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Complex realist economics: toward an ontology for an interested pluralism

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ABSTRACT

Contemporary economic theory has entered into an era of unprecedented pluralism. Convincing arguments have been presented for the integration of this pluralism, the possibilities for which however rest on questions of ontology. This paper looks at two hubs of pluralist research, complexity economics and heterodox economics, to evaluate the possibilities for an integration. Complexity economics constitutes an ontological broadening of neoclassicism, but is based on an implicit and incomplete social ontology. Heterodox economics has been argued to be systematized by a critical realist ontology, but has been criticized for limits in the operationalization of this ontology. An ontological merge is sketched, resulting in Complex Realist economics, which is argued to be capable of resolving the 'confused state' of complexity economics, providing the heterodox tradition with the necessary methodologies to study the phenomena that it theorizes, and constituting a consistent ontological foundation for an 'interested pluralism'.

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Introduction

Economic theory has over the last few decades seen a transition from an almost total dominance of the neoclassical[1] paradigm, to an explosion of new approaches, leading to an era of unprecedented pluralism. Where there used to be only 'economics' is now a plethora of prefixes: experimental, evolutionary, behavioral, agent-based, complexity, computational, institutional, economic, feminist, agent-based, adaptive, and so on (Garnett 2006). Even within

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[1]Terminologically, this paper uses the term 'neoclassical' to refer to the dominating (i.e. 'orthodox') core of current 'mainstream' economics, while acknowledging significant heterogeneity with regards to views on and commitment to neoclassical tenets within this mainstream.

single disciplines, there is increasing plurality when it comes to methods and approaches. But there is structure to be found in this explosive development: one can broadly single out two important hubs in the form of (i) complexity theory, centered around computational models and connected to disciplines such as agent-based economics, computational and complexity economics (Arthur 2013), and (ii) the heterodox umbrella bringing in primarily social, structural and institutional perspectives, and connected to e.g. old institutional, ecological, post-Keynesian economics (e.g. Hodgson 1993; Lawson 2006b).

This development has raised a number of important questions about where economics is headed: Will neoclassical economics be replaced by pluralism, or will they continue side-by-side as competing perspectives (Davis 2006)? Will pluralism converge into a new, unified and coherent economic framework, or will it remain divided and heterogeneous (Elsner 2017)? Will complexity economics be absorbed into the neoclassical paradigm, as so many of its predecessors, or will it become the basis for the new paradigm (Fontana 2010)? Or will it perhaps be brought into heterodox economics, from which interested glances have certainly been cast (e.g. Foster 2005; Potts 2000)?

For these questions, more has been said on what is desirable than on what is plausible. A petition by Hodgson *et al.* (1992) in the *American Economic Review*, signed by 44 leading economists, has been seen as a turning point in discussions about pluralism, calling for 'a new spirit of pluralism in economics, involving critical conversation and tolerant communication between different approaches' (Garnett *et al.* 2009). As Rothschild (1999) puts it, a 'plurality of paradigms in economics [is a] necessary and desirable phenomenon in a very complex and continually changing subject. […] Depending on circumstances and the problem to be tackled, different approaches, or a combination of them, have to be used in order to be able to get nearer to the far-away 'truth.'' [p. 5]. Certain convergence on the desirability of a more integrated and pluralist economics, which employs a range of methods and perspectives to its research questions, can thus be detected. This departs from a view of social reality as multi-faceted, and requiring a variety of perspectives for it to be described and explained (Norgaard 1989), meaning that every research question is unique and demands its own way of being studied, and that hence, the question should determine the method, and not vice versa (Bigo 2009; Dow 2008; Lawson 2004). As Doubush and Kapeller (2012) argue, this calls for an 'interested pluralism', that embodies a 'striving for constructive interaction between different theoretical traditions in order to come up with an improved and expanded set of relevant explanatory statements' [p. 1043].

In the end, however, as e.g. Fontana (2010) argues, the possibility for such integration leans heavily on questions of ontology[2]: to what extent are

[2]The term 'ontology' points both to (i) the branch of metaphysics that deals with questions regarding the nature of being, and to (ii) a particular set of responses to such questions. These

the ontological perspectives of these different perspectives compatible? To what extent do they agree on the fundamental questions about what economies *are*? Enabling a constructive philosophical exchange of such questions, that goes beyond the often shallow and ideologically charged use of terms like 'heterodox' or 'neoclassical', requires making explicit the ontological foundation of these approaches.

This paper looks at and compares the ontological stances of complexity and heterodox economics, with the aim of (i) evaluating the possibility for an integrated, 'interested' pluralism (Doubush and Kapeller 2012), and (ii) discussing what would constitute a possible ontological foundation for such an approach. The latter implies a 'turn to ontology' (Perona 2007, 13) in which the ontological perspective is neither reduced to the assumptions of specific methods (as with neoclassicism), nor to the set complement of those assumptions (as with heterodoxy).

From the basis of the understanding of economic systems of these approaches, this paper argues that a merging between the pluralist approaches is both possible and desirable, and identifies an ontological foundation that could enable such a fusion. A compatible ontological perspective is found in the combination between *critical realism*, argued to be the common denominator of the heterodox approaches, and *complexity theory*, in line with ideas in social theory under the banner of *complex realism* (e.g. Andersson *et al.* 2014; Byrne and Callaghan 2013; Harvey and Reed 1996; Reed and Harvey 1992). This goes beyond just another 'call for pluralism', to discussing the properties of an ontological foundation that could underlie the conscious formation of such a pluralist framework.

We begin by giving an overview of complexity and heterodox economics. We then compare the ontological foundations of these approaches and discuss the possibilities of a 'turn to ontology' (Perona 2007) that would enable the constructive merger of these plural approaches into a single integrative paradigm, to which we refer as *Complex Realist* economics.

