

Cordes, Christian

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# PAPERS on Economics & Evolution



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# 1402

## **The Application of Evolutionary Concepts in Evolutionary Economics**

**by**

**Christian Cordes**

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For editorial correspondence,  
please contact: [wp-ecoevo@uni-marburg.de](mailto:wp-ecoevo@uni-marburg.de)*

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Philipps-University, Marburg  
Department of Geography  
Economic Geography and Location Research  
Deutschhausstraße. 10  
35032 Marburg, Germany  
Fax: + +49 6421/28-28950

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## The Application of Evolutionary Concepts in Evolutionary Economics

Christian Cordes<sup>a</sup>

<sup>a</sup> *University of Bremen, Faculty of Business Studies and Economics, Institute for Institutional and Innovation Economics, Hochschulring 4, 28359 Bremen, Germany*

(c.cordes@uni-bremen.de).

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### **Abstract**

There are several ways to incorporate evolutionary concepts into economic thinking. This article reviews the most important transfers of this kind into evolutionary economics. It broadly differentiates between approaches that draw on an analogy construction to the biological sphere, those that make metaphorical use of Darwinian ideas, and avenues that are based on the fact that other forms of – cultural – evolution rest upon foundations laid before by natural selection. It is shown that an evolutionary approach within economics informed by insights from cognitive science, evolutionary biology, and anthropology contributes to more realistic models of human behavior in economic contexts.

*Keywords:* evolutionary economics, human behavior, biological evolution, cultural evolution, generalized Darwinism, continuity hypothesis, Neo-Schumpeterians, American Institutionalism, competition

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## 1. Introduction

Evolutionary economics is a paradigm for explaining economic change. In principle, there are several ways to incorporate evolutionary concepts into economic thinking to reach this explanatory goal. This problem has triggered an ongoing conceptual-methodological debate in the evolutionary economics community (see Knudsen, 2004; Hodgson and Knudsen, 2006; Cordes, 2006; Witt, 2003). This article broadly differentiates between two potential channels of concept transfer: first, economics can be turned into an evolutionary science by introducing aspects of Darwin's explanatory model of biological evolution to economic theory via the construction of analogies or the metaphorical use of Darwinian ideas. Second, Darwinian concepts are relevant for explaining the basis on which economic evolution rests. On the one hand, biological evolution defines the long-term constraints on human-made economic evolution. On the other hand, innate dispositions of humans that have been shaped by natural selection earlier in humans' phylogeny define the cognitive foundations on which economic evolution rests. This second way of incorporating evolutionary concepts to economics can be called a "naturalistic approach". Common to both approaches is the criticism of the widespread tradition in economics to derive human behavior from abstract principles without proper reference to insights from the evolutionary sciences.

## 2. Analogies to the biological sphere and the metaphorical use of evolutionary concepts in evolutionary economics

So-called Neo-Schumpeterians within the evolutionary economics camp consider the concept of selection as a core element of evolutionary economics. Selection processes, they argue, act on the diversity of behaviors and entail behavioral adaptations of agents who are only boundedly rational (i.e. their rationality is limited by the information available to them, and by their particular cognitive and time constraints). This fact prevents optimal adaptation to external environments by the agents themselves. Nelson and Winter's (1982) as well as Metcalfe's (1994) approaches belong to this strand of thinking. While the former relies on a largely metaphorical import of biological concepts to economics, the latter draws on a more direct application of a model of natural selection to economic competition. Finally, the idea of a Generalized Darwinism is based on a close analogy to the biological realm and claims that a set of abstract Darwinian principles can also be applied to economic evolution.

### 2.1 Nelson and Winter's concept of organizational routines

Nelson and Winter (1982) offer an evolutionary theoretic view of the firm that is inspired by previous works of Schumpeter (1934), Penrose (1959), Simon (1955), and Cyert and March (1992). Their theory is based upon the notion of "organizational routines" and draws on a metaphorical use of the Darwinian theory of natural selection. Their behavioral assumptions deviate substantially from those of standard economics: firms are not profit maximizers but follow rather rigid rules or routines, and agents, including managers, are only boundedly rational. For instance, there are two types of search rules for finding an improved technology: first, innovating by conducting local search close to the currently applied technology, whereby the probability of success decreases with an increasing distance to the actual technology. Second, by imitating technologies of competitors in one's industry by observational learning,

firms can adopt new technologies. In this context, an erroneous estimation of the new technology's input coefficients by managers is always possible.

