

The Two Blades of Occam's Razor in Economics: Logical and Heuristic

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Abstract

This paper is part of the general debate about the need to rethink economics as a human discipline using a heuristic to describe its object, about the need to explicitly reject the positivistic approach in neoclassical economics, and about the urgency to adopt a different methodology, grounded on a realistic set of initial assumptions able to cope with the complexity of the decision making process. The aim of this paper is to show the use of Occam's razor in the economic debate around realism in economic modelling. Occam's razor can be intended as a principle of logic that emphasises simplicity, or as a heuristic tool that emphasises parsimony. Neoclassical economists, such as Samuelson, have explicitly used Occam's razor as a logical principle to highlight the strict logic and simplicity of neoclassical economics; neoclassical models, however, are based on unrealistic assumptions. Some approaches of heterodox economics, *au contraire*, have used Occam's razor as a powerful heuristic tool to emphasise parsimony, building up models grounded on realistic initial assumptions and capable of embedding complexity into the general explanation of economic behaviour, as in Simon's bounded rationality (1955; 1957) and Hayek's notion of human rationality (1948; 1952; 1974) and cultural and social evolution (1967; 1978).

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Introduction

Occam's razor was formulated during the Middle Ages by *Doctor Invincibilis*, alias William of Occam (circa 1290-1349). Occam's razor states that of two competing theories, the simpler and more parsimonious is preferred. It derives from a more general application of Occam's philosophical outlook (according to which any knowledge is supposed to be grounded *only* on experience), and on a complete rejection of any traditional aspect of Aristotelian metaphysics (upon which traditional Scholastics had been developed). Simplicity (*entia non sunt multiplicanda praeter necessitate*, which means 'entities are not to be multiplied beyond necessity') and parsimony (*frustra fit per plura quod potest fieri per pauciora*, which means 'in vain is that explained by many things which can be explained by fewer things') are the two blades of Occam's razor.

Although simplicity and parsimony are related, they are not the same: simplicity is related to the capacity of a model to describe a complex phenomenon in a 'sophisticatedly simple way' (Zellner, 2001; 242); parsimony is 'a proper subset of simplicity' and it involves a paucity of factors (Jensen, 2001; 283). Hence, Occam's razor can be defined as follows: 'the widely held principle of science that the simplest (often shortest) explanation that is adequate

in number and type of assumptions (simplicity) and in technique (elegance) to explain the observed facts is the criterion by which to prefer explanations' (Reid, 1987, 551n).

Because Occam's razor advocates simplicity and parsimony, it influenced many philosophers and has been considered the most suitable tool to explain and predict phenomena not only in physics¹ but also in other fields, including economics. Hicks (1938) first introduced Occam's razor into economics, in terms of parsimony, to exclude the measurability of consumer utility (Pfouts, 2002). Samuelson (1947) and Friedman (1953) gave precedence to simplicity in their economic modelling.

In this paper I consider the two blades of Occam's razor – simplicity and parsimony – as the tools adopted respectively by neoclassical economics and by heterodox economics. Simplicity is the capacity to reduce complexity in building up a model, while parsimony is the capacity to reduce the number of factors included in a model. While simplicity emphasises logic, parsimony emphasises heuristic. By complexity is meant a non-equilibrium view of the economy, where actions and strategies constantly evolve (Arthur, 2014). Heuristic is intended as a specific feature of human behaviour under certain circumstances when agents adopt mental shortcuts in order to make decisions faster and more frugally (Gigerenzer and Todd, 1999).²

The use of the first blade of Occam's razor implies a trade-off between simplicity and realism: a simpler model is more logical, but less realistic.³ The lack of realism has two sources: the concept of the agent as *homo oeconomicus*, and the lack of structure – that is those institutions which promote methodological and ontological individualism. Conversely the use of the second blade of Occam's razor increases realism: parsimony reduces the number of factors included in a model by adopting only factors that are real.⁴

Let's consider the nature of rationality, as an application of the two blades of Occam's razor by neoclassical economics and heterodox economics respectively. On one side, neoclassical economics adopts full rationality in the name of simplicity (as in Friedman's *as if* assumption, see section 1). This adoption of full rationality implies an infinite amount of information *as if* it was available to agents and it implies a capacity by agents to handle that information. This process is logical but it is neither parsimonious (because the amount of information is infinite) nor realistic (because no agent is capable of acquiring or processing an infinite amount of information). On the other side, heterodox economics adopts bounded or

¹ Leibnitz and Newton used Occam's razor to drop any metaphysical residual from science. During the last century, Mach's principle of 'the economy of science' unified the methodology of Occam's razor along with the idea of an economy of nature, according to which nature is an organised and frugal system (Mach, 1960[1883]). Mach's formulation reinforced the pure theoretical principle of simplicity with the more operative principle of parsimony, according to the Occam's razor tradition. During the 1920s, the revival of Occam's razor had particularly taken place in European continental philosophy, especially in Schlick's circle (Vienna) as well as in Reichenbach's group (Berlin).

² As Peter Cserne suggested in his comments on this paper, there is an ambiguity in defining heuristic as a methodological rule of thumb, as it is possible to apply the notion of 'rule of thumb' either to economic agents' decisions or to researchers developing theories. According to Cserne, this ambiguity may be partially resolved by describing theory building as a special case of human decision-making.

³ A caveat on realism: as Mäki pointed out, scientific realism is not a uniform doctrine: 'while economists use the term "realism" to refer to a presumed property of theories, philosophers use it to denote a theory of theories'. Hence, Mäki suggested that 'realism', as used by economists, should be replaced by 'realisticness', i.e. 'a property of theoretical representations as adopted by economists and philosophers of economics' (Mäki, 1998a, p. 304). While I agree with Mäki's distinction, I do prefer to use the term 'realism' in this paper, as it is accepted by scholars of both disciplines. I owe this caveat to Fleetwood's comment of this paper.

⁴ Hirschman (1984) gave an alternative interpretation of 'parsimony': he identified parsimony with the abstraction of rational choice theory. According to Hirschman "[the] *parsimonious* postulate: that of the self-interested, isolated individual who chooses freely and rationally between alternative courses of action after computing their prospective costs and benefits" (p. 11) presumes to explain even noneconomic phenomena, such as family and crime. Hirschman was implicitly criticising Becker's notion of human economic behaviour (Becker, 1976).

limited rationality and heuristic in the name of parsimony (as in Simon or Hayek, see section 2). The notion of bounded/limited rationality reduces the quantity of information available and forces economic agents to adopt a heuristic in order to make a decision, as opposed to maximising an expected utility function as logic demands. This process is parsimonious (the amount of information is less than in the previous model) and more realistic (a heuristic, such as rule of thumb, is *de facto* adopted by agents to make a decision).

