

The future of evolutionary economics is in a vision from the past

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Abstract. This essay comments on discussions of the future of evolutionary economics by Winter (2014) and Witt (2014). I agree with their assessment of evolutionary economics as a theoretically fragmented field that has had little success in effecting a paradigm shift in mainstream economics. However, I question if such a paradigm shift should be the primary goal of evolutionary economists. I argue that evolutionary economists could increase their impact if they would be willing and able to recast themselves as evolutionary social scientists. This was the vision for economics that Veblen held out more than a century ago. I lay out the theoretical building blocks for realizing this vision available today.

1. Introduction

In 1898, Thorstein Veblen published a seminal paper that asked ‘why is economics not an evolutionary science?’ The paper developed a critique of the state of economics at the end of the 19th century and held out a vision of an evolutionary economics that would build on the latest insights into human nature from the behavioral and social sciences to explain ‘the economic life process’. More specifically, the goal of an evolutionary economics would be to build causal explanations of the ‘process of cultural growth as determined by the economic interest’ resulting in ‘a theory of a cumulative sequence of economic institutions stated in terms of the process itself’ (Veblen, 1898: 393). Today, mainstream economics is still dominated by an optimization-cum-equilibrium approach that has difficulty dealing with cumulative change, and a view of human nature emphasizing rational choice and self-interest that is often at odds with crucial empirical facts about human behavior established in the behavioral and social sciences.¹ Clearly, Veblen’s vision of a wholesale evolutionary turn in economics has not taken hold. At the same time, over the last 30 years we have seen the development of an active stream of research known as ‘evolutionary economics’.

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¹ This is not to say that there is no mainstream-oriented research that takes a more realistic view of human behavior (e.g. behavioral economics), or seeks to theorize about cumulative change (e.g. endogenous growth theory), but rather that mainstream respectability depends on positioning this research in terms of incremental extensions of, or minor *addenda* to, the neoclassical view of economics.

Reflecting on the state of this branch of economics, Winter (2014) qualifies it as a pre-paradigmatic science and Witt (2014) concludes that it is fragmented.

I agree with Winter and Witt's assessment of the pre-paradigmatic state of modern evolutionary economics, but I will give a different assessment of its achievements and prospects for the future. In particular, I will argue for the broader perspective that was implied in Veblen's original vision of economics as an evolutionary science and emphasize the potential of an evolutionary approach to social science more generally. From this broader perspective, my assessments of both the achievements and the prospects of evolutionary economics differ from those of Winter and Witt. If we look beyond the achievements of evolutionary economists in reforming the economics discipline, a project which indeed has had limited success (Winter, 2014), and include the impact of evolutionary economists on management and organization research, the picture is more positive than Winter seems to imply. And if we consider the prospects for a paradigmatic evolutionary social science rather than a paradigmatic evolutionary economics, and include the progress made by economists that do not necessarily self-identify as evolutionary economists but that do build on evolutionary theory, then we may be closer to achieving paradigmatic status than Witt (2014) suggests.

Nevertheless, what remains is the challenge to bring together the available building blocks. I will lay out what I see as the pieces of the paradigmatic puzzle in evolutionary social science: naturalistic behavioral foundations, generalized Darwinism, and multi-selection theory. I will argue that if evolutionary economists join forces with other social scientists in putting these pieces together, Veblen's vision of an evolutionary economics may be within reach, and with it the prospects of an effective challenge of the neoclassical paradigm. However, there are three obstacles on this road: first, evolutionary economists will have to see themselves as social scientists first and economists only second; second, more evolutionary research in economics will have to take an explicit behavioral turn; and third, the ambiguities in the relationship of evolutionary economics to the theory of biological evolution will have to be resolved.

2. Assessing evolutionary economics

What is evolutionary economics?

As Winter (2014) and Witt (2014) already emphasized, defining the field of evolutionary economics is not as easy as one might expect.² This is not just because evolutionary-minded economists address a wide variety of topics, ranging from technological innovation, firm behavior and industry evolution to institutional change. It is also because economists use the term evolution in different ways, often simply to denote change. But evolutionary economics is more than the economics of change. Going back to Veblen (1898) and

2 For article length reviews of the field see, for instance, Nelson (1995) or Witt (2008).

Schumpeter (1934), it is the analysis of how economic systems change themselves *from within*.³ This is the criterion singled out by Witt (2014) in his assessment of the various evolutionary approaches in economics when he states that '[t]here seems to be only one common denominator: to interpret changes that are investigated as not only being driven by exogenous shocks but also unfolding according to endogenous forces'.⁴ Winter (2014: 14) goes further in demarcating the field when he states that '[i]t is fundamental that economic evolution, like biological evolution, is a time consuming dynamic process involving sub-processes of variation, inheritance/replication and selection ... It is likewise fundamental that populations of entities are marked by competition for scarce resources.' This statement of the fundamental theoretical commitments of evolutionary economics goes further than Witt's in the sense that it explicitly refers to a Darwinian causal logic as a central feature of evolutionary analysis.

