On the Application of Darwinism to Economics: 
From Generalization to Middle-range Theories

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Abstract:

The purpose of this paper is to clarify and advance the recent ontological debate about the appropriate role of Darwinism in evolutionary economics. We unravel the arguments in this debate on the basis of a multi-level model of Darwinian theory that distinguishes between generalized meta-theory, specific middle-range theories, and empirical models. Doing so allows us to demonstrate that the arguments against the use of generalized Darwinism have been formulated in terms of critical evaluations of middle-range theories that have been developed on the basis of Darwinian precepts. We argue that these criticisms are both warranted and essential for the progress of the field, but that they do not invalidate the meta-theoretical claim of generalized Darwinism. We show that there are good reasons to prefer a generalized version of Darwinism at the level of meta-theory, but that the project of generalizing Darwinism is still ongoing and that there is no consensus on which specific version of generalized Darwinism to adopt in economics. We advocate empirically driven theory development at the level of middle-range theories on the basis of a version of generalized Darwinism that abstracts from the notions of inheritance and replication.

1. Introduction

There has recently been much interest in the ontological foundations of evolutionary economics (Dopfer 2005; Dopfer, Foster and Potts 2004; Dopfer and Potts 2004; Hodgson 2001, 2002; Hodgson and Knudsen 2006a,b; Stoelhorst 2005a,b; Vromen 2004; Witt 2003, 2004). Central questions in this literature are if Darwinism can play a role in strengthening the ontological foundations of economics, and if so, what this role should be? Special issues of the *Journal of Economic Methodology* (Klaes 2004) and the *Journal of Evolutionary Economics* (Witt 2006) are testimony to the lively debate around these questions. There are those who advocate a generalized version of Darwinism as the starting point for theory development in evolutionary economics (Hodgson 2001, 2002; Hodgson and Knudsen 2004, 2006a, Stoelhorst 2005a,b), while others strongly oppose this view (Witt 1999, 2003, 2004; Nelson 2006; Buenstorf 2006; Cordes 2006).

Vromen (2004) has argued that both supporters and critics of generalized Darwinism have tried to specify the general features of evolution, but that they disagree about (1) what the term evolution stands for, and (2) to what extent, and in which respects, processes of evolution in economics differ from evolutionary processes in other domains. The aim of this paper is to clarify the debate on these two issues by distinguishing between types of theories and different levels of theory development. We distinguish between meta-theory, middle-range theory and empirical models, and clarify the current ontological debate in these terms. We demonstrate that some of the arguments against the *meta-theoretical claim* of generalized Darwinism have in fact been formulated in terms of criticism at the level of *middle-range theories*. We argue that this has confused the debate and that fundamental questions about the possible role of Darwinism in economics can only be answered by carefully separating the arguments at different levels of theory development.
The paper proceeds as follows. Section 2 presents an analytical framework to unravel the structure of evolutionary theory. Section 3 discusses the debate around the meta-theoretical question ‘what does the term evolution stand for’? We argue that on logical grounds a Darwinian answer to this question has distinct advantages over competing answers, but we also show that attempts to generalize Darwinism are still ongoing. At least three different versions of generalized Darwinism need to be distinguished, each of which entails different ontological commitments. Section 4 discusses the debate with respect to the middle-range question ‘to what extent and in which respects do processes of evolution in economics differ from evolutionary processes in other domains’? We show that there is widespread consensus about the ways in which evolution in biology and economics differ, but that there is disagreement about the specific mechanisms that best capture evolution in these separate domains. Section 5 evaluates the state of affairs in the debate by discussing the points of agreement and disagreement on the ontological commitments that should drive the development of evolutionary theory in economics.

We conclude that only empirically informed discussions at the level of middle-range theories would be able to settle the debate on the possible value of Darwinism for evolutionary economics. However, we argue that the warranted criticisms that have been levied at the few middle-range theories developed on the basis of Darwinian precepts do not invalidate the claim of generalized Darwinism as such. There are strong meta-theoretical arguments to favor generalized Darwinism over alternative generalizations of the evolutionary process. At the same time, we should realize that the generalization of Darwinism is itself a project that is still ongoing and that there are different versions of generalized Darwinism that could guide the project of developing empirically meaningful middle-range theories. We see the ontological commitment to replicators and interactors of the Dawkins/Hull version of generalized Darwinism as problematic and advocate the Campbellian version of generalized Darwinism that abstracts from inheritance and replication mechanisms.

2. The structure of Darwinism: An analytical framework

We discuss the arguments in favor and against the use of generalized Darwinism in economics in terms of a simple hierarchical categorization of evolutionary theory (see Figure 1). This categorization draws on previous attempts to model the structure of Darwinian theory in biology (Ruse 1973; Tuomi 1983). ‘Darwinian theory’ is best viewed as a complex structure of different theories, connected by the central thesis of the general applicability of the Darwinian causal logic. Theories at different levels range from abstract with little empirical content at the highest level, to concrete theories of evolutionary change with specific empirical implications at the lowest level. The challenge in theory development is to establish clear connections between the different levels, ultimately leading to a situation in which the empirical confirmation of middle range theories via specific hypotheses and models provides evidence for the more abstract and general claims of the Darwinian logic. We propose the following categorization of Darwinian theories:
1. The meta-theory (MT)
At the highest level, a meta-theory should formulate the most abstract and fundamental principles of evolution. It is at this level that the question ‘what does the term evolution stand for?’ should be answered. An answer to this question does not include a specification of the detailed mechanisms leading to evolution: it is an exposition of the underlying logic of evolutionary change. There may well be different ways in which the theory at this level could be specified. In fact, as we will see, even in the specific case of generalized Darwinism there is no consensus about the best way of capturing the most abstract principles of evolution. And it is certainly possible that there are ways in which the most general principles of evolution could be captured without referring to Darwinism. What is important is that while the development of theories at this level is more a matter of logic than of empirical content, the specification of a meta-theory does lead to certain ontological commitments. For instance, a commitment to a generalized version of Darwinism at this level would mean that open complex systems studied by means of more explicit, lower level theories, are subject to Darwinian mechanisms and laws.