Complexity economics

While the development of neoclassical economics was strongly shaped and influenced by physics and the natural sciences, the last few decades have seen new results in these sciences that have implied an important critique against the neoclassical approach. The idea that solutions would tend toward a constant solution or a steady state, central to many neoclassical

questions may for instance include: What entities may be said to exist, and how can those entities be categorized and subdivided? How do these interact with each other? What questions may legitimately be asked about such entities? As the answers to such questions underlie scientific study, they are not targets of scientific inquiry but rather the prerequisites for conducting it.

methods, have increasingly been understood to be problematic, as researchers found that there could be more than one solution to many of these equations, and that these solutions could take the form of cycles or even chaotic behavior (Arrow 2005; Cvitanovic *et al.* 2005). Furthermore, while neoclassical economics had some empirical successes, as defined by its epistemological perspectives, many empirical phenomena could not be covered by theoretical methods or the empirical analysis based on linear stochastic systems (Arthur 2013; Fontana 2010).

It was with this background that *Santa Fe Institute*, the birthplace of complexity theory, in 1987 launched an endeavor to bring together a number of emerging methods under the label of *complexity*, with the aim of approaching economies as 'complex systems', i.e. as characterized by dispersed interaction, nonlinearity and out-of-equilibrium dynamics (Arthur *et al.* 1997). This was to become known as the *Santa Fe Perspective*.

This perspective was to a large extent enabled and driven by the development of computational methods, permitting study of areas outside the scope of analytical mathematics (Galison 1997). This can be seen in that, while the Santa Fe approach to complexity theory is an implicitly multidisciplinary endeavor, it is much less methodologically diversified, focusing on formal, quantitative methods. At the heart of this methodology lies computer simulation, which crucially brings the capability to describe the entities and interaction rules of dynamical systems so as to put it all 'into motion' (Fontana 2006). The typical model in this tradition has a microlevel of interacting nodes existing in a pre-defined environment. Having set up the rules and the environment, the system is allowed to play out, and the results and patterns that emerge from the often long causal chains of interaction are studied (Gilbert 2004; Macy and Willer 2002; Epstein 1996). This is a highly flexible methodology that made it possible to study and visualize dynamics that are inaccessible both to analytical mathematics and to unaided human cognition.

This can be viewed as an extension of the study of the micro aggregation from only additive cases to situations where 'the whole is more than the sum of its parts': what is often referred to as 'emergence' (e.g. Johnson 2002). Emergence is a central concept in complexity theory, and describes situations when a system property does not conform to one of the conditions of aggregativity, implying a dependence on their mode of organization (Wimsatt 2007, 274–276). As Elder-Vass succinctly puts it, 'Emergence is the idea that a whole can have properties (or powers) that are not possessed by its parts-or, to put it more rigorously, properties that would not be possessed by its parts if they were not organised as a group into the form of this particular kind of whole' (Elder-Vass 2007, 28). It is therefore not possible to study these systems by observing their elements in isolation, as emergence implies bottom-up nonlinear interaction, rather than the additive summation of identical behaviors (Sugden 1998). The dynamics of

the upper-level often results from long and intertwined chains of causation, that we are simply unable to process without the use of external tools, such as computer simulations.

While complexity in part entails a widening of economic study into aspects that were previously methodologically inaccessible, it also constitutes a change on the level of metatheory. Just as occurred in neoclassical economics – the 'social life' of these methods (Law *et al.* 2011) has increasingly led to the development of a corresponding social ontology: indeed, even the labeling of economics as a 'complex system' clearly goes beyond a methodological claim, and into the realm of ontology (Fontana 2010). As would be suspected from a concept that has evolved from the social life of such a recent and broad methodology, the definition of 'complex systems' is contested, and the state of its contributions in economics is hence – as Perona (2007) puts it – rather confused. Furthermore, the social ontology that complexity economics provides is patchy and incomplete. As Forbes-Pitt (2013) puts it, 'the work in complexity theory has proceeded, by and large, in a meta-theoretical vacuum, it is not possible to point to a specific causal theory or ontology to which it adheres' (Forbes-Pitt 2013, 106). Hence, the field has not developed any ontological framework, beyond an implicit naïve realism, for relating to social reality.

The complexity understanding of the world has thus, due to this lack of explicit social ontology, been reduced to its understanding of the phenomena of *complexity* and *emergence*. But even these concepts evade simple definition, and the definitions one can find are rather diverse (as pointed out by e.g. Perona 2007). The concepts generally refer to systems that allegedly cannot be understood using a linear reductionist approach. Johnson (2009, 3–4) defines complexity as 'phenomena which emerge from a simple collection of interacting objects'. Similarly, Mitchell (2009, 13) describes a complex system as 'a system in which large networks of components with no central control and simple rules of operation give rise to complex collective behavior, sophisticated information processing, and adaptation via learning and evolution'.

If we indeed accept this as an ontological characterization of economic systems, it does constitute an in many ways important step away from neoclassical economics. It rejects some of the strict assumptions required by neoclassical methods, by adding e.g. heterogeneity/morphological diversity, connectivity, nonlinearity, out-of-equilibrium dynamics, continual adaptation, and historical irreversibility (e.g. Arthur *et al.* 1997; Bak *et al.* 1997; Holland and Wolf 1998; Kauffman 1993). As Fontana (2010) puts it, the neoclassical 'ontology and epistemology cannot deal with complex phenomena' (Fontana 2010, 585), and 'there are compelling ontological and epistemological reasons for maintaining that the two research programs have almost nothing in common and mostly contrasting tenets' (Fontana

2010, 607). The macro is no longer seen as an additive aggregation, and humans are no longer seen as isolated atoms. Complexity economics also leaves behind the idea of certainty and exact prediction, to a perspective where only dynamics and general trends can be identified.

