

Bourgeois Ideology and Mathematical Economics – A Reply to Tony Lawson*

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Abstract

This paper challenges Tony Lawson’s account of the relationship between mainstream economics and ideology along two key axes. First off, we argue that Newtonian physics has been the primary version of pro-science ideology within mainstream economics, rather than mathematics *per se*. Secondly, we argue that the particular uses of mathematics within mainstream economics have always been ideological in the pro-capitalist sense of the term. In order to defend these claims we develop a line of argument that Lawson has thus far strategically avoided. Namely, we view mainstream economic theory as an integrated theoretical paradigm with intrinsic links to the capitalist economy. Viewed in this way, it becomes clear that Lawson’s (trans) historical account of ideology is too general to capture the complexity of the relationship between natural science, mathematics and mainstream methods. Having briefly outlined Lawson’s central argument, we highlight the non-mathematical methods underpinning Classical Political Economy. Thereafter, we assess the nature of the mathematics associated with the Marginal Revolution of the 1870s and the Formalist Revolution of the 1950s.

Keywords: mainstream economics, mathematics, science, ideology, apologetics

* In the review process for this paper we have become aware of a similar set of ideas being developed completely independently by Dimitris Milonakis. In ‘Formalising Economics: Social Change, Mathematics and Ideology in Economic Discourse’, Dimitris comes to very similar conclusions to us via a different route. This only came to light when Dimitris was asked to review our paper. Dimitris’ work, which is under review in another journal and part of a book project, should be viewed as complimentary to this paper, although not reliant on it in any way. The same applies to our paper. We therefore wish to acknowledge a case of parallel discovery in this case. Moreover, we believe that Dimitris’ work strengthens our critique of the Lawsonian perspective and *vice versa*.

1. Introduction

In *Mathematical Modelling and Ideology in the Economics Academy* Tony Lawson makes a number of important assertions. At the outset, he makes the familiar claim that mainstream economics is irretrievably flawed as a scientific paradigm. Thereafter, he posits two rival explanations of the mainstream’s failings which are presented in more or less dichotomous terms. According to Lawson, mainstream economics consistently fails *either* because of its substantive apologetics *or* because of its use of inappropriate techniques.¹ To investigate the merits of these alternative explanations, Lawson develops a novel taxonomy of ideological categories.

¹ Near the end of the paper, Lawson actually does acknowledge some pro-capitalist influences flowing from mainstream methods. Despite this, however, the main thrust of his argument is clearly designed to contest the ‘mainstream as ideology thesis’ on the basis of his own methodological thesis.

Ideology1 is defined as a form of society-wide cultural blindness which ensures that theorists often unwittingly import non-scientific techniques/procedures into economics. **Ideology2** is defined as a form of conscious concealment by apologists who are determined to use economic theory to mask and/or mystify economic reality. Ideology2 is quickly dismissed on the basis of current practices and opinions from within the mainstream project (Lawson, 2012, p. 9). Ideology1 is adjudged to be similarly defective as a form of pro-capitalist cultural bias, however Lawson does find an alternative version of cultural blindness that is rife within the economics academy. Drawing on analysis developed over many years, Lawson argues that the problems of mainstream economics reside in a complete disjunction between its object of enquiry and its methods of analysis (Lawson, 1997, 2003). The social world is characterised by ontological depth, processual change and internally-related structured relationships. Despite this, mainstream methods pre-suppose atomistic entities, a-temporal dynamics and deterministic (closed system) states (Lawson, 2012, p. 4). This results in a Sisyphean enterprise, as methods are employed that will never do the jobs expected of them. To explain this phenomenon, Lawson develops an analysis of the historical role of mathematics in economics. In most of his published writings, Lawson has delimited his analysis to the formalist economics of the post-war era. In this paper he takes a different tack, however, developing a novel account of *ideology* which is rooted in the long sweep of economic history. Specifically, Lawson argues that Western society is so enthralled by the use of mathematics that many economists wrongly presume that anything genuinely scientific must be couched in mathematical form. This is where the novelty of his paper emerges, as Lawson uses this sense of a long-standing cultural blindness to counterpose his own version of ideology1 to the 'mainstream as apologetics thesis'.

As advocates of the latter thesis, we wish to dispute Lawson's analysis of ideology on two main fronts. Firstly, we reject the idea that mathematics has been the dominant form of pro-science ideology1 within economics. Indeed, if ideology1 is defined as a set of background conceptions that decisively influence theoretical output, then *Newtonian science* is a far better candidate for this role in economics than *mathematics* per se. Prior to the establishment of Newtonian physics, economic theory – in the form of Mercantilism – was more of an art than a science (Roll, 1992, p. 52). Instead of investigating the fundamental structures of the capitalist economy, mercantilist thought occupied itself with the particular needs of merchant traders. Newton's influence on economic theory was to prove decisive in this regard (Skinner, 1999, p.12). It was through the application of Newtonian methods that Classical Political Economy (CPE) gained its scientificity, and yet, this was achieved without the use of complex mathematics (O'Boyle and McDonough, 2016, p.221). For roughly 100 years from 1776, CPE was both the dominant economic paradigm and the highpoint of Newtonian economics. Despite this, it was expressly non-mathematical in its analytical procedure. This causes a significant problem for Lawson's account of ideology as it was simply not true that 'ever since Newton succeeded in uniting heaven and earth in equations... the programme of mathematising economics has been underway' (Lawson, 2012, p. 16). For the first century of scientific economics, the use of mathematics was intermittent at best, suggesting that Lawson's explanation of ideology1 cannot be sustained on the basis of detailed historical and conceptual analysis.²

² In *Mathematical Modelling and Ideology in the Economics Academy* Lawson states that he is once again focused on specifically academic economics, particularly its mainstream manifestation (Lawson, 2012, p. 1, 11). However, in order to explain the weaknesses in this deductivist system he relies on an analysis of ideology1 that stretches back to at least the Enlightenment. This allows us to challenge his analysis of ideology1 with our own look at economics since the 18th century. See his subsection *Explaining the Ideology of Mathematical Techniques in Modern Economics* (Lawson, 2012, p. 15) for more details.