2. Middle range theories
Middle range theories postulate hypotheses about the evolutionary forces in a specific domain. The question ‘to what extent and in which respects do processes of evolution in economics differ from evolutionary processes in other domains?’ should be answered at this level. An answer to this question requires that the mechanisms of evolution in the meta-theoretical logic are given specific content for the domain in question. For instance, a commitment to a version of generalized Darwinism formulated in terms of variation, selection and retention at the meta-theoretical level would imply that a middle range evolutionary theory of, say, the firm should be specified in terms of assertions about the workings of variation, selection and retention that drive the evolution of firms. Theories in different domains may be very different at the level of the specific mechanisms, but their causal Darwinian logic, as postulated by the meta-theory, is the same. At the middle range level of theory development, an additional distinction can be made between:
2a. Auxiliary theories (AT)
Auxiliary theories aim to identify and address specific components of the overall evolutionary explanation. A good example of an auxiliary theory from biology is genetics. Economic examples would include studies of routines as a mechanism of retention, and theories of market selection. Auxiliary theories have clear empirical implications and should therefore be testable.

2b. Domain specific theories (DST)
A domain specific theory is a complete account of the mechanisms that drive evolution in a specific domain that can explain the patterns and outcomes of evolution in that domain. It is composed of different auxiliary theories. The Neo-Darwinian synthesis of Mendelian inheritance and natural selection is an example from biology. Perhaps the best example in economics is the research agenda set by Nelson and Winter (1982) to explain economic growth on the basis of a combination of evolutionary arguments about technological change and organizational learning.

3. Specific hypotheses of Darwinian evolution and theoretical models (SH/M)
Specific hypotheses and theoretical models build on a research agenda set by the domain specific theory. At this point, auxiliary assumptions are introduced to make predictions about the evolutionary paths of change of in the domain in question. Whereas higher-level theories give an account of the mechanisms that drive evolution in a certain domain, hypotheses and models of Darwinian evolution draw on this general scheme to formulate explanations of specific phenomena. At this point, the combination of (1) a domain specific evolutionary theory and (2) additional assumptions should ultimately lead to empirically testable predictions. An example from biology would be models that explain altruism. Examples in economics include the quantitative models of Nelson and Winter (1982), empirical research in organizational ecology (e.g. Hannan and Freeman 1989) and models of cultural evolution (e.g. Richerson and Boyd 2005).

The reason for categorizing theories in this hierarchical way is to obtain a deeper understanding of the nature of, and relationship between, different types of evolutionary explanation. This can help clarify the discussion about the contribution of Darwinism to the ontological foundations of evolutionary economics by unraveling arguments at different levels of theory development. For instance, to what extent does empirical falsification of lower level theories undermine the more abstract logical claims at the higher level? Or, if generalized Darwinism were not seen fit to serve as the overarching logic to explain evolution in the cultural domain, what would be a meta-theoretical alternative that can inform the development of adequate lower level theories? The next section will first address the latter question, while section four will turn to the former.

3. Debating Darwinism in economics at the meta-theoretical level
Questions about the possible role of Darwinism in furthering theory development in the social sciences are almost as old as Darwinism itself. However, the debate on these questions has recently been revived by claims that a generalized version of Darwinism applies to the evolution of all complex, open systems (Cziko 1995, Plotkin 1995, Dennett 1996). In economics, this claim has received support from some (Hodgson 2002, 2003; Hodgson and Knudsen 2006a; Stoelhorst 2005a,b), and has been rejected by others (Witt 1999, 2003, 2004;
Buenstorf 2006, Cordes 2006, Nelson 2006). The advocates of a generalized version of Darwinism hold that it captures what is general about evolution, while its opponents typically argue that it does not entail more than the construction of a possibly misleading biological analogy.

If the opponents of generalizing Darwinism were right to claim that it amounts to no more than an analogy construction, this would indeed constitute a devastating critique of the project of generalized Darwinism. After all, the central purpose of generalized Darwinism is to avoid getting hung up on biological analogies. The claim of generalized Darwinism is that the causal logic of Darwin’s theory of biological evolution can also explain evolution in other domains. Therefore, Darwin’s theory needs to be generalized by abstracting from specific biological content. This idea entails a very explicit answer to the question ‘what does the term evolution stand for’? Advocates of generalized Darwinism view the features of evolution that are captured by the fundamental logic of Darwin’s theory as general to all evolutionary processes. The project of generalized Darwinism therefore consists of uncovering the explanatory logic of Darwin’s theory so that it can be applied to understanding evolution in domains outside biology. The crucial issue in the ontological debate at the meta-theoretical level has been the value of this project.

3.1 The project of generalized Darwinism at the meta-theoretical level

There are at least two good reasons for the project of generalized Darwinism. The first is inductive and empirically informed: the evolution of many different types of system seems to involve Darwinian principles. The second reason is deductive and logically derived: barring an omniscient and omnipotent designer, the recursive causal logic of Darwinism is the only logically consistent explanation for the evolution of adaptive complexity (Dawkins 1983; Czikó 1995; Dennett 1996). Together, these two points provide a strong motivation to uncover what is general about Darwinism so that its explanatory logic can be widely applied.

Another question is to what degree such attempts have been successful. It is important to note that generalized Darwinism is not at all a theory that is set in stone. To the contrary, generalizing Darwinism is a project that is still in progress, and that has spawned a number of different attempts to capture what is general about evolution. We should distinguish at least three different ways in which attempts at generalizing Darwinism have been made, each of which has received its share of attention in economics.

Lewontin, Campbell and Plotkin have developed the first way of generalizing Darwinism. Each of these authors has explicitly tried to generalize Darwinism, although their specific ways of formulating the essence of Darwinism differ. Lewontin (1970) holds that the generic features of evolution are variation, differential fitness, and heritable fitness. Campbell (1960, 1965) sees the essence of Darwinism as involving a combination of variation, selection and retention (v-s-r) mechanisms. Plotkin (1995) subscribes to their views but contends that an even more general version of generalized Darwinism might be generate-test-regenerate (g-t-r). The common feature of these views is that three Darwinian mechanisms are brought to the foreground: a selection mechanism, a mechanism that causes variation and a mechanism that ensures that information about ‘what works’ is retained. In economics, generalizing Darwinism along these lines has been advocated by Hodgson (2002, 2004) and Stoelhorst (2005a,b), albeit with different emphases on which version to adopt. Hodgson has preferred variation-selection-inheritance, which is closest to Lewontin’s version. Stoelhorst has
advocated Campbell’s variation-selection-retention version because it more explicitly steers clear of genetic analogies.