Let's consider the nature of 'economics as a science' as another example of the application of the two blades of Occam's razor by neoclassical economics and by heterodox economics (see section 1 and 2). On one side, the use of the logical blade (=simplicity), adopted by Samuelson, Friedman and neoclassical economists, reduces economics (the science which describes economic individual and social behaviour) to physics (the science which describes nature). This operation is 'meaningful' (in Samuelson's terms) because it reduces complexity, i.e. it makes it simpler to describe economic phenomena if we consider decision makers as *if* they were atoms following natural laws, like decreasing marginal utility. A trade-off between simplicity and realism emerges again when economic agents, either individual or social, are compared with physical atoms. On the opposite side, the use of the heuristic blade (=parsimony) adopted by heterodox economics, increases realism by avoiding the conflation of economics and physics.

It is as a logical principle that gives precedence to simplicity that Occam's razor has been used in neoclassical economics and econometrics. We can see this in Samuelson's revealed preference theory, Friedman's concept of positive economics and Becker's model of the consumer (Wong, 2006). In econometrics, Keuzenkamp and McAleer (1995) explicitly used Occam's razor to develop simple models; those models, however, are not parsimonious, because parsimony implies an insufficient number of parameters. In using Occam's razor as a pure logical tool, one that gives precedence to the simplicity of a model, neoclassical economics incurs a fault: it neglects the reality that in the human sciences a trade-off exists between simplicity and realism, and this trade-off cannot be confused with the degree of abstraction that characterises the object of any natural science, like physics, because human behaviour cannot be compared with the behaviour of, say, atoms.

It is as a heuristic that puts emphasis on parsimony that Occam's razor has been used by heterodox economists, invoking a rule of thumb. Examples are Simon's bounded rationality and Hayek's approach to complex phenomena. In using Occam's razor as a heuristic tool, heterodox economics leverages an advantage: it permits a more realistic description of individual behaviour (under whatever constraint) because it implies the adoption of a rule of thumb (based on a realistic scenario in which individuals are not fully rational maximisers). The advantages of using Occam's razor as a heuristic rule of thumb is that it allows economists to develop their theories in a way that does justice to, rather than assumes away, the complexity of their subject matter, as in the case of Simon's bounded rationality and Hayek's theory of the social world and complex phenomena.

1. Neoclassical economics' adoption of Occam's razor simplicity blade: the role of logic

Neoclassical economics, which became the mainstream within the discipline in the mid-1950s (Colander, 2000; Dequech, 2007), had intended Occam razor's as a pure logical principle. The success (in the sense of becoming mainstream) of a paradigm (neoclassical economics) has many reasons behind it. It has been often remarked how neoclassical economics had formally reached a cognitive status as well as a scientific respectability due to the general agreement around neoclassical results, focused on general economic equilibrium and rational

choice theory (Weintraub, 2007). Both general economic equilibrium and rational choice theory adopt a set of initial methodological assumptions that are 'occamite', when Occam's razor is intended in a pure logical sense. The assumptions are the simplest possible (an economic agent is able to rank her preferences, which are transitive, complete and technically convex) and suggest a unique way of reasoning (given a budget constraint, a utility function is expected to be maximised in order to achieve the optimum).

Occam's razor logical blade is fashionable in neoclassical economics because it becomes the essential route towards elucidating a simpler description of individual and social dynamics in order to explain economic phenomena, albeit simpler does not always mean clearer. Furthermore, Occam's razor logical blade matches the urgency to express models⁵ as well as initial assumptions in mathematical terms. The advantage of using a formal language is twofold: it avoids any possible linguistic misunderstanding,⁶ and it makes explanations as simple as they can be.

The immediate example of the application of such a scheme within the natural sciences is physics. In fact, neoclassical economists have modelled the discipline on physics in order to become a *positive* science. The process of modelling economics as physics started with the rise of marginalism (at the end of the 19th century) and continued until the final systematisation of general economic equilibrium (in the 1930s through the 1950s), ultimately becoming the dominant style of neoclassical economics within the mainstream (Weintraub, 1985; Mirowski, 1989; 2002; Lawson, 2013). According to Mirowski (1989), it was Fisher who first tried to apply physics to economics, without understanding the differences between their domains, and, according to Boumans (1993), it was Tinbergen who introduced the concept of 'formal analogies' between physics and economics without drawing any substantial analogy between their domains.⁷

Why do physicists and neoclassical economists consider simplicity (the logic blade of Occam's razor) the best way to develop a theory? The answer seems immediately apparent: because in a simpler framework, mistakes are reduced. Although both physicists and neoclassical economists are aware that making Occam's razor operational in a non-arbitrary way can be difficult, they accept Occam's razor as a logical principle because it makes it easier to match theoretical knowledge with actual behaviour (as in Mach's economic principle of the economy of science).⁸

The analogy between physics and neoclassical economics is fundamental in the history of the discipline: in Samuelson's *Foundations*, this analogy has been modelled on the assumption that both physical and economic phenomena can be described and explained in the same terms. Both are in fact based on the existence of *operationally meaningful* theorems as well as on 'the existence of a general theory which underlies the particular theories and unifies them with respect to those central features' (Samuelson, 1947, 3). By a *meaningful theorem*, Samuelson means 'simply a hypothesis about empirical data which could conceivably be refuted, if only under ideal conditions' (Samuelson, 1947, 4), and by 'operational' he means a theorem that can be empirically tested. According to Samuelson, 'meaningful theorems exist in economics and they proceed from two hypotheses: any

⁵ Given the ambiguity of the term 'model', I will be following Mäki's definition of models as representations of some target or as surrogate systems (Mäki, 2009a).

⁶ However it may create its own misunderstanding, of a non-linguistic variety.

⁷ Even though the introduction of models in economics has reduced the naturalism of the discipline (Sugden, 2000; Morgan, 2012; Mäki, 2013), philosophers such as Cartwright (1999) defined economics' attitude to consider itself as a natural science, by following an 'imperialistic tendency', bound to fall into the trap of methodological fundamentalism.

⁸ The use of Occam's razor purely as a logical tool causes many other problems: for instance, what is the best way to measure simplicity, or how simplicity and empirical models are reciprocally related (Zellner et al., 2001).

equilibrium is a result of a process of maximisation (minimisation), and the stability of equilibrium' (Samuelson, 1947, p. 5).⁹

Along with Samuelson's modelling economics as a physical science, there is Friedman's modelling economics as a positive science. Friedman defined positive economics as 'an objective science, in the same sense as any of the physical sciences' (Friedman, 1953, p. 4);¹⁰ and behind Samuelson's and Friedman's neoclassical economics there is the emergence of rational choice theory, i.e., the transformation of individuals into economic agents whose behaviour can be reduced to uniformity, just as can the behaviour of physical atoms.