In other ways, however, the complexity ontology remains similar to the neoclassical ontology: it remains a perspective where structures are seen as merely *patterns* emerging from the behavior of underlying agents, limiting the possibilities for 'downward effects' (Hodgson 2009). As Lane (1993) puts it, out-of-equilibrium studies 'offer only very limited scope to the emergence of new structures – and, so far, none at all to the emergence of higher-level entities.' In other words, due to the models' inability to take human reflexivity and the resulting 'second order emergence' (Gilbert 2002) (i.e. the emergence that results from the human ability to identify and interact with emergent patterns) into account, the approach retains an individualist focus. This is unsurprising since the focus has been on the dominant neoclassical paradigm, and there has hence been relatively little need to consider critique from other economic disciplines, with e.g. a stronger focus on institutions and social structures.

However, these alternative perspectives on economics are growing in prominence, and the relationship – and possibilities for synergy – between complexity and heterodoxy is hence becoming a more and more topical question.

Heterodox economics

In some ways similar to how *Santa Fe Institute* brought together a diverse set of emerging methods and theories under the umbrella term 'complexity theory' in the 1980s, 1999 saw the formation of the *Association for Heterodox Economics* (AHE) to signify the coming together of sometimes long-standing heterodox projects or traditions, including post-Keynesianism, (old) institutional economics, feminist, social, Marxian, Austrian and social economics (Lawson 2006b). Hence, heterodox economics is a highly diverse set of approaches to economics, so much so that Colander, Holt and Rosser (2004, 492) suggest that 'beyond [the] rejection of the orthodoxy there is no single unifying element that we can discern that characterizes heterodox economics'. And, in the words of Dequech: 'Another possibility would be to define heterodox economics positively, but the result in the current period may be an empty set' (Dequech 2007, 279).

This rejection of orthodoxy can, however, certainly be elaborated upon (see also Colander *et al.* 2004; Dequech 2007). It is on the surface constituted by two primary directions: (i) a thematic direction, especially in the form of the lack of inclusion of institutions and social structures, and (ii) a methodological direction (e.g. Dow 2008), in the form of a broader critique

of its assumptions and methodology – exemplified by Hodgson's (1988) statement that 'mainstream economics is unacceptable in terms of its theoretical assumptions and the scope and direction of its formal argument' (p. 3). Clearly, these two points are strongly related, since, as we have seen, the underlying reason for the lack of focus on structural aspects of economies is to a large extent methodological limitations.

First, the inclusion of economic institutions and the study of social structures is likely the most easily discernible theme within heterodox economics. As Swedberg (1997, 161) puts it, '[o]ne of the most important developments in modern social science during the past few decades has been the race to fill the void created by mainstream economics' failure to do research on economic institutions'. Granovetter argues that economic action cannot be explained in terms of individual motives because 'it is embedded in ongoing networks of personal relations rather than carried out by atomized actors' (Granovetter 1992, 270). As a response to the atomized view dominant within economics, Granovetter suggests the concept of 'embeddedness' (Granovetter in Swedberg 1997, 164) thereby putting a strong emphasis on the social structures so readily neglected by the neoclassical approach. This emphasis is motivated by the view that the pursuit of economic goals 'is intertwined with noneconomic goals, and deeply embedded in structures of social interaction that extend backward in time and outward in space' (Granovetter 1990, 95). Individuals are hence considered to be directly interdependent and socially embedded (Elsner *et al.* 2014).

Second, the rejection of the methodological reductionism of the neoclassical methodology can perhaps best be discerned by the fact that mathematical-deductive methods are exceedingly rare within heterodox economics. The framework has however not been replaced by any single alternative methodological system, rather, heterodox economists use a range of methods and approaches (Lawson 2006b; Williamson 2000). It is, however, characterized by a strong general preference for empirical research and narrative-based methods, rather than abstract theory building: Wilber and Harrison (1978), for example, claim that *the* method of institutionalism is the participant-observer approach, a purely discursive method originating from anthropology. In line with this, Smelser and Swedberg (2010) argue that the meanings of social action 'must be investigated empirically, and are not simply to be derived from assumptions and external circumstances' (Smelser and Swedberg 1994, 5). The few formal methods that are used within heterodox economics, such as the social fabric matrix (Hayden 1982), system dynamics (Radzicki 1988) and evolutionary game theory (Elsner 2012), are generally methodologically holistic, focused almost exclusively on institutions and their effects and interactions. Emergence is rarely studied within the approach, due to the general rejection of the formalistic methodological individualism required to study emergence.

A natural follow-up question is whether these two points of opposition are truly only thematic and methodological, or whether they also carry more ontological significance. While explicit mentioning of ontology is rare within heterodox economics, it is easy to argue, as Lawson (2006b) has done, that there is indeed an ontological foundation of heterodox critique of neoclassicism. Since the exclusion of institutions and social structures from much of neoclassical economics is not the result of chance neglect, but rather an integral part of the dominating individualism of neoclassical economics, and hence, it seems natural that a critique against this should be granted similar ontological status.

Lawson (2006b) argues convincingly that this implicit ontology of heterodox economics is specifically *critical realism*, since a critical realist ontology 'systematises the implicit preconceptions of the various heterodox traditions, and ultimately explains their enduring opposition to the mainstream' [p.15]. Of course, not every heterodox scholar would agree to this characterization, but there is undeniably a strong critical realist stream within heterodox thought, even to the extent that, within philosophical matters, the flow of insights can be said to go both ways between ontological theory and the heterodox traditions (Fleetwood 1998). The field of critical realism in economics has made use of ideas from philosophy of science, and in particular the writings of Bhaskar (e.g. 1978; 2013), but, as Fleetwood (1998) emphasizes, it should also be recognized as an autonomous program and contribution on its own right.