Routines define the firm's core capabilities and are defined as regular patterns of deliberating and acting in organizational processes. They are partly unconscious or tacit and are only questioned in the case of insufficient performance ("satisficing behavior", see Simon, 1955). Routines enable coordinated behavior (behavior of others can be anticipated) while avoiding great decision effort on the part of cognitively constrained individuals. There is a hierarchy of organizational routines: lower-order organizational skills and higher-order decision procedures. Routines serve as a firm's "memory" and are based on meta-individual, partly implicit shared knowledge. On the one hand, routines allow for fast and effective behavior in well-defined situations. On the other hand, there are constraints in modifying, replicating, and imitating routines, which might entail dysfunctionality in changing business environments and organizational inertia.

Moreover, in order to innovate in a dynamic Schumpeterian environment, firms choose different strategies and have different core capabilities (e.g., in R&D), i.e., there is variety within the population of firms, which is a prerequisite for market selection to take place. The focus is on competition between heterogeneous firms instead of a representative firm or macro production functions. In this context, firm strategies are as much a matter of, for example, faith of top management or company tradition, as they are of calculation, and there is no reason to argue *a priori* that firm commitments are optimal. Nelson and Winter's theory involves the general Darwinian principles of variation, retention, and selection: variation is introduced by firms developing new routines, retention is facilitated by stable routines, and selection is represented by competition between firms endowed with varying sets of routines. The latter process determines the differential dissemination of routines, i.e., modified "gene frequencies" in the "gene pool", via differential firm growth through the reinvestment of profits. Routines are considered as a firm's genes and a population of firms represents an industry's "gene pool". Diversity in firm behaviors tends to be eroded by market selection.

Nelson and Winter's formal approach is based upon a replicator dynamic – a concept stemming from population genetics – that describes how profitable firms' capital stocks grow and unprofitable firms' capital stocks shrink. They then carry through a series of computer simulations of their model of firm competition. The final modeling aim of Nelson and Winter is to reproduce the results of the neoclassical (Solowian) growth model in a formal approach that includes competition via innovation and imitation. Their approach amounts to a revival of Schumpeterian ideas in combination with a biological metaphor. Moreover, it provides an alternative growth model that is based on a more realistic description of firm behavior and competitive processes.

## 2.2 Metcalfe's use of the replicator dynamic

Selectionist models analogous to phylogenetic biological evolution are prominent in many works in the field of evolutionary economics. One prominent example is the work of Stanley Metcalfe (1988, 1994). He analyzes the diffusion of innovation in an economy with the help of a replicator dynamic (analogous to "Fisher's principle" in population genetics). In general, diffusion analysis is concerned with how the economic significance of a new technology changes over time, which is an aspect of structural change:

new technologies are integrated into the economy and impose changes upon its structure. Metcalfe shows that the relative profitability of competing technologies or innovations is important, not their absolute profitability, and that the former will change during the diffusion process.

His basic argument relies upon technological variety across firms as the basis for competitive advantage and a determinant of how rival technologies diffuse relative to one another. The rate of diffusion of an innovation is linked directly to that innovation's distance from average-practice technology, i.e., economic variety is correlated with the pace of selection: the change of a technology's market share is proportional to the distance between its own unit cost and population average unit cost. By this process, the lowest-cost, best-practice technology is brought to dominance (other technologies dropping in relative terms to zero). Selection works on economic variety at a pace that is directly proportional to economic variety at any point in time, a phenomenon known as the "distance from the mean principle" that underlies many selection processes. In the course of this process, selection destroys the variety on which it depends. There is, however, also an endogenous relation between selection and variety generation: selection will, via induced technological creativity, generate new variety – as is assumed in Schumpeterian economic development.

Metcalfe's model reproduces empirically observable stylized developments of variables that have also been the subject matter of neoclassical growth models (e.g., capital accumulation in Solow-type growth models), industrial economics (e.g., within-industry competition processes), or diffusion theory (e.g., the dominant stylized fact that the usage of new technologies over time typically follows an S-curve). Diffusion phenomena, Metcalfe argues, should be treated as part of the broader picture of competition and structural change in capitalist economies since they describe the unfolding of economic structures as a consequence of variety in behavior or innovative activity. Therefore, at the root of the replicator dynamic is the notion that competition is driven by technological or behavioral variety implying that there is no representative firm or technology and no static equilibrium.