Moreover, the rise to dominance of mathematical economics was in no way automatic. Rather, mathematical formalism came into economics in a particular historical juncture, to play a particular conceptual role. This brings us to our second claim, which is that the particular uses of mathematics in mainstream academic economics have always been ideological in the apologetic sense of the term.

To appreciate this, it is worth remembering that the Marginal Revolution of the 1870s was a totalising paradigm shift involving every facet of the discipline. From a class analysis of capital accumulation, the discipline was transformed into a static analysis centred on individualistic resource allocation.

Marginalism proved so successful precisely because it developed an entirely new conception of the economic problem (Schumpeter's Economic Vision), a new set of *a priori* assumptions, a new set of substantive questions and a new set of analytical techniques (O'Boyle and McDonough, 2016, p. 224). In order to achieve its objectives, marginalism made a strong appeal to Newton's cosmology (a natural and ordered capitalist universe) at the same time as it severed Newtonian mathematics from his scientific methodology (O'Boyle, 2015, p. 26). Indeed, it was only once the latter had been achieved that the mathematics of the calculus could be deployed in order to 'prove' an identity between individual utility maximisation and free market capitalism (Jevons, 2013, p. 140). This suggests a complex admixture of ideology¹ (Newtonian science) and ideology² (pro-capitalist, non-science), wrapped up in the legitimating symbols of mathematics. It also suggests that Lawson is wrong to pose his analysis in terms of either/or categories, as he thereby misses the pro-capitalist ideology residing within the mathematisation of the mainstream itself.

To corroborate this argument further, we turn to the role of mathematics in the Formalist Revolution of the 1950s. Lawson has correctly noted that it was only in the period after World War II that mathematics truly rose to dominance within economics (Lawson, 2003, p. 273), but his narrative misses the crucial conceptual shift that had previously been made during the transition to Marginalism. Ever since the 1870s, mathematical economics has consistently been tied to a particular cosmology, wherein the various atoms of the economic universe are brought into mechanical alignment through the universal forces of natural self-interest. This has generally been the organising cosmology of the mainstream discipline and it was dutifully retained even as Newtonian physics lost much of its previous authority.

In the face of undeniable empirical evidence, the genuine sciences abandoned Newtonianism from the turn of the 20th century onwards. Once Eddington had confirmed Einstein's predictions about the bending of light near massive objects, most physicists abandoned the Newtonian cosmology in favour of new problems and new mathematics. In stark contrast, the mainstream economics profession steadfastly ignored these developments in order to sustain their Newtonian (pro-capitalist) cosmology. To justify this manoeuvre, the high-priests of neoclassicism relied on a Platonic / Bourbakian conception of 'doing mathematics entirely for its own sake' (Lawson, 2003, p. 271). Yet, once we accept that Newtonianism initially came into economics precisely in order to confer scientificity (physics envy), the retention of Newtonianism can be seen as part of an apologetic move to defend the legitimacy of free-market capitalism. After all, why else would a discipline dedicated to explaining reality move away from reality in order to uphold the mathematical forms of a superseded science? To explain this more fully, we need to see the apologetic functions of the mainstream discipline as being inextricably tied to their particular uses of mathematics. Before this, however, we briefly assess the central tenets of Lawson's argument.

2. Lawson's Methodological Thesis

Lawson begins his analysis by positing two versions of ideology which he claims are *representative* of those found in the extant literature. These are,

1) Ideology1: a relatively unchallenged set of (possibly distorted or misleading) background ideas that every society or community possesses, which forms the basis of, or significantly informs general opinion or common sense, a basis that remains somewhat invisible to most of society's members appearing as 'neutral'. A consequence is that viewpoints significantly out of line with these background beliefs are intuitively seen as radical, nonsensical or extreme no matter what may be the actual content of their vision.

2) Ideology2: a set of ideas designed, or anyway intentionally employed, in order to justify, preserve or reinforce some existing state of affairs, where this state of affairs is preferred perhaps because it facilitates or legitimates various advantages for some dominant or privileged group and where these ideas mostly work by way of intentionally masking or misrepresenting the nature of reality' (Lawson, 2012, pp. 6-7).

Having defined these alternatives, Lawson moves quickly to refute the potential for mainstream apologetics. His central argument rests on the inability of pro-capitalist ideology to explain the generalised failings of the discipline across all of its output over many years (Lawson, 2012, p. 9). Presumably the best way to assess this potential would be to hone in on mainstream economic categories, particularly those that are deemed to be axiomatic. If its foundational categories carry a form of pro-capitalist ideology within them, there is every potential that most, if not all, of the resulting output could be tainted by association. Unfortunately, this kind of structural / conceptual analysis is exactly what Lawson fails to deliver. Instead, he offers a shallow empiricism based on a selection of current practices and opinions from within the mainstream itself. On the basis of this selective 'evidence', Lawson insists that it is one thing to accept that most mainstream thinkers accept capitalism as normal and natural, quite another to assume that mainstream theorists are predominantly engaged in issues to do with political economy (Lawson, 2012, p. 8). The idea that they are all somehow 'motivated to demonstrate' that capitalism is characterised by efficient markets is an even bigger stretch, according to Lawson (2012, p. 8).

The truth is, that capitalism as a social system is barely even considered within the mainstream discipline. On the contrary, most mainstream theorists are busy doing highly specific, partial analysis, often centred on micro behaviour (Lawson, 2012, p. 9). As for those theorists who are (or were) engaged in general equilibrium analysis, Lawson presents a quote from Frank Hahn to the effect that it is never permissible to draw policy conclusions from abstract theory. Finally, Lawson claims that seemingly pro-capitalist categories such as 'rational expectations' and 'general equilibrium' are actually better understood in terms of their technical effects in modelling procedures, and that the substantive discipline is far too fractured to ever assume a conscious conspiracy amongst knowing apologists.

