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by

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Ontological issues in evolutionary economics: The debate between Generalized Darwinism and the Continuity Hypothesis

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Introduction

Recently evolutionary economists started to pay attention to ontological issues in their own subfield. Two projects dominate the discussions: Generalized Darwinism (henceforth: GD), promoted by Geoff Hodgson and Thorbjørn Knudsen, and the Continuity Hypothesis (henceforth: CH), put forward by Ulrich Witt. As a first and crude approximation (to be refined below), GD entails the view that abstract and general Darwinian principles suit the study of biological evolution and of economic evolution equally well. The CH entails the view that ongoing economic evolution proceeds on the basis of, and is still influenced by the outcomes of preceding processes of biological evolution. At present, GD and CH are vying for hegemony in the community of evolutionary economists. GD and the CH sometimes are pitted against each other as if they were mutually excluding rivals. This paper investigates to what extent (and if so, in what sense) GD and the CH are rivals.

As we shall see, part of the debate between proponents of GD and of the CH is about the very notion of ontology itself. At stake is whether the views expressed in GD are based on ontology rather than analogy. The categorization of ontological issues into three clusters that I first presented in Vromen (2004a) is taken here as a framework to organize the discussion. Again (as I already did in that paper) I will argue that we should start with recognizing not only that quite distinct issues are all deemed ontological in the literature, but also that stances taken on an issue in the one cluster often do not prejudge the stance that can be consistently taken on an issue in another cluster. For example, taking the stance that Darwinian principles are needed to explain economic evolution does not commit one to take the extreme and wildly implausible view that our genes fully determine our behavior. But I will also discuss a few cases in which the stance taken on an issue in the one cluster does narrow down the range of stances that can be consistently taken on an issue in another cluster. Thus, while I focused mainly on independencies between positions taken in different clusters of ontological issues in Vromen (2004a), in this contribution I will discuss independencies and interdependencies between them alike.

This contribution to the Handbook has the character of an overview rather than of an ordinary paper in which a specific thesis or claim is argued for. Presenting a fair and accurate discussion of the debate and of the several issues that are at stake in it is what I aim at. No attempt is made to add something original to these discussions. Insofar as there is originality in this contribution it is in the way in which the discussion is organized and in the links that are forged with other strands of literature. Connections will be made not only with relevant literature in philosophy of science, but occasionally, when I thought this informative and useful, also with currents in economic theorizing (that do not belong to evolutionary economics) and with currents in evolutionary theorizing in other fields and disciplines.

Evolutionary economics in a nutshell

Evolutionary economics is understood here quite narrowly as the branch within economics that has been developed in the wake of Nelson and Winter's seminal *An Evolutionary Theory of Economic Change* (1982).[2] Other evolutionary economists working in this tradition include, among many others,[3] Stan Metcalfe, Ulrich Witt, Geoff Hodgson, Giovanni Dosi, Kurt Dopfer, Brian Loasby, John Foster, Pier Paolo Saviotti, Esben Sloth Anderson, Steve Klepper, Andreas Pyka, Uwe Cantner, Jason Potts, Johann Peter Murmann, Thorbjørn Knudsen, Gerald Silverberg, Bart Verspagen, Bart Nooteboom and Koen Frenken. Papers written by evolutionary economists often find their way into journals like *Journal of Evolutionary Economics, Industrial and Corporate Change,* and *Structural Change and Economic Dynamics*.

There are several features of evolutionary economics distinguishing it from other traditions or schools of thought within economics. Two such features stand out: the level of analysis in evolutionary economics and the key assumptions in its explanatory framework. Evolutionary economics studies processes in which changes (notably technological change) are brought about at the ('population') level of industries, sectors, branches, markets or whole economies where the key players (the 'agents') are not individual persons but firms or other organizations. Note that this is not at all unlike traditional (or standard) neoclassical theory, in which households and firms are also treated as if they were unitary agents. Evolutionary economics is also quite like the neoclassical theory of the firm in another respect. In the neoclassical theory of the firm, firms are looked at from a technological perspective: firms are in fact equated with their production function. Evolutionary economics likewise focuses on firm-specific capabilities and routines to produce goods or services. The ways in which firm members and units are internally organized within firms get considerably less attention. Thus evolutionary economics is unlike more recent theories of the firm, in which intra-organizational issues are put centre stage. In those recent theories the agents figuring in the nexus of contracts (which, according to some theory, a firm basically is) or in governance structures are individual persons.

This raises the issue whether it is acceptable to treat firms as unitary agents (in the *explanantia*) in explanations, given that it is clear that multi-person firms in fact are not unitary agents at all. Multi-person firms house heterogeneous persons with different interests, beliefs, intentions, attitudes, perceptions and the like. One need not be a staunch defender of methodological individualism to appreciate that the behavior of a firm at least partly depends on (the success or failure of) attempts to align all these internal differences within firms (Abell, Felin and Foss 2007). One of the hallmarks of evolutionary economics is that it acknowledges heterogeneity within industries between firms. But it

[2] Which is not to say that evolutionary economists endorse and build upon the foundations Nelson and Winter laid for evolutionary economists. As we shall see later on in this paper, the two main protagonists in the paper – Hodgson and Knudsen on the one hand and Witt on the other – distance themselves from Nelson and Winter (1982) in several respects.

[3] With sincere apologies to those whose names deserve to be mentioned but are not mentioned here.

seems to pay considerably less attention to the heterogeneity within firms between firm members.

Thus evolutionary economics is not quite unlike the neoclassical theory of the firm *qua* its level of analysis and its technological (rather than organizational) theoretical orientation. But *qua* their key assumptions in their explanatory (or theoretical) framework they are very different. (Static) equilibrium analysis is discarded in evolutionary economics and so are strong rationality assumptions. Agents are boundedly rational at most. They satisfice rather than maximize. What is more, agents, firms in particular, differ with respect to their behavioral properties. There is heterogeneity in this respect. Thus representative agent type of theorizing is rejected. So is equilibrium theorizing. There is no presumption that economies (or industries) are in equilibrium. There is no presumption even that economies tend to move in the direction of equilibria. To the extent that the notion of equilibrium serves any analytical purpose at all (as a benchmark, for example) in models in evolutionary economics, economies may be out-of-equilibrium all of the time. And if an economy converges on an equilibrium, it need not stay there for long. Both exogenous and endogenous changes may dislodge the equilibrium. Static (or comparative-static) equilibrium analysis is replaced by dynamic process-analysis. Dynamic process-analysis need not take the form of analytically tractable models that allow for close-form solutions. Computer simulations are readily accepted. Attempts are made to make room for endogenous technological change (innovations); attempts that are taken by some to defy closed system theorizing.

Thus while evolutionary economics shares its level of analysis and technological orientation with the neoclassical theory of the firm, it seems their theoretical assumptions could not have been more different. In what respects does evolutionary economics distinguish itself from other attempts in economics to incorporate evolutionary theorizing or insights from evolutionary theorizing elsewhere? Elsewhere (Vromen 2004b) I introduced the following typology. I ranked evolutionary economists among the *revolutionaries*, stressing that evolutionary economists plead for a theoretical approach in economics that is radically different from the one advocated and followed in 'orthodox' economics.[4] In this they differ from 'conservatives' and 'revisionists', economists who believe that taking evolution seriously in economics entails no changes or only minor changes in the standard theoretical approach in economics. Economists stressing that the main lesson of evolutionary game theory is that the use of the solution concept of Nash equilibrium is vindicated in economics (cf. Mailath 1998) I call conservatives. Revisionists include economists who argue on evolutionary grounds that utility functions should make room for a taste for fairness, for example, or for altruism (cf. Frank 1988).

In Vromen (2008) I stress that evolutionary economists focus on current ongoing processes of economic change, which they take to be evolutionary (in senses yet to be clarified) in kind. This is really different from economists who hold, for example, that the main service evolutionary theorizing can render to economics is that it helps with identifying our basic preferences. I do not only have in mind here economists who want

[4] According to evolutionary economists, 'orthodox' economics is wedded to the '(individual) maximization cum (aggregate) equilibrium' framework.

to accommodate the ideas of evolutionary psychology, for example, but also bioeconomists and neuroeconomists (Vromen 2007), proponents of the so-called Indirect Evolutionary Approach (Güth and Yaari 1991) and protagonists of strong reciprocity (Bowles and Gintis 2003) and altruistic punishment (Fehr and Gächter 2002). This latter group of economists have processes of biological (and possibly also cultural) evolution in mind that took place long time ago (but that allegedly still indirectly influence our current behavior – through our basic preferences). They need not (and actually most of the time do not) believe that current processes of economic change are evolutionary in any meaningful sense.

