other examples like the role of ethics in individual and collective behaviour would have posed more fundamental challenges. But, given the apparent assumption that ethical differences can be expressed within the formal framework, we find again that Samuelson does not allow pluralism to threaten the integrity of the methodological framework.

In addition to his positivist focus on evidence, Samuelson was a realist in the sense that he was motivated to analyse real economic problems. In particular he developed dynamic analysis in an attempt to address the important macroeconomic issues raised by Keynes. But unlike Keynes he saw mathematics as the best medium for presenting facts. Indeed for Samuelson mathematical expression and derivation were necessary for economics to be regarded as a science, encompassing both description and explanation. His motivation was to develop a mathematical framework which would synthesise and define economics. It was the resulting overall mathematical structure and Samuelson’s neoclassical synthesis that unified post-war economics. Samuelson’s allegiance arguably was just as much to his methodological framework as to the facts.

What we have seen is that Samuelson identified a degree of plurality in most domains: ethics, nature, knowledge, and explanation. Yet the plurality is conditioned by his positivist methodology: ‘*what ultimately shapes the verdicts of the scientist juries is an empirical reality out there*’ (Samuelson 1983: 10, emphasis in original). The way in which Samuelson treated different paradigmatic accounts as distortions (sources of inexactness) is paralleled in his theoretical propensity to contemplate only disequilibria which would naturally self-correct. This parallel is best understood at the level of his mode of thought whereby he saw differences in reality, perception and theory as deviations from truth. His corresponding theoretical focus on general equilibrium was well-suited to the task of generating and testing explanations and providing technical adjudication on those ethical issues which could be expressed in terms of the framework. Unity in mainstream economics was thereby to be achieved, and pluralism tamed, by unity at the methodological level.

Unification and pluralism: different domains and justifications

Samuelson carried over into economics the powerful drive towards unification in the physical sciences. There is a large philosophical literature on unification in science, some of which Hands sets out in relation to Samuelson, exploring different views on the relations between ontological unity, derivational unity and explanatory unity. For Mäki, explanatory unity requires ontic unity (whereby what appear to be different phenomena are shown to be of the same kind), as well as, 'ideally', derivational unity (Mäki 2009, p. 87; see also Mäki 2001). Morrison's (2000) alternative unificationist approach allows for plurality of explanation, providing a philosophical reference point for Samuelson's approach.[3]

These views hold in common a scientific requirement for methodological unification by means of mathematical expression and empirical testing. But there is a circularity in that a deductivist mathematical framework *requires* that the subject matter is such that the resulting explanations can be derived mathematically and tested against facts as a full representation of that reality. The epistemological justification for unification presumes a particular type of ontology whose identification depends on a particular type of epistemology. This circularity poses a particular problem for the justification for unification since methodology is not neutral with respect to ontology and epistemology.

All epistemologies rely on an ontology, whether explicit or implicit and Lawson (1997) teases out the ontology implicit in an economic methodology focused on deductivist mathematical modelling. It is a closed-system ontology of the kind that not only allows but also justifies derivational unification by means of deductivist mathematical frameworks (see further Chick and Dow 2005). Further Lawson focuses on the limitations of identifying ontology only with the empirical level rather than also the underlying structures, powers, mechanisms and tendencies. These are potentialities which may be countervailing and yet not always active, and thus not identifiable from observed events. By identifying reality for the purposes of economic analysis purely in empirical terms Samuelson thus limited the scope of ontology. Again there is a circularity between the methodological, epistemological and ontological levels. Further the epistemological step is absent of justifying the ontological assumption that the subject matter is suited to a common general mathematical framework even when 'Mother Nature is eclectic'.

The very notion of unification as a necessary feature of science thus requires justification. It is not a universal goal of science, far less a universal demarcation principle. Indeed the persistence of paradigmatic differences within the physical sciences shows that unification has not been achieved. There is a long tradition of alternative approaches to the philosophy of science that support pluralism, or different forms of unification, in all domains including methodology and ethics. These pluralist approaches to science derive from alternative types of ontological account, in particular those which are holistic in emphasising interactions and processes which are evolutionary in a non-deterministic fashion, rather than emphasising equilibrium outcomes.[4] Such accounts defy the possibility of ontological unification in the

[3] The third approach considered is that of Kitcher's (1989), who sees derivational unification as ensuring explanatory unification without reference to ontology.