A second way of generalizing Darwinism has been developed by Dawkins and Hull. These authors have emphasized the multi-level nature of selection by putting the genotype-phenotype distinction centre stage and have tried to generalize this distinction beyond biology. Dawkins (1976) coined the terms ‘replicator’ and ‘vehicle’ as a generalization of the genotype-phenotype distinction. Hull (1988) changed this terminology to ‘replicator’ and ‘interactor’ to better capture the active role of the organism, or any other carrier of replicators, in its interaction with the environment. Plotkin (1995) describes this view as the RIL approach, for replicator, interactor, lineage. In economics, Hodgson and Knudsen have advocated this version of generalized Darwinism in their most recent work (Hodgson and Knudsen 2004, 2006a,b).

A third possible way of generalizing Darwinism is general selection theory (Price 1995). Knudsen has been the most verbal advocate of this approach in economics (Knudsen 2002, 2004; Hodgson and Knudsen 2006b). This theory turns on a mathematical specification of selection as the correspondence of two sets of entities at different points in time. It subsumes both ‘subset selection’ and ‘generative selection’. Subset selection amounts to choosing from an existing set of entities, without replenishment of this set, while generative selection also includes a mechanism to replenish variety in the set from which the selections are made. Subset selection may be part of Darwinism, but only generative selection can lead to adaptive complexity (Stoelhorst 2005b; Hodgson and Knudsen 2006b).

It is still an open question which of these versions of generalized Darwinism can best serve the development of evolutionary theories of economic phenomena. While general selection theory may prove to be a very useful tool in developing specific evolutionary models, it is questionable whether it can give much guidance to the ontological discussion about the role of Darwinism in evolutionary economics at the level of middle-range and meta-theory. Such guidance would require more specific clues on the mechanism that drive evolutionary processes than the ones provided by its mathematical specification. On the other two ways of generalizing Darwinism, Plotkin (1995, p.100-101) has remarked:

‘There remains the question of which is the better approach to identifying the units of selection: should it be a search for the mechanisms subserving the g-t-r (which I have labeled the Lewontin-Campbell approach), or should we be looking for replicators, interactors and lineages, the Dawkins-Hull approach? At present, we just do not know which is the best way to go about dissecting out the mechanisms, the units of evolution … Given these great gaps in our knowledge, we cannot yet be prescriptive but have to try both approaches, and probably change each, before we know with any certainty what is the best conceptual road to follow.’

The current debate in economics can be seen as an important contribution to this project because it is forcing us to consider what the ontological commitments of these different versions of generalized Darwinism are.

3.2 An alternative to generalized Darwinism?

Opponents of generalized Darwinism have claimed that its project amounts to no more than a possibly misleading biological analogy construction (Witt 2003; Cordes 2006; Nelson 2006). But if Darwinism is denied as a useful specification of the general features of evolution, it is reasonable to ask what an alternative way of capturing evolution would be. In other words,
what are the alternative generalizations of evolution that have been proposed by critics of generalized Darwinism?

Surprisingly, upon closer scrutiny the views on both sides of the debate do not always differ all that much. For instance, although Nelson (2006) positions his paper as a critique of generalized Darwinism, he seems to subscribe to a generalization of evolution that is consistent with the Campbellian version of generalized Darwinism:

‘… a broad evolutionary theory that posits that change occurs through a process that involves variation, selective retention, sources of new variation is a very powerful source of understanding regarding human cultural change … A universal Darwinism that is open to the nature of the detailed mechanisms involved … would be a very useful theory, that facilitates and stimulates interesting discussion across a wide range of disciplines’ (p.493-494).

In contrast, Witt (2003, 2004) does present an explicit alternative to generalized Darwinism. His contribution to the explanation of evolution in the cultural and economic sphere is based on two pillars: the continuity hypothesis and a general characterization of evolution in terms of the emergence and dissemination of novelty. Cordes (2006) summarizes the continuity hypothesis as follows:

‘At some point in time, Darwinian evolutionary theory lost its power to explain human behavior … Other forms of evolutionary change continue beyond that point within the freedom left by the constraints of Darwinian theory, though with different means and according to their own regularities. This establishes an ontological continuity of evolution, yet without expanding the domain of Darwinian concepts to these new evolutionary phenomena. There are other, cultural, domain specific realizations of evolutionary processes … natural evolution has shaped the ground and still defines the constraints for man-made, or cultural evolution. There is an ontological continuity between biological and cultural evolution, despite the fact that mechanisms and regularities differ between these domains’ (p.531).

The continuity hypothesis has been advanced as an alternative way of using Darwinism to strengthen the ontological foundations of evolutionary economics. But such a view turns on a false opposition between ontological continuity and generalized Darwinism. The ontological continuity hypothesis not only complements generalized Darwinism, but is in fact an essential part of it. Consider Dennett’s (1996) notion of the evolutionary process as a walk through the space of all possible design. In this view, all adaptive complexity (design) is the result of a Darwinian process that started from simple beginnings in biology and has worked its way up to cultural evolution by eventually producing humans capable of deliberated action. Dennett’s view of generalized Darwinism is (1) that all adaptive complexity needs to be understood as the result of one ongoing cumulative evolutionary process, and (2) that this evolutionary process needs to be understood in terms of the Darwinian logic. The first point establishes the ontological continuity of all evolution, and the second point establishes that all evolutionary processes are ontologically similar. In other words, generalized Darwinism and ontological continuity are entirely compatible. Where the advocates and opponents of generalized Darwinism differ is not on the first, but on the second point.

In contrast to the ontological continuity hypothesis, Witt’s characterization of evolution as involving the emergence and dissemination of novelty can be considered a possible alternative to generalized Darwinism as a meta-theory of evolution. Whereas advocates of generalized Darwinism hold that cultural evolution follows the causal logic captured by Darwin’s theory of biological evolution, Witt and his supporters claim that what is general
about evolution in biology and culture is the emergence and dissemination of novelty. However, formulated in these terms, the theory of evolution is reduced to a theory of change over time, and it is not entirely clear what the explanatory logic of the theory is. Is ‘the emergence and dissemination of novelty’ a statement about dependent variables, about independent variables, or about the mechanisms by which the state of a system changes from time t to time t+1? It may well be possible to develop this view of the generic characteristics of evolution into a full-fledged meta-theory, but in its current form it seems to mostly describe the phenomenon to be explained without specifying a causal logic.