The positions: Generalized Darwinism (GD) and the Continuity Hypothesis (CH)

Above I gave rough characterizations of GD and the CH. GD I described as entailing the view that abstract and general principles can be discerned in Darwinian evolutionary theory that suit the subject matters both of biology and of economics. The CH I described as entailing the view that ongoing economic evolution proceeds on the basis of, and is still influenced by the outcomes of preceding processes of biological evolution. In fact, both GD and the CH involve not only more substantive claims than the descriptions just given suggest, but also specific heuristics for further research.

Hodgson and Knudsen's version of GD

Hodgson and Knudsen (2006) give more substance to GD by specifying the following three abstract and general Darwinian principles: *variation*, *inheritance* (or *replication*) and *selection*.[5] Given the centrality of the three principles in their GD, it is remarkable how little Hodgson and Knudsen say about what these principles precisely are and what they entail. The few things they say about the principles are expressed in a loose way. Perhaps Hodgson and Knudsen simply take for granted that everyone knows what the principles mean. Anyway, the following can be extracted from their sparse remarks and comments about the principles. There is variation in a population of entities if the entities differ in relevant respects. There is inheritance (or replication) if there is a mechanism seeing to it that the properties are preserved (or retained) either in the units themselves or in their 'offspring' (to which the properties are passed on). And there is selection if the entities are mortal and degradable, if they face an omnipresent problem of scarcity and if they are therefore caught in a struggle for existence (Hodgson and Knudsen 2006, 4).

Hodgson and Knudsen argue that in any system in which all three principles are present Darwinian evolution occurs. The three principles are present not only in biological

[5] The three principles (albeit under slightly different names) were already presented in Darwin (1859). As Hodgson and Knudsen note, many scholars earlier noticed that the principles potentially have a wider scope than the biological domain (e.g. Lewontin 1970, Campbell 1965, Popper 1972, Hull 1981, Dawkins 1983, Plotkin 1994, Cziko 1995, Dennett 1995).

systems, they argue, but also in economic systems.[6] Hodgson and Knudsen do not deny that biological and economic systems differ in many significant ways, but they argue that biological and economic systems have these three principles in common. Again, Hodgson and Knudsen do not spend many words on what exactly Darwinian evolution is. But from the foregoing it can be gathered that what they mean is evolution through *natural selection*: the degree to which the entities are relatively successful translates into the spread or decline of the frequency (or proportion) of their properties in the population. The frequency of the properties of relatively successful entities increases in the population, while the frequency of the properties of less successful decreases.

GD is given even more substance by Hodgson and Knudsen by arguing (following David Hull's 1982 terminology) that *replicators* and *interactors* are identifiable both in biological and in economic systems.[7] Hull argues that evolution through natural selection involves two processes rather than one: replication and interaction. Interaction causes replication to be differential. Interactors are the entities that interact with their environment and with each other and replicators are the entities that are replicated. More precisely, replicators are those entities that pass on their structure intact through successive replications (see also Dawkins 1976). Interactors are those entities that interact as cohesive wholes with their environments in such a way as to make replication differential.[8] Paradigmatic examples of replicators and interactors in the biological domain are genes and individual organisms, respectively. Hull's general rendering of evolution through natural selection in terms of interactors and replicators is meant to imply that there might be other replicators and interactors than genes and organisms, not just within, but possibly also outside the biological domain. Thus evolution through natural selection need not be confined to the biological domain. One of the things Hull is famous for, for example, is for arguing that there also is evolution through natural selection in scientific development (Hull 1988).

Hodgson and Knudsen (2004) suggest that in the economic domain habits and routines are replicators and firms are interactors. Although they recognize that habits and routines are quite different than genes in several respects and that the way in which habits and routines are replicated differs from how genes are inherited, Hodgson and Knudsen argue that habits and routines meet Hull's definition of a replicator. And although firms are quite unlike individual organisms in many respects, they meet Hull's definition of an interactor. Hence, despite the differences between these economic and biological units, Darwinian evolution occurs in both domains. Hodgson and Knudsen also stress, however, that the fact that biological and economic evolution are both Darwinian at an abstract and general level of description does not imply that biological and economic evolution are

[6] Both Hodgon and Knudsen and Witt and his group members assume that economic evolution is a subspecies of cultural evolution. They believe that all general properties of cultural evolution are shared by economic evolution.

[7] As will be argued in more detail below (see also Vromen 2007), and as Hodgson and Knudsen themselves acknowledge, evolution through natural selection can occur without there being replicators.

[8] Hull (2001) argues that he introduced the distinction between replicators and interactors to disambiguate the phrase "unit of selection". Hull also makes clear that he believes that taken together replication and interaction are sufficient to characterize evolution by natural selection. Replication and interaction are not assumed to also cover other possible evolutionary forces causing evolution such as drift.

similar in other respects. They argue that the processes differ profoundly at the less abstract and general and more detailed level.

Hodgson and Knudsen argue that explanations of the evolution of a system in which the three principles are present cannot be acceptable unless they invoke the three principles: "… an adequate explanation of the evolution of such a system *must* involve the three Darwinian principles of variation, inheritance and selection." (Hodgson and Knudsen 2006, 5; *Italics* in the original; see also Hodgson and Knudsen 2008). Yet they also argue that explanations that invoke only the three principles are incomplete. If evolutionary processes in the economic domain are to be explained, auxiliary domain-specific explanations and hypotheses have to be added to the three generalized Darwinian principles. Thus Hodgson and Knudsen make a distinction between the three generalized Darwinian principles, which are taken to provide a general theoretical framework (also sometimes called universal metatheory) that is domain-unspecific, and auxiliary explanations and hypotheses, which are taken to be domain-specific details. Details that are specific for the economic domain are to be added to the three principles in order to get full-fledged causal explanations of economic evolutionary processes.

Thus Hodgson and Knudsen's case for GD involves not just a *description* of what Generalized Darwinism entails: the three general principles of variation, inheritance (or replication) and selection. It also involves the *claim* that these principles are not only applicable to economic evolution (and other forms of non-biological evolution) but are necessary in any study of complex evolving population systems. And, finally, it also involves a *program* (or project): more is needed than the application of just the three principles to have a satisfactory study of economic evolution. Domain-specific hypotheses and data have to be added to arrive at explanatory theories.

Witt's version of the CH

Above I asserted that the CH entails the view that ongoing economic evolution proceeds on the basis of, and is still influenced by the outcomes of preceding processes of biological evolution. Witt gives more substance to the CH by arguing that psychological features of human beings are outcomes of antecedent processes of biological evolution that are of special importance to ongoing processes of economic evolution. In particular, ancient processes of biological evolution produced both the basic, innate wants and primitive, non-cognitive forms of learning (such as conditioning) that still constrain and influence the behavior of present-day human beings. On the basis of their basic wants, for example, people also learn new acquired wants through conditioning (or associative learning). Thus when people regularly consume food in specifically arranged settings that have certain aesthetic aspects (furniture, tableware, etc.), for example, they tend to acquire a want for such settings even in the absence of eating (Witt 2001).

In virtue of their unique and superior intelligence, however, the behavioral repertoire of human beings has been extended vastly beyond these genetically encoded dispositions and capacities. People have devised all kinds of sophisticated tools for meeting their

wants, for example. And they have developed refined communication technologies enabling them to socially transmit new information and new knowledge rapidly and widely. In short, due to processes of cultural evolution people have transcended the state their ancestors were in (and that their cousin mammals still are in) when cultural evolution took off. Witt stresses that cultural knowledge differs considerably from genetically coded knowledge (Witt 2004).

> Genetic 'knowledge' comes in a form which *uno actu* interprets, expresses, and replicates its meaning in terms of blue prints for manipulating materials and/or triggering ad controlling processes, provided the necessary materials and free energy are available. Replication occurs with some variation between generations, and since genetic novelty originates from those variations, the emergence of novelty is a part of the programmed automatism. None of this holds in the case of cultural knowledge. The latter is coded and stored in a form lacking an automatic copying, interpreting, and self-expressing modus. The generation, storage, expression (utilization and application), and even the replication of cultural knowledge all need to be effected by human action and require at least a minimal form of intelligence.

(Witt 2004, 138-139)

Witt argues that differences between genetically coded knowledge and cultural knowledge like these are so huge that the Darwinian triple of variation, replication and selection is unsuitable for studying cultural evolution. The Darwinian tripe fits biological but not cultural evolution. Instead, what biological and cultural evolution do have in common with each other is that they both deal with processes of *self-transformation*. They both involve the transformation of systems through the emergence and dissemination of novelty. The specific ways in which novelty is created and disseminated in biological and economic systems differ significantly. The creation of novelty in economic systems crucially involve intelligence and intentionality, for example, things that are completely lacking in biological evolution. Despite such differences, self-transformation through the emergence and dissemination of novelty is a generic formulation of evolutionary processes that fits both realms.