[4] See Chick (1995) for an account of such an approach in chemistry, discussed in relation to economics.

sense outlined above, not least because the subject matter itself is understood as a plurality and also because it cannot be fully captured by empirical data (Dow 1997a, Davis 2021). Further, ethical stances are built into the process from the ground up, motivating and delineating lines of enquiry. If it is not taken as given that the subject matter is a unified closed system for which a unified closed-system epistemology is suitable then positivist methodologies lack justification.

For a system to be closed a number of conditions need to be satisfied; failure to satisfy any one of those conditions renders the system open (Chick and Dow 2005). There is therefore a range of possibilities for open-system ontology, justifying a range of open-system epistemologies, i.e. methodological pluralism. Just as with a closed-system ontology, an open-system ontology is a matter of belief, albeit justified by reason and evidence. But reason and belief in turn are conditioned by the character of the ontology and its corresponding epistemology and thus the preferred methodology. The particular source(s) of openness of an ontology thus ground(s) a methodological approach, or school of thought.

Ontology can then be said to unify a particular epistemological approach, not in the sense of ontic unity but by founding different approaches on different ontologies. Each may or may not promote pluralism of theory and/or method. But this type of unification is more usefully thought of as *philosophical consistency*. Indeed the term 'unification' is not normally used within the pluralism discourse. The preferred term is 'monism', which is used as a way of categorising the exclusivist focus of mainstream methodology on mathematical modelling. Far from regarding monism as a goal, as unification is in mainstream economics, it is regarded as an inferior alternative to pluralism for building knowledge with respect to an open-system ontology.

Given the recognition that theory and empirical evidence cannot be demonstrated to provide a true explanation with respect to an open-system ontology, even as an approximation, it is common (although not necessary) for a pluralist epistemology to justify a pluralist methodology. While the official discourse of mainstream economics instead requires a unified methodology in the form of mathematical formalism, McCloskey (1983) demonstrates that multiple methods are in practice employed in unofficial mainstream discourse. Yet, even if only sociologically rather than logically, a demarcation criterion of mathematical formalism in official discourse is critical if implemented as part of the power structure of the discipline (see e.g. Lee 2009, Akerlof 2020).

The issue is much more complex than mathematics/no-mathematics. First mathematics itself evolves with changing understandings of consistency and rigour (Weintraub 2002, Dow 2003). In particular it is critical whether the consistency and rigour refer to internal deductive logical structures or to application to reality. In any case, as with the closed-system/multiple-open-systems categorisation, there is a multiple categorisation ranging from an exclusive reliance on deductivist mathematics to no mathematics, with all sorts of possibilities in between.[5] There is

[5] It is important to distinguish between mathematisation and formalism; arguably all theory requires some form of formal (logical) argument, even if expressed only verbally.

a wide variety of mathematical traditions, of which deductivism is only one, just as there are many forms of logic other than classical logic.[6] Further, pluralist methodologies may well include formal mathematical methods alongside other methods of argument (Chick 1998). Any formal model is a closed system, but if this closure is provisional, to be modified in relation to other forms of argument, mathematical models can form *part* of a pluralist methodology, consistent with an open-system ontology and epistemology.

To pursue, as Samuelson did, an exclusivist mathematical strategy is to assume that the subject matter is adequately described and explained by his formal mathematical system. But there is a considerable literature on the limitations of mathematical frameworks which purport to offer representations of the economy. These limitations have particular force when these models are put forward as approximating complete representations such that model results have direct policy implications.[7] A policy recommendation can then be understood to follow directly from the model as a technical result to which political values are added. Colander (1992) does make the case for a pluralist methodology for policy application. But he assumes that the closed-system methodology for deriving the core theoretical results which are to be applied is retained as being the most scientific; only at a later stage are considerations of history, institutional arrangements, ethics etc. to be brought into consideration.[8]

It is common to encounter Samuelson's view that mathematics is 'just' a language which facilitates more precise, rigorous analysis than verbal argument, although the meaning of rigour with respect to mathematics itself has evolved over time (Weintraub 1998; see also Davis, 1999). But, given the limitations of this language in representing an evolving open-system reality, the method itself limits the subject matter. It does so in a way that prescribes both ontology and epistemology. The circularity between ontology and epistemology therefore extends also to methodology: the chosen methods determine the scope of the subject matter and its analysis. Mathematical formalism is not neutral (Chick and Dow 2001). Samuelson's formal mathematical interpretation of Keynes's *General Theory* provides a good case study for considering this non-neutrality.