Both the commonalities and differences between Winter and Witt's statements illustrate important features of the evolutionary economics field. The commonalities imply that all evolutionary economists are in some sense committed to analyzing the processes of change by which socio-economic systems change themselves from within. The systems studied may vary, but the nature of the analysis clearly sets an evolutionary approach apart from the optimization-cum-equilibrium approach of mainstream economics, which, for as far as it is interested in change at all, only allows a-historical analyses in terms of adaptations to externally generated shocks that change the given constraints on a system.

The differences between Winter and Witt's statements show the uneasy relation that evolutionary economists have with the theory of biological evolution. This is also the main point of Witt's (2014) essay, with its emphasis on adopting the naturalistic framework proposed by Tinbergen (1963) as a way of integrating and demarcating work in evolutionary economics. In doing so, Witt advocates forging a closer link between work in evolutionary economics and work on human behavior in biology, evolutionary anthropology, and evolutionary psychology. At the same time, Witt is an avowed skeptic when it comes to giving the Darwinian variation-selection-retention logic embraced by Winter a central place in the analytical framework of evolutionary economics (Levit *et al.*, 2011; Witt, 2004).

We may conclude that the common denominator of evolutionary approaches in economics seems to be an interest in dynamics, rather than any particular theoretical commitment. This helps explain the diversity in the historical roots

3 As the introduction to this special issue notes, there are differences in how Veblen and Schumpeter addressed the process of 'change from within', with Veblen emphasizing Darwinian population thinking and Schumpeter emphasizing developmental processes.

4 The quote is from the original version of Witt's paper. In the published version this statement had disappeared. For another statement of 'change from within' as the central feature of evolutionary economics see Witt (2003).

that modern evolutionary economists of varying stripes may claim, ranging from Veblen to Schumpeter, Hayek, and Simon. It also helps explain the conclusion that modern evolutionary economics is fragmented (Witt, 2014). It is probably fair to say that today most people primarily associate the label evolutionary economics with the Neo-Schumpeterian stream of research that emerged in the wake of Nelson and Winter's (1982) seminal book '*An Evolutionary Theory of Economic Change*'. This stream of research is primarily concerned with technological innovation and industry evolution (*cf.* Hanusch and Pyka, 2007) and is the main point of reference in Winter's (2014) paper. At the same time, a bibliometric study by Silva and Texeira (2009) finds that the largest contingent of published work in evolutionary economics is concerned with the history of economic thought. A recent example of this stream of research concerns discussions of the ontological foundations of evolutionary economics, which have, among other things, raised the question which role, if any, theories of biological evolution should play in evolutionary economics (e.g. Dopfer and Potts, 2004; Herrmann-Pillath, 2001; Hodgson, 2002; Hodgson and Knudsen, 2006, 2010; Stoelhorst, 2005, 2008a; Vromen, 2004; Witt, 2008). The underlying ambition in these discussions is to overcome the pre-paradigmatic nature of research in evolutionary economics signaled by Winter (2014). Witt's (2014) paper fits into this stream of research.

What has modern evolutionary economics (not) achieved?

Modern evolutionary economics is in many ways a vibrant branch of economics, as reflected in the success of a number of journals and associations in which evolutionary theory plays an important role.⁵ However, both Winter (2014) and Witt (2014) emphasize what evolutionary economics has *not* achieved. From Veblen (1898) to Schumpeter (1934) and Nelson and Winter (1982), evolutionary economists have positioned their work as an alternative to the neoclassical mainstream and have advocated a paradigm shift in the economics discipline. Such a shift has not taken place, and as both Winter and Witt note, to the extent that the project of evolutionary economics is seen as an attempt to displace the optimization-cum-equilibrium approach at the core of mainstream economics it has been a failure. Bibliometric studies of evolutionary research in economics confirm this conclusion. Silva and Texeira (2009) find that evolutionary research is almost exclusively published in B journals, and Dolfma and Leydesdorff (2010) find that while the leading evolutionary economics journal, the *Journal of Evolutionary Economics*, frequently cites the A journals in the field, the favor is rarely returned.

