EVOLUTIONARY ECONOMICS

Geoffrey M. Hodgson
University of Hertfordshire Business School, Hatfield, Hertfordshire Al10 0ab, UK

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Contents

Summary

Historically, a number of approaches in economics, including works by Adam Smith, Karl Marx, Carl Menger, Alfred Marshall, Thorstein Veblen, Joseph Schumpeter, and Friedrich Hayek, have been described as 'evolutionary'. This is legitimate, because 'evolutionary' is a very broad word, loosely denoting concern with transformation, innovation and development. But today the term 'evolutionary economics' is more typically associated with a new wave of theorizing signaled by the seminal work of Richard Nelson and Sidney Winter in their *Evolutionary Theory of Economic Change* (1982). Although there is not yet any consensus on core principles, this wave of evolutionary thinking has given rise to a number of policy developments and has proved to be influential in a number of sub-disciplines, in business schools and in institutions concerned with science and innovation policy. Citation and other bibliometric studies show that despite its internal diversity, modern evolutionary economics has created a global network of identifiable interacting researchers. As well as discussing these background issues, this essay turns to theoretical principles and outlines some of the shared common assumptions of this broad approach. It also addresses the possibility of the creation of a shared theoretical framework based on generalized Darwinina principles. Further sections compare evolutionary economics with mainstream economics and with evolutionary game theory. A notable difference with mainstream and game-theoretic genres is that evolutionary economics gives greater relative emphasis to appreciative theorizing. Mathematical and statistical techniques are widely used, but there is less concentration on full analytic solutions and more on illustrative simulations including agent-based modeling. A concluding section to this article considers the prospects for evolutionary economics for the future.

1. Introduction

The term 'evolutionary economics' is today applied to a set of diverse approaches. They vary widely in terms of their basic assumptions, their distances from mainstream economics, whether or not they adopt Darwinian ideas from biology, and in terms of their policy conclusions. The historical sources and nature of some of these divergences will be explored later below. In part this diversity results from the fact that 'evolution' is a vague word, with a variety of meanings.

Despite this diversity, there are common themes among these economists describing themselves as evolutionary. Among these is a shared emphasis on matters of economic change and transformation. Often evolutionary economists do not take institutions or technology as given: they focus is how they emerge and develop. There is a shared interest in novelty and innovation. It is also generally assumed that complex phenomena do not typically emerge by design. As in nature, complex phenomena result from processes of self-organization and competitive selection.

This essay examines the historical roots of evolutionary economics and then elaborates on its shared concerns and ideas. A further section establishes a simply taxonomy of differences within this school. A subsequent selection considers recent work on shared evolutionary principles. Further sections elaborate on differences with mainstream economics and make a comparison between evolutionary economics and evolutionary game theory (Hodgson and Huang 2011). The final section considers the prospects for evolutionary economics in the twenty-first century.

2. The Emergence of Evolutionary Economics

The first use of the term 'evolutionary economics' in English was probably by Thorstein Veblen (1898, p. 398). He gave this term a particular meaning that has not been universally adopted since. Veblen (1899, 1919) argued that economics should become 'post-Darwinian' and embody the insights of Darwinian evolutionary theory. He upheld that selection processes operated on institutions in society, as well as on organisms in nature (Camic and Hodgson 2011).

Although Veblen was one of the founders of the original institutional economics, his followers quickly abandoned his Darwinian legacy (Hodgson 2004a, Rutherford 2011). By the 1920s any appeal to ideas from biology had become extremely unpopular in the Anglophone social sciences. Even when Veblen's followers retained the word 'evolutionary', it was used to refer more broadly to development and change, and mostly without any Darwinian connotations, as with the Association for Evolutionary Economics in the USA.

Although Joseph Schumpeter (1934, pp. 57-8) for a while saw the term 'evolution' as 'discredited', later he was to adopt the term himself (Schumpeter 1939, 1942). But he never interpreted evolution in Darwinian terms (Hodgson 1993, Witt 2002). He made the analyses of technical change, entrepreneurship and innovation the centre-pieces of his work. While static analysis of the circular flow had a place in his analysis, he saw that a primary question for economists was to understand the processes of restless

dynamism and transformation. Work influenced by Schumpeter is also described as 'evolutionary economics' as evidenced by the title of the *Journal of Evolutionary Economics*, published by the International Joseph Schumpeter Society.

Another strand of evolutionary thinking originates within the Austrian school of economists, particularly Carl Menger, Ludwig von Mises and Friedrich Hayek. Menger's (1871) theory of the emergence of money is often cited as evolutionary, because it is an attempt to understand the emergence of an institution. But the evolutionary credentials of Austrian economists are much more developed in the case of Hayek (1967, 1973, 1979, 1988). He makes much more use of notions of evolutionary selection and draws parallels between evolution in society and evolution in the natural world. But while Hayek acknowledges Darwin, he sees Darwinism as one stage in a long line of evolutionary thinking, rather than an intellectual revolution in its own right (Hodgson 1993).