Samuelson on Keynes: a case study of mathematisation

Keynes employed an open-system methodology which included mathematics. He used limited formal mathematical models as an 'organised and orderly way of thinking out particular problems' at a preliminary stage of any analysis (Keynes 1936, p. 297). He deliberately held back from combining his analysis into a comprehensive formal mathematical system, but he was pragmatic in exploring simplified mathematical relations, such as the consumption

[6] See Feynman (1965) on Babylonian mathematics, for example (see further Dow 2003).

[7] See Lawson's (2009) critique of Colander et al.'s (2009) search for a new model to replace the old in the wake of the financial crisis.

[8] Ethical judgements are in fact built into all theory, whether acknowledged or not.

function, in a partial analysis.[9] This methodology was consistent with his open-system philosophy (see e.g. O'Donnell 1990, 1997; Chick 1998; Chick and Dow 2001). Keynes presented his theory as general in its derivation from an open-system epistemology characterised by uncertainty; neoclassical theory was a special case which required certainty or certainty-equivalence, a condition only rarely satisfied.

Keynes was explicit that what had been abstracted from (as a simplification) needed to be brought back to the fore before any policy conclusions could be justified.

> It is a great fault of symbolic pseudo-mathematical methods of formalising a system of economic analysis, ... that they expressly assume strict independence between the factors involved and lose all their cogency and authority if this hypothesis is disallowed; whereas, in ordinary discourse, we can keep at the 'back of our heads' the necessary reserves and qualifications and the adjustments which we will have to make later on, in a way in which we cannot keep complicated partial differentials 'at the back' of several pages of algebra which assume they all vanish (Keynes 1936, pp. 297-8).

Samuelson is noted for championing a version of Keynesian macroeconomics within his neoclassical synthesis. The dynamic analysis which sits alongside optimisation-based microeconomic analysis in the *Foundations* was an attempt to address the evident possibility of the labour market not clearing. But this approach succeeded in portraying Keynesian macroeconomics as a special case of a Walrasian system whereby price and wage rigidities could prevent speedy reversion to full-employment general equilibrium. Samuelson's philosophy of science meant that his enquiry was driven by real-world observation. But he regarded it as necessary for scientific rigour in operationalising his analysis that it be encompassed within his deductive mathematical framework.

The fact that Keynes made only limited use of formal mathematical expression encouraged Samuelson (1946: 188) to doubt Keynes's mathematical abilities. Further, '[a]s for expectations, the *General Theory* is brilliant in calling attention to their importance and in suggesting many of the central features of uncertainty and speculation. It paves the way for a theory of expectations, but it hardly provides one' (ibid.: 192).[10] By a 'theory of expectations' Samuelson presumably meant a mathematical theory which would fit into his optimisation model, which was precluded by Keynes's (1921) theory of probability. Samuelson was seeing Keynes through the lens of his own methodological unification.

For Keynes, fundamental uncertainty, as the general outcome of an open-system ontology, underpins economic institutions and behaviour, but also the theorising of economists. The early focus of Post-Keynesianism was on challenging the mainstream representation of Keynes's economics as a special case of Walrasian economics, rather than the reverse, with Davidson (2006, 2015) making this case explicitly with respect to Samuelson's interpretation. It is telling

[9] Keynes also accepted the usefulness of econometric analysis. But in his debate with Tinbergen such analysis was only justified if it could be demonstrated that the structure underpinning a particular relationship was stable (Garrone and Marchionatti 2009).

[10] These views of Keynes's *General Theory* are echoed by Lucas (1980).

that Hicks (1980-81), the key figure in developing the form of IS-LM framework which took hold in Samuelson's neoclassical synthesis, grew to doubt the robustness of that framework in that it disregarded expectations and the consequences for equilibrium analysis of the potential for their disappointment.