⁵ These include the International Joseph A. Schumpeter Society (ISS) and its journal the *Journal of Evolutionary Economics*, the European Association of Evolutionary Political Economy (EAEPE) and its part-ownership of the *Journal of Institutional Economics*, the Association for Evolutionary Economics (AFEE) and its journal the *Journal of Economic Issues*, as well as *Industrial and Corporate Change*, *Journal of Bioeconomics*, *Journal of Economic Behavior and Organization*, and *Research Policy*.

It is instructive to consider the parallels between the failure of modern evolutionary economics to have a substantial impact on the mainstream of the economics discipline and the history of the original institutional economics. Hodgson (2004) gives a detailed account of the rise and fall of this latter school of thought, which was quite successful in challenging neoclassical economics for dominance of the mainstream in the interwar period before disintegrating. Central among the reasons for the long-term failure of the original institutional economics was its inability to offer a convincing alternative to the optimization-cum-equilibrium approach of neoclassical economics. Veblen's (1898) exhortation to turn economics into a 'post-Darwinian science' was one of the sources of inspiration for the original institutional economics, but while Veblen formulated a compelling vision neither he, nor his fellows and followers, ever fully articulated an evolutionary paradigm for economics research (Hodgson, 2004; Rutherford 1998). As a result, the original institutionalism developed into a fragmented stream of research that lost out in influence to neoclassical economics and eventually became marginalized.

The fate of the original institutional economics gives us reason to worry about the conclusion that modern evolutionary economics is a pre-paradigmatic science (Winter, 2014) and a fragmented field of inquiry that lacks a common core (Witt, 214). Like the original institutional economists before them, modern evolutionary economists lack an integrative paradigm to study the various phenomena in which they are interested. This may not necessarily be a problem at the level of individual research programs, but without such a paradigm the overarching project of challenging the neoclassical domination of the mainstream is a hopeless task. For such a challenge to be effective, a convincing, full-fledged, alternative to the optimization-cum-equilibrium paradigm and its rational choice foundations is needed.

Redefining the project of evolutionary economics

Paradoxically, the probability that evolutionary economists could mount an effective challenge to neoclassical views would be much increased if their project would *not* be defined in these terms. One reason for this is that even if evolutionary economists would be able to produce a full-fledged alternative to the neoclassical paradigm, it is doubtful that mainstream economists would take note. Consider the role of anomalies in economics research. Winter (2014) notes how the Kuhnian view of science inspired Nelson and Winter's research program. He makes an important point of the fact that the central role of technological change in economic growth that had become apparent in the 1950s constituted an anomaly for the neoclassical paradigm. Addressing this anomaly was a central motivation for Nelson and Winter's research program. So was addressing another one, namely that actual human behavior does not correspond to the behavioral assumptions of the rational choice model underlying the neoclassical optimization-cum-equilibrium paradigm. The

Neo-Schumpeterian research program that Nelson and Winter launched was based on applying insights from the behavioral theory of the firm (Cyert and March, [1963] 1992), most notably the fact that human behavior is driven by bounded rationality (Simon, 1957), to explaining technological change, industry evolution, and economic growth. It dealt with two important anomalies at once and undoubtedly presented a model of how economies operate that was substantially more realistic than the neoclassical model. Yet its impact on mainstream economics has been minimal.

This outcome seems to defy the Kuhnian view of science. Why would neoclassical economics be immune to anomalies? An important part of the answer is that it is not primarily an empirical science. To many neoclassical economists, their project simply isn't the search for scientific truth. It is rather to show how humans *should* behave. Their project is not descriptive, in the sense of explanatory, it is normative. If, following Robbins (1932), economics is defined as the science of allocating scarce resources,⁶ and if its aim is essentially normative, then the fact that actual human behavior does not correspond to neoclassical assumptions is not a problem for neoclassical theory but a problem for humanity: if people only were to behave rationally, this would result in the most efficient allocation of scarce resources. This view of economics research goes a long way in explaining the preoccupation with the deductive logic of equilibrium modeling that is characteristic of neoclassical economics. This preoccupation, in turn, results in an economics that is best understood as a branch of applied mathematics, rather than an empirical science. The criterion for judging mathematics is internal consistency, rather than external empirical validity. Hence, Kuhnian anomalies are unlikely to have any impact.

To the extent that this characterization of mainstream economics discipline is correct, attempts to convince neoclassical economists that an evolutionary approach would lead to better economics research are likely to be just so much wasted energy.⁷ On the neoclassical definition of economics, much of the work by evolutionary economists would not even qualify as economics research simply because it addresses a fundamentally different *explanandum*. In contrast to explaining the allocation of *given* scarce resources, the main emphasis of evolutionary economics is on explaining how cumulative change *alters* the resource constraints in the economy. In combination with a neoclassical line of defense favoring mathematical elegance over empirical realism, this suggests that attempts by evolutionary economists to convince mainstream economists that they are doing better economics research are simply misdirected. On the mainstream view of what economics research should be about, they are not.