Critical realism in heterodoxy

Let us now briefly review this critical realist perspective within heterodox economics, departing from the basis of Lawson (2006b).

Reality

Critical realism starts from the postulate that a reality exists outside human perception, and this reality is driven by causality. The term 'causality' however does not imply universal laws or necessity, but rather that mechanisms operate within specific configurations, local in time and place, and that these bring about certain phenomena. This understanding of causality through 'tendencies' rather than 'laws', meaning that absence of a certain effect does not mean that its mechanisms are also absent, poses limits on possible knowledge-claims: while research can aid in describing and understanding how these configurations operate, critical realists understand that social reality is too complex to be completely understood.

Action

While critical realism places significantly more emphasis on structural aspects than e.g. neoclassicism, it maintains the view that social reality depends on human agency, and that the social world turns on human practice: we operate through social structures, and through this, we perpetuate and transform them. In the critical realist view, social structures are not planned, but often unexpected and emergent: people do not marry to reproduce the nuclear family, nor do they work to reproduce the capitalist economy, but these are nevertheless the unintended consequences or their activity (Bhaskar 1979). This also implies that social reality is understood as inherently *dynamic and processual*. It also means that the stuff of the social realm also includes things like *value* and *meaning*.

Openness

Furthermore, social systems are in general *open*, meaning that they cannot be cut off from the rest of the world, which is notably what fully capturing them through models would require (Bhaskar 1979). The picture painted of the social realm is furthermore highly *interconnected and organic*: relations rather than agents are seen as the central and defining units of analysis, with agents generally defined in virtue of their relations.

Emergence

Just like in complexity economics, the concept of *emergence* plays a central role in critical realism. This is understood as strata of reality possessing *causal powers* that cannot be reduced to the lower levels from which the strata depend and arise. This is furthermore related to the social realm being seen as *structured*, i.e. consisting of multiple ontological levels, each depending on the other. Emergence is here understood to imply that the social world is not reducible to its underlying elements, e.g. human practices, but also encompasses social structures and processes.

As can be clearly seen in this brief characterization of critical realism in heterodox thinking, there are many – both implicit and explicit – connections to complexity theory. Indeed, the complexity theory understanding of complex systems can be seen as fitting in as a sub-set of this social ontology: e.g. just as complexity theory posits, the macro can emerge from the micro, but there is also emergence between macro entities, as well as from interaction between the levels (Byrne and Callaghan 2013). This means that it puts complexity and emergence into a plausible context as part of a larger social ontology. As opposed to complexity theory, critical realism is a complete and explicit social ontology, which, furthermore, through its emphasis on openness points toward a pluralist approach.

While critical realism is a complete and theoretically sound framework, it is a 'philosophical' rather than 'scientific' ontology, meaning that it does not provide the basis for operationalization of economic systems (Bhaskar 2009, 36). This can be seen, e.g. in the concept of emergence holding a rather abstract status compared to its concrete understanding within complexity theory.

In summary, the heterodox traditions are a loose-knit collection of disciplines, bound together by an ontological critique of the mainstream that can and has been systematized as Critical Realism. Method-wise, the heterodox traditions lean toward qualitative and discursive methods, and the formalist methods that it employs are largely holistic. While *emergence* is emphasized within the critical realist ontology, the term is loosely defined, and the traditions – due exactly to its critique of formalisms – largely lack methods and theories to study it.

Having now concluded an overview of economic ontology, we will now compare and contrast these ontological perspectives.

Comparing complexity and critical realism

The social ontology of complexity economics, just as the ontology of the neoclassical school before it, seems to have developed primarily from its methodology, in a version of what Parson called the 'fallacy of misplaced concreteness' (Parsons 1935, 661) – i.e. confusing the abstract and the real by treating an abstraction as a description of concrete entity. In the case of heterodox economics, no unifying methodology can be found, other than 'non-neoclassical', implying an avoidance of methodologically individualist methods and a general bias toward holistic perspectives.

While the social ontology of complexity economics differs from, and can, as Fontana (2010) argues, be seen as largely incompatible with, neoclassical perspectives, they also share some important characteristics that become evident through a comparison with heterodox approaches. The social ontology of neoclassical economics has in important part been related to its deductivism, linear and steady-state, seeing individuals as isolated atoms (Lawson 2013). Complexity theory is instead dominated by *algorithmic-deductivism*, hence shedding the requirement to assume linearity and steady-state solutions, as well as the isolated-atomistic perspective, which, while not universal, are central tenets of neoclassicism: it permits relations and a broader set of aggregation principles (Fontana 2006; see also Wimsatt's 2007 definition of emergence, p. 274–276). However, the complexity perspective does remain both methodologically individualist and deductivist – a feature likely springing from their shared heritage in the natural sciences. It furthermore lacks a complete social ontology, implying that it builds on treacherous philosophical foundations (e.g. Archer 2013).

Because of this, while complexity science constitutes a step toward a more relational perspective, the heterodox criticism against the neoclassical ontology's individualist foundation applies largely also to that of complexity economics. Complexity economics constitutes an extension of the bottom-up perspective on economic systems that brings in important aspects of emergence that are also emphasized within heterodox economics, but it remains a largely individualist perspective (Wan 2011). The macro is seen as emerging from an underlying micro, and is hence perhaps better described as *patterns* rather than structures.