The meta-theoretical point is that generalized Darwinism can already explain this phenomenon, along with other phenomena. Moreover, it does so on the basis of a well-developed recursive causal logic. In essence, the emergence and dissemination of novelty is about how variety evolves from common origins. This is one of the explananda of generalized Darwinism, and it is explained on the basis of a clear logic. Mechanisms of variation are necessary to explain the emergence of novelty, and a combination of mechanisms of selection and retention is necessary to explain the dissemination of this novelty over time by way of selective retention. Also, in addition to being able to explain variety from common origins, generalized Darwinism can also explain adaptive fit and the accumulation of design. These three explananda are beyond a characterization of evolution in terms of the emergence and dissemination of novelty. As the next section will clarify, on logical grounds any explanation of adaptive fit needs to be embedded in Darwinian logic.

3.3 Evaluating the alternatives: The importance of dependent variables

One of the central issues in the debate at the meta-theoretical level is the specification of the dependent variable of an evolutionary theory (Stoelhorst 2005b). The term evolution is often used to merely express change over time. But explaining the reality (and indeed inevitability) of change is only a small part of Darwinism (albeit central in doing away with Platonian essentialism). What makes Darwinism unique is its ability to explain the evolution of adaptive fit, the emergence of variety from common origins, and the accumulation of adaptive complexity (Dennett 1996).

If it is these three things that we want to explain, there is no alternative to Darwinism but an omniscient and omnipotent designer. Consider the evolution of adaptive fit, which is generally seen as central to the explananda of Darwinism (Maynard Smith 1993; Mayr 2001). As Dennett (1996, p.48-60) has pointed out, Darwinism is essentially a substrate neutral algorithmic explanation: if there is variation, a consistent selection process, and a mechanism to retain variations that are better adapted to the environment, evolution will occur. Note that this is a logical claim. In other words, the combination of variation-selection-retention mechanisms will necessarily lead to adaptive fit. What is more, only the combination of these mechanisms will lead to adaptive fit.

Consider the alternatives where one of the mechanisms is missing. Let us assume a population of entities. In the case of a selection and retention mechanism without a source of variation, we have a system where unsuccessful entities get weeded out and successful ones are retained. In a stable environment, this may lead to adaptive fit. If we have a set of apples and, for instance, blemished apples are selected out, we may end up with a set of apples that fit a selection environment favoring unblemished apples. However, such an algorithm cannot explain the evolution of variety from common origins, or the accumulation of adaptive complexity. Moreover, as soon as we allow the selection pressure to change over time, even
the explanation of adaptive fit breaks down. When, for instance, the selection criterion changes to the color of the apples and only red apples are favored, then, assuming that there is variety in the color of the apples within the set of unblemished apples, the only effect can be a further trimming of the set. In the limit, an algorithm consisting of a selection and retention mechanism without a mechanism to replenish variety can only result in an empty set.

Next, consider the case of a variation and retention mechanism without selection. Here we have a situation where ‘everything goes’. Every variation that comes about is retained through time because there is no selection pressure. In the limit, this algorithm can only lead to an infinite set. Moreover, in the absence of selection pressure, the resulting set will be largely uninteresting because it will be dominated by entities that are not at all functional. Finally, consider the case of a variation and selection mechanism without retention. This amounts to a system without memory. Variation is generated completely haphazardly, rather than being informed by past success. Because success in environmental interaction is purely a matter of chance, in the limit such an algorithm will result in an empty set. Finally, an algorithm consisting of only variation and selection cannot evolve any sort of complexity. Without a feedback loop to selective retain information about what works, there can be no accumulation of design.

The fact that only the combination of variation, selection and retention mechanisms can explain adaptive fit does not mean that there cannot be change in the absence of one of the three mechanisms. There can be variations that are selectively neutral and that do not positively or negatively affect the functionality of the entity. While selectively neutral change can be understood within the Darwinian framework, theories other than Darwinism may also be perfectly capable of explaining such change. But on logical grounds only the Darwinian algorithm can explain the evolution and accumulation of adaptive complexity. Given the centrality of these phenomena to both biological and cultural evolution this seems a conclusive reason to favor generalized Darwinism at the meta-theoretical level.

3.4 Taking stock of the debate at the meta-theoretical level

We have so far focused our analysis on the aspects of the ontological debate about Darwinism that are pertinent to the meta-theoretical level of our analytical framework. It is at this level that the first of area of disagreement noted by Vromen (2004) plays out. At the meta-theoretical level the question ‘what does the term evolution mean’ is central to the debate. A theory at this level should specify the ontological similarities of evolutionary processes across different domains. In other words, the central issue is what the general features of evolution are. To advocates of generalized Darwinism, the general features of evolution are those identified by Darwin. In the Campbellian version of generalized Darwinism, these features are an algorithmic process driven by a combination of variation, selection and retention mechanisms that leads to adaptive fit, variety from common origins, and the accumulation of design.

Opponents of generalized Darwinism take a different view, but have not yet offered a convincing alternative to generalized Darwinism. Witt’s ontological continuity hypothesis

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1 Note that this situation also leads to two logical problems with regard to the assumption of there being a population of entities to select from. First, without a source of variation, where do these different entities come from? Second, given a limited number of entities in the population and without a Darwinian history involving all three mechanisms, why would there be entities among the population that fit the environmental conditions they face?
makes an important point, but is entirely compatible with generalized Darwinism. In contrast, his specification of the general features of evolution as being the emergence and dissemination of novelty is a potential alternative, but on logical grounds it cannot be expected to offer an adequate explanation of adaptive fit. Darwinism can, and it is also able to explain two more phenomena that are central to both biological and cultural evolution: the evolution of variety from common origins, and the accumulation of design. Given the additional fact that the logic of Darwinism is well understood, there are strong arguments to favor Darwinism at the level of meta-theory. On the other hand, it should be noted that while Darwinism may be well understood, the project of generalizing Darwinism is still underway. In addition to a debate between advocates and critics of Darwinism, there is also room for debate among the supporters of generalized Darwinism about which version of generalized Darwinism to adopt. Ultimately, only a combination of logical argument at the meta-theoretical level and empirical corroboration of Darwinian theories at the middle-range level will be able to decide these debates. It is to the level of middle-range theory that we turn next.