6 To be precise 'Economics is the science which studies human behavior as a relationship between ends and scarce means which have alternative uses' (Robbins, 1932: 15).

7 It certainly would be overly simplistic to claim that mainstream economics has no interest in empirical research at all. One example is the increasing impact of behavioral economics.

A better goal than trying to convince mathematically-oriented mainstream economists that evolutionary economists do good economics is to convince empirically oriented social scientists that evolutionary economists do good science. This brings us to a second reason why the chances of a fundamental impact of evolutionary economists on the economics mainstream may be enhanced by not primarily defining their project in those terms. Winter (2014) likens the project of evolutionary economics to establishing a beachhead for the conquest of scientific territory, and the territory he seems to have in mind is the economics discipline. But there is more scientific territory out there, and much of it is far more receptive to evolutionary approaches than economics. Moreover, if we look beyond the achievements of self-identified evolutionary economics and consider the totality of evolutionary approaches that have developed in the social sciences over the last three decades, the beachhead is also much larger.

This broader view of the playing field is born out in a recent bibliometric study (Hodgson *et al.*, 2013). Hodgson *et al.* surveyed the use of evolutionary reasoning in economics, sociology, business, and management from 1986 to 2010, and their results lead to a picture of both the evolution and the current state of evolutionary research in the social sciences. On the negative side, their findings corroborate the conclusions that evolutionary oriented research is relatively fragmented and that evolutionary economics is disconnected from mainstream economics. But two rather more positive conclusions also present themselves. The first is that a number of seminal contributions to evolutionary economics, most notably Nelson and Winter (1982), but also Penrose (1959) and Dosi (1982), are central to a well-connected cluster of literatures in the management discipline. This suggests that while evolutionary economics may be marginal to mainstream economics, it is central to management research. The importance of this should not be dismissed. It would be easy for self-identified economists to shrug off what they may perceive as their accidental impact on an adjacent discipline. But today management research in fact claims a larger piece of scientific territory than economics. Moreover, in contrast to economics, evolutionary oriented research does find its way into the A journals of the management field.

A second positive conclusion that can be drawn from Hodgson *et al.*'s (2013) study is that when we consider the territory to be conquered as the social sciences as a whole, the beachhead is also substantially larger than the one established by self-identified evolutionary economists. One research cluster, in particular, stands out as an important pillar for an evolutionary social science: the research on the evolutionary foundations of human behavior (e.g. Axelrod 1984; Boyd and Richerson, 1985). A central topic in this literature is the evolution of human cooperation (Bowles and Gintis, 2011). Not only is this a crucial topic for understanding economic phenomena that is habitually glossed over in neoclassical theory, but the research on this topic also regularly features in the leading science journals. This adds substantial credibility to an evolutionary approach in social science research that, in the longer run, even mainstream

economists may not be able to ignore. While it may be relatively easy to dismiss research published in the B journals of the economics discipline or in the A journals in an upstart field like management research, it is much harder to ignore work that is published in *Science* and *Nature*.

This brings us back to Veblen's vision of economics as an evolutionary social science. If we survey all the evolutionary oriented research in the social sciences, then the prospects for the type of economics that Veblen had in mind are better than ever – and with it the chances of an eventual paradigm shift in economics. But the best way for evolutionary economists to achieve such a shift would be to primarily define themselves as evolutionary social scientists. This would allow research in evolutionary economics to become an integral part of a broader movement towards a paradigmatic evolutionary social science that is already well under way. However, becoming part of this broader movement does require giving theories of biological evolution more prominence, and as Witt (2014) already noted this is something that Neo-Schumpeterian evolutionary economists have tended to avoid. Even if their work makes use of the Darwinian variation, selection, and retention logic, following the lead of Nelson and Winter (1982), this is typically merely seen in terms of employing a useful analogy (Hodgson, 2002). A crucial move would be to explicitly establish evolutionary economics on naturalistic and Darwinian foundations. The remainder of this essay offers some suggestions for making such a move.

3. Building blocks for a paradigmatic evolutionary social science

Surveying the broader literature on evolutionary theory and its application to socio-economic behavior, we may begin to discern the contours of an evolutionary approach to social science that can help put evolutionary economics on more solid paradigmatic footing. I will sketch these contours through (necessarily short) discussions of three fundamental building blocks for a paradigmatic evolutionary social science: behavioral foundations, epistemology, and ontology.