Witt (2007) argues that the CH is committed to monism and naturalism as specific "ontological creeds". Instead of assuming that the subject matters of evolutionary biological and evolutionary economics belong to different, disconnected spheres of reality, as non-monistic ontologies do, the CH takes them to be causally connected. The CH presumes that there is one and the same ontological basis for all evolutionary pheomena (Witt 2004, 129). In particular, the CH is at odds with the most (in)famous and tenacious two-tier ontology in history, namely Cartesian dualism. Witt also suggests that the CH implies a rejection of the doctrine that the humanities (*Geisteswissenschaften),* to which economics belongs, ought to have a different method or approach (*Verstehen*) than the sciences (*Naturwissenschaften*, which are assumed to be in the business of *Erklären*). Like biology and the other natural sciences, the aim of economics is to explain phenomena and processes.

The ambitious research program of Witt and his Evolutionary Economics Group members in Jena is to build a new consumption theory and a new production theory on the basis of the CH.[9] The challenge is to develop new theories that can explain historical changes and trends in consumption and production patterns better than the rather sterile neoclassical consumption and production theories. On the basis of the CH, substantive conjectures are made not only about why there has been an explosion of new products and services even though many of the basic wants that they ultimately serve are satiable, but also about how consumers arrive at the preferences that they have and when, why and how preferences change (Witt 2001, 2008). Likewise, the CH can serve as a useful starting point for understanding better (than standard economic theory is able to do) how human cultural knowledge enables mankind both to steer nature's production processes in desired directions and to create ever new artificial production processes (Witt 2004).

In short, Witt's CH links ongoing cultural and economic evolution with prior biological evolution: prior biological evolution paved the way for, and still defines the constraints for ongoing cultural and economic evolution. Where biological and economic evolutionary processes meet in particular is in the genetic endowment of humans. The genetic endowment of humans is a product of antecedent biological evolution that still affects current human consumption and production behavior in various ways (through determining innate wants, for example, and programming non-cognitive learning processes). Focusing on antecedent processes of biological evolution allows one to reconstruct the conditions from which processes of cultural evolution started. And it puts what happened subsequently in processes of cultural evolution in the right perspective. This is why the CH is believed to be useful as a starting-point for developing new consumption and production theories that are better able to explain the enormous changes in consumption and production patterns over the last centuries than standard neoclassical consumption and production theory.

The debate: what is at stake?

Analogy or ontology?

Hodgson and Knudsen's GD has been criticized by the proponents of the CH, not only by Witt (2004, 2007) himself, but also by several members of his Evolutionary Economics Group at the Max Planck Institute of Economics in Jena (cf. Buenstorf 2006 and Cordes 2006, 2007). Witt and his collaborators argue that Hodgson and Knudsen's GD is based on a *biological analogy*. The Darwinian triple was first formulated in the field of biological evolutionary theory and was only later transferred to, or taken over by other fields. Witt et al. recognize that Hodgson and Knudsen aim at giving a domain-general formulation of the Darwinian principles. But Witt et al. deny that Hodgson and Knudsen succeed in shaking off features that are specific and peculiar to biological evolution. Even

[9] Witt mentions Veblen, Georgescu-Roegen, Gowdy, Faber and Proops and the late Hayek as precursors of this ambitious project.

in Hodgson and Knudsen's abstract and general rendering of the three principles, Witt et al. argue, the principles betray their origin in evolutionary biology.

Hodgson and Knudsen emphatically deny that their GD is based just on an analogy. They have different trump cards on their sleeves here. Hodgson and Knudsen draw attention to the fact that Darwin himself hinted at applications of his three principles outside the biological domain (for example, to account for the evolution of language). So even Darwin already had a wider application of his three principles in mind than just biological evolution. Hodgson and Knudsen also note that in developing the three principles Darwin was inspired by the work of the political economist Thomas Robert Malthus on natural checks on population growth. Thus Hodgson and Knudsen call into question that the three Darwinian principles originated from within evolutionary biology. More importantly, Hodgson and Knudsen argue that their case for GD is based on the observation that biological and economic systems have the three rather abstract properties of variation, replication and selection in common. Even if it were the case that the Darwinian triple was first formulated in evolutionary biology, this would do nothing to either vindicate or invalidate this observation.

Hodgson and Knudsen's proposal to invoke the Darwinian triple to study cultural (and in particular economic) evolution arguably is based on an analogy. If all it takes for some idea or concept to be based on an analogy is that a connection involving more or less formal similarities is made between different domains of discourse (which is what Hodgson himself suggests; see Hodgson 2002, 263), then their proposal is based on an analogy. After all, Hodgson and Knudsen did not invent the Darwinian triple themselves, but obtain it from Darwin and from Darwinism. The principles of variation, selection (or rather, the struggle for existence) and inheritance were first coined by Darwin, not by any of his precursors outside biology. But it seems that Hodgson and Knudsen are right in insisting that their case for GD is based on an ontological claim. Arguing that biological and economic systems have the three rather abstract properties of variation, replication and selection in common, as they do, is making an ontological claim. It is a claim about properties that different domains in reality (allegedly) have, not about concepts or principles in different theories or fields of enquiry. Hodgson and Knudsen also seem to be right in arguing that their case rests on the truth of this ontological claim rather than on the issue of whether or not the Darwinian triple first was formulated in evolutionary biology.

"Analogy or ontology" seems to be a false opposition here. Hodgson and Knudsen's case for GD is based on both analogy and ontology. Their Darwinian triple is an abstracted and generalized version of theories developed in another field of enquiry. Yet their assertion that the triple suits cultural (and more in particular economic) evolution is based on their ontological assessment that complex evolving cultural systems have the required properties for evolution through natural selection to occur. Those who reject Hodgson and Knudsen's GD also do so on ontological grounds. They believe that Hodgson and Knudsen's Darwinian triple do not fit the specific characteristics of evolving economic systems. In this respect, the objections of Witt et al. against Hodgson and Knudsen's GD are reminiscent of the objections earlier opponents of "the biological metaphor (or

analogy) raised (Foster 1997; Witt 1999). These earlier opponents likewise argued that the biological metaphor is ill-suited to do justice to the specificities of economic evolution.

Different sorts of ontological issues are at stake

In Vromen (2004a) I argued that the ontological claim made here belongs to a first cluster of ontological issues. If we confine our attention to biological and economic evolution, what is at stake in this first cluster is whether processes of biological and economic evolution have common properties. If so, it is possible to formulate a general (or generic) description of both processes by referring to the common properties. This is exactly what Hodgson and Knudsen aim to do with their GD. Witt et al. argue that Hodgson and Knudsen fail in their attempt because variation, replication and selection are properties of biological evolution but not of economic evolution. Witt et al. do not deny that processes of biological and economic evolution have common properties, however. Both processes are argued to involve the emergence and dissemination of novelty.[10] What this means is that strictly speaking Witt's generic description of evolution in terms of self-transformation rather than his CH is the real competitor of Hodgson and Knudsen's GD (as Witt 2003 himself recognizes). It is Witt's description of evolution in terms of self-transformation that is meant to be rivaling Hodgson and Knudsen's GD in giving a domain-unspecific description of evolutionary processes, based on different (allegedly) common properties of evolutionary processes in different domains in reality.

Witt's CH is not meant to give a generic description of evolutionary processes based on properties that evolutionary processes in different domains (allegedly) have in common. Instead, it is meant to describe how evolutionary processes in different domains (notably evolution in biology and evolution in culture) are *causally* connected to one another.[11] The issue that the CH addresses belongs to a different, second cluster of issues (Vromen 2004a). At stake in this second cluster is not whether or not biological and economic evolution have common properties (and, if so, what are these properties), but whether or not biological and economic evolution interact causally with each other (and, if so, how). Witt's CH asserts, as we saw above, that products of antecedent processes of biological evolution prepared the ground for, and still determine the constraints for, subsequent processes of cultural evolution. It is assumed that biological selection pressures on humans have faded away. Hence no systematic feedback effects of cultural evolution on biological evolution are envisaged. This reflects one particular view on how biological and economic evolution interact. There are others. An example is gene-culture co-evolution (Boyd and Richerson 1985), which assumes that the causal interaction between biological and cultural evolution is a two-way rather than a one-way street. It is not just that products of biological evolution affect ongoing cultural evolution, as is recognized in

[10] Witt (personal correspondence) stresses that both the emergence and the dissemination of novelty capture more than the emergence of new variants and selective retention processes respectively.
[11] As Witt correctly notes, we can say that evolutionary processes in all domains have particular properties in common without saying anything about how (if at all) they are causally connected (Witt 2003, 282).