Given the rather broad and vague set of concerns that been described as 'evolutionary' and the wide usage of the term, it is quite appropriate for writers to identify 'evolutionary' themes in other writers including Adam Smith, Karl Marx, Carl Menger and Alfred Marshall. Evolution is a broad word and it catches a lot of ideas. There is nothing wrong with that. It would be a mistake to infer that 'evolution' implies a clear set of principles, or that 'evolutionary' necessarily means Darwinian. There is no Darwinian copyright on the term 'evolution'.

The modern wave of evolutionary economics began in the 1980s. Hayek's prescient works in the 1970s have already been noted. Nicholas Georgescu-Roegen (1971) introduced the entropy law into economic theory, and alse made bridges between some types of evolutionary analysis and egonological economics. Kenneth Boulding (1981) also produced a systematic treatise. But the real boost came with the publication of Richard Nelson's and Sidney Winter's (1982) *Evolutionary Theory of Economic Change.* Their line of research originated in the RAND organization and was there inspired by Armen Alchian (1950). Nelson and Winter were also influenced by the behavioral theory of the firm (Cyert and March 1963). Since 1980 theoretical developments in evolutionary economics have been significant, and a huge amount of related material has been published, but as yet there has been no convergence on an integrated approach (Silva and Teixeira 2009).

Nevertheless, by the 1990s it was possible to write of an international network or 'invisible college' of 'evolutionary economists' who, despite their analytical differences, were focusing on the problem of analyzing structural, technological, cultural and institutional change in economic systems (Verspagen and Werker 2003, Witt 2008, Silva and Teixeira 2009). Reference within this informal college is typically made to a variety of alleged precursors such as Schumpeter, Hayek, Marshall and Veblen, but the evolutionary college is too amorphous and eclectic to warrant a description in terms of a single mentor.

Despite its internal heterogeneity and lack of consensus on key issues, the networks, journals and forums that developed after the 1980s created a scattered but linked community of scholars addressing common problems and overlapping research

agendas. They were also united by their common dislike of the static and equilibrium approaches that dominated mainstream economics.

There are also links with research programs that originated outside economics. Among these is the 'organizational ecology' approach (Hannan and Freeman 1989), work on organizational adaption (Levinthal 1992), and other work of an evolutionary nature in organization studies (Aldrich and Ruef 2006).

Post-1980 evolutionary economics has also been prominent in various policy debates, particularly concerning policies for technological development, innovation and business strategy (Dosi et al. 1988, Lundvall 1992, Nelson 1993, McKelvey 1996, Murman 2003). Its influence is probably stronger in business schools and other applied research institutions than in departments of economics within universities. Nevertheless, policy work emanating from evolutionary economics ranges from advocacy of some state intervention in the economy to vigilant support of free-market policies.

3. First Principles and Shared Concerns

Despite the variety of approaches involved, it is possible to find some shared concerns at a basic level. The most fundamental issues are ontological. Consider the nature of the world to which the principles of evolutionary economics are said to apply. We find that among contemporary evolutionary economists there is universal agreement on five important features.

First, it is a world of change. But this change is not merely quantitative or parametric: it involves qualitative changes in technology, organizations and the structure of the economy (Veblen 1919, Schumpeter 1934, Hayek 1988). The equilibrium orientation of much mainstream economics is criticized precisely for its limited ability to embrace such qualitative change (Klaes 2004). In its emphasis on process rather than equilibrium, evolutionary economics aspires to characterize transient effects even in the presence of a well-defined rest point in the long-term dynamics.

Second, an important feature of economic change is the generation of novelty. What are the sources of innovation and change? Variety and its replenishment through novelty and creativity is a central theme of contemporary evolutionary economics. Nicolai Foss (1994, p. 21) argues that evolutionary economics of the type developed by Giovanni Dosi, Richard Nelson, Sidney Winter, Ulrich Witt and others is concerned with 'the transformation of already existing structures and the emergence and possible spread of novelties.' Witt (1992, p. 3) writes: 'for a proper notion of socioeconomic evolution, an appreciation of the crucial role of novelty, its emergence, and its dissemination, is indispensable.'

Third, evolutionary economists stress the complexity of economic systems. There are various definitions of ontological complexity, but many invoke the key idea of causal interaction between a number of entities with varied characteristics (Saviotti 1996). Such complex ontologies involve non-linear and chaotic interactions, further limiting predictability. They create the possibility of emergent properties and further novelties.

And generally the combination of novelty and complexity make many evolutionary changes irreversible (Dosi and Metcalfe 1991).