How to respond? In a previous paper we pointed out that Lawson consistently sticks to the surface appearances of the mainstream project rather than delving into its structural nature (O'Boyle and McDonough, 2011, p. 10).³ This matters, moreover, as the idea that one

³ Although Lawson references our earlier work to the effect that 'following his particular critique of the mainstream is to relinquish the tools that are needed to uncover the anatomy and ideological function of orthodoxy' (O'Boyle and McDonough quoted in Lawson 2012, p. 5), he continues to argue in the overly subjectivist and empiricist manner that we then accused him of. This frames his opponents in a way that

can refute 'apologetics' by invoking practices and opinions from within the mainstream itself is not credible for two reasons. Firstly, if a pro-capitalist version of ideology¹ is doing its job, then the intentions, motivations, and subjective opinions of mainstream economists can surely be considered under its sway. When asked, mainstream thinkers may well dispute the links between their work and pro-capitalist ideology, but this will not decide the matter unless we assume that they are perfectly aware of their cultural blindness. Meanwhile, the key theorist that Lawson actually does invoke to defend his case, makes it quite clear that 'equilibrium analysis is easily convertible into an apologia for existing economic arrangements and it is frequently so converted' (Hahn quoted in Lawson, 2012, p. 9). This assertion is particularly important given the links between rational expectations (RE), general equilibrium (GE) analysis and the Washington Consensus (Backhouse, 2009; Mirowski, 2013). Whether Hahn was overtly political or not, thinkers such as Robert Lucas, Milton Friedman and Gary Becker most certainly were (Backhouse, 2009, p. 23) It is obviously true that the assumptions underpinning RE and GE models have been employed in their technical capacities, but to miss their political role in the development of neoliberalism is to let mainstream apologetics completely off the hook.

Secondly, the fact that mainstream economists are specialising in fields far removed from political economy is not a measure of their distance from apologetics, but a measure of the fact that once the normal (potentially pro-capitalist) parameters for a paradigm have been defined, it is essential for specialisation to begin to occur. Indeed, normal science (in the Kuhnian sense) predicts this specialisation as the mainstream paradigm is extended in all manner of acceptable ways. What is important in this respect is that an investigation of rational behaviour within the system has replaced analysis of the system itself, thereby foreclosing any sense of real alternatives. Thus when Lawson asserts that 'in truth, the social system that is capitalism, is qua social system, barely even considered' he unwittingly strengthens the case of his opponents. What better way to defend the interests of the status quo than to delimit all 'legitimate' analysis to within its parameters. The way out of these dilemmas is to engage in the kinds of detailed historical and conceptual analysis that Lawson has so far failed to deliver – except when it comes to mainstream methodological techniques.

Be that as it may, one gets the sense that Lawson's real energy is being held in check for his own analysis of ideology¹. Indeed, the category is tailor made to fit with the key ideas in Lawson's previously published output (see e.g. Lawson, 2003, Chapter 10). In an argument heard many times before, Lawson roots the problems of the mainstream discipline in an incessant use of closed system modelling techniques. Given that the world is open and relational, these techniques will never (and can never) do the jobs expected of them. This ensures that mainstream modellers pursue their craft in good faith, only to be ultimately undermined by the tools of their trade. Why would anyone persist in the face of such repeated failure? Here Lawson relies on a cultural identification of scientific progress and mathematics that supposedly goes back over 2,000 years (Lawson, 2012, p. 15). Although Lawson's work has generally focused on academic economics, here he relies on an account of ideology that goes back at least as far as the Enlightenment. Indeed, he explicitly argues that 'a large part of the explanation [for the weakness in mainstream methods] is simply that mathematics has been so successful in the history of human endeavour and especially within (non-social) natural science that its centrality to all science... is taken as an article of faith' (Lawson, 2012, p. 15). This leaves us with an alternative version of ideology¹, wherein the blindness is to do with a set of analytical techniques rather than the social system in which economists work and

is functional for his own arguments rather than meeting them on their own terms. We elaborate on this point below.

live. It also makes it permissible to look at the longer sweep of economic history – including classical political economy – in a way that Lawson has strategically avoided.

The first thing to notice about his narrative here is its trans-historical quality. Instead of tying the emergence of (political) economics to the capitalist society that actually produced it, Lawson goes all the way back to the ancient Babylonians (Lawson, 2012, p. 15). This makes his subsequent analysis far too general, with the inevitable corollary that he is proven wrong when it comes to specifics. The second thing to notice, is Lawson's continual separation of economic theory from economic methods. Instead of seeing mainstream theory as an integrated paradigm consisting of concepts *and* methods, Lawson fractures the discipline illegitimately (O'Boyle and McDonough, 2016, p. 219). This compounds the trans-historical weakness by presenting an account of the rise of mathematical economics which leaves out the attendant conceptual transformations associated with the Marginal Revolution. To rectify these deficiencies, we will investigate three crucial turning points in the development of the mainstream discipline. Specifically, our analysis will argue that,

- (1) In its classical phase, mainstream political economy relied on Newton's scientific methods without the use of his mathematics.
- (2) In its neoclassical phase, mainstream economics relied on Newton's cosmology alongside the use of his mathematics.
- (3) In its formalist phase, mainstream economics held onto Newton's cosmology whilst justifying it on the basis of Bourbakian mathematics.⁴

Outlining these key phases will also allow us to make two assertions that directly contradict Lawson's ideological thesis. Namely, that (1) Newtonian science has historically been the paradigmatic version of mainstream pro-science ideology¹ and, (2) that mainstream mathematics came into the discipline to play a role in justifying capitalism (a complex interaction of pro-capitalism ideology¹ and ideology²).

3. The Newtonian Roots of Classical Political Economy

The links between natural science, mathematics and capitalism are extremely important. By providing the wherewithal to understand and control nature more successfully, science and mathematics gave the bourgeoisie crucial advantages in their battles with the established order. From the outset, capitalists realised that costs could be significantly reduced through the right technologies and that many new lines of business could be opened with an understanding of natural forces (Humphreys, 1955 p. 421). This inevitably made them strong defenders of 17th-century natural philosophy. It would be too crude to tie the achievements of Galileo or Targatalia solely to the needs of the newly developing merchant economy, but there can be little doubt that much of the wider cultural respect for the natural sciences flowed from their role in economic advancement. In the realm of abstract mathematics, Descartes' development of analytical geometry was extremely important in laying the foundation for a deeper understanding of physical reality (Struik, 1936, p. 85). Newton's seminal contribution was to put these mathematics into the service of his laws of motion / gravitation.