4. Debating Darwinism in economics at the level of middle-range theory

The ultimate test of the value of generalized Darwinism in the social sciences is at the level of middle-range theories. It is at this level that Darwinism needs to show that it can explain something about the patterns and outcomes of economic and cultural evolution. It is also at this level that the second area of disagreement noted by Vromen (2004) plays out. Supporters and critics of generalized Darwinism seem to disagree about the ways in which processes of economic and cultural evolution differ from other sorts of evolutionary processes. The advocates of generalized Darwinism hold that it captures the essential features of all evolutionary processes and that it can therefore be applied to a wide variety of cultural and economic phenomena such as organizations, technology, scientific knowledge, language, law and beliefs. In contrast, the opponents of Darwinism argue that it does not capture what is essential about economic evolution. As we will see, this argument is typically made in terms of assertions about the differences between economic and biological evolution.

4.1 The project of generalized Darwinism at the level of middle-range theory

Despite frequent claims to the opposite, there is no disagreement between the critics and advocates of generalized Darwinism about the question if biological evolution and cultural evolution are different. It is widely recognized that they are. The claim of generalized Darwinism is of an abstract generality in terms of an algorithmic logic consisting of variation, selection and retention mechanisms. In the words of Plotkin: ‘The actual mechanisms in each case, of course – and one cannot repeat this point often enough – are entirely different’ (1995, p.100, emphasis in original). This means that a Darwinian theory always needs auxiliary theories that detail the mechanisms of variation, selection and retention to complete an explanation of evolution in the domain to which it is being applied (cf. Hodgson and Knudsen 2006a). Generalized Darwinism as such is entirely agnostic and ecumenical about the nature of the auxiliary theories that may be needed to flesh out how its recursive algorithmic logic operates in different contexts.

It follows that the challenge at this level of theory development is largely empirical, and consists of developing auxiliary theories that accurately reflect the mechanisms of variation, selection and retention for the domain in question. Important differences between the biological and cultural realm will have to be taken into account. Such differences are
The partly intentional nature of human behavior allows for directed variation. Human deliberation involves preselection of alternative behaviors. Even though imitative behavior exists in biology, there are probably qualitative differences in our ability to imitate as well as in the importance of this ability to success in the face of the socio-economic selective pressures of human societies. There is clearly a qualitative difference in our ability to use instruction to disseminate successful behaviors. Part of this latter ability derives from our ability to codify the knowledge that underlies successful behaviors and to manipulate and pass on this knowledge both within and between generations.

But not only do cultural evolution and biological evolution differ, so do the ways in which different cultural entities evolve. Darwinian theories for each of these domains are likely to involve overlapping, but different, auxiliary theories at the level of each of the three mechanisms of the evolutionary algorithm. The auxiliary theories to build a Darwinian explanation for the different domains are likely to overlap because each of these domains involves human behaviour in a cultural context. Evolution in each domain is driven by the intentional but boundedly rational behaviour of humans and is likely to involve imitation of behaviour and codification of knowledge. At the same time, the specific nature and combination of variation, selection and retention mechanisms will vary between the domains. For instance, the nature of selection that drives the evolution of a population of firms (market selection) and a body of scientific knowledge (peer selection) is different. There are differences in the way in which variations emerge in language (largely spontaneous) and in the law (designed and negotiated). And retention takes a different form for technology (by use and codification) than it does for beliefs (by instruction and internalisation).

The two cultural domains that have received most attention in evolutionary economics are technology and organizations, or more specifically firms. These two domains illustrate the ultimate challenge at this level of theory development, which is not only to develop convincing Darwinian explanations for each of them, but also to do so in a way that makes the theories consistent with each other and with theories of biological evolution. First of all, there are important differences in how firms and technologies evolve. Firms are social entities that coordinate human behavior, while technologies manifest themselves in material artefacts that manipulate physical components. The evolution of technology can be largely understood in terms of increased functional performance as a result of knowledge of a material substrate, while the evolution of firms needs to be understood in terms of their relative competitive performance as a result of knowledge of a social substrate. Secondly, while the two domains are different in important ways, they are also closely related. Firms are an important driver of technological change, while technological change affects the performance of firms. This shows the importance of developing evolutionary theories of these two phenomena that are consistent with each other. An evolutionary theory of the firm should ultimately be consistent with an evolutionary theory of technological change. Finally, Darwinian theories of technological change and the firm should be consistent with what we know about biological evolution. This means that they will, for instance, have to accommodate what we know about the drivers of human behavior from such disciplines as evolutionary psychology.

4.2 Domain specific theories: Is generalized Darwinism an analogy construction?

Advocates of generalized Darwinism in economics leave no doubt about their position on the differences between evolution in the biological and cultural realm: these differences are real and important (Hodgson 2002, Hodgson and Knudsen 2006a, Stoelhorst 2005a,b). This means that objections to the application of Darwinism in the cultural domain that hinge on arguments
that cultural evolution involves other mechanisms of variation, selection and retention than biological evolution are vacuous. This has been most clearly demonstrated in the way in which the most common objection to the use of Darwinism in the cultural domain has been countered: that cultural evolution is Lamarckian (e.g. Penrose 1959, Nelson and Winter 1982). It has been conclusively shown that Lamarckian evolution is entirely compatible with Darwinian principles, and that a Lamarckian explanation of evolution in fact needs to be embedded in Darwinian logic to be able to explain adaptive fit (Hodgson 2001, Knudsen 2001). In other words, the Darwinian logic can accommodate directed variation and the inheritance of acquired characteristics. That such mechanisms seem to indeed play an important role in cultural evolution does in no way invalidate the claim of generalized Darwinism.

Yet this seems to be the very argument that supports the claim that generalized Darwinism amounts to no more than a possibly misleading analogy construction (Witt 2003, Cordes 2006). As Cordes (2006) states:2

‘Using Darwinian terms is confusing for the underlying mechanisms of selection differ fundamentally’ (p.538)

‘… Darwin’s principles pass on part of their domain specificity to any theoretic concept based on the approach of Universal Darwinism that is brought forward to explain phenomena in the cultural sphere.’ (p.532)

‘According to one of Darwin’s core principles … evolutionary change comes about through the generation of organic variance combined with differential reproductive success … this process differs in fundamental ways from processes of variation in the cultural sphere. Nevertheless, Universal Darwinism claims the Darwinian principle of variation to be applicable to an explanation of the evolution of socio-economic systems. However, due to the distinct mechanisms, only a very abstract notion of variation may be invoked that inevitably loses all its domain-specific content and thus the label ‘Darwinian’ that denotes a domain-specific theory’ (p.534)

This argument seems circular. It states that the variation, selection and retention mechanisms in the cultural domain are different from those in the cultural domain (which they are), it claims that Darwinism is specific to the biological domain (which it only is in its neo-Darwinian manifestation) and then states that Darwinism cannot be generalized because it would lose its domain specific context. In other words, Darwinism is a domain specific theory that cannot be generalized. It cannot be generalized because it is domain specific. And if it can be, it no longer qualifies as Darwinism, because Darwinism is domain specific.