Witt's CH, it is also possible that products of cultural evolution affect ongoing biological evolution.[12]

Note that it is presupposed in both Hodgson and Knudsen's GD and Witt's CH that biological and economic evolution are distinct processes. Only if biological and economic evolution are distinct processes we can ask whether they have common properties. And only of distinct processes we can ask whether they causally interact with each other. All parties mentioned thus far (not just Hodgson and Knudsen and Witt et al., but also Boyd and Richerson) agree that biological and cultural evolution mutually exclude each other in that either genes (or possibly other biological units of replication) or that ideas, tunes, habits, routines (or possibly yet other cultural units) are transmitted from the one individual (or possibly a unit at a different level of organization, such as a firm) to another. All parties agree that the social transmission of cultural units does not involve the transmission of genes. The parties might disagree on many other issues, but they agree that the fact that non-biological entities are transmitted makes biological and cultural evolution two distinct, non-overlapping processes.

In fact, Hodgson and Knudsen on the one hand and Witt et al. on the other agree on many more things. Witt (2007) argues that his CH and Hodgson and Knudsen's GD find common ground also in their endorsement of monism.[13] And, indeed, Hodgson's (2004) discussion of a layered ontology indicates that here too Witt and Hodgson are in basic agreement.[14] Instead of assuming that reality is partitioned into two (or more) separate, disconnected spheres, the notion of a layered ontology suggests that the whole of reality is ultimately or in essence one. The notion of a layered ontology implies that adjacent layers (or levels) of organization exist in reality. Adjacent layers are assumed to be connected to each other as wholes are related to their parts, so that all layers are related ultimately with the layer that is addressed by elementary particles physics. Firms are composed of individual human beings, human beings are composed of their organs (such as their brains), organs are composed of their cells (such as neurons), cells are composed of their molecules (such as genes) and so on, all the way down to elementary subatomic particles.[15] Hodgson argues that at higher levels there are emergent properties, properties that are absent at lower levels and that cannot be fully reduced to lower-level entities and their properties. Witt (2007) likewise argues that he endorses a non-reductionist monism.

[12] Christian Cordes seems to be subscribe to Boyd and Richerson's gene-culture co-evolutionary theory rather than to Witt's one-directional view on the causal relation between biological and economic evolution.

[13] Witt seems to conflate ontological monism with methodological monism, however, when he argues that both the humanities and the sciences should aim at giving causal explanations of phenomena. Ontological monism does not imply such methodological monism (cf. Dennett's defense of taking the intentional stance).

[14] Hodgson (2002) calls evolution a multi-level process, suggesting that biological and economic evolution occur at different levels.

[15] This is not to suggest that the ways in which the components are organized (or arranged, or connected) may (and, indeed, presumably does) does not matter. Their organization surely do matter (cf. Vromen 2006).

Issues like these belong to yet another, third cluster. At stake here is what is the basic furniture of the world. The issues belonging to the third cluster can be called metaphysical issues. That metaphysical issues are different in kind than the issues belonging to the second cluster can be nicely illustrated with the example of *intentionality*. The issue of how the capacity of intentionality evolved in the past (which belongs to the second cluster) differs from the issue of what (if any) is the material basis of the capacity of intentionality (which belongs to the third cluster). In both cases we can talk of the emergence of the capacity of intentionality, but the meaning of 'emergence' is different in each case. If we talk of the evolutionary origin of the capacity, we have a causal, diachronic sense of 'emergence' in mind. If we talk of the material basis of the capacity, we have a constitutive, synchronic sense of 'emergence' in mind (Bedau 1997; Craver 2007). Similarly, if we look at the how economic and biological phenomena relate to each other from the metaphysical perspective of the third cluster, their connection is not causal, but constitutive.

Biological phenomena or the biological domain and economic phenomena and the economic domain are not seen here as mutually exclusive, which, as we saw, is presupposed by the adversaries Hodgson and Knudsen and Witt et al. alike, but rather as inclusive. Biological phenomena, pertaining to the levels of organs, cells and molecules, appear as parts of the phenomena that economists address, which typically are the higher levels of firms, industries, markets and whole economies.

Different sorts of ontological issues also surround the *routines* of firms. Nelson and Winter (1982) introduced routines as analogous both to the skills of individual persons and to the genes of organisms. Routines are characterized by Nelson and Winter as involving automatic rather than conscious, deliberate option selection, just as is the case with the exercise of skills, and as being durable or inert, just like genes. We saw that Hodgson and Knudsen likewise argue that routines are replicators in the economic domain, just as genes are paradigm cases of replicators in the biological domain. As will be spelled out in more detail below, Witt et al. disagree. The issue at stake here is one belonging to the first cluster: are there long-lived routines in the economic domain, and if so, do they have the properties in common with genes that Dawkins, Hull and others ascribe to replicators? Again, the shared presupposition is that the biological domain (with genes in them) and the economic domain (with routines, or other units, in them) are distinct, mutually exclusive domains of reality. This is quite different if we look at routines from a metaphysical (third cluster) point of view (cf. Vromen 2006). Then the biological domain appears as part of the economic domain. Whether or not routines are similar to genes, all agree that if there are routines, their functioning involves the exercise by of certain skills of the individuals participating in the functioning of the routines, which in turn involves the existence and expression of certain genes in the individuals.

All the issues at stake in the three clusters can be called ontological. Yet they are different in kind. We saw that the relation between the biological and the economic domain is cast in a different light in each cluster. In the first cluster, biological and economic evolution are considered as distinct processes. Properties of biological and of economic evolution are compared with each other. Do biological and economic evolution

have properties in common (and if so, what are these?), warranting a generic description of evolutionary processes? Hodgson and Knudsen's GD and Witt's CH both purport to provide such a generic description. Whether or not biological and economic evolution are connected with each, causally or otherwise, is not an issue here. This is clearly different in the second cluster. The issue of whether or not (and if so, how) biological and economic evolution are causally connected with each other takes centre stage here. Witt's CH speaks out on this issue: antecedent processes of biological evolution not only set the stage for more recent processes of cultural evolution (including economic evolution), but still constrain and influence ongoing processes of economic evolution. The issue of how the biological and economic domain are connected is also central in the third cluster. But here the connection considered is not causal, but constitutive (or componential). The entities in the biological domain appear here as being at a lower level of organization than (and hence to be parts of) the entities in the economic domain. Economic evolution is seen as a multi-level phenomenon, including rather than excluding biological phenomena.

Are GD and the CH rivals, complements, both, or what?

We saw that Hodgson and Knudsen's GD can be seen as a stance taken on an issue in the first cluster. Witt's CH can be seen as a stance taken on an issue in the second cluster. Thus seen, Hodgson and Knudsen's GD and Witt's CH are not direct rivals of each other. The direct rival of Hodgson and Knudsen's GD is Witt's self-transformation view on evolution, not his CH. Yet, Witt and members of his group at Jena criticize Hodgson and Knudsen's GD from the perspective of Witt's CH and present Witt's CH as a superior alternative to Hodgson and Knudsen's GD. What sort of opposition is there (if any) between Hodgson and Knudsen's GD and Witt's CH?

In Vromen (2004a) I argued that a particular stance taken on an issue in the one cluster typically does not commit one to take a particular stance on an issue in another cluster. Often there is independence between these. I suggested in particular that the CH and GD are compatible with each other. Contrary to what Witt et al. argue, acceptance of the CH need not imply the rejection of GD. The issue of whether there is one encompassing continuous causal chain leading to the evolution of human intelligence (belonging to cluster II), for example, seems to be orthogonal to the issue of whether the Darwinian triple is well-suited to grasp the dynamics of cultural systems (belonging to cluster I). Taking a stance on the first issue does not seem to prejudge the stance to be taken on the second issue.

This seems to be precisely the stance that Hodgson and Knudsen take. Hodgson and Knudsen do not take issue with Witt's CH. In this sense the debate between Hodgson and Knudsen and Witt et al. is asymmetrical. Whereas Witt et al. criticize Hodgson and Knudsen's GD, Hodgson and Knudsen do not criticize Witt's CH. In fact, Hodgson (2002, 2004) himself endorses a Darwinian doctrine of continuity.[16] This doctrine implies

[16] Hodgson (2002) suggests that Darwinian ontology is related to Darwin's unflinching commitment to causal explanation rather than to Darwin's three principles of evolution through natural selection.

among other things that intentionality cannot be an uncaused cause. Hodgson argues that Darwinism implies that intentionality is caused in antecedent evolutionary processes. Intentionality can be called a proximate cause of human behavior; a cause that itself in turn is produced by an ultimate cause such as natural selection (Mayr 1961). Hodgson's doctrine of continuity resembles Witt's CH in that both take as their starting-point the view that whatever exists is the product of antecedent evolutionary processes, either biological ones, cultural ones or a combination of both.

Hodgson seems to be right in arguing that the latter view does not rule out that ongoing cultural (and in particular economic) processes can be explained accurately with the Darwinian principles variation, replication and selection. In particular, the capacity to act intentionally that supposedly plays a large role in cultural evolution does not necessarily invalidate the applicability of the three Darwinian principles. Indeed, as many have argued (cf. Hull et al. 2001), certain forms of human learning can be analyzed with the three principles at an abstract and general level. Sometimes Witt seems to suggest not only that the three principles are applicable only to biological evolution, but also that the products of biological evolution are limited to genetically programmed behavior (thereby ruling out more sophisticated forms of intentional action). To Hodgson and other proponents of GD this is question-begging. This is exactly what they deny. The whole point of GD is that the applicability of the three Darwinian principles is *not* limited to biological evolution and to genetically programmed behavior.