Despite of this central difference, there has been significant interest in complexity science from heterodox economics (e.g. Foster 2005; Potts 2000). Perona (2007) provides a plausible explanation for this by using Lawson's (2005) distinction between 'theoretic' and 'ontic': 'theoretic' denotes the quality of being a feature of a model, and 'ontic' the quality of being features of the world. In this terminology, the fallacy committed by neoclassical and complexity approaches is a conflation of the two, with the latter reduced to the former. But if one instead views the characterization of complex systems as 'theoretic', i.e. a description of the ontology of the models used within complexity science, the concepts and tools become potentially useful ways for heterodox economics to approach emergence without abandoning embeddedness.

This perspective, of separating between the complexity of models and the complexity of reality, also resonates with a number of perspectives that separate between the complexity of social and natural systems. In this view, complexity *models* of social systems are complex in the same way as are some simple natural systems, such as flocks of birds, or anthills, but the complexity of social systems, however, is radically different. This point of view can be seen in Morin's (2008) distinction between 'restricted complexity' and 'general complexity', as well as in the separation between 'complex' and 'wicked systems' in Andersson *et al.* (2014). According to the latter, when the system property of being structured/complicated is combined with emergence/complexity, the combination is more than the sum of its parts: the system becomes *worse* than complex. This notion – that social systems are not necessarily complex in the same sense as natural systems – implies that complex social systems would require a fundamentally alternative ontology.

It is clear that neither the heterodox nor complexity economics could be brought into the mainstream: the atomistic and individualist mainstream ontology can absorb neither of the directions (see also Fontana 2010). The mainstream direction could potentially bring in some of the novel methods and tools, just as it previously has with e.g. game theory, but it would form an increasingly unstable collection of methods, lacking the metatheoretical foundation for ontological coherence. In other words, the research would be operating on the basis of different implicit views of what the economy

is, without making those views explicit or tying them together to a coherent understanding. A convergence is hence more plausible, and indeed desirable, within an ontology that supports an epistemology that would be compatible with a pluralist approach. As we have seen, critical realism – underlying the heterodox traditions – does constitute such an ontology.

Furthermore, it would seem that the partial ontology of complexity theory would indeed be compatible – even synergic – with the social ontology of critical realism. Such a combination could furthermore help to resolve (i) complexity theory's problematic lack of an adequate social ontology, (ii) the heterodoxy's vague characterization of emergence and complexity, in turn following from lack of methods and theories, as well as (iii) the tendency for an underemphasis of the downward effects of institutions and social structures in complexity economics, and corresponding underemphasis of agency and bottom-up effects in heterodox economics.

We will now attempt to briefly outline a potential combination between heterodox and complexity economics ontology, which could lay as foundation for an 'interested pluralism' (Doubush and Kapeller 2012).

Toward a common complex realist foundation

In order to merge these perspectives, one would need to construct a common ontological foundation that would allow the combination of the strengths of each approach. Luckily, such a merged ontology has already developed within philosophy of science. This was first developed by Reed and Harvey (1992) and Harvey and Reed (1996), concluding that complexity science provides a 'scientific ontology' consistent with a critical realist 'philosophical ontology', together forming a 'social ontology'. This has been further developed under the label of *Complex Realism* by e.g. David Byrne (e.g. Byrne 2002; Byrne 2011; Byrne and Callaghan 2013). As Harvey and Reed put it, in a statement that could have been referring to the current contentious state of economic theory, such an approach allows us to 'steer a course midway between those positivists who would use chaos theory to revivify an exhausted scientism and those postmodernists who reject quantification 'on principle.'' (Harvey and Reed 1996, 296).

In the following section, we will look at how the understanding of complexity changes when made part of the ontological framework of critical realism, thereby highlighting in particular four ontological aspects of reality (see Byrne 2011; Gerrits and Verweij 2013).

Non-decomposable

Critical realism emphasizes the notion of social systems as 'open', meaning that describing components of reality as discrete entities is inadequate,

since real structures and processes come about through the internal and external interactions between these components. In open systems, components interact between levels, and are so interlinked with their environment that their boundaries become ill-defined (e.g. Archer *et al.* 2013; Bhaskar 1978; Collier 1994; Von Bertalanffy 1950).

This becomes more precisely defined in the language of complexity theorist Simon (1991), in which open systems are understood to be 'non-decomposable', meaning that they do not fulfill the conditions under which systems can be fully captured in formal models. Near-decomposable systems are separated into levels, that bring separations of timescales, which ensures that the ontology of the system level will be relatively fixed during a relevant 'short run': a time scale that is long enough for interesting dynamics to occur, but short enough for the assumptions about the interfaces to remain valid. This is what allows one to study them as if they were cut off from external influences. Hence, openness/non-decomposability means that social structures change qualitatively: their very nature can be transformed under any time-scale. This is related to what Lane and Maxfield (2005) call 'ontological uncertainty': not only the truthfulness of statements about entities is uncertain, but even what entities inhabit the world and how they interact (c.f. Danermark *et al.* 2001, 34).

Emergence

Complex realism views structures and individuals as each possessing distinct properties and powers in their own right. This implies a broader understanding of emergence than how it is generally understood within mainstream complexity theory, as it allows for emergence to go in more than one direction. The capacity of humans to relate and act upon emergent structures, what Gilbert (2002) calls 'second order emergence', results in that interaction not being limited to a single stratum; emergence can occur from interaction between social structures and the actors that underlie them. As the interacting entities become aware of patterns emerging from their interaction, they bring in those patterns into their very interaction, which makes the realm of meaning particularly difficult to study, as its structures constantly 'fold in upon themselves' (Polkinghorne 1988). This interplay between social structure and agency occurs over time, meaning that their emergence takes the form of a continual process; as Sober (1980) puts it, 'Causality, in virtue of its transitivity, gives aid and comfort neither to the holist nor to the individualist. The causal chain just keeps rolling along.' (Sober 1980, 95).Another way of understanding this is as going from a Darwinian 'population thinking' to an 'organization thinking', in which no relevant population can be discerned, and variation/selection are inadequate to describe change, which is rather based on a modality of

'organizational self-transformation' (Lane *et al.* 2009). While the natural world is often seen as hierarchical, the social world is better described as consisting of sets of nested structures, and its effect on actors as 'a plurality of interpenetrating constraints deriving from many recognisable 'levels' looping back and around each other' (Dyke 1988, 64). This ultimately implies that the goal of social analysis is to study the link and interaction between structure and agency, rather than to reduce one to the other (Danermark *et al.* 2001).