This is an unfortunate misinterpretation of the project of generalized Darwinism that reduces its possible value to a labeling question. On this reasoning one could suppose that if we were to talk of generalized evolution instead of generalized Darwinism, the project would be able to meet with the approval of its opponents. Upon closer scrutiny, the argument reduces to an apparently strongly held belief that Darwinism is domain specific. This belief is not substantiated in any meaningful way. And it is a belief that involves a misrepresentation of

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2 The term Universal Darwinism that Cordes uses derives from Dawkins (1983) and has for some time been used in economics as well (e.g. Hodgson 2002; Stoelhorst 2005a). However, Dawkins introduced the term to make a claim about biological processes; that if there were life elsewhere in the universe, it would have to have evolved on the basis of Darwinian principles. The term generalized Darwinism better captures the much more general claims that are the topic of the ontological debate in economics.
the project of generalized Darwinism, which is explicitly aimed at transcending the domain specific elements in the Darwinism.

But maybe the possibility of generalizing Darwinism is not the real issue. What also seems to be at stake is the question of what the value of doing so would be. As Cordes (2006) adds in a comment on the attempt to specify a generalized version of Darwinism: ‘… such an approach will lose its logical coherence and explanatory power’ (p.534). On this reading, there seem to be two types of arguments against the project of generalized Darwinism. The first type of argument is that generalizing Darwinism is not possible. This argument rests on the belief that Darwinism is domain specific and that the differences in the variation, selection and retention mechanisms between biology and economics defy generalization. Darwinism cannot be generalized because it is intimately tied to the specifics of biological evolution. The second argument is that generalizing Darwinism is not useful. This argument rests on the contention that a generalized version of Darwinism would lose its explanatory power and would therefore not be much use in building theories of economic phenomena.

Given the nature of the project of generalized Darwinism, these arguments need to be countered on two levels. The arguments at the meta-theoretical level have already been discussed. In essence Darwinism is a substrate neutral algorithm. In that sense it has always been a general theory that derived its strength from its recognition of population thinking and its use of a recursive causal logic. This is most easily seen if we realize that Darwin was himself unaware of the actual genetic mechanisms of variation and retention in biology, and that he added a second type of selection to his theory with his work on sexual selection. In other words, Darwinism always was a generic algorithm requiring additional details about the nature of variation, selection and retention mechanisms. Generalizing Darwinism is therefore possible, and its usefulness derives from the very explanatory power that the opponents of generalized Darwinism question. As was argued above, the population thinking and recursive logic of Darwinism make it uniquely capable of explaining adaptive fit.

The second level at which the advocates of a generalized Darwinism need to counter the arguments against their project is at the level of middle-range theories. Here the arguments of the opponents of Darwinism can be easily countered in principle, but carry more weight when applied to the actual practice of developing middle range theories. The argument in principle is that different middle-range Darwinian theories can be developed by specifying the mechanisms of variation, selection and retention for the domain in question. This would be useful because such a middle-range theory would be able to explain the evolution and accumulation of adaptive complexity. But of course the ultimate test at this level of argument is our ability to actually develop useful middle-range theories of economic phenomena on the Darwinian template. On this point much work remains to be done, and the critiques of the opponents of generalized Darwinism on the efforts to date are often warranted.

4.3 Auxiliary theories: The example of routines

That much work remains to be done at this level of theory development becomes clear when we consider attempts to develop an evolutionary theory of the firm. The firm is arguably the cultural phenomenon that has been central to the application of Darwinian arguments in economics and elsewhere in the social sciences (Nelson and Winter 1982, Hannan and Freeman 1989, Aldrich 1999). In modelling the evolution of firms in terms of variation, selection and retention mechanisms, Nelson and Winter’s (1982) work is still the benchmark in economics (e.g. Hodgson 2003; Hodgson and Knudsen, 2006a). But despite its widespread
impact on both evolutionary economics and management studies, there are a number of inherent problems with Nelson and Winter’s conceptualisation of the firm that tend to carry over into contemporary work. These problems centre on the notion of routines as the genes of organizations (Nelson and Winter 1982, 2002). It should be noted that this analogy was an elegant solution in the context of Nelson and Winter’s original research agenda, which was aimed at quantitatively modelling population level phenomena. But at the same time it also entailed a number of drawbacks in furthering our understanding of what actually happens within and between firms.

There are at least three drawbacks to the notion of routines as used by Nelson and Winter. The first of these is that they used the term for both phenotypic behavior and the genotypic coding of this behavior (Hodgson 2002). The second is that invoking the analogy of routines as genes of organizations does not actually explain how behavior that works is retained. The notion of routines does not do much more than say that organizations are somehow able to consistently reproduce certain behaviors. There is no mechanism specified to explain how this is achieved. The third problem with the notion of routines is that we lose sight of individual behavior as the essential driver of variation in organizational behavior. This is most obvious in the way in which a higher order of 'search routines’ is invoked to explain how variations in routines come about (Winter 2003). Progress has been made on the first of these problems, with a consensus emerging about a routine as a propensity to certain behavior (Hogdson 2003; Hodgson and Knudsen 2004). But while this distinction neatly separates routines as such from the actual behaviors that firms display, it does not solve the other two problems. The notion of routines still requires that we specify how this propensity is retained over time. And it still abstracts from individual behavior as the driver of what organizations do.

This last problem is exacerbated in attempts to view routines as replicators (Hodgson and Knudsen 2004). There is a fundamental difference between genes and routines. Routines do not replicate themselves. In that sense they are, in contrast to Hodgson and Knudsen (2004), not causally involved in their own replication. The existence of a routine is a necessary, but not a sufficient condition for its replication to occur. While firms can indeed be fruitfully seen as interactors and carriers of routines, there is not much value in insisting that routines should be seen as replicators. In contrast to genes, a routine does not replicate itself, and is therefore no replicator. That does not mean that there is no replication involved in how organizations evolve. But the agency and source of causality is elsewhere. It is the firm as such that replicates routines. There is no replication in the cultural domain without human action, and in the case of organizational routines it is the collective of individuals in their organizational context that achieves replication. The firm as such is the replicator of routines, and it follows that the firm is both replicator and interactor.