### *2.3 Generalized Darwinism: applying a core set of Darwinian principles*

Generalized Darwinism shows how abstract principles derived from Darwin's explanatory model of biological evolution can be applied to cultural evolution. In his article "Darwinism in Economics: From Analogy to Ontology", Hodgson (2002) expounds his notion of this concept (here still labeled "Universal Darwinism"): a core set of Darwinian principles that, along with auxiliary explanations specific to each scientific domain, is considered applicable to a wide range of phenomena. Hodgson argues that evolutionary aspects of the biological and the cultural spheres both involve the general Darwinian principles of variation, inheritance, and selection. Generalized Darwinism seeks to apply Darwinian principles to cultural evolution, i.e., it is argued that these principles are also valid for explaining other forms of evolution. Consequently, Generalized Darwinism is proposed as a broad theoretical framework for the analysis of the evolution of all open, complex systems, including economic systems. Hodgson argues that Darwinian evolution shares these common general features with economics due to the fact that both biology and the social sciences address evolving systems. Thus, he says, Darwin's explanatory model provides a theoretical framework and ontological precepts. Hence, Generalized Darwinism

suggests making substantial use of Darwinian concepts, i.e., the latter are not applied in a heuristic or metaphorical form only.

The intention of a Generalized Darwinism is to apply Darwinian principles as a general purpose tool to various forms of evolution sharing a common ontological basis (see Hodgson and Knudsen, 2004; Knudsen, 2004; Stoelhorst, 2008). These principles – variation, inheritance, and selection – are an abstract reduction derived from Darwinian theory in evolutionary biology and are, by analogy, transferred to economics. Knudsen argues “... that an appreciation of the causal structure of neo-Darwinism may help develop a general selection theory which can be used as a basis for a development of evolutionary economics” (2002, p. 446). Hodgson (2002; 2003) introduces socio-economic replicators such as habits, routines, and institutions, which are compared to DNA, and that are subsequently subject to selection. Moreover, he states that socio-economic replicators make copies of themselves, although imperfect ones. Proponents of a Generalized Darwinism argue that abstraction removes the particular content from the specific domain in which principles apply. Hence, they maintain, the abstract principles of Darwinian evolution can be applied in different evolutionary domains.

### **3. The naturalistic interpretation within an evolutionary economics**

The approaches in this section all focus on the lasting influence of humans’ biological inheritance on contemporary behavior and the constraints on economic evolution set by biological evolution.

#### *3.1 American Institutionalism: turning economics into an evolutionary science*

Since their emergence during the second half of the nineteenth century, Darwin-inspired, instinct-based theories of human agency have delivered the psychological foundations of American Institutionalism (e.g., Rutherford, 2000; Asso and Fiorito, 2004).<sup>1</sup> This understanding of instincts as evolved, innate human dispositions by institutionalists enabled cross-fertilization between economics, evolutionary biology, and psychology. Psychologist William McDougall (1910; 1924) laid the foundation of instinct theory. He argued that, directly or indirectly, instincts are the prime movers of all human activity by determining the latter’s ends. McDougall defined instincts as innate psycho-physical dispositions that determine what agents perceive, pay attention to, experience as an emotional excitement, and the impulses to act on objects in a particular manner (1910, ch. II). Humans’ intellectual apparatus then is the instrument by which these impulses seek their satisfaction. Consequently, at the beginning of the twentieth century, early institutionalists like Thorstein Veblen, Wesley Mitchell, John R. Commons and others employed instinct theory in their analysis of economic behavior and focused especially on the interaction between instinctive motivation and intentional economic action (Mitchell, 1910; Veblen, 1914; Clark, 1918; Tead, 1918; Commons, 1920; Parker, 1920).

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<sup>1</sup> In contrast to the modern ethological understanding of the term “instincts,” institutionalists at that time did not consider them as more or less fixed behaviors, but as a bundle of flexible dispositions or propensities that can be suppressed or diverted (Hodgson, 2004, p. 162). Present day cognitive scientists would speak of “psychological dispositions” when addressing the same phenomena.

A path-breaking strand of this interpretation of an evolutionary economics reaches back to Thorstein Veblen. In 1898, Veblen (1898) put the question “Why is Economics not an Evolutionary Science?” to the audience and delivered an early theoretical concept for an evolutionary approach to economics, inspired by contemporary Darwinian thought. Veblen developed a theory of institutional evolution that takes into account the cumulative nature of the cause and effect sequence of the process of institutional development. The first part of Veblen’s “Instinct of Workmanship” (1914) contains the most systematic formulation of his theory of institutional change and its psychological foundations. Instincts are a key component of Veblen’s theory of institutional evolution (see also Ayres, 1958).