Contingency

The openness and non-decomposability of the social world means that reality is contingent: any explanation is local in time and place. We can talk about generative mechanisms of social structures because they do make something happen, but while doing so, we must not forget that the effects of structures are mediated by agency: in social life, nothing happens without the activation of the causal powers of people. There is no singular 'humanity', but only plural and heterogeneous mortals, giving the social world its organic, interconnected and contingent nature. Hence, values and meaning are deeply connected to qualitative change, since humans are capable of navigating and transforming them through action. For example, when studying how changing pay structures affect employee behavior in companies (e.g. Lazear 2000), it is easily forgotten that the desires and values underlying these behaviors had to be taught, as workers would otherwise work no longer than necessary to meet their traditional needs. Put in another way: change is to a large extent driven by values and meaning, and hence hermeneutic elements (e.g. Geels and Schot 2007; Geels 2005). For economists to disregard these dimensions hence constitutes 'nothing less than the wilful obliteration of their very subject matter' (Arendt 1958, 57).

Non-compressible

Reality cannot be reduced or compressed without loss, which is to say that an explanation can never fully contain the complexity it describes (Cilliers 2002). While abstraction or compression is of course an essential component in all theorizing, '[t]he problem comes when the move circles around to constitute the abstraction as the original form from which the world's multiplicity derives. Then complexity appears as a 'fuzzing up' of an essential reality rather than as a manifestation of the world's holistic nature.' (Hayles 1999, 12). While the neoclassical and complexity approach differ in that the neoclassical approach tends to infer 'from the world's noisy multiplicity a simplified abstraction', and complexity economics tends to go from simplicity to multiplicity, '[t]hey share a common ideology – privileging the

abstract as the Real and downplaying the importance of material instantiation.' (Hayles 1999, 13)

Complex realism instead suggests that there simply is no simple Platonic ideal to which the world can be reduced; likewise, there are no universal models or methods that can be used to study all aspects of reality. This lays waste to the recurring question within economic modeling about 'realistic' versus 'unrealistic' assumptions, since all theories are abstractions, partial and unrealistic (Mäki 1992). Since the systems under study are open, and 'all theorising in science [...] involve some partial or temporary closure' (Hodgson 2006, 3), no model will be able to capture the full extent of the system.

This does not mean that modeling is meaningless: while economic systems cannot be reduced to any single model, different models are capable of casting light at different aspects of them – giving us what Byrne (1998) calls 'traces of reality'. This is illustrated by the fact that, undeniably, neoclassical, complexity and heterodox economics all have many important examples of successful models and studies, despite their fundamentally contradictory understanding of the ontological nature of reality. Even mathematics is not necessarily employed as a map of reality or for prediction, it can also be applied as explanatory heuristics (Hodgson 2013; Sugden 2000).

Some methodological implications of complex realism

Having sketched the metatheoretical perspective suggested by complex realism, we will now look at a brief outline of some central aspects of a complex realist methodology, focusing in particular on the question of how to combine complexity methods with an approach that permits an open, contingent and non-compressible social world. A useful point of departure for such an outline is with an important sub-question: what *method* does complex realism imply? As has already been suggested, the short answer is: *use all you have* – not only scholarly theories and methods, but what you know from experience (Sayer 2010). The understanding of reality proposed by a complex realist perspective suggests letting our choice of methods be guided by a nuanced understanding of reality rather than relying on any fixed method.

Models as metaphors

While the narrative and discursive methods already employed within heterodox economics provides a good starting point, the addition of complexity into the critical realist framework emphasizes certain limitations of our unaided cognitive capacities. Our intuition for a complicated world is in many ways quite poor, both with respect to our limited short-term working memory and our ability to make strict inferences, but when it comes to our

ability to handle emergence and complexity, our intuitive capacities are arguably worse than poor: they are treacherous.

This is well illustrates through the example of the Schelling (1971) model of segregation. This model shows how even slight individual preferences with regards to what neighbors that we would like to live among can lead to high levels of macro segregation. The model points to a dynamic that is not only intuitively unexpected, but that would be hard to even grasp without the aid of the model. This illustrates the treacherous nature of emergence: the large earlier literature on segregation had not even noted the emergent feedback effect being at play, despite its possibly central role. In other words, we may think that we understand a system, while we are in fact missing central aspects of its dynamics as they are concealed *between* the entities and levels. Qualitative methods do need to be complemented with formal theorizing to get past those impasses where intuition will get us no further, and complexity is perhaps the steepest of those impasses.

However, formal methods put strict requirements on the objects that they are to represent. As Spiegler (2015) argues, modelling requires the objects under investigation to plausibly be *stable*, *modular*, and *quantitative*, with no qualitative differences between different instantiations of each type. As we have seen, these requirements are difficult to unite with the complex realist vision of the social world, which emphasizes precisely the opposite properties: non-decomposability, non-compressibility, and the context-dependent and polyvalent nature of human action.