⁴ One advantage of our taxonomy is the ability to explain the nature of the mathematics actually adopted by mainstream economic theory. In Lawson's account, deductivist methods '*just happen*' to be those that economists (so far) find easiest to wield or otherwise more convenient' (Lawson, 2012, p. 11 emphasis added). In our account, the use of deductivist methods is tied to a distorted use of Newtonian science and to a pro-capitalist theoretical procedure that deduces *laissez faire* capitalism from the axioms of choice. In this sense the use of the mathematics is far more determined than Lawson admits.

It would be hard to overstate the status of Newtonian physics throughout the late 17th and 18th centuries. More than a century after the Copernican Revolution, Newton's laws were widely believed to have finally unlocked the secrets of nature, with the supreme proof coming by way of (capitalist) industrialisation. Newtonian physics thereby represented a unique combination of scientific achievement and capitalist advancement, which helped to transform them into a paradigmatic version of ideology¹. Gascoigne writes that Newtonianism actually 'set the intellectual boundaries within which much of eighteenth-century natural philosophy was conducted' (Gascoigne, 2003, p. 289). White Beck fundamentally agrees, arguing that 'the eighteenth century as a state of mind began in any country when the heaven of Newton was brought to it' (White Beck, 1966, p. 5).

More important than even his results, was Newton's development of trustworthy scientific procedures. Thanks to his undoubted successes, Enlightenment thinkers came to believe that they 'finally stood on firm ground which could never again be shaken by any future revolution in science' (Cassirer, 1979, p. 44). The power of the Newtonian method lay in its unmatched ability to bring together empirical observations, creative leaps of imagination, powerful mathematico-deductive logic and skilled induction. Real-world observation was absolutely crucial, as was the move from empirical effects to underlying causes. To begin a scientific investigation, the various phenomena that were to be explained had to be meticulously observed, recorded and otherwise investigated. This entailed a process of analytical resolution which ended with a creative leap to the causal connections potentially underlying empirical phenomena. Once this was achieved, a whole series of further implications could be logically deduced through a synthesis of mathematico-deductive logic, empirical verification techniques and inductive inferences. As the scientist moves to explain ever more (seemingly) disparate phenomena, there is a dialectical interplay between one's reasons for accepting the efficacy of the postulated force/mechanism and increasing empirical knowledge of the world around us. Newton summarises his method in the following terms,

'From Effects to their Causes, and from particular Causes to more general ones... This is the Method of Analysis: And the Synthesis consists in assuming the causes discover'd and establish'd as Principles, and by them explaining the Phenomena proceeding from them, and proving the Explanations' (Newton, 1979, pp. 404-05).

It was into this Newtonian ground that Adam Smith pitched his *Inquiry into the Nature and Causes of the Wealth of Nations* (Montes, 2003, p. 723). Starting with important empirical phenomena such as productivity and the division of labour, Smith posits commodity values as the ultimate regulator of the capitalist economy, before moving back to assess the ways that prices are constructed. Having looked at the explosion of output associated with private production and social exchange, Smith uses his chapter on value to highlight an important disjunction between the way the capitalist system necessarily appears and the way the system actually functions. Although the nominal (empirical) prices of commodities are determined by the amount of labour embodied within them, labour values can scarcely be seen by the casual observer. Capitalist markets seem to be moved exclusively by supply and demand, meaning that 'though labour be the real measure of the exchangeable value of all commodities, it is not that by which their value is commonly ascertained' (Smith, 1999, p. 134). For Smith, genuine economic science necessitates moving beyond these surface phenomena to the causal mechanisms that bring order to our observations. He writes that natural philosophy 'is the science of connecting principles that can introduce order into the chaos of jarring and discordant appearances' (Smith, 1982, p. 45). Having outlined the key

parameters of his value analysis, Smith therefore moves back towards more visible phenomena such as rent, profits and wages. This process didn't prove internally consistent, but there is nevertheless a clear attempt to apply the Newtonian method of analysis and synthesis (Smith, 1982, p. 46).

On this basis there are clear grounds for arguing that Newtonian science was the most important version of pro-science ideology¹ in Classical Political Economy, particularly given Smith's influence on Jean Baptiste Say, Thomas Malthus and David Ricardo. Like these authors, moreover, Smith's methods were expressly non-mathematical, posing an important dilemma for Lawson's assertion that mathematics envy has dominated science since the Enlightenment (Lawson, 2012, p. 16). Throughout the 18th and 19th centuries there were undoubtedly instances of individual theorists applying the calculus to economic questions (Cournot in France comes to mind). By and large, however, the first embodiment of Newtonian political economy was self-consciously (and often expressly) non-mathematical. Lawson has sought to address this anomaly in the case of Walras' reception in the late 19th century French academy (Lawson, 2003, Chapter 10). He has yet to offer a plausible explanation as to why the predominant school of British Political Economy eschewed mathematics so resolutely, however. *Surely the kind of cultural blindness that he relies upon in the 20th century would have been even more prevalent in the 18th and early 19th centuries?* Despite this, there was little push to mathematise political economy prior to the Marginal Revolution of the 1870s.

Acknowledging this necessitates making two important adjustments to Lawson's thesis. The first relates to Lawson's trans-historical sequence, which is simply not specific enough to take account of a prominent non-mathematical school of Political Economy. This means that contra Lawson, mathematics has not always been assumed culturally necessary for economic science. The second flows from the pro-capitalist ideology which comes from CPE's inadvertent naturalising of what were historically specific forms of social relationships. There are essential links between (uncritically) using natural scientific methods and naturalising capitalist social relations which ensure that, contra Lawson, there has always been a version of pro-capitalist ideology¹ built into mainstream economic methods. In line with his wider Newtonianism, Smith uncritically assumed that his search for the laws of the capitalist system must be rooted in the universal laws of (human) nature (Clarke, 1989. p. 600). Instead of investigating the social and historical influences on human behaviour in a capitalist society, Smith therefore makes bourgeois social institutions expressive of our natural proclivities. Epistemologically, this illegitimately reversed the arrow of causation leaving Smith with the assumption that human nature was the bedrock of capitalist society. Ideologically, it produced a form of capitalist apologetics, as every impediment to bourgeois society had to be removed in the name of natural progress. Rubin captures the nature of this pro-capitalist ideology exceedingly well,

'The Classical economists took the socially-conditioned and historically changing nature of the commodity producer and elevated it into being the naturally-conditioned and immutable nature of man in general... And as the new bourgeois social institutions are a necessary condition for the complete manifestation of the invariable nature of the individual, they thereby take on the character of eternal, "natural" forms of economy' (Rubin, 1979, pp. 168-9).