Veblen (1919, p. 231) criticized the hedonistic, selfish, and rationalistic psychology of orthodox economics. As an alternative, he suggested a psychology based on instincts and habits that was crucially inspired by McDougall’s work and integrated it into his model of institutional change (see Mitchell, 1914; Rutherford, 2001). He considered the determinants of human behavior to be the main explanatory variables and driving forces of institutional change. Thereby, behavior responds to two kinds of determinants: the basic drive of instinctive factors and the drive to conform to habits. With respect to the capacity to motivate behavior, instincts and habits are functionally equivalent. Habits, as elements of the socially approved scheme of conduct and pursuit, become proximate ends of endeavor. They may even occupy the interests of agents to such an extent that the instinctively given ulterior purpose temporarily loses influence (Veblen, 1914, p. 7). While the formation of habits relies on evolved sophisticated forms of social learning, instincts are directly based on innate cognitive dispositions. In general, Veblen identified instincts as specific innate tendencies of the mind that have evolved in the process of adaptation of species to their environment.

Veblen’s theory of cumulative evolutionary change takes the following shape (see Rutherford, 1998): the starting point of institutional change always consists of the given instinctive endowment of humans – comprising, for example, the “instinct of workmanship” that underlies technological creativity, and social instincts, such as the “parental bent” that aims at the welfare of the family or group including non-relatives. Objectives that people pursue are, in line with McDougall, a matter of instinct (Veblen, 1914, p. 3). It is by the prompting of instinct that reflection, deliberation, and technological creativity come to be employed. The established way of life comprising society’s material and technical conditions gives rise to corresponding habits of action as well as thought and finally institutions. The latter are supported by social sanction and are passed on through socialization. Institutions are largely “... a matter of tradition out of the past, a legacy of habits of thought accumulated through the experience of past generations” (Veblen, 1914, p. 7). If the existing institutional circumstances are not too obstructive, the instinctive nature of humans will express itself in ways that result in new technological insights, new corresponding habits of action and thought, and ultimately new institutions.

### *3.2 The evolution of institutions: Hayek and North*

In a manner similar to Veblen’s ideas of human nature, F. A. Hayek – as a representative of the Austrian School – assumed a core set of human instincts that evolved in the primitive tribal societies of pre-history. Hayek’s theory of their exact nature is, however, much less developed than Veblen’s (see Hodgson, 2007). Following Hayek, innate behavioral dispositions can be assumed to have great influence



on the evolution of institutions. He stated that frugal forms of social behavior, values, and attitudes became genetically fixed during human phylogeny. His conception of instincts starts from his notion of social rules: a stratification of rules of conduct rests on genetically inherited “instinctive” drives that are determined by “physiological structure” (1979, p. 159f). This system of layered rules comprises traditions of the past and a thin layer of deliberately added “made” rules. Hayek also explicitly stated that humans’ instinctive proclivities evolved in the course of millions of years during which the biological constitution of humans was created by natural selection. Hayek did not, however, appreciate the continuous impact of instincts on intentionality, learning, and other forms of cognition (see Hodgson, 2007).

Moreover, Hayek did not specify the exact contents of humans’ innate instincts and how their working keeps influencing institutional evolution. Instead, he just claimed that instincts are “tamed and checked” by the rules of conduct and institutions of civilized society (1960, p. 60f). In Hayek’s theory of human nature there is therefore a constant conflict between innate instincts – adapted to life in primitive societies or tribes – and the necessity to behave according to a civilized society’s abstract rules. The social rules of conduct are meant to restrain the “natural” instincts to enable the “open society” that is based on larger and ordered groups (Hayek, 1979, p. 160ff).

Hayek also shared a strong interest in theories of cultural evolution with Veblen. They both emphasized the unique human capability for cultural adaptations through cultural learning. Moreover, they both paid extraordinary attention to group-regarding proclivities. Hayek argued that an inherent part of human nature includes the welfare of others as a condition for individual happiness (1960, p. 78). In particular, he mentioned the instincts of solidarity and altruism, which apply to the members of one’s group (1988, p. 12 and sections 3 and 4). Furthermore, Hayek’s theory of societal evolution comprises the idea of a process of cultural group selection – an idea that was also prominent among American Institutionalism (Cordes, 2007). According to Hayek, social learning processes form a layer “between instinct and reason” consisting of rules of conduct as basic institutions. This part of his conception of cultural evolution is akin to Veblen’s notions on the role of habits. The rules of conduct can, Hayek argued, emerge as collective, unintended outcomes and then affect a society’s economic prosperity, which, in turn, drives the group selection process between societies (1979, p. 160). Existing rules of conduct have developed because the groups practicing them were more successful and displaced others (1973). Hayek therefore claimed that beneficial institutions and ideal rules of conduct are not a result of human reason but spring from a cultural evolutionary process, i.e., group adaptation to past experiences (1979, p. 155ff).