Yet, it would be premature to conclude that Witt's CH and Hodgson and Knudsen's GD are compatible. On closer inspection Witt's CH turns out to be richer, or more substantive in terms of ontology than Hodgson's doctrine of continuity. Hodgson's doctrine of continuity only involves the commitment to the idea that all causes acting now are the effects of causes acting previously. Witt's CH involves more than this. What Witt adds to this in his CH is the hypothesis that the genetic material that antecedent processes of biological evolution endowed us with has remained pretty much the same since processes of cultural evolution started long time ago. Witt furthermore argues that the specific cognitive and behavioral repertoire based on this genetic material has given rise to a dynamics of cultural evolution that is distinctly non-Darwinian. As Cordes puts it, "Darwinian theories of evolution are suited to explain the natural origins of, for example, human learning, intentionality and deliberative behavior, but they are ill-suited to grasp the dynamics of cultural evolution that is based on these evolved cognitive capabilities." (Cordes 2006, 539). The claim of Witt et al. is that antecedent Darwinian processes of biological evolution produced cognitive and behavioral dispositions in humans that paved the way for recent and ongoing non-Darwinian processes of cultural evolution to take off.

Witt argues among other things that our evolved cognitive and behavioral dispositions enable us to anticipate future (possibly disastrous) selection effects and to devise strategies to forestall them. Thus unlike Darwinian biological evolution, in which mechanisms for creating new variation and mechanisms for selection are assumed to work independently of each other, cultural evolution is characterized by systematic feedbacks between selection and variation. Likewise, Witt (2003) argues that the

Darwinian assumption of "blindness" or "randomness" in the processes of variation does not do justice to human intuition and creativity in cultural evolution.

Cordes (2006) spells out in detail many more differences between biological and economic evolution. Cordes argues that the notions of replication and of replicator are especially problematic in the economic domain. There simply are no credible examples of replicators in the economic domain (and the same holds for generations and lineages). Furthermore, perfectly in line with the CH and also with Boyd and Richerson's work on cultural evolution (Boyd and Richerson 1985, Richerson and Boyd 2005), Cordes argues that social transmission in cultural evolution is biased by a host of biologically pre-evolved cognitive dispositions. Hence, high-fidelity copying, which is at the heart of the notion of replication, is the exception rather than the rule in cultural evolution. Biologically pre-evolved psychological mechanisms also play an important role in cultural selection. They might underlie the choice of whom to imitate, for example. Boyd and Richerson suggest that conformist and prestige-based biases in imitators (and, more generally, social learners) play a key role here.

Cordes seems to be right in arguing that especially the notions of replication and replicator do not fit cultural and economic evolution very well. As Hull himself argues, "Replication is inherently a copying process. Successive variations must in some sense be retained and then passed on" (Hull et al. 2001, 514). There is quite some evidence mounted suggesting that the notion of copying captures not even approximately what is going on in social learning and social transmission. The socially learning individual (or the receiver of cultural information) often has a specific interest in what he wants to learn; an interest that often differs from the senders of cultural information (teachers, e.g.). And even in cases in which the interests of senders and receivers coincide and in which the receiver (or learner) has an interest in making faithful copies, the fidelity in social transmission is often severely compromised by pre-evolved psychological mechanisms (Sperber 1996, 2000; Wimsatt 1999; Sterelny 2006). Note that Sperber's insights seem to be congenial to especially Cordes's views on the implications of Witt's CH.

Hodgson and Knudsen take over Nelson and Winter's (1982) suggestion that routines of firms are similar to the genes of organisms. Hodgson and Knudsen (2004) take this to mean that routines are similar to genes in the sense that both are replicators. With their routines as genes analogy, Nelson and Winter never wanted to suggest that routines are as faithfully copied by firms as genes are inherited by offspring, however. Nelson and Winter do not deny that firms sometimes engage in attempts to imitate routines of successful other firms. But they stress that these attempts are bound to lead to mutations rather than to faithful copies (see also Winter and Szulanski 2001). What Nelson and Winter really wanted to establish with their routines as genes analogy is that just like genes routines tend to be long-lived rather than short-lived:

> While Winter and I (1982) referred to organizational routines as like the genes of an organization, what we largely meant was that they were what gave constancy and durability to organizational behavior, not that they were easily transferable to, or replicable by, other organizations.

(Nelson 2007, 90)

Nelson and Winter argue that once routines emerge in firms they tend to be stable and robust.[17] Routines tend to survive personnel turnover and sometimes even survive deliberate attempts by top management to change them.

Thus the notions of replication and replicator seem to be ill-suited to do justice to economic evolution. Hodgson and Knudsen's decision to give more substance to their Darwinian triple by requiring that replicators and interactors are to be identified is all the more remarkable given that there does not seem to be a compelling conceptual or theoretical reason to require this. Godfrey-Smith (2000) argues convincingly that replicators are not essential for evolution through natural selection to occur. There can be evolution by natural selection without entities that satisfy Hull's definition of 'replicator'. It is enough for evolution through natural selection to occur if offspring resemble (in the relevant respects) their parents more than other organisms in the population.

Interdependencies between stances taken on issues in different clusters

It now seems that even though Hodgson and Knudsen's GD and Witt's CH are stances taken on different issues, they do bear upon each other after all. Pre-evolved psychological mechanisms bias processes of cultural and economic evolution in such a way and to such a degree that Hodgson and Knudsen's notions of replication and replicator do not fit cultural and economic evolution. This shows that there can be interdependencies rather than independencies between stances taken on issues in different clusters.

Another example of such an interdependency is provided by the so-called major transitions in evolution (Maynard Smith and Szathmary 1995; Michod 1999). Many take the existence of several layers or levels of organization in reality stipulated in the layered ontology (cluster III) simply for granted. But it has not always been like that. In evolutionary time, higher levels of organization emerged only recently. It took major transitions for higher levels to evolve. Solitary replicators first had to coalesce into networks of replicators enclosed in compartments. Subsequently unlinked genes had to evolve into chromosomes. Next prokaryotic cells had to give way to eukaryotic cells, single-celled organisms had to be transformed into multi-celled organisms until finally colonies arrived on the scene. According to Maynard Smith and Szathmary this is how new levels of organization have come into being. After each transition, entities that were capable of independent replication before the transition can replicate only as part of a

[17] This suggests that Campbell's (1965) 'retention' is befitting economic evolution better than 'replication'. Retention also seems to fit Vanberg's (2002) 'program-based explanation' better than replication. See also Stoelhorst and Hensgens (2007).

larger whole. They leave open the possibility that other major transitions are yet to occur and that other major transitions in fact already occurred.

In terms of my three clusters of ontological issues, major evolutionary transitions belong to cluster II. Hypotheses about what major evolutionary transmissions already took place have implications for stances that can consistently be taken on issues in cluster III. Only those levels of organization can be considered to be part of the layered ontology that evolved after a major transition.

As Okasha (2006) points out, major transitions also have consequences for how we think about group selection and, more generally, about multi-level selection. Okasha makes a useful distinction between two different conceptions of group selection. One conception is derived strictly analogously to individual selection. Lewontin's (1970) characterization of evolution through natural selection in terms of the three principles phenotypic difference, differential fitness and heritability is transposed to the group level. Groups must satisfy the three principles for group selection to occur. This means in particular that collective group fitness is measured in the (expected) number of offspring groups that the groups in some population leave. One would perhaps expect that this conception of group selection, which is strictly analogous to individual selection, would dominate the discussion. But this is not the case. The conception of group selection dominating the discussion is the one that is revitalized by Sober and Wilson (1998). In Sober and Wilson's conception, the collective fitness of groups is not measured in terms of the (expected) number of their "offspring" groups, but as the aggregate fitness of their constituent particles (i.e., the individuals in them). Groups are not treated as Darwinian units in their own right, but as parts of the environments for the individuals in them. Sober and Wilson's conception of group selection can be epitomized as "population structure matters". The way in which populations are partitioned in groups (defined minimally in interactional terms as sets of individuals that interact at least once, where the interactions must have fitness consequences for the individuals) partly determines what evolves.

Okasha suggests that for major transitions to get off the ground there must be group selection in the second sense. For groups to emerge as a genuine collective,[18] competition between their parts must be suppressed. This can only happen if populations have the right structure. But once groups have emerged as cohesive and integrated wholes, group selection of the first kind comes into play. Although it might be a bit farfetched and premature to try to draw conclusions from Okasha's insightful discussion for our thinking about multi-level selection in economic systems, it seems that firms often do display the degree of cohesiveness and integration that is needed to get group selection in Okasha's first, substantive sense started. Hodgson and Knudsen seem to be right that firms often are interactors in Hull's sense. This implies that economic evolution is multi-level, with firm selection being similar to Okasha's group selection in the first sense. But it took something group selection in the second Sober and Wilson type for firms to evolve as interactors.