This process is made possible by the introduction of an axiomatic system to describe human preferences and of a mathematical language to describe human utility in order to explain individual decision making (including any decision making under uncertainty) as cohesive. In fact, from a methodological point of view, Samuelson approaches Friedman in considering the instrumental role of theory in maximising behaviour in building up economic models of equilibrium. Samuelson wrote:

'In cases where the equilibrium values of our variable can be regarded as the solutions of an *extremum* (maximum or minimum) problem, it is often possible regardless of the number of variables involved to determine unambiguously the qualitative behaviour of our solution values in respect to changes of parameters (...). It is possible to derive operationally meaningful restrictive hypotheses in consumers' behaviour so as to maximise an ordinal preference scale of quantities of consumption goods and services' (Samuelson 1947, pp. 21-22).

The microeconomic process of maximising expected utility functions combines individual dynamics with the static stability of the final equilibrium in the economic system, as happens in physics. This interpretation describes the logic mechanism of the economic system as if it determined the logic of the economic maximising agent (Davis, 2003).

By adopting Occam's razor as a purely logical tool that gives precedence to simplicity, neoclassical economists are able to model economics as a physical and positive science. In order to make this theoretical operation possible, some fundamentals (listed below) have been accepted by neoclassical economists, and they form the pillars of neoclassical economics:

⁹ In his epistemic position, Samuelson was influenced by Bridgman's operationalism in physics and by early logical positivism: 'his view of scientific theories [was] *descriptivist*: scientific theories merely describe the empirical evidence and do not go beyond the evidence to *explain* any deeper, underlying, or hidden causes of the phenomena' (Hands, 2001, p. 63).

¹⁰ Friedman's positive economics stands in contrast to normative economics as it implies the independence of economics from any particular ethical position or normative judgment (Friedman, 1953, p. 4). As this process developed, ethics was discarded from economics, as it diverged further from the other social science (Sen, 1987; Putnam, 2002). For a recent debate on the relationship between ethics and economics, see De Martino and McCloskey et al. (2016). Nevertheless, many scholars consider fictitious the distinction between positive and normative economics: 'a modernist chimera founded on the rigid dogmas of positivism, the total structure of neoclassical economics is normative in nature on account of the special role it ascribes to the postulate of rationality and the fact that the theorist must necessarily invoke non-cognitive mental notions which he or she must interpret in subjectivist and evaluative terms' (Keita, 1997, p. 82).

- a. An axiomatic set of prerequisites (the proprieties of individual preferences) described by a mathematical language;¹¹
- b. A specific role for causality (economic relations usually depend on personal expectations);¹²
- c. Formal models that are considered able to describe the real world (general economic equilibrium model took a Bourbakian approach);¹³
- d. The use of microeconomics to explain aggregate phenomena intended as a method of making aggregations by assuming that the actions of individuals are the outcomes of optimising decision-making processes, and that equilibrium is the final outcome.¹⁴

These fundamentals, however, show that neoclassical economics rests on **hypotheses** and **assumptions** that are not just simple (in terms of Occam's razor) but oversimplified and inconsistent with reality.¹⁵ Furthermore, their simplicity becomes apparent and is misleading (this would be an example where Occam's razor retards rather than enhances economic knowledge (Reid, 1987)). In fact, economic agents, as well as social aggregates, do not follow linear paths of behaviour: hence, the completeness, symmetry, reflexivity and transitivity axioms of preferences can be violated, as has been demonstrated in different ways (Allais, 1953; Kahneman and Tversky, 1981). Furthermore, the transition from a description of individual economic behaviour to a description of complex social groups is fallacious, because it is based on the idea that complex systems are simply the sum of their single components (individuals), which is not valid (Albin and Foley, 1998; Israel, 2005). In describing social behaviour, the theory of expectations can be a guideline for economists (Lucas and Sargent, 1981), but it does not guarantee a correct and robust economic forecast (Davidson, 1982). Moreover, the lack of realism in neoclassical economics is one of its main faults that reduce the complexity of *explananda* and the possibility of moving closer to a proper explanation (Hodgson, 2004);

The *lack of realism* (or *realisticness* as a property of models¹⁶) in neoclassical economics' initial assumptions and the way they are adopted to *reduce complexity* in describing decision making processes are two interconnected aspects of neoclassical economics and thus have to be analysed as related, in order to understand how they make neoclassical economics problematic in terms of a proper description of economic behaviour.

To be concerned about the realism of a theory implies a concern about the degree to which models represent and resemble the chunks of the real world they seek to engage with, as well as between theoretical assumptions and empirical models (based entirely on data). The collection of data is the very first methodological issue in constructing any empirical model: relevant data serve to test or calibrate models (Knuutila, 2009; Morgan, 2001). These

¹¹ Rational choice theory is grounded on the axioms of consumer preference that has been modelled with the aim of allowing a mathematical interpretation of utility functions, of portraying rational behaviour as optimal, and of deriving proper demand curves.

¹² Rational choice theory models individual expectations, which may be adaptive and rational, in a way that implies a direct and simple behaviour: the economising behaviour of maximisation.

¹³ Although at a certain point, neoclassical economists rejected the use of physics to explain formal models, like general economic equilibrium, in favour of pure bourbakian mathematics (Giocoli, 2003), as in the case of Debreu (Weintraub, 2002).

¹⁴ Macroeconomics is reduced to microeconomic analysis: macroeconomic phenomena can be explained by deriving them from microeconomics parameters, such as individual preferences and expectations. For a critical view on this methodological reductionism see Hoover (2001; 2010) and King (2012).

¹⁵ For some scholars, this is enough to consider it as a form of powerful rhetorical discourse (Nelson 2001; Mitchell, 2016), and for some scholars of other disciplines as a pseudo-science (Patterson and Fosse, 2015).