A naturalistically inspired theory of economic change has also been brought forward by Douglass North (2005). His approach puts human cognition center stage: the driving forces of economic evolution are, he argues, human intentionality, beliefs, cognitive learning, and knowledge creation including its subsequent dissemination via social learning. Denzau and North (1994) have provided a conceptual link between human cognition and the evolution of institutions. They argue that in order to understand the constraints on human choice one has to explore the relationship between, on the one hand, the categories and mental models that individuals construct to make sense out of their environment and, on the other hand, the institutions that develop in historical time to order social interactions. Categories and mental models are based upon individual and collective learning processes, i.e., evolved capabilities of social cognition contribute to the design and the passing on of these mental frameworks.

### *3.3 Thermodynamics: constraints on economic evolution*

Another author who took up a naturalistic stance on economics is Georgescu-Roegen (1966; 1976; see also later contributions in this spirit: Gowdy (1994) or Faber and Proops (1997)). His focus is on the long-term constraints biological evolution puts on economic evolution. Georgescu-Roegen labeled his approach “bioeconomics”. He brought forward the idea that the economic process is a continuation of the biological one that involves exosomatic instruments to obtain low entropy in addition to nature’s endosomatic instruments (1966, p. 98f). The exosomatic instruments, he maintained, are a result of humans’ instincts, those of workmanship and of idle curiosity – a reference to Veblen’s proposed set of instincts. Georgescu-Roegen suggested concrete contents of human preferences, including biological, social, and personal wants. He showed that human beings exhibit lexicographic preferences, for example, in ethical matters, so that maximum equality of liberty takes lexicographic priority over economic wellbeing. These preferences violate standard assumptions concerning substitutability in choice. When referring to “social instincts”, Georgescu-Roegen argued that utility to an individual is not only a function of her own consumption, but also considers the welfare of her community (see Gowdy and Mesner, 1998).

Moreover, starting from thermodynamics, he argued that some basic laws of physics are widely ignored by economists: the closed systems of growth models, for example, do not account for the necessary continuous inflow of low entropy from the environment to maintain economic growth; the economic process is entropic: it transforms low into high entropy (1966, p. 96f). Georgescu-Roegen insisted that economic theory be grounded in biophysical reality. By accounting for these physical laws, he introduced some fundamental naturalistic aspects to economics: natural limitations to economic evolution. By invoking the Second Law of Thermodynamics, Georgescu-Roegen presented a constraint on all economic activity: entropic degradation. He emphasized the necessity of recognizing human agents as members of a biological species bound by biophysical processes and as social beings shaped by institutional patterns.

### *3.4 The indirect evolutionary approach and game theory*

There are several more recent approaches claiming that certain basic features of economic behavior are best explained as a result of natural selection. They account for human behaviors such as reciprocal altruism, notions of fairness, moral behavior, and other rules of conduct that presumably have a genetic background (e.g., Hofbauer and Sigmund, 1988). Güth and Yaari (1992), for example, suggested their so called indirect evolutionary approach that can be used to help explain what basic wants evolutionary processes have endowed us with. They argue that wants guide behavior, behavior determines reproductive success, and the latter, as a manifestation of genetic fitness, in turn drives the evolution of wants. Individuals whose wants made them relatively more successful in acquiring and efficiently tapping scarce resources under the prevailing circumstances will have a higher number of offspring. On condition that the offspring inherit the genetically fixed wants, those wants will ultimately be disseminated within the population, which enable an individual to cope more successfully with an environment that contains scarce resources. In this Darwinian perspective, aspects of human behavior are viewed as a product of biological evolutionary history. Furthermore, in his theory of social contract, Binmore (1998; 2001)

applied a game-theoretic analysis to specify some contents of humans' preferences regarding fairness, leadership, and justice that might have evolved during phylogeny.