Behavioral foundations: a naturalistic approach

The starting point of an evolutionary social science should be a naturalistic approach to studying human behavior. A naturalistic approach starts with the explicit recognition that humans are an animal species and that our evolution has been subject to a Darwinian process of natural selection. This means that cultural, and by extension economic, evolution takes place on a substrate of behavioral dispositions that has been shaped by biological evolution. This is what Witt (2003) has referred to as 'the continuity hypothesis'. This hypothesis reflects a widely held conviction in modern psychology and anthropology that we can only fully understand human behavior by taking into account what Veblen referred to as our instincts, or in other words, our genetic dispositions.

Accepting this hypothesis does not imply genetic reductionism: what sets humans apart from other animal species is our capacity for culture. While other species have culture, our abilities for symbolic language and imitation are vastly more developed than they are in other animal species, and, as Veblen (1898) already recognized, when studying ‘the economic life process’ we are in fact studying a process of cultural evolution. However, the nature of this process needs to be understood in relation to genetic evolution: because of its relatively slow pace, genetic evolution, in the (in)famous words of E. O. Wilson (1978), holds cultural evolution on a leash – although in the long run culture feeds back on genetic evolution. These two aspects of building naturalistic explanations of human behavior are reflected in the research programs of evolutionary psychology (Barkow *et al.*, 1992), which is interested in understanding how the behavioral dispositions that we have inherited from our Neolithic past affect our modern behaviors, and evolutionary anthropology (Boyd and Richerson, 1985; Richerson and Boyd, 2005), which explains socio-economic change in terms of the co-evolution of genes and culture.

Adopting a naturalistic approach to studying economic evolution has two important implications. First, it forces evolutionary economists to take a more explicit behavioral turn. On the one hand, from Veblen’s (1899) analysis of conspicuous consumption, through Schumpeter’s (1934) emphasis on the heterogeneity of entrepreneurial proclivities, to the central role of bounded rationality in Nelson and Winter (1982), evolutionary economists have always been intent on building their theories on more realistic behavioral assumptions than neoclassical economists. In fact, the need to build economic theory on the latest insights into human behavior from the behavioral sciences was a central point in Veblen’s (1898) vision for an evolutionary economics. On this point, however, modern evolutionary economics has not made much progress beyond following the lead of Nelson and Winter in giving bounded rationality a central place in its theorizing. Harsh as it may sound, on this particular aspect, modern evolutionary economics, at least in its Neo-Schumpeterian manifestations, barely qualifies as an evolutionary science in the sense envisioned by Veblen.

A second implication of taking a naturalistic approach to studying economic evolution is that it naturally leads to Witt’s (2014) proposal to embed theory development in Tinbergen’s (1963) framework – a proposal that is also central to a number of contributions to a recent special issue of the *Journal of Economic Behavior and Organization* on the possible role of evolutionary theory in economics (Wilson and Gowdy, 2013; Stoelhorst and Richerson, 2013). Tinbergen developed his framework to make sense of different types of theory building with respect to animal behavior. Incorporating an earlier distinction between proximate and ultimate explanations in biology by Mayr (1961), Tinbergen’s framework was able to integrate what before seemed a fragmented field of inquiry. As humans are an animal species, the framework

holds the promise of playing a similar role for research on human behavior. At a minimum, adopting it would allow evolutionary economists to join forces in understanding human behavior with biologists, evolutionary psychologists, and evolutionary anthropologists, as well as other economists who may not necessarily identify with the label ‘evolutionary economics’ but who do study human behavior from an evolutionary perspective (e.g. Bowles and Gintis, 2011).

Tinbergen’s framework can be instrumental in establishing a crucial building block for a paradigmatic evolutionary social science: a realistic and empirically grounded alternative to the behavioral foundations of the rational choice model. Stoelhorst and Richerson (2013) is an attempt in this direction based on an application of Tinbergen’s framework to explaining human cooperative behavior. Human cooperation is not just an interesting topic because of its obvious economic significance, but also because there is a long history of attempts to explain it on the basis of rational choice models.⁸ It turns out that these models cannot explain human cooperation. While models based on kinship selection and (indirect) reciprocity offer plausible explanations of cooperation among self-interested agents, they fail to explain the particular nature of human cooperation, which extends to large-scale cooperation among non-kin. Instead, the evidence points to an explanation in terms of a combination of group selection and gene-culture co-evolution. Operating over a long evolutionary history, these mechanisms have played an important role in shaping our cooperative dispositions and as a result a large percentage of human agents is much more cooperative than neoclassical economists assume (Bowles and Gintis, 2011; Stoelhorst and Richerson, 2013).