¹⁶ See footnote 3.

models are able to make hypotheses testable, problem solving and prediction being the two main aims of science. Scientists and scholars of social disciplines are 'empirical modellers... making logical inferences based on data, to understand what is going on and what will happen' (Thompson, 2011, p. 1). The lack of realism, which remains the main fault of neoclassical economics from a methodological point of view,¹⁷ became explicit in Friedman's 1953 definition of positive economics, where the concordance between a theory's predictions and observed phenomena is the only thing that matters.¹⁸ In fact, Friedman said, a discourse on 'unrealism' is pointless, and theory can only yield predictions that are good approximations; furthermore, assumptions cannot test an economic theory, because they are ambiguous, and a criticism based on the discrepancy between assumptions and the real world is rooted in 'the confusion between descriptive accuracy and analytical relevance' (Friedman, 1953, p. 33). Friedman's conclusion is his well-known *as-if* principle:

'it is frequently convenient to present such a hypothesis by stating that the phenomena it is desired to predict behave in the world of observation *as if* they occurred in a hypothetical and highly simplified world containing only the forces that the hypothesis asserts to be important' (Friedman, 1953, p. 40).¹⁹

Although recently Friedman's anti-realism has been reconsidered (Hoover, 2009; Mäki, 2009),²⁰ his methodology has been overtly criticised since its publication (Hausman, 1992b, Gul and Pesendorfer, 2008; Gilboa, 2009; Mäki, 2011). Ernst Nagel's critique of Friedman's methodology is based on the fact that Friedman failed to distinguish between three kinds of 'unrealism': the lack of an 'exhaustive' description; the possible accordance between an unrealistic assumption and a correct theory; and the instrumental use of unrealistic assumptions when they reveal discrepancies between pure theory and described phenomena (Nagel, 1963).²¹

The critique of Friedman's methodology – the so-called Friedman's *as-if*, or Friedman's twist, as Samuelson stigmatised it – 'has paved the way for an internal debate in economics around the falsifiability of a theory, and the possibility to develop a theory of empirical contest as well as to provide testable axioms for describing individual behaviour' (Chambers, Enchenique and Shmaya, 2014). In Samuelson's words, 'F-twist is fundamentally wrong, in thinking that unrealism in the sense of factual inaccuracy even to a tolerable degree

¹⁷ Robert Lucas, for example, claimed that the insistence of realism damages the scientific aspects of economics (Lucas, 1981).

¹⁸ Friedman's essays, and particular Chapter I on methodology, have been called 'the most cited, the most influential, the most controversial piece[s] of methodological writing in twentieth century economics' (Mäki, 2009c, p. xvii), and 'a marketing masterpiece' (Caldwell, 1982, p. 173).

¹⁹ Blaug's well-known battle for a realistic methodology of economics (1992), based on a falsificationist critique of both mainstream and heterodox economics, led him to a normative approach mainly as a result of 'meta-theoretical claims about economics often descriptively unrealistic' (Mäki, 2013a, p. 89). It was Hutchison (1938) who introduced Popper's falsification principle (Popper, 1959[1935]) into economics, as an attack on Mises' apriorism (Hands, 2001). For an extensive consideration of the problem of demarcation in economics, see Latsis at al. (1976) and Mäki (2008). For a historical reconstruction of the legacy of Friedman's principle within economics, see Mäki (2009b), and Mayer (2009).

²⁰ For a more complex and recent analysis of Friedman's *as-if* principle, see Mäki at al. (2009).

²¹ A discourse about the realism of initial assumptions in economics, and more generally within the social sciences, should take account of the distinction between abstraction (the process of focusing on a particular aspect of a phenomenon to build up a model able to explain it) and idealisation (the tendency to isolate an economic phenomenon as if it worked without any external interference). They are independent methods of reasoning. In the process of idealisation, a distinction between internal validity (the correct use of data) and external validity (the actual degree of generalisability) should be made in order to test a model (Rol, 2008). According to Runde (1997), neoclassical economics adopts idealisations to facilitate the application of a deductive method.

of approximation is anything but a demerit for a theory or hypothesis (or set of hypotheses)' (Samuelson, 1966, p. 1774). Samuelson's position against Friedman's methodological approach has been criticised by Machlup, who, referring to Samuelson's '*operationally meaningful* theorems' (mentioned before), claimed that the best results of Samuelson, as a theorist, are deduced from unrealistic assumptions: 'Samuelson produces his best work when he deduces from unrealistic assumptions general theoretical propositions' (Machlup, 1964, p. 735).

Unlike Friedman, Samuelson claimed that the realism of assumptions matters and introduced the so-called Samuelson's razor valid for both physics and economics (Samuelson, 1966). In Samuelson's reply to Machlup, he reminded the latter that his doctrine of revealed preference is grounded in realism, and he explicitly mentioned Occam's razor as a 'primarily aesthetic' tool to criticise unrealistic assumptions in science; Samuelson used Occam's razor's logical blade to justify his position: 'Occam's razor has cut away every zipper, collar, shirt, and fig leaf' (Samuelson, 1964, p. 738).

A possible explanation for Samuelson's use of Occam's razor purely as a logical tool can be found in the fact that, as Hands clarifies, he (along with Friedman and Hutchison) was influenced by positivist ideas:

'[Friedman's] purposes of positive (as opposed to normative) economics, *the truth of the assumptions of a theory do not matter at all*, [because] the only thing that matters in deciding among various economic theories is which one is most successful in making empirical *predictions*. The Theory that makes the most accurate predictions in the relevant domain is the best theory, and if it employs "unrealistic" assumptions this should not in any way detract from its success as a positive scientific theory. (...) [In] Samuelson's methodological position, scientific theories *merely describe* the empirical evidence and do not go beyond the evidence to *explain* any deeper, underlying, or hidden causes of the phenomena. On this view, science can indeed provide explanations, but such explanations are independent of the cognitive content of the scientific theories involved (...) such descriptivism was representative of early (but not later) logical positivism' (Hands 2001, pp. 54-63).

They were still embedded in the cultural framework of economic positivism, i.e., the application of positivist methodology to economics (Wilber and Wisman, 1975), and the promotion of neoclassical economics as the only scientific approach to explain individual and social behaviour in economic model building (Boland, 2003). Although 'economic positivism' has different nuances, and can be very confusing, the idea of 'positive economics is mostly a matter of rhetoric' (Boland, 1997, p. 117), and Occam's razor's power of rhetoric is highly enlightening.

Let us now turn to the other aspect of economics with which the lack of realism is connected: the reduction of complexity. In neoclassical economics, the reduction of complexity started with the introduction of *homo oeconomicus*, a rational maximiser of a utility function, and it continued with the application of individualism to describe social institutions. This process led to rational choice theory, focused on the methodological assumption that individuals are rational economic agents able to rank their preferences and, given a budget constraint, choose the optimal solution. The story of rational choice theory began with Pareto's concept of revealed preferences, later developed by Samuelson's revealed preference axioms (Mas-Colell, 1978), and it finally ended up with Becker's economic

approach to human behaviour as the combination of 'maximising behaviour, market equilibrium and stable preferences' (Becker, 1976, p. 7). Rational choice theory was dominant in the discipline from the 1950s, with Friedman-Samuelson's systematisation, up to the 1990s, when some alternative theories were advanced without successfully replacing it (Moscati, 2016).

Rational choice theory uses an 'oversimplified pattern of human behaviour [that] ignores the irreducibility of wants (...) the background for unpredictable results is reduced to probability' (Georgescu-Roegen, 1954, p. 531). Rosenberg has defined the neoclassical reduction of complexity in describing economic behaviour as a 'formalised folk psychology' based on subjectivism and preferences, which fails to define the real causes of individual behaviour (Rosenberg, 1992). Under strict rationality, the complex problems associated with the acquisition of human knowledge are reduced and oversimplified in the automatism of human behaviour (reduced to maximisation of an expected utility function).