As far as Smith was concerned, successful science had to rest on natural foundations, with the immutable laws of natural self-interest mirroring the immutable laws of motion/gravitation. Our natural proclivities were expressed in the hustle and bustle of capitalist markets with the

division of labour becoming a consequence of a 'certain propensity in human nature... to truck, barter and trade one thing for another' (Smith, 1999, p. 117). If Lawson's account of ideology¹ is reserved for background ideas that are overwhelmingly hegemonic, then Newtonian science fits the bill perfectly. Convinced of the need to explain phenomena through Newtonian methods, Smith naturalised what were historically specific social relations, before positing policy prescriptions that were solely in the interests of the ruling classes. Contradictions and conflicts were theoretically eradicated and the behavioural characteristics of property holders became imbued with an authority that rendered them immutable. Despite this, it is important to remember that capitalist society became eternalised as the best of all possible worlds, not because Smith set out to defend sectional class interests, but because these interests were genuinely believed to be those of humanity.

A combination of pro-science and pro-capitalist ideology¹ was central to everything that was subsequently produced, with considerable advances and elementary errors attributable to this strategy. By rooting his economic laws in the behaviour most characteristic of a capitalist society, Smith was able to deliver foundational insights into the workings of the system, at the same time as he mystified and naturalised them (Marx, 1968; 1978). All-the-while, Smith was working under the influence of unchallenged background beliefs that Newton had discovered *the* scientific method. By investigating the conceptual structure of Classical Political Economy we have identified a resolutely non-mathematical version of pro-capitalist ideology¹. Next we turn to the Marginalist Revolution to expose a resolutely mathematical version of pro-capitalist ideology².

4. The Mathematisation of Mainstream Economics – Phase One (the Marginal Revolution)

If Classical Political Economy (CPE) was a genuine attempt to root the workings of the capitalist economy within human nature, Marginalism was the elevation of this nature into the primary object of economic investigation. For William S. Jevons and Leon Walras it was imperative to begin with a thorough understanding of human behaviour and this resulted in a fundamentally novel set of analytical procedures. First off, actually existing capitalist relations were to be replaced with a logical analysis rooted in axioms of human behaviour. Thereafter, the laws of social interaction were to be presented via a combination of utilitarian metaphysics and Newtonian mathematics. Jevons explains this new method in the following terms,

'In this work, I have attempted to treat Economy as a calculus of Pleasure and Pain, and have sketched out, almost irrespective of previous opinions, the form which the science, as it seems to me, must ultimately take. I have long thought that as it deals throughout with quantities, it must be a mathematical science in matter if not in language... The Theory of Economy thus treated presents a close analogy to the Science of Statical Mechanics... The nature of Wealth and Value is explained by consideration of indefinitely small amounts of pleasure and pain, just as the theory of statics is made to rest upon the equality of indefinitely small amounts of energy' (Jevons, 2013, p. xxix).

What is most striking in this statement is the systematic transformation of economic theory being proposed. The introduction of marginalist categories was to be a totalising paradigm shift in every sense of the term. Each facet of the discipline was to be utterly transformed,

with mathematics helping to legitimise the process through being deployed to solve a static allocation problem (Maas, 2013, p. ix). In the event, the so-called Marginal 'Revolution' was a more drawn out affair than is commonly realised, but there can be little doubt that the new paradigm was tailor made for the use of – a certain kind of – mathematics. As indicated above, marginalism uses the machinery of the calculus to prove an isomorphism between the equilibrium attained in energy systems and the equilibrium attained through optimising market-based decision making. It is vitally important to situate the rise of mathematical economics within this overarching paradigm shift and in-so-doing a number of important questions present themselves. The first is whether or not marginalist theoretical procedures were genuinely scientific and specifically, whether or not their mathematics were deployed in an analogous way to their physical science counterparts? The second is whether or not their particular uses of marginalist mathematics were ideological in the pro-capitalist sense of the term.

To start with their own intentions, it is clear that the marginalist pioneers genuinely believed that scientific economics must become a psychical mechanics. When Wilhelm Wundt proclaimed that 'mechanics is the beginning and the foundation for all explanatory natural science' he might well have been speaking for Jevons or Walras (Wundt in Georgescu-Roegen, 1979, p. 320). Edgeworth's *Mathematical Psychics* (1909) also explicitly claimed the mantle of Newton, whilst Walras repeatedly sought to prove an identity between his psychic-mathematics and the classical mechanics (Walras, 1909, p. 5). Assessing this output in its entirety, it is clear that we are dealing with a form of pro-science ideology¹ centred on Newtonian mechanics.

The marginalists evidently believed themselves to be placing economics onto a scientific footing, and yet the way that they actually constructed their analysis was deeply non-Newtonian (and non-scientific). Why was this? The first thing to notice is the utter lack of empirical investigation in the marginalist paradigm. In the Newtonian sciences, ongoing observations of external reality are central to the entire investigation. Newton famously disputed the Cartesian vortex for example, on the basis that it was not compatible with real world observations (Snow, 1924, p. 551). More to the point, his own analysis of gravitation relied upon empirical accounts of comets, satellites, planets and moons (Newton, 1995, p. 349).

For Newton, even abstract mathematics had its ultimate roots in practical activity, which always took precedence in any enquiry,

'In mathematics we investigate quantities of forces with their proportions consequent upon any conditions supposed, then we enter upon physics, *we compare those proportions with the phenomena of nature...* and this preparation being made, we argue more safely concerning the physical species, causes and proportions of forces' (Newton, in Boas and Hall 1959, p. 170, emphasis added).