Since truly 'capturing' the subject matter, as one may hope to do within the natural sciences, is not a plausible aim within such systems, this cannot be the epistemic aim of modeling. Again taking the example of the Schelling segregation model, this model is clearly not intended to capture segregation in any realistic way, but rather to throw light on specific feedback effects that play part in the dynamics of the phenomenon. This way of thinking casts the model not as something that may instantiate the true underlying laws of phenomena, but rather as *metaphors* that emphasize and bring into clearer light certain aspects of reality. While the latter is unquestionably a more modest aim than the former, this should not lead us to dismiss models for being 'merely metaphoric'; as Lakoff and Johnson (2003) put it, *metaphors are what we live by*.

How, then, can such metaphors help us approach a phenomenon? A suitable way of exploring this question is perhaps to use a metaphor: we can think of a model as a spotlight, throwing light on the object under study from a certain direction and thus projecting a shadow on the corresponding wall. An apt such spotlight will cast a light that helps us to see certain aspects of the object more clearly: the lower-dimensional projection is easier to measure and study, and may reveal shapes hidden within an otherwise amorphous object. Depending on the placement of the light, different

aspects may be revealed: a cylinder may cast either a circle or a square depending on the direction in which the light hits it, both revealing relevant aspects of the object. But not all spotlights are intrinsically useful for illuminating a given object, some may rather distort or obscure its shape and form. Similarly, a metaphor may be useful in certain circumstances but fail completely when the context changes.

A central point that this metaphor directs our attention to is that when we study the intricacies of a shadow, we cannot see what the given projection leaves out: any evaluation will be possible only in relation to specific projection, as the measurements themselves will be performed on the projection (Spiegler 2015). In other words, empirical testing, in itself, is never an adequate means of assessing the aptness or compatibility of a model with its target. We thus need to at times turn of the sharp spotlight – leave the metaphor – and study reality in a more ambient light, to become aware of what we are seeing and what is left out, and to make sure that the metaphor is in fact useful for our epistemic goals. Doing so also reduces the inherent risk of being caught up in the shadow play, i.e. taking the abstractions to be the object of scientific inquiry rather than the phenomena they were supposed to represent.

Knowledge-claims

This view of modeling does have implications for what knowledge-claims can plausibly be made, compared to parts of e.g. neoclassical thinking. What has made mathematics attractive are arguably its qualities as a precise, unambiguous language which promises to extend our powers of deductive reasoning while simultaneously ostensibly providing an objective view of the world through *true-or-false* statements subject to internal rather than empirical check. It may thus seem as a loss to abandon this dream for the seemingly endless contestability characteristic of other social sciences. This loss is, however, merely the loss of self-delusion. As Aristotle warned, one should not expect more precision than one's subject allows (Sayer 2010); we study a social world that is, as Archer (2014, 1–2) puts it, 'quintessentially kaleidoscopic in form[:] shaped and reshaped but conforms to no mold; it is patterned and repatterned but is confined to no pattern'. Confidence in one's predictions in such a world seems only possible for a discipline that 'has become so mesmerized with its own internal logic that it has begun to confuse the precision it has achieved about its own world with the precision that it has about the real one' (Caballero 2010, 85)

This is not merely a question of going from an exact to a probabilistic account. The uncertainty of open systems is not merely of the quantitative nature that could be handled through probabilistic methods. Since open systems are *ontologically* uncertain the uncertainty pertains to the very

concepts and categories under use, as they represent aspects of reality that are undergoing transformation. For instance, we can make probabilistic prediction for the future level of unemployment, but as we venture further into the future these predictions would become not only increasingly quantitatively uncertain, but also *ontologically* uncertain, as the very meaning of 'unemployment' is more and more likely to be affected by e.g. technological change, making the model lose its connection to its target. Constantly evaluating and re-evaluating the conceptual matching between model and reality is thus central to a complex realist modeling approach.

Models as crutches

As Spiegler (2015) argues, the process of modelling involves a double translation, in that one must first translate the subject matter into the language of the model, and after having operated within that language, one must re-translate the findings back into terms of the target. If the model is to be more than an baseless conjecture, the translation and re-translation need to be founded in empirical observation; in order to ensure the model is actually relevant for some real social phenomenon, we must use some other mode of access to the subject to ascertain the connection between the model and reality (Spiegler 2015). As Spiegler (2015) shows, the appropriate methods for doing so will necessarily be 'hermeneutic' or 'interpretive'[3]. The hermeneutic approach allows one to let the phenomenon itself guide the development of concepts and categories to describe it, since the approach can be made 'open-ended enough to [allow] the phenomena to speak for themselves' (Spiegler 2015, 277). Such interpretative approaches have been systematized within other disciplines, such as anthropology, and, as Spiegler (2015) argues, economists should draw on those disciplines to develop its capacities for hermeneutical study.

However, one needs not stray quite so far to find inspiration. The way that formal methods were applied among classical economic scholars can provide useful guidelines for an approach that uses models as part of a

[3]Spiegler (2015) suggests that this function should be organized as a separate discipline, 'interpretative economics', in a suggestion that is in some ways reminiscent of Parsons' call in the 1930s for a clear division of labor between the economics and sociology – which arguably played an important role for getting economics into problems in the first place. As Velthuis (1999) outlines, there is a subtle but important difference between establishing an 'independent discipline' and a discipline that is 'unrelated to the other disciplines' (Parsons 1934, 522, in Velthuis 1999). Parsons' quest for the former resulted in the latter, serving both to legitimize neoclassical economics' neglect of institutional economics and sociology, and preventing useful exchange at the disciplinary boundaries. As economics lost interest in institutions and structural explanations, it, as Granovetter (1990, 89) puts it, 'started to ignore the 'pseudoscience' of sociology', leaving it free to instead slide gradually into the realm of abstractions. This history illustrates the tendency of scientific disciplines to have their ontological perspectives be shaped by their methodology – which, alone, is a strong argument for a discipline that does not separate out hermeneutical and narrative steps from its formal methods.