In fact, empirical results from social psychology and behavioral economics begin to suggest a specific alternative to the standard behavioral assumptions of rational choice theory. Rather than assuming that human behavior needs to be explained in terms of the rational maximization of self-interest,⁹ the evidence suggests that it needs to be understood in terms of the social interactions among three major classes of agents: a substantial minority whose motivations are indeed consistent with the self-interest assumptions of neoclassical economics, a majority of so-called reciprocators, and a small number of competitors (*cf.* Stoelhorst and Richerson, 2013). This means that an evolutionary social science should not only be based on acknowledging bounded rationality, but also should adopt an empirically grounded notion of ‘bounded self-interest’.¹⁰

8 The reason for this is that biology shares a base-line model with neoclassical economics in the sense that the Darwinian variation–selection–retention model can only reward behaviors that are in the reproductive self-interest of the individual.

9 As Field (2007) observed, the rational choice approach can in principle accommodate all kinds of (social) preferences, but in practice it typically goes hand-in-hand with assuming self-interest.

10 For a recent evolutionary approach to human morality, see Hodgson (2013).

Epistemology: generalized Darwinism

The second building block for a paradigmatic evolutionary social science is generalized Darwinism (Aldrich *et al.* 2008; Hodgson, 2002; Hodgson and Knudsen, 2006, 2010; Stoelhorst, 2005; 2008a). At its heart, generalized Darwinism is nothing more or less than an attempt to specify what an evolutionary explanation entails.¹¹ In Veblen's terms, it is about specifying the causal logic that is central to an evolutionary social science. In its specification of this logic, generalized Darwinism finds inspiration in evolutionary epistemology. Evolutionary epistemology holds that all knowledge is the result of a variation, selection, and retention algorithm (Campbell, 1960; Dennett, 1995; Plotkin, 1994). Importantly, knowledge is seen as equivalent to adaptive complexity (Plotkin, 1994). In a very fundamental sense, the adaptations of living organisms to their environments (for instance, the beaks of Darwin's finches) are similar to what we would refer to as knowledge in everyday language (for instance, knowing how to drive a car).¹² Both allow *functional* behaviors, i.e. behaviors that work in the local environment, and both are the result of a particular organization of the system displaying that behavior – an organization that has been shaped by the positive and negative feedback of cycles of interactions with the local environment. In the case of the beaks of Darwin's finches, natural selection provided the feedback in generational cycles, resulting in a functional morphology encoded in the species' genes. In the case of driving a car, trial and error learning provided the feedback over the course of a number of driving lessons, resulting in functional behaviors encoded in an individual's neural connections.

One of Darwin's achievements was that he did away with the need for invoking a superior intelligence to explain the adaptive complexity that is everywhere in evidence in nature. What he showed was that functional designs could emerge from more or less random, bottom-up processes without intelligent top-down interference. As long as there is a mechanism to keep introducing new variations in the way a system interacts with its environment, a positive and/or negative feedback loop from the environment to select the variations that work best, and a way to retain the better variations so that they can become the basis for the next cycle of variation, selection, and retention, then given enough cycles the result will be a system that is adapted to its environment. The importance of this insight for evolutionary social science can hardly be overstated. Its implication is that, barring an omniscient and omnipotent designer, all adaptive complexity must be the result of a Darwinian process. To appreciate this, consider the typical

11 Deriving this specification involves both matters of epistemology and ontology – the latter are discussed below.

12 An economically more relevant example than driving a car would be building a car, but the collective nature of this process introduces complications that will be dealt with in the discussion of ontology below.

objection to emphasizing the centrality of Darwinian processes in economic evolution: that evolution takes on a different nature once human intentionality plays a role.

This was Penrose's (1952) reason for eschewing Darwinism in her theory of the evolution of firms (Penrose, 1959). It was also Nelson and Winter's (1982) reason for calling their theory Lamarckian rather than Darwinian. And it is still a central argument among opponents of generalized Darwinism as a fundamental building block for evolutionary theory in economics today. But this objection is misguided, and this can be seen if we acknowledge that human intentionality is constrained by bounded rationality and Knightian uncertainty. Giving these two phenomena a central place in theory development is one of the things that sets evolutionary economics apart from the mainstream. But recognizing their important role in human affairs also means that we must acknowledge that human intentionality does not change the fundamental nature of the process that leads to knowledge. As long as there is some residual of trial and error in the process, as under conditions of bounded rationality and uncertainty there must be, the process is Darwinian. Whether or not variation is guided, for example, may have consequences for the number of feedback cycles that are required to hone in on functional behavior, but the only *alternative* to a Darwinian variation–selection–retention process is to posit an omniscient and omnipotent intelligence. On a continuum from purely random variation to the perfect foresight of an omniscient and omnipotent designer, human behavior is somewhere in between. But all of the processes on that continuum, with the only exception of the omniscient and omnipotent designer, are Darwinian.