The different interpretations of Keynes were recognised by Coddington's (1976) classification in terms of 'hydraulic Keynesianism' which he associates with Samuelson and 'fundamentalist Keynesianism' which he associates with Joan Robinson and George Shackle. In fact Samuelson and Robinson engaged in a lengthy correspondence. But Gram (2019) shows how their early shared interest in expectations and uncertainty was not sustained as their methodological judgements increasingly diverged. Coddington (1982) even described some fundamentalist Keynesians as verging on 'nihilism': without being able to quantify probabilities, a mathematical framework could not generate definitive results. He was applying the demarcation criterion of Samuelson's derivational unification to dismiss any theorising outside that framework.

Pluralism in modern mainstream economics

The third form of Keynesianism identified by Coddington was the 'reconstituted reductionists', referring to the work of Clower and Leijonhufvud to relate market failure at the macroeconomic level to behaviour at the microeconomic level. This line of enquiry was taken over by mainstream macroeconomics in the form of the microfoundations agenda, undermining Samuelson's project by promoting theoretical unification. Samuelson had deliberately developed an alternative route to explanation at that level since optimisation could not be applied at the macro level without the introduction of the representative agent. But the power of the unificationist microfoundations logic meant that Dynamic Stochastic General Equilibrium (DSGE) models came to dominate mainstream macroeconomics. They provided the benchmark on which to build a response to the crisis, perpetuating what Haldane and Turrell (2018) describe as a monoculture within macroeconomics (see also Kuorikoski and Lehtinen, 2018).

But the failure of DSGE models to account for the financial crisis has spawned debate over the future of mainstream macroeconomics, as in the Oxford-based Rebuilding Macroeconomic Theory Project (Vines and Wills 2018, 2020).[11] One route they consider was to develop DSGE models further in order to explain financial crises, i.e. to promote explanatory unification in a continuing departure from Samuelson. This requires moving beyond the representative-agent framework and addressing the substantial challenge of building in money and a financial sector (see Rogers, 2018, on the nature and extent of the challenge). An alternative would be to accept that macroeconomics will proceed as an applied field independent of microfoundations, in the spirit of Samuelson. But the conclusion is that, while structural econometric models (SEMs) can usefully be developed at the macroeconomic level alongside DSGE models, the design of a more satisfactory core DSGE model is still the ultimate goal (Vines and Wills 2020). The

[11] This is not to be confused with the UK's ESRC-financed Rebuilding Macroeconomics project based at NIESR (https://www.rebuildingmacroeconomics.ac.uk/). This project was a response to the call from the ESRC for the development of non-mainstream macroeconomic research. The project is pluralist in all domains.

proposed strategy is to proceed by means of small satellite models, established empirically to represent parts of the economy (such as the financial sector) excluded by DSGE modelling. These are to amplify the core DSGE model to encompass the wider institutional and behavioural considerations which have dominated post-financial-crisis discourse. But the ultimate goal of a synthetic DSGE model shows that the hold over mainstream economics of the ideal of both derivational and explanatory unification has been remarkably tenacious.

There is still scope for Samuelsonian explanatory plurality in that formal models can perform diverse roles suited to different purposes, particularly with respect to theory, testing and application (Morgan and Morrison, 1999). Indeed the tensions which had arisen from the strictures of the DSGE framework created the space for the development of alternative explanatory strategies outside the optimising framework and in some cases outside Samuelson's general mathematical framework. Hands argues that theoretical pluralism was thus restored by means of some methodological plurality in diverse fields such as game theory and behavioural economics; there is no longer a common formal basis for unification in mainstream economics.

How far can any such plurality survive absorption in the enhanced-DSGE project? Kuorikoski and Lehtinen (2018: 255) argue that the kind of modifications being called for are incompatible with the framework:

> 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.

At the same time the grip of derivational unification is evident in those fields such as behavioural economics which are looked to for explanatory pluralism. For example, Camerer and his colleagues introduce their substantial behavioural 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 (Camerer, Loewenstein and Rabin 2004, p. 1, emphasis in the original).

Similarly Hong and Stein (2007, p. 126) spell out the pressure for behavioural finance to fit into the standard mainstream approach if it is 'ever to approach the stature of classical asset pricing'.

Most significantly for our discussion of Samuelson, macroeconomists who espouse external consistency still aspire to derivational unification, i.e. internal consistency, as the ideal. Even those who are the most forceful critics of DSGE modelling and who thus promote explanatory pluralism aspire to explanatory unification:

> 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).