narrative capable of grounding them in their subject matter (Sayer 2010). For instance, Marx's use of simple mathematical representations, in particular in Volume 2 of Capital, is instructive in this respect. Prior to outlining a model, Marx begins with an in-depth qualitative exploration of the subject matter, with successive qualitative approximations that in turn inform successive approximations of the mathematical model. Having drawn the model to its conclusion, Marx re-translates the conclusions of the model back into the larger narrative, making its argument convincing also in discursive form. This approach differs from most uses of modeling, in that it abandons calculability for the sake of plausibility and convincing explanation, and applies modeling as an integrated part of a narrative approach.

In short, thus, complex realist economics suggests using a plurality of methods, stitching their view of the world together to a coherent, larger understanding, with thread weaved by hermeneutics and narrative. Such an approach fulfills the aim of reframing models from attempts to match or access an imagined Platonic ideal form of the system to indicators giving us 'traces of reality' (Byrne 1998) by throwing light on some specific aspects of the social world. This changes our understanding of the toolkit of complexity from attempts to realistically represent reality, to *crutches that can help our intuition navigate cognitively difficult terrain – but that should never be expected to walk on their own*. The approach then becomes one of computationally-assisted exploration, which treats formal methods not as a replacement, but as aids to human intuition and interpretation, and an extension of human cognitive capacities. This approach is not focused on testing pre-established hypotheses, but rather of a *quantitative* or *computational hermeneutics*: continuing re-engagement with the data that mixes levels of interpretation and analysis, predicated on the idea that '[e]xploration is the real and serious game' (Byrne 2002).

Conclusions

This paper has provided an overview of two important hubs of pluralist thought, complexity and heterodox economics, with the purpose of evaluating the possibilities for the development of a merging of the disciplines, in line with what has been referred to as 'interested pluralism' (Doubush and Kapeller 2012).

Complexity science has been framed as an ontological critique of the limitations of neoclassical economics, but can also instead be seen as a *generalization* of the neoclassical ontology to a broader algorithmic deductivism. Complexity economics seems however similarly guilty of the 'epistemic fallacy' (Bhaskar 2013) or 'fallacy of misplaced concreteness' (Parsons 1935, 661) in that this ontological understanding has emerged from its methods rather than from an explicit ontological framework. It has correspondingly

been criticized for its 'confused state', as well as for lacking any plausible causal theory (Forbes-Pitt 2013), and has because of this been suggested to be in dire need of a 'turn to ontology' (Perona 2007).

Heterodox economics, on the other hand opposes the ontological perspective of the mainstream neoclassical school, and is instead characterized by a strong stream of critical realism (e.g. Lawson, 2006a; Lawson 2006b). While this is a complete and explicit ontological framework, heterodox economics however lacks in translating this ontology to plausible methodology, perhaps in particular with regards to complexity and emergence, which hold central roles in its ontology but remain largely absent in actual study. This can likely be explained by the heterodox rejection of formalisms and methodological individualism, which has limited its possibilities to study emergence as such study necessitates formal algorithmic methods. Due to this, the powerful critical realist ontological foundation of heterodox economics remains somewhat toothless and abstract in its application.

The conclusion from this overview was that, as Fontana (2010) argues, while the neoclassical paradigm provides an inadequate foundation for a pluralist economics, so does complexity economics due to its patchy and incomplete social ontology. The heterodox ontology does, however, contain the seed of an interested pluralism, in the form of critical realism. Bringing together heterodoxy, complexity and neoclassicism hence becomes a matter of integrating the complexity and heterodox ontologies, since neoclassicism can – as has been argued – be seen a subset of complexity ontology. Furthermore, from a pluralist stance, there is no basis for a complete exclusion of neoclassical arguments – which is certainly a desirable outcome since important contributions have undeniably been made from neoclassical theory (see also King 2012, 8–9).

Such an ontological integration between complexity theory and critical realism has already been developed within philosophy of science, in the form of 'complex realism.' This approach rejects the idea of universal formal models, pointing instead to an epistemology where a plurality of methods is employed – deep qualitative study, quantitative techniques, inferential statistics, as well as modeling and simulation – while being mindful with respect to their epistemological limitations, conscious of the ontological nature of the system under study, and hence drawing on social theory to frame the research and make sense of the findings. This calls for a question-driven and methodologically pluralist approach, that uses modeling tools from both neoclassical economics and complexity science to explore stasis and dynamics, but does so within an epistemological framing that enables economists to draw insights that are situated, reflexive and meaningful.

Such a social ontology may allow the convergence of not only heterodox economics, but also the methods of the neoclassical and complexity economics, into a single plural discipline that fits with the reality of its subject

matter (perhaps from a 'partitioned bureaucratic' discipline to a 'fragmented adhocracy' in Whitley's 2000 terminology). This could open for a dialogue-based relation between different schools in line with seeing the subject matter as an open system, emphasizing polite and constructive dialogue between different schools (in line with suggestions by e.g. Colander *et al.* 2007; Colander *et al.* 2004; Garnett 2006).

This provides an ontological foundation for a coherent and interested pluralist paradigm, in which paradigm-specific idiosyncrasies can be successively replaced by reflexive and undogmatic pluralist principles capable of guiding future economic research.

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Notes on contributor

Petter Törnberg's research lies on the boundary between social science and complex systems, studying conflict, power and identity through the lens of digital trace data, by combining computational methods with qualitative approaches to contribute to sociological theory.

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