Fourth, human agents have limited cognitive capacities. Especially given the complexity, uncertainty and ongoing change in the real world, agents are unable to fully understand what is going on or what is likely to happen. They are unable to obtain a fully-specified set of options and decisions are based of simpler rules of thumb rather than comprehensive rational deliberation. As Herbert Simon (1957) put it, there is 'bounded rationality'.

Fifth, complex phenomena can emerge through self-organization or piecemeal iteration rather than comprehensive overall design. Just as Darwin showed that intricate and complex phenomena can emerge without God, evolutionary economists adopt the insight of Friedrich Hayek (1988) and others that many human institutions and other social arrangements evolve spontaneously through individual interactions, without an overall planner or blueprint.

But universal acceptance of the importance of self-organization or undesigned order does not mean unanimity on its ontological details or its explanatory significance. One crucial problem is whether markets or exchange are the universal ether of human interaction (from which spontaneous order emerges) or whether markets and contracts depend significantly on other institutions (such as the state) and whose evolution has to be explained, which may in fact involve a significant measure of planning or design, as well as spontaneity (Vanberg 1986, Hodgson 1993, 2009). Differences of view over the latter issue lead to a variety of policy positions over the roles of states or markets in the evolutionary college.

There is also a divergence over whether the idea of self-organization is sufficient to explain social evolution (Foster 1997, p. 444), or is an 'abstract, general description of evolutionary processes' (Witt 1997, p. 489), or has to be supplemented by other major mechanisms including selection (Kauffman 1993, Hodgson and Knudsen 2006, 2010, Aldrich et al. 2008, Geisendorf 2009). In the next section it is shown that this particular division of opinion is related to different foci of evolutionary analysis.

4. Different Evolutionary Approaches

There are a number of different ways of classifying different evolutionary approaches in the social sciences (Campbell 1965, Hodgson 1993, 2007b). One relatively simple criterion is to consider the difference between, first, the evolution (or development) of a *single* entity and, second, the evolution of a whole *population* of entities. Confusion or conflation of these different types of evolution has often created unwarranted controversy. In modern biology the former is referred to as development or ontogeny, and the latter as evolution or phylogeny. Accordingly, we may make the distinction between:

a) *ontogenetic or developmental theories of social evolution* that focus principally on a single entity or structure and consider its development through time; and

b) *phylogenetic or population theories of social evolution* that address the evolution of whole populations of entities, as well as the development of entities themselves.

For example, Hegel's and Marx's theories of history come into the category of ontogenetic or developmental theories of social evolution. In *Capital* Marx (1976, pp. 90-2) focused on the development of the capitalism largely as a result of its own internal logic. The hugely influential nineteenth-century evolutionary theorist Herbert Spencer (1862, p. 216) was also primarily an ontogenetic theorist. He defined evolution in terms of a single system and its 'change from an indefinite, incoherent homogeneity, to a definite, coherent heterogeneity through continuous differentiations.' Schumpeter was strongly influenced by Marx and focused principally on the development of singular systems. Like Marx, he saw evolution as the development of a single system, largely 'from within' (Schumpeter, 1934, p. 63). Witt (2003) similarly emphasizes endogenous change.

Evolution 'from within' downplays interactions with the environment. It either concentrates on a single entity or defines the system so broadly that a great deal is 'within'. Either way, the focus is on a singular entity or system rather than a population of entities. But there is always an external environment. And many social, economic or political changes result from exogenous shocks. Developments 'from within' are also important but it is a mistake to give them exclusive stress. In biology, neither individuals, nor species, nor ecosystems are entirely 'self-transforming.' Evolution takes place within *open* systems involving *both* endogenous and exogenously stimulated change.

Likewise, in social evolution, exogenously stimulated change is sometimes of great importance, partly because of the cultural mechanisms of imitation and conformism that tend to reduce internal variety and can lead to institutional ossification. Exogenous shocks sometimes overcome the rigidity of the system. In history there are many examples of the role of exogenous shocks. The arrival of American warships in Tokyo Bay led to the Meiji Restoration of 1868 and the abrupt transition of Japan from feudalism to a Western-inspired capitalist society. The occupation of Japan and Germany by American and allied troops in 1945 also led to major institutional changes. The course of institutional evolution was altered by the intrusion of new forces across the boundaries of the system, as in many other cases of institutional transformation being promoted by invasion or other forces from outside.

Ontogenetic approaches themselves put different degrees of emphasis on the role of environmental interactions. In some accounts ontogeny is treated as the 'unfolding' of the phenomenon with an outcome that is pre-destined and independent of environmental contingencies. More realistically, ontogeny involves sequential adaptation to environmental circumstances and events. But in both cases a singular entity is involved.

Self-organization is insufficient to deal with cases of multiple entities. It provides no adequate explanation of how one entity rather than another adapts to survive in this environment. On its own, self-organization theory can explain neither the current adaptedness nor the process of adaptation to the environment (Cziko 1995, p. 323).