Summing up, neoclassical economics, grounded on 'operationally meaningful hypotheses' (*à la* Samuelson), on the notion of positive economics (*à la* Friedman), and on economic agents depicted as fully rational Bayesian maximisers of subjective utility, does not explain the *complexity* of human actions in a *realistic* way. In Buchanan's words:

'The *subjective* elements of our discipline are defined precisely within the boundaries between the positive, predictive science of the orthodox model (...) The recognition of the domain of an operationally meaningful economic theory does not carry with it any implication concerning the practical usefulness of this theory in making predictions in the real world' (Buchanan 1982, pp. 8-16).

2. Heterodox economics' adoption of Occam's razor parsimony blade: the role of heuristic

The common intent of many so-called heterodox approaches to economics is to work towards a major revision of neoclassical methodological assumptions and to open up alternative theoretical perspectives able to consider, in a more realistic way, the interconnection between individual dynamics and social phenomena. Recently, some heterodox economists used heuristics in a serious attempt to separate themselves from the neoclassical model of economic rationality: unlike neoclassical economics, they adopt Occam's razor as a heuristic rule of thumb and accuse neoclassical economists of applying a mathematical-deductive method to a series of inappropriate (unrealistic) conditions, such as using individual preference axioms in a static context. In such a context, heterodox approaches consider the lack of realism in neoclassical economics as the most severe limitation within the discipline, and they introduce alternative models, such as rhetoric, persuasion, metaphors, and heuristics (McCloskey, 1983; Lawson, 1997; Mäki, 1998b; 2012; Hausman, 1998; Gigerenzer, 2008; Gigerenzer and Todd, 1999; Keen, 2001; Lewis et al., 2004; Lavoie, 2014).

In the previous section we have just considered some faults of neoclassical economics with regard to Occam's razor logical blade. But what about the advantages of using Occam's razor heuristic blade in economics? Advantages are mainly focused on the possibility of building up a coherent and realistic theory of human behaviour and economic dynamics in social terms. As Simon recalled:

'Occam's razor has a double edge. Succinctness of statement is not the only measure of a theory's simplicity. Occam understood his rule as

recommending theories that make no more assumptions than necessary to account for the phenomena. A theory of profit or utility maximisation can be stated more briefly than a satisficing theory, but the former makes much stronger assumptions than the latter about the human cognitive system. Hence in the case before us, the two edges of the razor cut in opposite ways' (Simon 1992, pp. 345-346).

To describe economic behaviour in the most realistic and coherent way, Occam's razor has to be adopted as a heuristic rule of thumb (Lauth, 1997; Burgess, 1998), which gives precedence to parsimony rather than to simplicity. This will allow economists to better explain the complexity of the object of economics (individual and social dynamics within a specific context) and to reach a more realistic *explanation* (the causal inference and the connected relations between means and ends in individual and social dynamics) of its own *explanandum* (the object of economics). In fact, the object of economics is complex, and individual decision making, as well as social dynamics, do not, I argue, necessarily follow the strict regularities imposed by neoclassical economics, as social dynamics are not simply the sum of individual dynamics as implicitly asserted by neoclassical economics.

Against neoclassical economics, which reduces the complexity of its *explanandum* (economic behaviour) and loses realism as a result, Hayek retains the complexity of the *explanandum* and stresses the importance of reducing any lack of realism. The following passage, quoted from Hayek, illustrates this point:

'[Model building] brings out an important feature which all explanations possess but to very different degrees. (...) To the physicist the value of a model (especially of a mathematical model represented by a set of equations) normally consists in the fact that he can ascertain and insert the relevant variables and thus derive the quantitative values of the events to be predicted or explained. Yet in [social sciences] similar models are regularly used although the values of the variables cannot in fact be ascertained. (...) The service of a theory [within the realm of social sciences] would perhaps be better described by the term *orientation* than by speaking of prediction. Although such a theory does not tell us precisely what to expect, it will still make the world around us a more familiar world in which we can move with greater confidence' (Hayek, 1967, p. 18).

Occam's razor, intended as a heuristic tool, has at least two advantages: it makes it possible to produce realistic models describing human behaviour and social phenomena,²² and it provides an easy procedure for problem solving, based on practical experience, one that does not guarantee an optimal solution, but one that can nevertheless provide a satisfactory one in an uncertain context.²³ An important turning point in establishing the advantages of Occam's razor as a heuristic device capable of providing a realistic description of economic behaviour as well as economic phenomena was Simon's model of bounded rationality, based on the

²² As in Lawson's distinction between agency and structure intended as two dimensions of social reality that condition one other (Lawson, 2013).

²³ As Karl Menger, the mathematician son of Carl the economist, had claimed about the use of Occam's razor in social science modelling: '*It is vain to try to do with less what requires more.* This more general formulation of the counterpart of Occam's law, besides denouncing ontological gaps, may also be construed as a semantic maxim opposing equivocations. (...) Under certain circumstances, the methodological tool that is needed is not a razor but a prism resolving conceptual medleys into the spectra of their meanings or, if one wishes to remain in the tonsorial domain of the razor, a comb disentangling and straightening out the various threads of thought' (Menger, 1961, p. 332).

satisficing principle rather than maximising behaviour (Simon 1955; p. 1957). According to Simon, 'human beings have reasons for what they do, but they seldom maximise utility, (...) given the complexities and uncertainties of the choice situations they face' (Simon, 2001, p. 57). Although Simon did not explicitly consider the choice of parsimony over simplicity as a superior criterion, neither did he talk about realism,²⁴ I consider his critique of neoclassical economics' modelling of economic behaviour as an implicit application of the heuristic blade of Occam's razor, focused on parsimony. If we intend satisficing as a humanly rational strategy, it appears simpler and more frugal than maximising because in this scenario, individuals are following a rule of thumb in a dynamic context; while in the neoclassical scenario, individuals are optimisers in a static and non-realistic context of perfect knowledge and complete information. To seek optima is not a reasonable strategy, because finding optima requires unrealistic assumptions in formal modelling.²⁵

In this context, Gigerenzer's notion of a 'fast and frugal' heuristic is one of the best examples of an 'occamite' approach, based on parsimony, in explaining the decision making process (Gigerenzer and Selten, 2001): a fast heuristic requires only a short time to solve a problem, and a frugal heuristic solves a problem with the information actually available (Gigerenzer, 2008). In terms of Occam's razor, neoclassical economics, based on rational assumptions, makes the building of economics as a science more complicated, rather than simpler, and more inaccurate rather than more correct. In Hayek's words: 'this is a consequence of the fundamental difficulty of any complete explanation of highly complex phenomena and not merely of an insufficient development of economic theory' (Hayek 1967, p. 259).