[18] Note that this involves a more substantive notion of a group than Sober and Wilson's.

Are GD and the CH compatible after all?

Let us now return to the debate between Hodgson and Knudsen's GD and Witt's CH. We just concluded that Witt and Cordes seem to be right in arguing that Witt's CH, which is ontologically speaking richer than Hodgson's doctrine of continuity, implies that Hodgson and Knudsen's GD does not fit economic evolution. How do Hodgson and Knudsen respond to this? One might expect Hodgson and Knudsen to reply that what Witt adds to Hodgson's doctrine of continuity (which, we saw, is compatible with Hodgson and Knudsen's GD) is mistaken. And indeed, Hodgson and Knudsen do seem to have reservations about Witt et al.'s hypothesis that allegedly unchanging products of antecedent biological evolution still have a large causal impact on ongoing economic evolution. The overall thrust of their response is not to deny the differences that Witt et al. observe between economic and biological evolution, however. They argue instead that these differences do not impair the usefulness (and , indeed, even the necessity) of invoking the three Darwinian principles in explanations of processes of economic evolution.

Perhaps somewhat surprisingly Hodgson and Knudsen subscribe to many, if not all the differences between biological and economic evolution that Witt et al. identify. They furthermore agree that the differences are significant. They recognize that intentionality, intelligence and learning processes, which are mostly absent in biological evolution, play an important role in economic evolution. Hodgson and Knudsen (2008) also note that replication in economic evolution is quite unlike replication in biological evolution. Replication in biological evolution is direct, while replication in economic evolution is indirect and inferential (i.e., it works via the observation of the behavioral consequences of replicators). Hodgson and Knudsen also agree that social transmission has lower fidelity than genetic inheritance. Yet they maintain that all these differences do not invalidate the use of their Darwinian triple. They argue that all these differences are differences in details that are irrelevant for assessing the suitability of the (allegedly) domain-unspecific Darwinian principles (Hodgson 2007). The differences only become relevant if one adds domain-specific to the (alleged) domain-unspecific Darwinian principles to arrive at full-fledged explanatory theories and explanations in biology and economics, respectively.

Thus in their interpretation of the three Darwinian principles, Hodgson and Knudsen are trying to get rid of many connotations that are commonly attributed to the principles. This they do to accommodate the many significant differences between biological and economic evolution. In their attempt to show that the principles are truly domain-general, they are driven to rather extreme levels of abstraction. The price they have to pay for this, however, is (as Cordes 2007 correctly notes) that the principles are emptied from virtually all of their content. It is hard to see how principles that are practically devoid of any content could give much guidance in the construction of full-fledged domain-specific theories and explanations (Vromen 2007). Almost all the substance that is needed to arrive at full-fledged causal explanations of concrete processes of economic evolution must come from elsewhere and the three principles are not of much help in finding or constructing this domain-specific substance.

Summing up now, in the foregoing discussion three stages can be been distinguished with respect to the issue of whether Hodgson and Knudsen's GD and Witt's CH are compatible with each other. In the first stage, we saw that Hodgson is right that his GD and his doctrine of continuity are compatible. If continuity means nothing more than that every proximate cause is the effect of an ultimate cause, then continuity does not rule out the possibility that the three Darwinian principles are well-suited to explain ongoing cultural evolution. We also saw that Witt's CH entails a richer ontology than Hodgson's doctrine of continuity, however. What Witt adds to Hodgson's doctrine of continuity is the hypothesis that antecedent processes of biological evolution have endowed humans with a cognitive and behavioral repertoire that makes cultural evolution significantly different than biological evolution. Indeed, these differences are so vast that the Darwinian principles (replication, in particular) seem to be ill-suited to explain cultural evolution. Thus in this second stage Hodgson and Knudsen's GD and Witt's CH appear to be incompatible. Yet in the third and final stage we saw that Hodgson and Knudsen agree with the differences between biological and cultural evolution that Witt et al. identify on the basis of Witt's CH. Accordingly, in their interpretation of the three Darwinian principles, Hodgson and Knudsen are prepared to dispense with connotations that are commonly associated with the principles but that they agree do not fit the economic domain. What is left is an even further watered-down version of GD that is compatible with Witt's CH.

Other possible uses of Darwinism

Where does this leave us? It is not just that as a result Hodgson and Knudsen's GD is virtually devoid of content. It is also possible that in the end the same causal-etiological explanations are arrived at, whether we start from Hodgson and Knudsen's GD or from Witt's CH. This also calls into question that as research programs they provide different heuristics. Above I argued that Hodgson and Knudsen's GD and Witt's CH are rivals in the sense that they steer further research in different directions. Hodgson and Knudsen's GD spurs researchers to do further investigations into how processes of interaction (with firms as examples of interactors in the economic domain) and of replication (with routines and habits as examples of replicators in the economic domain) interact to produce processes of economic evolution. Witt's CH invites researchers to look more closely into how ongoing processes of economic evolution build upon and are still constrained and causally affected by the products of antecedent processes of biological evolution. But this was based on the assumption that the three principles and notions such as interactors and replicators retain their original connotations. Now that we have seen that Hodgson and Knudsen get rid of many of their original connotations, it is no longer clear whether their GD gives any direction to future research at all. All the content should come from domain-specific data and hypotheses and the watered-down principles and notions are not very useful in gathering the domain-specific data and in constructing the hypotheses.

It seems Witt's CH fares better in this respect. Witt's CH seems to give more direction to future research efforts than Hodgson and Knudsen's watered-down GD. The professed final aim of both Hodgson and Knudsen's GD and Witt's CH is to arrive at causal explanations of actual concrete evolutionary processes in the economy. Witt's CH gives more guidance to how to reach this aim than Hodgson and Knudsen's GD. Witt's CH specifies innate wants and non-cognitive learning mechanisms on the basis of which people are assumed to build learned or acquired wants, for example. But here it is left unclear how these substantive hypotheses about the cognitive and behavioral repertoire of human beings follow from or are explained by Darwinian theories of evolution. It is unclear how much work is done by Darwinian evolutionary theorizing in either identifying or explaining the human repertoire. In their attempt to specify the cognitive and behavioral repertoire of human beings, Witt and his group members draw on many sources (in social psychology, for example). They argue that Darwinian evolutionary theory is well-suited to explain ancient processes of biological evolution in which human learning, intentionality and deliberative behavior evolved. But they do not provide such explanations. Nor do they provide references to work of others in which such Darwinian explanations are given. That Darwinian evolutionary theory is able to explain these human cognitive capacities and dispositions is a promissory note rather than something that is actually shown.

This leaves us wondering what contributions Darwinism does have or could make to evolutionary economics. Both camps put their cards on the guidance that Darwinism could give to constructing full-fledged causal theories, either about ancient processes of biological evolution, of ongoing processes of economic evolution, or of both. But both camps have been found to be lacking in this respect. This forces us to further reflect on what contribution Darwinism could possibly make to evolutionary economics. I want to finish this paper by briefly outlining two other possible roles that Darwinism could play in evolutionary economics.

Darwinian evolutionary theory could help in seeing common patterns in already existing explanations, both inside and outside of evolutionary economics. What Darwinism then contributes would be an increased unification, integration and systematization of work already done in evolutionary economics and other fields of enquiry.[19] What would be gained is increased simplicity and coherence (Hull 1988, 402; see also Hull et al. 2001, 527). Darwinism could help in organizing discussions by giving them more theoretical structure (Nelson 2006). Thus Darwinism could also help in constructing bridges between various behavioral disciplines and in making them more compatible (Gintis 2007). In doing so, it would facilitate cross-disciplinary work and also enhance the Darwinian movement (Mesoudi et al. 2006, 346-347).

All this, I submit, gets close to what Kitcher (1993) has in mind with explanatory unification. Kitcher argues that Darwin's three principles provide a paradigmatic example of a general explanatory pattern (or schema) that has been enormously successful in unifying seemingly disparate phenomena. Darwin's principles unify the phenomena by showing that they are all instantiations of the same general explanatory pattern. The more

[19] Hodgson and Knudsen seem to also hint at this when they call Darwinian theory a metatheory.

phenomena we can show to be instantiations of the same general pattern and the fewer the principles in the explanatory pattern, the greater the explanatory power of the pattern. Kitcher contrasts his notion of unification-as-explanation with causal-etiological explanation,[20] the sort of explanation that Hodgson, Knudsen and Witt think Darwinism should be conducive to.