Note that Tinbergen's naturalistic framework and generalized Darwinism go hand in hand. Darwinism provides the explanatory logic for the ultimate explanations in Tinbergen's framework and without the Darwinian logic there is no naturalistic approach. In that sense the fact that Witt (2014), who has been one of generalized Darwinism's main opponents, advocates Tinbergen's framework could be taken as a sign that the controversy surrounding generalized Darwinism may be resolved. At the same time, critics of general Darwinism have never denied the central role of the Darwinian logic in explaining the genetic substrate of human behavior, and over the years their opposition to generalized Darwinism has increasingly been couched in terms of doubts if Darwinism can lead to very insightful explanations of more complex economic phenomena at levels of analysis above the individual. It is therefore not necessarily inconsistent to adopt Tinbergen's framework and be critical of generalized Darwinism, but such a position would imply that Tinbergen's framework only can be applied to explaining individual, as opposed to collective, behavior.¹³ However, restricting evolutionary analyses to individual behavior would mean that the bulk of the

13 In that sense the more relevant fact in light of the debate on generalized Darwinism is not that Witt (2014) advocates Tinbergen's framework as such, but that he uses it to analyze collective-level institutions.

research interests of evolutionary economists would fall outside the purview of an economics grounded in Tinbergen's framework. As Winter (2014) notes, one of the reasons that the economics discipline has an important role to play among the social sciences is its systemic point of view. Therefore, the question is how Tinbergen's framework and generalized Darwinism can also help build better theories of such complex collective phenomena as organizational learning, technological innovation, industry evolution, institutional change, and economic growth.

Ontology: multi-level selection theory

This question brings us to what is probably the main frontier of a paradigmatic evolutionary social science today: an articulation of its ontology. It is one thing to claim that economic evolution can be understood as a Darwinian process, but quite another to translate this statement into a fruitful conceptualization of social reality that is amenable to an evolutionary analysis. For instance, let us follow Winter (2014) in adopting Veblen's specification of the main *explanandum* of an evolutionary economics: 'the process of cumulative change that is to be accounted for is the sequence of change in the methods of doing things – the methods of dealing with the material means of life' (Veblen, 1898: 10). One way of interpreting this statement is to say that the central aim of evolutionary economics is to explain the growth of productive knowledge – where productive knowledge can be understood as the human ability to create (material) welfare. This ability is a collective phenomenon, and explaining its evolution calls for carving social reality at its joints.

Evolutionary economists are well aware that explaining our ability to create material welfare requires consideration of such collective phenomena as firms, technologies, and institutions. But how do these collective phenomena fit into an evolutionary ontology? Ongoing discussions about such central concepts as routines and institutions in the evolutionary economics literature indicate that the answer to this question is not necessarily clear. For instance, Nelson and Winter (1982) held that the explanatory role of the concept of routines in their theory was equivalent to the role of genes in the theory of biological evolution. But from the point of view of generalized Darwinism, the notion of routines as the genes of organizations is at best a very loose metaphor (Stoelhorst, 2005). Moreover, as Hodgson (2002) has pointed out, Nelson and Winter refer to the routines concept in terms of both the phenotype and the genotype of an organization. This compromises the Darwinian explanatory logic, which hinges on a clear distinction between these two components of an evolving system (Stoelhorst, 2008a). So, while routines no doubt are a very successful and theoretically useful concept, the place of this concept within an evolutionary ontology that is

As he noted in personal communication, his essay leads 'to conclusions that leave room for Generalized Darwinism' (email dated 5 November 2013).

grounded in naturalistic and Darwinian foundations is not necessarily clear. The same can be said for the concept of institutions.

One way of dealing with such ontological problems is to take a bottom-up approach to conceptualizing social systems (Stoelhorst, 2008b). In such an approach, the interactions among individual human agents are explicitly seen as the historical and ontological linking pin between genetic and cultural evolution. This is consistent with the perspective taken by Veblen (1898: 391) when he stated that '[a]ll economic change . . . is always in the last resort a change in habits of thought'. This means that central concepts like routines or institutions ultimately need to be understood as multi-level phenomena: they are concepts at a collective level of analysis, but fundamentally depend on individual level cognitive mechanisms. This, in turn, brings us to a fundamental problem in all of the social sciences: the relationship between agency and structure. Translated to the case of routines, the problem is that routines are both the result of human agency and impose structure on this agency.