In stark contrast, Jevons admits that his own science will begin (and end) with principles that are entirely non-empirical (Jevons, 2003, p. 18). Instead of investigating the social relations of an external economy, Jevons begins with behavioural laws found immediately through introspection (Jevons, 2013, p. 18). What is more, his mathematical analysis never investigates the congruence between the abstract laws of human consumption and the actual state of a market economy. For all his talk of investigating human nature 'as it actually is' (Jevons, 2013, p. 38), Jevons' analysis is never put to the test of empirical evidence. Walras' analysis is even more idealistic, explicitly relying on a Platonic philosophy that glorifies

universal forms rather than empirical particulars (Walras, 2003, p. 71). Indeed, Walras' system of General Equilibrium is entirely *a priori* from the founding axioms right the way through to the theorems and the proofs (Walras, 2003, p. 71).

This matters, because it opens up the possibility that the use of mainstream mathematics may well have been ideological in the pro-capitalist sense of the term. Put another way, although the marginalists invoked the same mathematics as many physicists, their non-empirical theoretical procedures meant that their particular deployment of the calculus was fundamentally different. Instead of using mathematics to unearth the workings of natural phenomena, marginalist mathematics were entirely subservient to an ideological utilitarianism. To get a handle on this, it is useful to think about whether or not the deductive results that the marginalists achieved could be squared with the reality of Victorian capitalism.

In the final decades of the 19th century, capitalism was subject to a growing level of working class militancy which was exacerbated by economic crises for much of the period. The final resolution of these problems relied upon a wave of mergers and acquisitions which definitively transformed capitalism into an oligopolistic system around the turn of the 20th century. Any fair assessment of the period would have had to contend with (1) growing levels of working class militancy, (2) recurrent economic crises and, (3) increasing monopolisation of the means of production (Henry, 1990, p. 176). Despite this, the axioms built into marginalist doctrine presupposed (1) perfectly harmonious social interactions (2) market equilibrium and (3) perfect competition. When Wisman states 'it is ironic that toward the end of the nineteenth century, when the [free] market... was proving to be increasingly socially unviable, economic thought received its fullest mechanistic expression' (Wisman, 1979, p. 311), he understates the case entirely.

Capitalism was moving in exactly the opposite direction to the assumptions built into marginalist models which could hardly be classified as empirical science under any reasonable definition of the term. Rather than functioning as an investigative aid, the marginalists separated mathematics from the wider logic of scientific enquiry in order to prove an identity between the natural laws of Newtonian cosmology and the natural laws of capitalist exchange (O'Boyle and McDonough, 2016, p. 221). Neoclassicism thereby maintained its claim to scientificity by redefining what it is to do science (O'Boyle and McDonough, 2016, p. 225). Walras substantiates our claim in the following remarks,

'From the viewpoint of pure science, all that we needed to do, and all that we actually have done... was to treat free competition... as an hypothesis, for it did not matter whether or not we observed it in the real world, since strictly speaking it was sufficient that we should be able to form a conception of it. It was in this light that we studied the nature, causes and consequences of free competition. We know now that these consequences may be summed up as the attainment within certain limits, of maximum utility... the equations we have developed do show [that] freedom procures the maximum utility; and since factors that interfere with freedom are obstacles to the attainment of this maximum, they should... be eliminated as completely as possible (Walras, 2003, pp. 255-6).

Pro-capitalist ideology is built into the very fabric of Walras's *Pure Economics*, as a metaphysical defence of capitalist society is presented as the endpoint of a scientific deduction. Walras's belief in mathematical psychics may have been genuine, but his uses of algebra and geometry were entirely ideological in the apologetic sense of the term. A particular version of mathematics came into economics in a particular historical juncture in

order to play a particular theoretical role. Yet instead of investigating the nature of this role conceptually, Lawson severs formalism from the initial period of mathematisation at the same time as he separates deductive methods from substantive content.

Neither of these moves are permissible once we realise that (1) the fundamental conceptual shift that facilitated mathematical economics took place as part of the Marginal Revolution and, (2) that mainstream methods have always been internally related to the forms of content that could subsequently be developed (Chick and Dow, 2001, p. 719). Contra Lawson, mathematics came into economics as part of a totalising paradigm shift in which utilitarian metaphysics were predominant. Once the outlines of the new discipline had been properly secured, moreover, it was entirely permissible for mainstream economists to apply these categories without any knowing apologetic intent. What really mattered was the prior transformation of the hard core of the discipline around individual utility calculations.

5. The Mathematisation of Mainstream Economics – Phase Two (The Formalist Revolution)

Having argued that the conceptual facilitation of mathematics occurred during the 1870s, it is important to acknowledge the subsequent drive to formalise economics that took place after WWII. Reflecting on this process, Backhouse writes that 'between the 1930s and the 1970s economics became mathematised in the sense that it became the normal practice for economists to develop their arguments and to present their results... using mathematics' (Backhouse, 2002, p. 237). Mark Blaug is even more specific, arguing that the widespread formalisation of economics really took place during the 1950s (Blaug, 2003, p. 145).

This shift towards formalism can be considered significant in-so-far as the project brought David Hilbert's programme of axiomatic mathematics into economics. The centrepiece of this project was Arrow and Debreu's formal demonstration of General Equilibrium (GE), which quickly took pride of place within the discipline (Blaug, 2003, p. 146). The influence of GE theory has since declined, but Lawson is convinced that the prioritisation of mathematical form over economic content has been the lasting legacy of the shift towards axiomatics. Indeed, having neglected the period around the Marginal Revolution, Lawson stresses the shift into formalism as the surest way to defend his overarching methodological perspective.

To explain this rise of axiomatic-deductive methods, Lawson uses a Darwinian evolutionary analysis, wherein changes in the immediate academic environment interacted with wider political changes to provide the conditions for a sustained growth in mathematisation. According to Lawson, the classical reductionist programme which had sought to reduce everything to the model of physics (particularly mechanics) fell into disarray in the wake of moves towards Relativity Theory and Quantum Mechanics. Around the same time, Hilbert sought to move mathematics away from any sense of real-world application / interpretation (Lawson, 2003, p. 271). Many physicists had been openly sceptical about their models being applied in economics and Hilbert's project offered a way for mathematically-inclined economists to pursue their analysis more or less for its own sake. Debreu paradigmatically argued that his sole allegiance was to conceptual rigour, for example, insisting that his axiomatic analysis was entirely separate from any interpretation that could subsequently be given to it (Debreu, 1959, p. 5).