Samuelson's approach privileged consistency with the data over internal theoretical consistency and there is an increasing concern with policy application of theory which adds weight to the need for external consistency. As Backhouse and Cherrier (2017) show, there has been a general shift of attention and prestige in economics away from theory to application. This need not hold implications for exclusivist mathematical methodology. While Weintraub (1998) espouses 'rigour' as the unifying principle for science, he advocates attention to rigour in the *application* of mathematics as an alternative to rigour in the form of pure mathematics.

Yet theory of necessity continues to play a central role in application, either explicitly or implicitly in the way in which evidence is understood. The latter was recognised up to a point by Samuelson when he noted the constructed nature of 'facts'. Even if theory is only to be applied in a 'rough and ready' way, what is the proper basis for such modifications to pure theory? Does this accord with Samuelson's mode of thought whereby pluralities and modifications are only marginal? Further, is derivational unification to be retained as the basis for theory formulation? Or should the focus on application be allowed to generate an alternative approach to theorising, and if so on what grounds?

If the derivational and explanatory unification of DSGE modelling is to be discarded, we seem to be back to the drawing board. Ontology and epistemology need to be specified if the philosophy underpinning a new methodological approach is to be coherent (Dow 1997b). Consistency, both internal within a modelling framework and external with respect to a particular form of evidence, does not address the requirements of other forms of consistency. In particular, philosophical consistency can provide the necessary grounding for methodology.

The fragmentation within mainstream economics, both in terms of content and in terms of methodology, represents a move away from traditional prescriptive methodology. Associated with this has been a shift in the field of methodology itself to a more descriptive role, addressing that plurality (Hands 2001). Davis (2007) identifies that plurality particularly with the importation of methodologies, as well as content, from other disciplines. But without a philosophical framework there is a danger that mainstream economic methodology is vulnerable to the charge that 'anything goes'. This is a charge more commonly levelled at non-mainstream methodology, but the latter is coherent in its ontological and epistemological groundings, even if the methodology is not consistent with the mainstream approach. Different approaches within non-mainstream thought start from a particular ontology which sets the parameters for an appropriate epistemology and methodology.[12]

[12] In practice, if only for logistical reasons, there is only a limited number of communities coalescing around any one approach (Dow 2004).

Methodological pluralism, with different methodological approaches stemming from different ontologies, may use alternatives to classical logic which are more consistent with the relevant ontology (King, 2012; see also Dow, 2016). The methodology may or may not include use of formal mathematics, and econometric expression of evidence, depending on its groundings. But there is the common characteristic of some specified form of open-system methodology for the investigation of an open-system ontology. This justifies a pluralist approach whereby no one model and no one form of empirical testing can constitute a sufficient argument for policy-making. Anything does not go.

Conclusion

In contemplating Samuelson's combination of derivational unification with his explanatory pluralism, the question arose as to the justification for unification in the first place. It was concluded that the justification is circular, with unification requiring the type of ontology, epistemology and methodology which justifies it. Promoting unification is a scientific convention in the sense that there are alternative bases for science which cannot be *categorically demonstrated* to be either better or worse in relation to some notion of truth. While we found various aspects of plurality in Samuelson, he did not allow this to challenge his derivational unificationism. The plurality he identified at the ontological and epistemological levels was a sort of approximation to truth, a feature of what we might call his mode of thought.

We explored an alternative in the form of pluralism based on an open-system approach. The plurality in ontology and epistemology here is substantive rather than deviations from some central truth. Such an approach is based on philosophical consistency in place of unification. Any particular ontology determines the possibilities for knowledge, including its type and scope. In turn this pluralist epistemology justifies the choice of methodology. This type of approach characterises the different schools of thought which operate outside the economics mainstream.

So what are we to make of developments within the mainstream which seek to use a different methodological framework from Samuelson's unifying approach? Tensions remain and we have seen how difficult it is for mainstream macroeconomics to break away from the DSGE framework as a unificationist ideal. Even while the emphasis is on empirical application, the goal of unification remains, as does the role of deductive mathematics and empirical realism.

But if methodological unification is to be abandoned, on what basis is theorising to proceed? The onus is on economists to be able to justify their methodological approach in terms of ontology and epistemology – whether a Samuelsonian approach or some alternative. Including accounts of such philosophical groundings fits well with the dominant (critical) descriptive practice of the 'new methodology'.

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