Another possible use to which Darwinism can be put is to construct hypotheses about end-product of evolutionary processes. More specifically, Darwinism can be helpful in generating hypotheses about specific cognitive capacities, dispositions and heuristics. This is how Darwinism is actually used in for example evolutionary psychology (Cosmides, Tooby and Barkow 1992). Evolutionary psychology identifies specific evolutionary problems and pressures that our ancestors were confronted with in the so-called Environment of Evolutionary Adaptedness and then formulates hypotheses about specialized mental modules (or psychological mechanisms) in the human mind that supposedly evolved to solve them. Subsequently the hypotheses are put to empirical tests. There is a similar tradition in economics, starting with Becker (1976), that uses Darwinism to construct hypotheses about what basic preferences we have (see, for example, also Guth and Yaari 1991, Bolton and Ockenfels 2000). More recently, neuroeconomists started to take recourse to Darwinism to formulate hypotheses about the computations and firing rates of groups of neurons (Glimcher 2003, Ross 2005).

At first sight, this might resemble the use to which Witt wants Darwinism to be put. Witt (2007) takes the fact that evolutionary economists regard new developments in evolutionary psychology and cognitive science as a hopeful sign that there is support in the evolutionary economics community for his own CH rather than for Hodgson and Knudsen's GD. But it seems that Witt sees the role of Darwinism as limited to explaining already and independently identified cognitive dispositions. By contrast, the theoretical movements just alluded to want to use Darwinism as an engine to find out about the cognitive machinery of human beings. Furthermore, the specific sorts of cognitive dispositions that Witt ascribes to human beings might not be supported by Darwinism-as-an-engine for constructing hypotheses about the human mind and brain. Sometimes it seems Witt still works with traditional dichotomies (wants and dispositions are either innate and genetically encoded or are learned or culturally acquired) that evolutionary psychology wants to overcome (Cosmides and Tooby 1992), for example.

In perhaps the most sustained attempt to see what implications Darwinism has for how the human cognitive machinery looks like to date, Sterelny (2003) argues that "… we have evolved wiring-and-connection features that are something like, but not perfectly like, beliefs and preferences as portrayed by intentional psychology" (10). We have evolved separate systems for representing preferences and beliefs, Sterelny argues, that are more sophisticated than just physiological drives or instincts and specific environmental triggers respectively. Furthermore, the connections between the two systems are not fixed but flexible. Beliefs do not directly code for specific behaviour, for example. This seems to come close to how decision theory depicts human behaviour. But

[20] But see Darden and Cain (1989) and Skipper (1999) for a counter-argument that Darwin's principles are used in Darwinism to construct causal-mechanistic explanations.

Sterelny does not believe that decision theory is vindicated. What he takes from various experimental findings is that our motivations are not stable across different contexts (Sterelny 2004, 516-517). Decision theory is not able to account for this rather radical form of context-sensitivity. It is not clear whether the views on the human cognitive machinery of Witt and his group members can accommodate the great context-sensitivity of human motivations observed and explained by Sterelny.

In short, the use that Hodgson and Knudsen and Witt et al. want to put Darwinism to, namely to use Darwinism as a point of departure for constructing causal-etiological explanations of economic evolutionary processes, is not the only use to which Darwinism might be put. What is more, there might be other uses to which Darwinism might be more profitably put. One such use is to use the three Darwinian principles to unify and integrate already existing explanations in various fields. Another use is to use Darwinism to construct new hypotheses about various parts of the human cognitive machinery.

Conclusions

In the debate between Hodgson and Knudsen's GD and Witt's CH, the two positions are often regarded as rivals. It was argued that several sorts of ontological issues are at stake in the debate. One is about the properties that biological and economic evolution have in common. Hodgson and Knudsen's GD asserts that the Darwinian principles of variation, replication and selection aptly capture properties that biological and economic evolution share with each other. Witt and his Group members disagree. They argue that the Darwinian principles only fit the domain-specific properties of biological evolution. Their argument that the Darwinian principles do not fit economic evolution is based on Witt's CH. Yet, strictly speaking, Witt's CH addresses an ontological issue of a different sort than Hodgson and Knudsen's GD, namely how biological and economic evolution are causally connected. This issue is orthogonal to the issue of whether biological and economic evolution have common properties that is addressed by Hodgson and Knudsen's GD. Strictly speaking, the alternative to Hodgson and Knudsen's GD that Witt puts forward is not his CH, but his generic view on evolutionary systems as self-transforming systems.

Once we realize that Hodgson and Knudsen's GD and Witt's CH are not directly rivaling each other, the issue pops up how then we should think of the relation between them. Are they rivals nonetheless, are they rather compatible with each other or what? Witt and his group members argue that they are rivals nonetheless, while Hodgson and Knudsen believe that they are compatible. It was argued that the critical issue here is how much ontological substance and content is given to both Hodgson and Knudsen's GD and Witt's CH. If Witt's CH is taken to assert only that all the human cognitive capacities and dispositions at work in ongoing economic evolution are products of prior evolutionary processes, as Hodgson's own doctrine of continuity asserts, then Hodgson and Knudsen are right that their GD and Witt's CH are compatible. Witt and his group members argue that Witt's CH involves more than this, however. They argue that prior processes of biological evolution have endowed us humans with specific cognitive capacities and

dispositions. These capacities and dispositions are argued to have given rise to a specific dynamics in economic evolution for which in particular Darwinian notions such as replication (and replicators) and selection are ill-suited. Hodgson and Knudsen do not counter this critique by dismissing the extra substance that Witt's CH adds to Hodgson's own doctrine of continuity, but by diminishing the ontological substance of their own GD. They purge the three Darwinian principles from several connotations that are commonly associated with the principles. This enables Hodgson and Knudsen to rescue their claim that their own GD and Witt's CH are compatible. But the price they have to pay for this is that it leaves their Darwinian principles with virtually no content.

The discussion culminated in a discussion of how useful the three Darwinian principles of variation, replication and selection can be for studying economic evolution. It is clear that if practically all the substance is removed from the principles, they are not of much help in collecting the substance that needs to be added to them in order to produce domain-specific causal explanations. Witt's hypotheses about the specific cognitive capacities and dispositions that natural selection allegedly has equipped us with seem to fare better in this respect. But here the problem is that Witt and his group members fail to make clear how these hypotheses are informed by Darwinism. Here again it is doubtful that Darwinism contributes a lot to studying economic evolution. The paper ended with a few suggestions about alternative uses to which Darwinism can be put in evolutionary economics.

REFERENCES

Abell, P., Felin, T. and N.J. Foss (2007), Building microfoundations for the routines, capabilities, and performance links. *SMG Working Paper* No.1/2007 (to be published in *Managerial and Decision Economics*, 2008).

Becker, G. S. (1976), Altruism, Egoism, and Genetic Fitness: Economics and Sociobiology, *Journal of Economic Literature*, 14(3), 817-826.

Bedau, M. (1997), Weak Emergence, in J. Tomberlin (ed) *Philosophical Perspectives: Mind, Causation, and World, Volume 11*. Malden: Blackwell, 375-399.

Bolton, G. and A. Ockenfels (2000), ERC: A Theory of Equity, Reciprocity, and Competition, *The American Economic Review*, 90(1), 166-193.

Bowles, S. and H. Gintis (2003), The origins of human cooperation, in P. Hammerstein (ed.) *The Genetic and Cultural Origins of Cooperation*, Cambridge, Mass.: MIT Press.

Boyd, R., and P. Richerson (1985), *Culture and the Evolutionary Process.* Chicago: University of Chicago Press.

Buenstorf, G. (2006), How useful is generalized Darwinism as a framework to study competition and industrial evolution?, *Journal of Evolutionary Economics*, 16, 511-527.

Campbell, D. T. (1965), Variation, Selection and Retention in Sociocultural Evolution, in Barringer, H. R., Blanksten, G. I. and R.W. Mack (eds) (1965) *Social Change in Developing Areas: A Reinterpretation of Evolutionary Theory* (Cambridge, MA: Schenkman), 19-49. Reprinted in *General Systems*, 14, 1969, 69-85.

Cordes, C. (2006), Darwinism in economics: from analogy to continuity, *Journal of Evolutionary Economics*, *16*(5), 529-541.

Cordes, C. (2007), Can a Generalized Darwinism be criticized? A Rejoinder to Geoffrey Hodgson, *Journal of Economic Issues* 41(1), 277-281.

Cosmides, L. and J. Tooby (1992), Cognitive adaptations for social exchange, in Cosmides, L., Barkow, J.H. and J. Tooby (eds), *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*, New York, NY: Oxford University Press, 163-228.

Cosmides, L., Tooby, J. and J.H. Barkow (eds) (1992), *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*, New York, NY: Oxford University Press.

Craver, C. (2007), *Explaining the Brain*. Oxford: Clarendon Press.

Cziko, G. (1995), *Without Miracles*: MIT Press.

Darden, L. and J. Cain (1989), Selection type theories. *Philosophy of Science, 56*, 106-129.