Meanwhile, the external environment also changed as this kind of abstract formalism suddenly became lauded in the context of Cold War McCarthyism (Lawson, 2003, p. 274). The nature of economic output became a particularly sensitive issue after WWII, making a

project based on empty symbols attractive in American universities (Lawson, 2003, p. 274). America also became the centre of the academic universe, meaning that there were important transmission mechanisms working within and without the discipline. Lawson quotes Reinert to the effect that,

'McCarthyism and the Cold War [wanted] a kind of economics that mechanical versions of neo-classical economics and Austrian economics could both provide. The Neoclassical utopia of market clearing harmony and factor price equalisation was an important counterweight to the communist utopia and its omnipotent state that promised to wither away... The pure neoclassical techniques in which economic harmony is solidly built into the basic assumptions... was the kind of theory that was ideologically and politically in demand' (Reinert in Lawson, 2003, p. 275).

In responding to this narrative, the first thing to notice is Lawson's implicit acceptance that prior to the 1950s it was physics, and specifically the mechanical model, that was predominant within economics. The move into axiomatic mathematics relied on moving away from *Newtonian science* suggesting that it is wrong to separate economic methods from economic content as historically the two came into the discipline together. Indeed, Lawson has accepted as much in some of his earlier writing. In 2003, for example, he wrote that 'the nature of the (potential) content is always constrained by the method' (Lawson 2003, p. 276). In addition, he has recently highlighted the links between atomistic deductive methods and the elimination of crucial social scientific categories such as 'power, discrimination, oppression and conflict... [which are] effectively masked... or hidden, or at best trivialised' (Lawson, 2012, p. 17). We wholeheartedly accept the merits of the latter assertions, whilst thereby arguing that there seems to be little merit in upholding Lawson's predominantly methodological thesis as a rival for apologetics.⁵ Instead it is better to see the methods as working alongside the content to construct the defence of free-market capitalism that Reinert so accurately describes.

The second thing to notice is the inherent applicability of Lawson's thesis to the history of capitalist society more generally. Michel De Vroey rightly points out that 'in a class society the ruling class cannot be indifferent to the types of social science developing in the society in which it holds power' (De Vroey, 1975, p. 416). If the American ruling class were anxious to select pro-capitalist economic analysis in the context of the Cold War USA, then presumably all capitalist ruling classes would be similarly motivated in the context of their general struggle with the working classes. In the early phase of capitalist development the newly rising bourgeoisie had an inherent interest in scientifically understanding the laws of their system. Classical Political Economy was the highest expression of this material need, setting out to expound the way that capitalist relations actually function.

By the 1870s, however, Classical Political Economy no longer served the interests of the bourgeoisie. Ricardo's scientific forthrightness meant that he honestly illuminated the distributional conflicts associated with capitalism that were seized upon by the Ricardian Socialists and later by Marx and Engels. This latter development was particularly threatening given the increasing crises besetting the system and the attendant rise in working-class militancy referenced above. In these circumstances, it is not at all surprising that the ruling

⁵ Jamie Morgan has remarked that apologetics and deductive methods should be seen as complimentary problems rather than explanatory rivals. We accept this characterisation so long as the methods themselves are seen as being full of pro-capitalist ideological resonance, even if those wielding them are often unaware of this (personal communication).

classes would prefer neoclassical theory to political economy. Indeed, the great merit of the marginalist paradigm was its ability to package a version of bourgeois ideology as natural scientific progress. Meanwhile, the professionalisation of the discipline provided the perfect institutional context for the Marginal Revolution. The fact that Lawson references pro-capitalist forces for the post-war period makes it regrettable that he hasn't generalised them for the entirety of capitalism.

The third thing to notice is the highly unusual way that mainstream theory reacted to the breakdown of its preferred metaphysics. Once the empirical evidence for Quantum Mechanics and Relativity Theory had been sufficiently corroborated, most physicists abandoned the Newtonian paradigm in favour of new problems and new mathematical techniques (Riemannian geometry for example). This was necessary in a discipline dedicated to exploring reality, and yet it contrasts sharply with the response of the economic mainstream to the breakdown of Newtonianism. There is a deep elective affinity between the Hidden Hand of Newtonian Cosmology and the Hidden Hand of Free Market Capitalism that was unlikely to ever be relinquished. Instead of moving with their physicist counterparts, the high priests of neoclassicism therefore abandoned reality altogether (Martins, 2012, p. 31).

Once the laws of physics had been significantly reconceptualised, neoclassical theory abandoned these laws in favour of formalised manipulation of (supposedly) empty symbols. This suggests that alongside the extra-theoretical pressures that Lawson has identified, the discipline itself worked hard to hold onto its utilitarian credentials. Perhaps a case could be made for mathematicians pursuing axiomatic analysis purely for its own sake. Pure mathematics has often led in fruitful directions, but presumably a subject previously dedicated to upholding the precepts of the natural sciences would be loath to relinquish all claims to empirical adequacy.

Be that as it may, the search for immutable axiomatic foundations had itself been discredited by the time that Arrow and Debreu came to do their seminal work. In their *Principia Mathematica*, Bertrand Russell and Alfred Whitehead came to the conclusion that if mathematics was to become rigorously consistent, then all traces of 'self-reference' would have to be eliminated. Unfortunately for them, Kurt Gödel (1931) subsequently proved that mathematics could always be mapped onto itself, effectively ending all aspirations towards closing axiomatic systems consistently (Winrich, 1984 p. 993). Gödel's work had a lightning rod effect in mathematics, but has been dutifully ignored by the economic mainstream (Winrich, 1984, p. 994). Instead, the discipline continues to cling to its pro-capitalist (atoms in General Equilibrium) metaphysics even if that means hitching its star to a manifestly unsuccessful project in mathematics.

One final point is important. When Lawson speaks about the influence of the US military industrial complex on post-war economics he doesn't go nearly far enough. In the early 1950s, military planners in the US Department of Defence believed that game theory, GET and linear programming could be useful in their struggle with the Soviet Union. To this end, the US army lavished major funding on graduate programmes at the Universities of California, Harvard, Stanford, Yale, Chicago, Columbia and Princeton (Fullbrook, 2007, p. 4). Over time this funding became the catalyst for a battery of technically-trained economists at the highest levels of policy making in the global economy. Of the 800 economists recently employed at the World Bank for example, more than half received their training at one of these seven universities (Fullbrook, 2007, p. 4). Little wonder that Phillip Mirowski has recently highlighted the links between the Neoliberal Thought Collective and orthodox economics (Mirowski, 2012, p. 245). After all, the links between general equilibrium models, neoliberalism and the Washington Consensus have been extremely well documented (see Mirowski, 2013; Hart-Landsberg, 2006; Marangos, 2002).