Conclusions

In one regard, Occam's razor is the more sophisticated and elegant version of what is usually considered common sense (Fenk, 2010). At an initial glance, Occam advocates simplicity and parsimony in order to reduce the risk of mistakes. The presumption that an increase in the number of hypotheses will increase the chances of formulating a wrong theory may be valid in physics, but it is misleading in the social sciences. When applied to the social sciences, economics in particular, Occam's razor logical blade gives us a model that lacks realism, whereas Occam's razor parsimony blade supplies a powerful heuristic: it does not reduce the complexity of an *explanandum*, but rather, it is able to cope with it in better terms, that of parsimony. The main fault of neoclassical economics is with its initial assumptions, which are oversimplified and unrealistic, both in terms of individual behaviour and in terms of social institutions. Neoclassical economists try to reduce the complexity of individual and social dynamics rather than to describe them in realistic terms. Rational choice theory, based on the general validity of the expected utility function, and general economic equilibrium, are representations of individuals and society somehow disconnected from the real world. In Simon's terms, the epistemology of neoclassical economics is inconsistent with our knowledge of actual human choice behaviour; in Hayek's terms, it is an abuse of reason.

There are many alternatives to neoclassical economics. Regardless of the differences among heterodox economic approaches, their main concern is to build up an economic discipline capable of defining economic agents and institutions in a way that makes adherence to reality more effective, and that is able to include complexity. Occam's razor

²⁴ I owe this observation to Cserne's comment on Simon in his referee report.

²⁵ About Simon's concept of bounded rationality, it is important to underline that it reduces the amount of information available to neoclassical *homo oeconomicus*, but does not radically deny the model of perfect knowledge. Nevertheless, Simon's bounded rationality broke the wall of neoclassical economics and many heterodox approaches to economics went through it.

parsimony blade allows complexity by adopting heuristic to describe human dynamics. This process opens up a more pluralistic view within economics.

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References

- Albin P. and Foley D. (1998) *Barriers and Bounds to Rationality: Essays in Economic Complexity in Interactive Systems*. Princeton: Princeton University Press.
- Allais M. (1953) 'Le Comportement de l'Homme Rationnel devant le Risque: Critique des Postulats et Axiomes de l'École Américaine.' *Econometrica*, Vol. 21:4, pp. 503-546.
- Arrow K.J., E. Colombatto, M. Perlman, and C. Schmidt (Eds.) (1996) *The Rational Foundations of Economic Behaviour*. London: Macmillan.
- Becker G. (1976) *The Economic Approach to Human Behavior*. Chicago: Chicago University Press.
- Blaug M. (1992) *The Methodology of Economics, or How Economists Explain*, Cambridge: Cambridge University Press.
- Boland L. (1997) *Critical Economic Methodology. A Personal Odyssey*. London and New York: Routledge.
- Boland L. (2003) *The Foundations of Economic Method: a Popperian Perspective*. London: Routledge.
- Boumans M. (1993) 'Paul Ehrenfest and Jan Tinberger: a Case of Limited Physics Transfer.' In De Marchi N. (Ed.) *Non-Natural Social Science: Reflecting on the Enterprise of More Heat Than Light*. Durham, NC: Duke University Press, pp. 131-156.
- Buchanan J. (1982) 'The Domain of Subjective economics: Between Predictive Science and Moral Philosophy.' In Kirzner I. (Ed.) *Method, Process, and Austrian Economics*. Toronto: Lexington Books, pp. 7-19.
- Brian Arthur W. (2014) *Complexity and the Economy*. Oxford: Oxford University Press.
- Burgess J. (1998) 'Occam's Razor and Scientific Method.' In Schirn M. (Ed.) *The Philosophy of Mathematics Today*. Oxford: Clarendon Press, pp. 195-214.
- Caldwell B. (1982) *Beyond Positivism: Economic Methodology in the Twentieth Century*. London: George Allen & Unwin.
- Cartwright N. (1999) *The Dappled World*, Cambridge: Cambridge University Press.
- Chambers C., Enchenique F, and Shmaya S. (2014) 'The Axiomatic Structure of Empirical Contest.' *American Economic Review*, Vol. 104:8, pp. 2303 -19.
- Colander D. (2000) 'The Death of Neoclassical Economics.' *Journal of the History of Economic Thought*, Vol.22:2, pp. 127-143.
- Davidson P. (1982) 'Rational Expectations: A Fallacious Foundation for studying Crucial Decision Making Processes.' *Journal of Post-Keynesian Economics*, Vol. 5:2, pp. 182-198.
- Davis J. (2003) *The Theory of the Individual in Economics: Identity and Value*. New York: Routledge.

- De Martino G. and McCloskey D. (Eds.) (2016) *The Oxford Handbook of Professional Economic Ethics*. New York: Oxford University Press.
- Fenk A. (2010) 'Hume's Problem, Occam's Razor, and Wittgenstein's Standpoint of Common Sense.' In Nemeth E., Heinrich R., and Pichler W. (Eds.) *Image and Imagining in Philosophy, Science, and the Arts*. Kirkberg am Wechsel: Österreichische Ludwig Wittgenstein Gesellschaft, pp. 84-86.
- Friedman M. (1953) *Essays in Positive Economics*. Chicago: Chicago University Press.
- Gigerenzer G. and Todd P. (1999) *Simple Heuristics That Make Us Smart*. Oxford: Oxford University Press.
- Gigerenzer G. and Selten R. (Eds.) (2001) *Bounded Rationality. The Adaptive Toolbox*. Cambridge, MA: MIT Press.
- Gigerenzer G. (2008) *Rationality for Mortals. How People Cope With Uncertainty*. New York: Oxford University Press.
- Gilboa I. (2009) *Theory Decision under Uncertainty*. Cambridge: Cambridge University Press.
- Giocoli N. (2003) *Modeling Rational Agents: From Interwar Economics to Early Modern Game Theory*. Cheltenham: Edward Elgar.
- Gul F. and Pesendorf W. (2008) 'The Case for Mindless Economics.' In Caplin A. and Schotter A. (Eds.) *The Foundations of Positive and Normative Economics: a Handbook*. New York: Oxford University Press, pp. 3-42.
- Hammond P. (1997) 'Rationality in Economics.'. *Rivista Internazionale di Scienze Sociali*, Vol. 105:3, pp. 247-288.
- Hands D. W. (2001) *Reflection without Rules. Economic Methodology and Contemporary Science Theory*. Cambridge: Cambridge University Press.
- Hausman D. (1992a) *Essays on Philosophy and Economic Methodology*. Cambridge: Cambridge University Press.
- Hausman D. (1992) *The Inexact and Separate Science of Economics*. Cambridge: Cambridge University Press.
- Hausman D. (1998) 'Problems with Realism in Economics.' *Economics and Philosophy*, Vol. 14:2, pp. 185-213.
- Hayek F. (1948) *Individualism and Economic Order*. London: Routledge.
- Hayek F. (1952) *The Sensory Order*. Chicago: University of Chicago Press.
- Hayek F. (1967) *Studies in Philosophy, Politics and Economics. Philosophy*. Chicago: University of Chicago Press.
- Hayek F. (1978) *New Studies in Philosophy, Politics and Economics*. London: Routledge and Kegan Paul.
- Hayek F. (1979[1952]) *The Counter-Revolution of Science*. Indianapolis: Liberty Fund Press.
- Hayek F. (2008[1974]) 'The Pretense of Knowledge.' In Hayek F. *A Free-Market Monetary System and The Pretense of Knowledge*. Auburn, AL: Ludwig von Mises Institute, pp. 29-56.
- Hicks J. R. (1938) *Value and Capital*. Oxford: Oxford University Press.
- Hirschman A. (1984) 'Against Parsimony: Three Easy Ways of Complicating Some Categories of Economic Discourse.' *Bulletin of the American Academy of Arts and Sciences*, Vol.37: 8, pp. 11-28.
- Hodgson G. (2004) 'Some Claims Made for Critical Realism in Economics: Two Case Studies.' *Journal of Economic Methodology*, Vol.11:1, pp. 53-73.