Darwin, C. (1859), *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*, London: John Murray.

Dawkins, R. (1976), *The Selfish Gene* Oxford: Oxford University Press.

Dawkins, R. (1983), Universal Darwinism, in Bendall, D.S. (ed.) (1983) *Evolution from Molecules to Man,* Cambridge: Cambridge University Press, 403-425.

Dennett, D.C. (1995), *Darwin's Dangerous Idea*, Penguin Press.

Fehr, E. and S. Gächter (2002), Altruistic Punishment in Humans. *Nature*, 415, 137-140.

Foster, J. (1997), The analytical foundations of evolutionary economics: from biological analogy to economic self-organisation, *Structural Change and Economic Dynamics, 8*, 427-445.

Frank, R.H. (1988), *Passions within Reason*, New York: W.W. Norton & Company.

Gintis, H. (2007), A Framework for the Unification of the Behavioral Sciences, *Behavioral and Brain Sciences*, 30, 1-61.

Glimcher, P.M. (2003), *Decisions, Uncertainty, and the Brain: The Science of Neuroeconomics*, MIT Press.

Godfrey-Smith, P. (2000), The Replicator in Retrospect. *Biology and Philosophy, 15*, 403-423.

Güth, W. and M. E. Yaari (1991), Explaining Reciprocal Behavior in Simple Strategic Games: An Evolutionary Approach, in Witt, U., *Explaining Process and Change: approaches to evolutionary economics*, Ann Arbor: University of Michigan, 23 - 34.

Hodgson, G.M. (2002), Darwinism in economics: from analogy to ontology. *Journal of Evolutionary Economics, 12*(3), 259-281.

Hodgson, G.M. (2004), Darwinism, causality and the social sciences, *Journal of Economic Methodology*, 11(2), 175-194.

Hodgson, G.M. (2007), A response to Christian Cordes and Clifford Poirot, *Journal of Economic Issues*, 41(1), 265-76.

Hodgson, G. M. and T. Knudsen (2004), The firm as an interactor: Firms as vehicles for habits and routines, *Journal of Evolutionary Economics*, 14(3), 281-307.

Hodgson, G. M. and T. Knudsen (2006), Why we need a generalized Darwinism, and why generalized Darwinism is not enough, *Journal of Economic Behavior & Organization, 61*(1), 1-19.

Hodgson, G.M and T. Knudsen (2008), Information, Complexity and Generative Replication, *Biology and Philosophy* 43(1), 47-65.

Hull, D.L. (1981), Units of Evolution: A Metaphysical Essay, in Jensen U.J. and R. Harré (Eds.), *The Philosophy of Evolution*, 23-44, Brighton: Harvester Press.

Hull, D.L. (1982), The naked meme, in Plotkin, H.C. (ed.), *Learning, Development and Culture*, New York: John Wiley & Sons Ltd., 273-327.

Hull, D.L. (1988), *Science as a process: An Evolutionary Account of the Social and Conceptual Development of Science*. Chicago: University of Chicago Press.

Hull, D.L. (2001), *Science and Selection: Essays in Biological Evolution and the Philosophy of Science*, New York & Cambidge, UK: Cambridge University Press.

Hull, D.L., Langman, R.E. and S.S. Glenn (2001), A general account of selection: Biology, immunology, and behavior. *Behavioral and Brain Sciences, 24*, 511-573.

Kitcher, P. (1993), *The Advancement of Science: Science without Legend, Objectivity without Illusions*, Oxford: Oxford University Press.

Lewontin, R.C. (1970), The units of selection. *Annual Review Of Ecology And Systematics*, 1, 1-18.

Mailath, G.J. (1998), Do people play Nash equilibrium? Lessons from evolutionary game theory, *Journal of Economic Literature*, 36(3): 1347-1374.

Maynard Smith, J. and E. Szathmáry (1995), *The Major Transitions in Evolution*, Oxford: Oxford University Press.

Mayr, E. (1961), Cause and effect in biology, *Science* 134, 1501-1506.
Mesoudi, A., Whiten, A. and K.N. Laland (2006), Towards a Unified Science of Cultural Evolution, *Behavioral and Brain Sciences, 29*(4), 329-383.
Michod, R.E. (1999), *Darwinian Dynamics: Evolutionary Transitions in Fitness and Individuality*, Princeton: Princeton University Press.
Nelson, R.R. (2006), *Economic Development from the Perspective of Evolutionary Economic Theory*: TTU Institute of Humanities and Social Sciences.
Nelson, R.R. (2007), Universal Darwinism and evolutionary social science. *Biology and Philosophy, 22*(1), 73-94.
Nelson, R.R. and S. Winter (1982), *An Evolutionary Theory of Economic Change*, Cambridge: Harvard University Press.
Okasha, S. (2006), *Evolution and the Level of Selection*, Oxford: Oxford University Press.
Plotkin, H. (1994), *Darwin Machines and the Nature of Knowledge*, London: Penguin Books.
Popper, K.R. (1972), *Objective Knowledge: An Evolutionary Approach*, Oxford: Clarendon Press.
Ross, D (2005), *Economic theory and cognitive science: microexplanantion*, the MIT Press
Skipper, R. (1999), Selection and the extent of explanatory unification. *Philosophy of Science* 66 (*Suppl.*), S196-S209.
Richerson, P.J. and R. Boyd (2005), *Not By Genes Alone: How Culture Transformed Human Evolution*, Chicago and London: University of Chicago Press.
Sober, E. and D.S. Wilson (1998), *Unto Others: The Evolution and Psychology of Unselfish Behavior*, Cambridge, Mass: Harvard University Press
Sperber, D. (1996), *Explaining Culture: A Naturalistic Approach.* Oxford: Basil Blackwell.
Sperber, D. (2000), An objection to the memetic approach to culture, in Robert Aunger (ed.), *Darwinizing Culture*. Oxford: Oxford University Press.
Sterelny, K. (2003), *Thought in a Hostile World: The Evolution of Human Cognition*, Oxford, Blackwell.
Sterelny, K. (2004), Reply to Papineau and Stich, *Australian Journal of Philosophy* 82(3), 512-522.
Sterelny, K. (2006), Memes Revisited, *British Journal for the Philosophy of Science, 57*(1), 145-165.
Stoelhorst, J.W. and R. Hensgens (2007), *On the Application of Darwinism to Economics: From Generalization to Middle-Range Theories* (working paper).
Vanberg, V.J. (2002), Rational choice vs. program-based behavior: alternative theoretical approaches and their relevance for the study of institutions, *Rationality and Society* 14, 7-53.
Vromen, J. J. (2004a), Conjectural revisionary economic ontology: Outline of an ambitious research agenda for evolutionary economics, *Journal of Economic Methodology, 11*(2), 213-247.

Vromen, J.J. (2004b), Taking evolution seriously – What difference does it make for economics?, in Davis, J.B, Marciano, A. and J. Runde (eds), *The Elgar Companion to Economics and Philosophy*, Cheltenham, UK: Edward Elgar 2004, 102-131.

Vromen, J.J. (2006), Routines, genes and program-based behaviour, *Journal of Evolutionary Economics* (special issue on *Evolutionary Concepts in Economics and Biology*, edited by Witt, U.), 16 (5), 543-560, 2006.

Vromen, J.J. (2007), Generalized Darwinism in Evolutionary Economics – The Devil is in the Details, *Papers on Economics and Evolution* #0711, Max Planck Institute of Economics, Jena.

Vromen, J.J. (2008), Evolutionary explanations in Economics, Kincaid, H. and D. Ross (eds), *Oxford Handbook on Philosophy of Science on Economics*, Oxford University Press, 2008.

Wimsatt, W. C. (1999), Genes, Memes and Cultural Heredity, *Biology and Philosophy*, 14, 279-310.

Winter, S. G. and G. Szulanski (2001), Replication as Strategy. *Organization Science*, 12(6), 730-743.

Witt, U. (1999), Bioeconomics as economics from Darwinian perspective, *Journal of Bioeconomics*, 1(1), 19-34.

Witt, U. (2001), Learning to consume - A theory of wants and the growth of demand, *Journal of Evolutionary Economics*, 11(1), 23-36.

Witt, U. (2003), Generic features of evolution and its continuity: A transdisciplinary perspective, *Theoria*, 48(18), 273-288.

Witt, U. (2004), On the proper interpretation of 'evolution' in economics and its implications for production theory, *Journal of Economic Methodology*, 11(2) 125-146.

Witt, U. (2007), Heuristic twists and ontological creeds: Road map for evolutionary economics, *Papers on Economics and Evolution* #0701. Max Planck Institute for Economics, Jena.

Witt, U. (2008), Evolutionary economics and psychology, Alan Lewis (ed.), *Cambridge Handbook of Psychology and Economic Behavior*, Cambridge: Cambridge University Press, 493-511.