Over time, a functional division of labour has emerged, as mainstream theorists build their models without regard to empirical validity, whilst their technicist counterparts invoke the scientificity of these models in their concrete programmes. Since the 1970s, economists at the IMF and the World Bank have regularly relied on computable general equilibrium models to foist structural adjustment policies onto 'Third-World' countries (Hart-Landsberg, 2006, p. 4). Similar processes were rolled out in the economies of Eastern Europe two decades later with 'the neoclassical model often adopted as the only solution to the "transition problem" by...the IMF and the World Bank' (Marangos, 2002, p. 260). The development of Rational Expectations models has, meanwhile, been no less political. Over the last 30 years neoliberal ideologues have set about burying all forms of Keynesian interventionism on the basis of perfect foresight by market participants. Milton Friedman famously led the way with his particular mix of right-wing populism and mainstream theory. Friedman's enormous influence on policy makers was premised on his reputation as a technical economist, and yet, his political role in inspiring Thatcherite monetarism and Pinochet's neoliberal coup has been well documented (Palley, 2015, p. 28). Besides Friedman, a host of other Chicago-based members of the Mont Pelerin society made their reputations by linking rational expectations models to neoliberal policy interventions.

From the 1980s, Robert Lucas's New Classical Macroeconomics proved highly influential both in mainstream theory and in government policy circles (Backhouse, 2009, p. 21). Over the same period, Gary Becker has had a similar influence on micro-modelling techniques across the academy (Backhouse, 2009 p. 21). Assessing the extent of their ideological functions, Colin Hay has suggested that 'rationalist assumptions and stylized models proved crucial to the popular articulation of normative neoliberalism' (Hay, 2004, p. 514). Bresser-Pereira fundamentally agrees, arguing that 'in the latter half of the 20th century neoclassical economic science turned the model of general equilibrium into an "idealist-realist" image of the capitalist system, while at the same time the macroeconomic theory of rational expectations demonstrated that no policies were needed to counter economic cycles' (Bresser-Pereira, 2009, p.16).

All of this makes it extremely regrettable that Lawson continues to highlight the purely technical aspects of GE and RE for abstract modelling. Despite their patent un-realism, strict rationality postulates are now firmly embedded in the hard-core of a mainstream project that continues to push free-market orthodoxy in every direction (Backhouse, 2009, p. 22). More than any other discipline, academic economics has been implicated in the drive to neoliberalise the institutions of the global economy, all the while hiding behind abstract aloofness and technical finery.

Conclusion

According to Lawson, neoclassical economics has caught itself in trap of its own making. Essentially, it has imported a great deal of mathematical modelling into its practices out of respect for the role of mathematics in the physical sciences and in search of the validation that the parallel use of these scientific techniques might bring. This, Lawson contends, is one of the chief defining features of neoclassical economics as a school (Lawson, 2013, p. 947). The irony, Lawson observes, is that the use of mathematical techniques suitable to investigating potentially closed physical systems firmly sacrifices the possibility of generating scientific knowledge of open systems like the economy.

It is undoubtedly true that 'scientism' is a powerful force within the neoclassical school. It is equally true that a realist approach to social science debar a primary emphasis on mathematical modelling. Nevertheless, these undeniable elements of the Lawsonian

critique do not exhaust the sources of mainstream economics' lack of scientificity. There is plenty of room left for distortions and obfuscations which are due to ideology rather than the misguided application of mathematics. Lawson contends that the ideological elements in neoclassicism are neither strong nor salient, and that such an argument diverts attention from the more important problems surrounding the school's illegitimate use of mathematics. We have contended on the contrary that the very manner of the deployment of mathematics within the neoclassical school is an instance and evidence of its ideological character.

We develop this argument through examining the relationship between the mainstream in economic thought and the main currents of physical science, most particularly the reception of Newtonian science. Classical Political Economy adopted Newtonian scientific procedures but did not uncritically import Newtonian mathematics. Indeed, the main lines of classical economic thinking relied very little on the application of mathematics. This matters, as it reveals a post-Enlightenment science not in the thrall of Lawson's purported long-standing cultural blindness. The Marginal Revolution of the 1870s came with a new set of analytical techniques as mathematical formalism arrived with a vengeance in economics in the latter part of the 19th century. This formalism accompanied the importation into economics of Newton's cosmology which was facilitated, in an ironic move, by the renunciation of the role of empirical observation in his scientific method.

In the neoclassical universe, isolated individuals are moved in a utilitarian process through the attractive and repulsive effects of pleasure and pain to reach an equilibrium attained by optimising decisions. This vision is obtained, not through observation, but through an introspectively justified set of first principles, from which further conclusions could then be derived. The mathematisation of this procedure in Newtonian fashion conferred the great physicist's prestige on the programme at the same moment as establishment economics covertly abandoned his scientific method. Mathematics arrives in full force in economics in the service of an analysis of utility maximisation by self-interested individuals interacting in unfettered markets – that is, in service of a utopian conception and defence of capitalist society. From the Marginal Revolution onwards, mathematics serves in the economic mainstream as an under-labourer for an ideological conception of the social reality. It is only after this under-labouring had occurred, that mathematical formalism in economics begins to wreak the damage to the analysis of inherently open and processural social systems that Lawson so eloquently describes.

Subsequently, this under-labouring role has served as a winnowing criterion for which forms of mathematics are allowed into the economist's tool kit. Set theory is fine for example, but chaos theory must be resolutely ignored. No mathematical model of the economy can be allowed which cannot be turned to a defence of capitalism and no wholesale revision of textbook economics can be contemplated in the absence of a new formulation which can undertake this essential ideological function, no matter how mathematically sophisticated. Lawson is correct that mathematical modelling is potentially a problem in any form of social analysis. In the case of neoclassical economics, mathematical modelling is this, and also so much more.

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