If this seems confusing, it only is when we would insist that the evolution of firms involve neat analogues to the concepts of replicators and interactors in biology. But this is not necessarily the case. We only need to understand where variation in behavior comes from and how successful behavior is retained over time. The best way of unravelling these mechanisms in organizations is by way of detailed empirical studies (Stoelhorst 2005a; Buenstorf 2006; Nelson 2006). Such studies may well show that replication is involved in how organizational evolution occurs, but the empirical data need not be forced into the straightjacket of the Dawkins-Hull conception of generalized Darwinism. Consider some illuminating recent work by Winter et al. (2006) on the importance of replication in organizational performance. The provocative finding of this research was that franchisees performed better when they replicated the entire franchise formula without attempting any local adaptation. But note that
it is the firm (in this case corporate headquarters) that is the replicator. There is no empirically meaningful way in which the formula replicates itself. Also note that a clear substrate of the routines can be identified in this case. The knowledge of what works has been codified in the franchise formula. It is on the basis of this codification of what works that the franchisor replicates the outlets. It is not the routines that replicate themselves.

4.4 Taking stock of the debate at the level of middle-range theory

At the level of middle-range theories, the debate is about the extent to which generalized Darwinism is able to capture what is essential about evolution in economics. The main line of attack of the critics of generalized Darwinism has been that it is not possible to capture economic evolution with the help of Darwinism because it is specific to biology. This line of reasoning has not been substantiated by any meaningful arguments. It also misrepresents the project of generalized Darwinism, which is explicitly aimed at abstracting from the domain specific features of Darwinism. The first line of attack is therefore irrelevant to the ontological debate.

A second, albeit largely implicit, line of attack is that generalized Darwinism is unable to explain what is important in economic theory. Although this second line of attack tends to lose much of its bite when it is mixed in with arguments from the first line of attack, it needs to be taken seriously. It is not logically inconsistent to allow for the possibility of generalized Darwinism, but to take the position that it would be largely irrelevant to understanding economic evolution. The argument would be that Darwinism may be generalized to capture what is general about evolution, but that what is general about evolution is not particularly useful in explaining the specifics of economic evolution. This would mean taking the position that what is essential to economic evolution is not variation, selection and retention leading to adaptive fit, the evolution of variety from common origins, and the accumulation of design.

We may conclude that arguments that turn on differences between biological evolution on the one hand, and economic and cultural evolution on the other, cannot invalidate the meta-theoretical claim that generalizing Darwinism is possible. On the other hand, the usefulness of generalized Darwinism for economics is open to debate. Such a debate should focus on the value of middle-range theories grounded in generalized Darwinism when addressing empirical phenomena. Attempts to develop such middle-range theories can be criticized, and the warranted criticisms cast some doubt on the value of the replicator-interactor distinction for economic theory. However, note that accepting this criticism would only invalidate one specific versions of generalized Darwinism, and would not undermine the project of generalized Darwinism as such.

5. From generalization to middle range theory - and back

Let us summarize the status of the debate on generalized Darwinism by taking stock of the main points of agreement and disagreement with respect to what the ontological commitments of evolutionary economics should be. One of the ways in which this debate has already advanced the more general discussion about ontological foundations is by making clear that there are in fact a number of ontological commitments that are widely shared. At least four ontological commitments seem to be uncontroversial:

1. There is evolution: Things change
2. Change is caused: There is a need for causal explanations of evolution
3. There is continuity: Causality needs to be specified in terms of the mechanism by which the state of things at time \( t \) change into the state of things at time \( t+1 \)
4. Change takes place at multiple, interrelated, levels of analysis: There is a need for a layered ontology

In contrast to these areas of agreement, there has been substantial controversy about the additional ontological commitments that the application of generalized Darwinism to economic theory would entail. The distinction between different levels of theory development made in this paper clarifies the nature of this controversy by showing that the two main areas of disagreement over generalized Darwinism play out at different levels of theory development.

The first area of disagreement is what the term evolution stands for (Vromen 2004). This is a meta-theoretical issue that translates into the question ‘what are the general features of all evolution’? There are two positions in the debate about this question. The advocates of generalized Darwinism hold that Darwinism captures what is general about all evolutionary processes, while the critics of generalized Darwinism deny this. Both positions are respectable, but the latter cannot be substantiated by arguments made at the level of middle-range theories, as has typically been the case. A stronger line of attack would consist of proposing a serious alternative to generalized Darwinism, and such an alternative has not yet been developed.

The second area of disagreement is to what extent and in which respects evolution in economics differs from evolution in biology (Vromen 2004). This is a middle-range theoretical issue that translates into the question ‘what are the essential features of economic evolution’? There are again two respectable positions in the debate about this question. The advocates of generalized Darwinism hold that it not only captures what is general about all evolutionary processes, but also what is essential about economic evolution. The critics of generalized Darwinism deny the latter claim, albeit often in terms that conflate the discussion at the middle-range level with meta-theoretical claims. However, note that the position that generalized Darwinism cannot capture what is essential about economic evolution is logically distinct from the position that there is something wrong with generalized Darwinism as a meta-theory. It is possible to accept that Darwinism can adequately and usefully be generalized, while denying that such a generalization would have much value when applied to economic evolution.

We believe that separating the possible arguments against the project of generalized Darwinism into arguments at the level of meta-theory and middle-range theory in this way can advance the debate. At the meta-theoretical level, the project of generalized Darwinism consists of generalizing the causal logic of the theory of evolution developed by Darwin. The explicit aim of this project is to generalize beyond the domain specific characteristics of the Neo-Darwinism we know from biological evolution. In terms of the four ontological commitments listed above, the project of generalized Darwinism at the meta-theoretical level aims to specify the causal logic that is called for in point three. At the level of middle-range theories, the project of generalized Darwinism is to develop testable domain-specific theories. These theories should not only be consistent with the causal logic of generalized Darwinism, but also be consistent with each other, in the sense that theories in one domain do not violate the empirical results derived in other domains. In that sense, the project of generalized
Darwinism at the level of middle-range theory development aims to specify the layered ontology called for in point four of the ontological commitments listed above.