### *3.5 Another naturalistic endeavor: the continuity hypothesis*

Another naturalistic endeavor in evolutionary economics starts from a "continuity hypothesis" (Witt, 2003, p. 15f, 2004; Ruprecht, 2005; Cordes, 2006; Buenstorf and Cordes, 2008; Woersdorfer and Kaus, 2011). This departure rejects the application of abstract principles derived from "Darwinism" to socio-economic evolution. At some point in time, it is argued, Darwinian evolutionary theory lost its power to explain human behavior. After a period of co-evolution with biological evolution, cultural evolution eventually allowed forms of human behavior to emerge that entailed a strong relative reproductive success, reducing selection pressure significantly and increasing behavioral variety. Other forms of evolutionary change take place within the freedom left by the constraints of Darwinian evolution, though with different means and according to their own regularities. The foundations of cultural evolution have, however, been laid before by natural selection in the form of humans' cognitive apparatus. 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. The continuity hypothesis shows the way in which Darwinian theory can be relevant for economics: the human species is a result of natural (Darwinian) evolution; biological evolution has shaped the ground and still defines the constraints for human-made, or cultural, evolution.

Moreover, Darwinian theory explains the origins of economic evolution in human phylogeny and fosters the understanding of the lasting influence of innate elements, dispositions, and programs on behavior. Evolutionary selection has created a set of cognitive devices that participate in generating human behavior. The human behavioral repertoire is the basis on which other forms of evolution rest, not least those which are socially contingent. From this perspective, the biologically evolved foundations of learning and reasoning directly enable and affect cultural evolution. Darwinian theories of evolution are therefore 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 – with its own modes of transmission – that are based on these evolved cognitive capabilities.

Among other things, a naturalistic approach that includes a set of evolved cognitive dispositions can account for the motivational underpinnings of human behavior within organizations (Nicholson and White, 2006; Langlois, 2003). There are several naturalistic contributions dedicated to an analysis of the evolution of business cultures that offer a behavioral enrichment of the theory of the firm (e.g., Witt, 1998; Cordes et al., 2008; Cordes et al., 2010). Some of these papers use formal models of cultural evolution that stem from anthropology (Cavalli-Sforza and Feldman, 1981; Boyd and Richerson, 1985). It is shown that what successful firms do better than markets – besides economizing on transaction costs – is to establish a cooperative regime among its employees that "crowds in" desirable behavior based on humans' unique evolved group-regarding social predispositions – behaviors that go beyond the self-regarding concerns emphasized in traditional economic and biological theory (e.g., Gintis, 2007). In this context, the theory of gene-culture coevolution serves as a central tool in this analysis (Boyd and Richerson, 1980; Richerson and Boyd, 2005). It shows how non-selfish, cooperative human traits have

evolved in humans' past and how they take effect in contemporary behavior (e.g., Henrich, 2004; Gintis et al., 2005). Moreover, several of these contributions tackle the task of understanding how entrepreneurs and other business leaders can actively shape behavior within a firm as prominent role models in cultural learning and how this affects firm performance and size – a cognitive dimension that is neglected in both transaction cost economics and the theory of the firm more generally (Witt, 2007).

The continuity hypothesis has been applied to several other areas in economics. A naturalistic concept of wants inspired by behavioral theory and cognitive psychology, for example, can explain the origins and development of – innate and learned – wants people pursue. Moreover, it is suited to grasp changes in wants, i.e., to account for the fact that preferences are not constant (Witt, 2001; Ruprecht, 2005; Schubert, 2012). Consumer behavior also has an essential role to play in any transition toward a more sustainable economy: “green” consumption patterns, for example, can spread within a population via processes of social learning that are based on, as well as influenced by, evolved cognitive capabilities (see Buenstorf and Cordes, 2008; Woersdorfer and Kaus, 2011).

#### 4. Conclusions

There are different possibilities for how Darwinian concepts can be harnessed to further develop economic theory. This article has presented approaches within evolutionary economics that are based on analogy to the biological sphere, concepts that draw on a merely metaphorical use of Darwinian ideas, and some avenues that argue that the Darwinian theory of biological evolution is relevant for the social sciences in a very basic sense: the human species is, after all, a result of natural (Darwinian) evolution and all other forms of cultural evolution rest on these foundations. In general, an evolutionary approach within economics informed by insights from modern cognitive science, evolutionary biology, and anthropology can be assumed to contribute to the development of more realistic models of human behavior in economic contexts (see Hodgson, 2004, ch. 19).

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