The paradigmatic building block that evolutionary theory offers to deal with the multi-level nature of agency-structure problems is multi-level selection theory (Sober and Wilson, 1998). Multi-level selection theory recognizes that the evolution of collective entities like human groups (be they ancestral tribes or modern firms) needs to be understood in terms of the net effect of two selection processes. Competition for scarce resources among individuals within a group (within-group selection) is likely to undermine the stability of a collective entity (Campbell, 1994), but if there are sufficient advantages to group membership, competition among collective entities (between-group selection) can overcome this effect and help stabilize cooperative solutions. The contributions of this logic towards a paradigmatic evolutionary social science are twofold.

First, multi-level selection theory complements the explanatory logic of generalized Darwinism in the sense that it offers a crucial building block for explaining *cumulative* change. The Darwinian variation–selection–retention algorithm can explain how existing complex systems become adapted to their local environments, but to explain how the evolutionary process is able to accumulate adaptive complexity we need to invoke multi-level selection. Of course, in doing so, we are 'simply' acknowledging that the Darwinian algorithm can simultaneously operate at multiple levels of analysis, but this conceptual move is crucial for our ability to explain how a bottom-up process can lift itself up to ever higher levels complexity.¹⁴ The second contribution of multi-level selection theory is that it offers a framework for taking a bottom-up approach to carving social reality at its joints. It suggests that social systems are best understood in terms of the more or less stable interactions among individual

14 In biology, multi-level selection logic is central to explaining major transitions like the evolution of multi-cellular organisms out of their single-celled ancestors, or the evolution of colonies out of individual organisms (Maynard Smith and Szathmary, 1997).

human agents. To the extent that these interactions stabilize we can speak of groups, and to the extent that these groups are in competition with other groups (either for members, status, or material resources) they become units of selection in their own right.

As an example of how multi-level selection theory can help clarify social ontology let us return to the case of routines. Evolutionary epistemology suggests that we should understand firms as complex adaptive systems: firms evolve knowledge that allows them to display functional behaviors in interactions with their environments. If we understand routines as collective action patterns, then routines can be understood as *expressions* of the productive knowledge that a firm has evolved: routines are (the building blocks of) functional behaviors.¹⁵ But this obviously leaves us with the question what it is that enables the expression of a firm's productive knowledge in such functional behaviors. Taking a bottom-up approach, much of the productive knowledge of a firm may be thought of as dispersed knowledge residing in the individual employees that make up the firm. But following the logic of multi-level selection, an equally crucial part of the firm's productive knowledge lies in its ability to achieve the cooperation and coordination that is necessary to express this knowledge in collective action patterns. This suggests that understanding routines requires an understanding of the rule systems that firms evolve to enable functional collective action. On this view, these rule systems are the 'genotype' of firms and routines themselves are part of the firm's phenotype.¹⁶

4. Conclusion

Evolutionary economics in its various manifestations, from the classical contributions of Veblen and Schumpeter to Nelson and Winter and modern evolutionary economics, has always been about building theories of the cumulative endogenous change of economic systems on the basis of realistic behavioral assumptions. An important inspiration for this project has been the desire to offer an alternative for the neoclassical optimization-cum-equilibrium approach and its rational choice foundations. Offering an alternative to the dominant paradigm in economics is a laudable goal, and the prospects for doing so are more promising than ever. But this does not mean that evolutionary economists serve themselves well by defining success in terms of their impact on the economic mainstream. Paradoxical as it may seem, the likelihood of a substantial impact on this mainstream would be increased if evolutionary economists are willing to cast themselves as evolutionary social scientists first, and as economists only second. A crucial step in this direction would be for evolutionary economics research to take a more explicit behavioral turn.

15 Of course, routines also can become maladaptive when the environment changes.

16 Stoelhorst (2014) develops these arguments in more detail.

The prospects of a paradigmatic evolutionary social science, and with it a paradigmatic evolutionary economics, are more promising than ever. The behavioral, epistemological, and ontological foundations for such a science are coming into focus. Following the logic of Tinbergen's framework, there has been enormous progress on understanding the evolutionary foundations of human behavior in a range of behavioral sciences that have adopted a naturalistic perspective, like evolutionary psychology, evolutionary anthropology, and parts of behavioral economics. And following the lead of philosophers and philosophically inclined social scientists, including some self-identified evolutionary economists working on generalized Darwinism, we have a fairly good grasp of what an evolutionary explanation entails. Currently, the most pressing puzzles concern ontology, in particular the conceptualization of socio-economic systems as both the emergent result of interactions among social actors and as the constraints on these same interactions. Multi-level selection theory gives us a way to systematically think about this. It is here, in particular, that economists can contribute to the development of an evolutionary social science by virtue of their systemic view: through developing and testing theories of organizations, technological regimes, and institutions as the products of multi-level selection. If such theories are also grounded in realistic behavioral assumptions, Veblen's vision of economics as an evolutionary science may be in reach.

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