Against this background, our reading of the debate is that convincing arguments against the use of generalized Darwinism at the meta-theoretical level have not yet been made, while critiques of the few middle-range theories inspired by Darwinism that have been developed to date have been much more convincing. At the meta-theoretical level there are no serious alternatives for generalized Darwinism, and on logical grounds it would seem difficult to develop a general theory of evolution with more explanatory power than Darwinism. Witt’s ontological continuity hypothesis makes a fundamental point about the nature of cultural evolution, but this hypothesis is entirely compatible with generalized Darwinism. The way in which human behavior is both enabled and constrained by our genetic dispositions is crucially important to understanding how cultural systems evolve. Given the third and fourth point of ontological agreement listed above, genetic evolution does indeed form a substrate on which all cultural evolution takes place. But this position does not undermine generalized Darwinism in any way, and should in fact be an integral part of its application to economics. On the other hand, it is important to note that the project of generalizing Darwinism is still ongoing. Among Darwinians there are different views on how to generalize the causal logic of evolution, and these views differ in the ontological commitments they entail.

Not all of versions of generalized Darwinism as they have been proposed at the meta-theoretical level may be equally well suited to the development of evolutionary theories in economics. While we are in agreement with the opponents of generalized Darwinism about some of their criticisms of middle-range Darwinian theories, we think that these criticisms only invalidate the replicator-interactor version of generalized Darwinism. On the basis of the empirical evidence on the evolution of firms, the Dawkins-Hull version of generalized Darwinism with its ontological commitment to the existence of replicators and interactors seems a step too far. The problem with the value of the Dawkins-Hull version of generalized Darwinism for economics is neither with the notion of interactors, nor with the multi-level nature of the explanatory scheme, which holds that there needs to be a carrier of the information on what works in environmental interaction. In fact, these two levels are essential to capture the feedback loop by which the success of environmental interaction is fed back into the system that is interacting. The problem is with the notion of replicators. While there may be replication involved in the process by which firms evolve, the notion of replicators is unnecessarily restrictive. There is a lot of variation in the behavior of firms that does not result from replication as such, and there are other ways of retaining information about functional ways of interacting with the environment than by replicating routines. The notion of the routines as the genes of organizations is metaphorical at best (Stoelhorst 2005a), and this holds a fortiori for replicators. Attempts to look for an analogue of self-replicating genes in firms are more likely to obfuscate than clarify what goes in organizations. But such attempts are not a necessary part of the project of generalized Darwinism: all we need is to understand where variation in behavior comes from and how behavior that works is retained.

Given these empirical considerations, the position adopted here is that the Campbellian version of generalized Darwinism that turns on variation, selection and retention mechanisms to explain the evolution of adaptive fit provides the most powerful statement of Darwinism. In addition to the four ontological commitments on which there is general agreement stated above, the Campbellian version of generalized Darwinism entails a further ontological commitment to the existence of variation, selection and retention mechanisms at all levels of analysis. However, it should be noted that this additional ontological commitment is derived
from a *logical* argument. At the heart of generalized Darwinism is the recognition that, barring an omniscient and omnipotent designer, variation, selection and retention are both necessary and sufficient conditions to explain the emergence of variety from common origins, the evolution of adaptive fit and the accumulation of design. If we accept that human beings are boundedly rational or that they face uncertainty, let alone if we accept both, there is a very strong case for making use of the Darwinian logic to address these *explananda*.

A middle-range theory based on Campbell’s version of generalized Darwinism would have to specify which mechanisms of variation, selection and retention operate in the domain in question. The problem with developing middle-range theories is that we are often back to exploring biological analogies. Only empirically informed arguments can help us decide which analogies, if any, can usefully serve as a heuristic for developing domain specific theories in economics. It may well be, for instance, that our understanding of how selection works in biology can help us build economic theory. But a middle-range theory could equally well be developed without calling on such an analogy. Both supporters and opponents of generalized Darwinism will most likely be criticising each other’s attempts at theory development at the level of middle-range theories for quite some time. This is how progress will be made. But note that even warranted criticisms at this level of theory development could never invalidate the meta-theoretical claim of generalized Darwinism. As long as there is a progressive research program at the level of middle-range theories, only the specification of a better causal logic for explaining all evolution could undermine the project of generalized Darwinism at that level of theory development.

This leaves the possibility of accepting the project of generalized Darwinism at the meta-theoretical level, while denying it much relevance for understanding economic evolution. As noted above, the argument to support this position would be that while economic evolution may share some general features with evolution in other domains, these general features are not particularly interesting. This could be the case if only the features that are specific to economic evolution allow us to adequately explain economic change. If such an argument at the level of middle-range theory is adequately distinguished from possible arguments at the level of meta-theory, this means taking the position that what is essential about economic evolution is *not* how variation, selection and retention mechanisms lead to variety from common origins, adaptive fit, and the accumulation of design. An argument along these lines can be recognized in the assertions of opponents of generalized Darwinism that its logic requires a consistent selection process that gives enough time for adaptive fit to evolve (Witt 2004; Buenstorf 2006). The contention is that in economic evolution selection pressures change too fast to result in adaptive fit. This is a substantial point, but only holds up if the faster pace of change in selection pressures has not been matched by the evolution of variation and retention mechanisms that are equally fast. Such questions can only be settled empirically.

The test of the research agenda of generalized Darwinism, or any competing general theory of evolution, is threefold. At the meta-theoretical level it needs to stand up to logical scrutiny, while at the level of middle-range theory and specific models and hypotheses, it needs to be empirically tested. The ultimate test, however, is not how its general logic or individual theories hold up, but how the entire structure of interrelated theories derived from Darwinian principles stands in the face of empirical facts. This is how Neo-Darwinism established itself in biology. Along similar lines, the long-term promise of generalized Darwinism for the social sciences is a better understanding of the interrelationships between all the bio-socio-cultural
evolutionary processes that have moved life beyond simple beginnings to the complexities of the institutionalized lives that our conscious species lives today.

6. Conclusion

The substantive criticisms of generalized Darwinism have been of its specific applications in constructing middle-range theories. These criticisms are partially warranted, but do not offer any arguments against the meta-theoretical claim of generalized Darwinism that it applies to the evolution of all complex, open systems. What they do demonstrate is that the project of generalizing Darwinism is still underway, and that both the generalization of its principles and its application to different domains depends on careful empirical studies of the evolving systems in question. The promise of generalized Darwinism as a powerful meta-theory for the social sciences in general and evolutionary economics in particular still stands, but the realization of this promise depends on our progress in the development of middle-range theories that link meta-theoretical insights to empirical data.
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