- Hoover K. (2001) *Causality in Macroeconomics*. Cambridge: Cambridge University Press.
- Hoover K. (2009) 'Milton Friedman's Stance the Methodology of Causal Realism.' In Mäki U. (Ed.) *The Methodology of Positive Economics: Reflections on the Milton Friedman Legacy*. Cambridge MA: Cambridge University Press, pp. 303-320.
- Hoover K. (2010) 'Idealizing Reduction: The Microfoundations of Macroeconomics.' *Erkenntnis*, Vol. 73:3, pp. 329-347.
- Hutchison T. (1938) *The Significance and Basic Postulates of economic Theory*. London: MacMillan.
- Israel G. (2005) 'The Science of Complexity: Epistemological Problems and Perspectives.' *Science in Context*, Vol. 18:3, pp. 479–509.
- Kahneman D. and Tversky A. (1981) 'The Framing of Decisions and the Psychology of Choice.' *Science*, Vol. 221:4481, pp. 453-458.
- Jensen U. (2001) 'The Simplicity of an Earnings Frontier.' In Zellner A., Keuzenkamp H., McAleer M. (Eds.) *Simplicity, Inference and Modelling: Keeping it Sophisticatedly Simple*. Cambridge: Cambridge University Press, pp. 277-291.
- Keen S. (2001) *Debunking Economics: The Naked Emperor of the Social Sciences*. New York: St Martin's Press.
- Keita L. (1997) 'Neoclassical Economics and the Last Dogma of Positivism: Is the Normative-Positive Distinction Justified?' *Metaphilosophy*, Vol. 28:1-2, pp. 81-101.
- Keuzenkamp H. and McAleer M. (1995) 'Simplicity, Scientific Interference and Econometric Modelling.' *Economic Journal*, Vol. 105:428, pp. 1-21.
- King J. (2012) *The Microfoundation Delusion: Metaphor and Dogma in the History of Macroeconomics*. Cheltenham: Edward Elgar.
- Knuutila T. (2009) 'Representation, Idealization and Fiction in Economics: From the Assumptions Issue to the Epistemology of Modelling.' In: M. Suárez (Ed.): *Fictions in Science. Philosophical Essays on Modeling and Idealization*. London: Routledge, pp. 205–233.
- Latsis S. (Ed.) (1976) *Method and Appraisal in Economics*. Cambridge: Cambridge University Press.
- Lauth B. (1997) 'New Blades for Occam's Razor.' *Erkenntnis*, Vol. 46:2, pp. 241-267.
- Lavoie M. (2014) *Post Keynesian Economics: New Foundations*. Cheltenham: Edward Elgar Publishing Limited.
- Lawson T. (1997) *Economics and Reality*. London: Routledge.
- Lawson T. (2013) 'What Is This "School" Called Neoclassical Economics?' *Cambridge Journal of Economics*, Vol. 37:5, p. 947-983.
- Lewis P. (Ed.) (2004) *Transforming Economics: Perspectives on the Critical Realist Project*. New York: Routledge.
- Lucas R. (1981) *Studies in Business-Cycle Theory*. Cambridge, MA: MIT Press.
- Lucas R. and Sargent T. (Eds.) (1981) *Rational Expectations and Econometric Practice*. Minneapolis: University of Minnesota Press.
- Mach E. (1960[1883]) *The Science of Mechanics: A critical and Historical Account of its Development*. La Salle: Open Court.
- Machlup F. (1964) 'Professor Samuelson on Theory and Realism.' *American Economic Review*, Vol. 54:5, pp. 733- 735.
- Mäki U. (1998a) 'Aspects of Realism about Economics.'" *Theoria: An International Journal for Theory, History and Foundations of Science*. Vol. 13: 2, pp. 301-319.

- Mäki U. (1998b) 'Realism.' In Davis J, and Mäki U. (Eds.) *The Handbook of Economic Methodology*. Cheltenham: Edward Elgar, pp. 404-409.
- Mäki U. (2008) 'Method and Appraisal in Economics, 1976–2006.' *Journal of Economic Methodology*, Vol. 15:4, pp. 409-423.
- Mäki U. (Ed.) (2009) *The Methodology of Positive Economics: Reflections on the Milton Friedman Legacy*. Cambridge MA: Cambridge University Press.
- Mäki U. (2009a) 'Realistic realism about unrealistic models.' In H. Kincaid and D. Ross (Eds.) *The Oxford Handbook of Philosophy of Economics*. New York: Oxford University Press, pp. 68-98.
- Mäki U. (2009b) 'Reading the Methodological Essay in Twentieth-Century Economics: Map of Multiple perspectives." In Mäki U. (Ed.) *The Methodology of Positive Economics: Reflections on the Milton Friedman Legacy*. Cambridge MA: Cambridge University Press, pp.47-67.
- Mäki U. (2009c) 'Preface.' In Mäki U. (Ed.) *The Methodology of Positive Economics: Reflections on the Milton Friedman Legacy*. Cambridge MA: Cambridge University Press, pp. xvii-xviii.
- Mäki U. (2011) 'Scientific Realism as a Challenge to Economics (and vice versa).' *Journal of Economic Methodology*, Vol.18:1, pp. 1-12.
- Mäki U. (Ed.) (2012) *Philosophy of Economics*. Oxford: Elsevier.
- Mäki, U. (2013) 'Scientific Imperialism: Difficulties in Definition, Identification, and Assessment.' *International Studies in the Philosophy of Science*, Vol. 27:3, pp. 325-339.
- Mäki U. (2013a) "Mark Blaug's Unrealistic Crusade for Realist Economics", *Erasmus Journal for Philosophy and Economics*, Vol. 6:3, pp. 87-103.
- Mas-Colell A. (1978) 'On Revealed Preferences Analysis.' *The Review of Economic Studies*, Vol. 45:1, pp. 121-131.
- Mayer T. (2009) 'The Influence of Friedman's Methodological essay.' In Mäki U. (Ed.) *The Methodology of Positive Economics: Reflections on the Milton Friedman Legacy*. Cambridge MA: Cambridge University Press, pp. 119-142.
- McCloskey D. (1983) 'The Rhetoric of Economics.' *Journal of Economic Literature*, Vol. 21:2, pp. 481-517.
- Menger K. (1961) 'A Counterpart of Occam's Razor in Pure and Applied Mathematics: Semantic Uses.' *Synthese*, Vol. 13:4, pp. 331-349.
- Mirowski P. (1989) *More heat than Light. Economics as Social Physics, Physics as Nature's Economics*. New York: Cambridge University Press.
- Mirowski P. (2002) *Machine Dreams: Economics Becomes a Cyborg Science*. Cambridge: Cambridge University Press.
- Mitchell R. (2016) *The Language of Economics. Socially Constructed Vocabularies and Assumptions*. Palgrave, MacMillan.
- Morgan M. (2001) 'Models, Stories and the Economic World.' *Journal of Economic Methodology* Vol. 8:3, pp. 361-84.
- Morgan M. (2012) *The World in the Model: How Economists Work and Think*. Cambridge: Cambridge University Press.
- Moscato, I. (2016) 'Retrospectives: How Economists Came to Accept Expected Utility Theory: The Case of Samuelson and Savage.' *Journal of Economic Perspectives*, Vol. 30:2, pp. 219-236.

- Nagel E. (1963) 'Assumptions in Economic Theory.' *American Economic Review*, Vol. 53:2, pp. 211-219.
- Nelson R. (2001) *Economics as Religion: From Samuelson to Chicago and Beyond*. University Park: The Penn State University Press.
- Patterson O. and E. Fosse (2015) 'Overreliance on the Pseudo-Science of Economics.' *New York Times Opinion Pages*, February 9.
- Pfouts R. (2002) 'On the Need for a More Complete Ontology of the Consumer.' In Fullbrook E. (Ed.) *Intersubjectivity in Economics. Agents and Structures*. London: Routledge, pp. 71-84.
- Popper K. (1959[1935]) *The Logic of Scientific Discovery*. London: Hutchinson.
- Putnam H. (2002) *The Collapse of the Fact/Value Dichotomy and Other Essays*. Cambridge MA: Harvard University Press.
- Ramsey F. (1931) *Foundations. Essays in Philosophy, Logic, Mathematics and Economics*. London: Routledge.
- Reid J. (1987) 'The Theory of Sharecropping: Occam's Razor and Economic Analysis.' *History of Political Economy*, Vol. 19:4, pp. 551-569.
- Rol M. (2008) 'Idealization, Abstraction, and the Policy Relevance of Economic Theory.' *Journal of Economic Methodology*, Vol. 15:1, pp. 69-97.
- Rosenberg A. (1992) *Economics: Mathematical Politics or Science of Diminishing Returns?* Chicago: University of Chicago Press.
- Runde J. (1997) 'Abstraction, Idealization and Economic Theory.' In P. Arestis, G. Palma, and M. Sawyer (Eds.) *Markets, Unemployment and Economic Policy. Essays in Honour of Geoff Hartcourt*. Vol 2. London: Routledge, pp. 16-29.
- Samuelson P. (1947) *Foundations of Economic Analysis*. Cambridge MA: Harvard University Press.
- Samuelson P. (1964) 'Theory and Realism: a Reply.' *American Economic Review*, Vol. 54:5, pp. 736-739.
- Samuelson P. (1966) 'Comment on Ernst Nagel's "Assumption in Economic Theory".' In Stiglitz J. (Ed.) *The Collected Scientific Papers of Paul A. Samuelson*. Cambridge: MIT Press, pp. 1772-1778.
- Sen A. (1987) *On Ethics and Economics*. Oxford: Basic Blackwell.
- Simon H. (1955) 'A Behavioral Model of Rational Choice.' *Quarterly Journal of Economics*, Vol. 69:1, pp. 99-118.
- Simon H. (1957) *Models of Man*. New York: John Wiley and Son.
- Simon H. (1992) 'Rational Decision-Making in Business Organizations.' In Lindbeck A. (Ed.) *Economic Sciences 1969-1980. Nobel Lectures*. London: World Scientific Publishing Co, pp. 343-371.
- Simon H. (2001) 'Science Seeks Parsimony, Not Simplicity.' In Zellner A., Keuzenkamp H., McAleer M. (Eds.) *Simplicity, Inference and Modelling: Keeping it Sophisticatedly Simple*. Cambridge: Cambridge University Press, pp. 32-72.
- Sugden R. (2000) 'Credible Worlds: the Status of Theoretical Models in Economics.' *Journal of Economic Methodology*, Vol.7:1, pp. 1-31.
- Thompson J. (2011) *Empirical Model Building: Data, Models, and Reality*. Hoboken, NJ: John Wiley & Son.

Weintraub E. R. (1985) *General Equilibrium Analysis*. Cambridge: Cambridge University Press.

Weintraub E. R. (2002) *How Economics Became a Mathematical Science*. Durham, NC: Duke University Press.

Weintraub E. R. (2007) 'Neoclassical Economics.' *The Concise Encyclopedia of Economics*. Retrieved June 5, 2016 from <http://www.econlib.org/library/Enc1/NeoclassicalEconomics.html>

Wilber C. and Wisman J. (1975) 'The Chicago School: Positivism or Ideal Type.' *Journal of Economic Issues* Vol. 9:4, pp. 665-679.

Wong S. (2006) *The Foundations of Paul Samuelson's Revealed Preference Theory*. London: Routledge.

Zellner A. (2001) 'Keep It Sophisticatedly Simple.' In Zellner A., Keuzenkamp H., McAleer M. (Eds.) *Simplicity, Inference and Modelling: Keeping it Sophisticatedly Simple*. Cambridge: Cambridge University Press, pp. 242-262.

Zellner A., Keuzenkamp H., McAleer M. (Eds.) (2001) *Simplicity, Inference and Modelling: Keeping it Sophisticatedly Simple*. Cambridge: Cambridge University Press.

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