Self-organization is important in nature and society but it cannot offer a complete explanation of evolution in populations.

In contrast, phylogenetic or population theories of social evolution enlarge the scope of evolutionary theory from one entity to a population of entities, and introduce a number of additional critical issues. First, there is the existence and possible regeneration of variety among this population. Second, there is the question of the differential survival of different members. As a result of accident, choice or differential fitness, some survive longer than others. Third, there is the possibility that some members of the population may pass on information concerning population solutions to others.

We are reminded of Darwin's (1859) famous trinity of principles of variation, selection and inheritance. But Darwinian ideas have been strongly resisted in the social sciences for most of the twentieth century (Degler 1991). We return to the question of Darwinism later below.

The contrast between ontogenetic and phylogenetic theories of evolution stems from differences in the types of phenomena being addressed: ontogenetic theories address singular developing entities, including social formations such as institutions, while phylogenetic theories address populations, with an interest in the differential survival capacities of different entities. Matters are more complicated because phylogenetic evolution always also involves the ontogenetic development of individual entities. Furthermore, ontogenetic development may involve phylogenetic selection of components, such as the selection of bacteria in the guts of animals, or the selection of teams within firms.

As noted above, Menger's (1871) theory of the evolution of money is an example of an ontogenetic theory. Although it involves multiple individual traders, the focus is not on their differential survival but on the emergence of money as an institution. But when Veblen (1899, p. 188) wrote of 'the natural selection of institutions' he was concerned with their differential survival, as well as the natural selection of individuals.

Problems and further taxonomic divisions arise when we consider what populations of entities are relevant in the social domain. Several early theorists of phylogenetic social evolution regarded either human individuals or ideas as the appropriate entities or units (Hodgson 2004a, ch. 5). But the choice of individuals as units of selection has accommodated a number of views concerning human nature, including the extreme view that it is wholly and biologically determined. A key question is this: what makes an entity social, rather than merely being a common attribute of a number of individuals? An adequate answer to this question must point to social structures or relations that are irreducible to the properties of individuals taken severally. This suggests that an exclusive focus on individuals as units of selection in social evolution is inadequate.

In this respect the lead offered by Nelson and Winter (1982) is particularly important. Using the analogy of 'routines as genes' they argued that organizational routines involving groups of workers act as replicators in the evolution of firms. Although this insight is responsible for a new way of viewing firms and their evolution, the details

remain controversial and many writers have stressed the need to define the replicator concept carefully (Hodgson and Knudsen 2010).

5. The Search for General Evolutionary Principles

In this section we address the evolution of populations of entities that have differential capacities for survival and can replicate key information to pass from one to another. These may be described as 'complex population systems' (Hodgson and Knudsen 2010). We find examples of these broadly-defined systems in both nature and human society. Accordingly, some leading evolutionary economists have advanced the idea that general, over-arching evolutionary principles may apply to both biological and social evolution. Sidney Winter (1987, p. 617) argued that

> natural selection and evolution should not be viewed as concepts developed for the specific purposes of biology and possibly appropriable for the specific purposes of economics, but rather as elements of the framework of a new conceptual structure that biology, economics and other social sciences can comfortably share.

Similarly, J. Stanley Metcalfe (1998, pp. 21-2, 36) proposed that a common set of 'evolutionary ideas' apply to both social and biological phenomena: 'Evolutionary theory is a manner of reasoning in its own right quite independently of the use made of it by biologists. They simply got there first …'. But while upholding abstract principles that span both the biological and the social domains, Winter and Metcalfe refrained from describing them as Darwinian.

An objection to such generalizations is that the processes of biological and socio-cultural evolution are so different that the generalization of Darwinian or other principles to encompass them is unhelpful (Cordes 2006).

But the argument that biological and social evolution are so different that any general principles is unviable overlooks the fact that detailed mechanisms of evolution also differ greatly *within* the biological world. These differences of mechanism are as impressive in some ways as the differences between the biological and the social. Yet general (Darwinian) principles apply. As David Hull (1988, p. 403) argues: 'the amount of increased generality needed to accommodate the full range of biological phenomena turns out to be extensive enough to include social and conceptual evolution as well.'

Generalization is central to all science, which compares and groups varied phenomena for the purpose of explanation. It is obvious, even trivial, that such generalization covers diverse phenomena and cannot capture all the details.

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Biographical Sketch

Geoffrey M. Hodgson is a Research Professor at University of Hertfordshire Business School in the UK. He is author of *From Pleasure Machines to Moral Communities* (2012), *Darwin's Conjecture: The Search for General Principles of Social and Economic Evolution* (2010, with Thorbjørn Knudsen), *The Evolution of Institutional Economics* (2004), *How Economics Forgot History* (2001), several other books and over 120 academic journal articles. He is Editor in Chief of the *Journal of Institutional Economics* and an academician of the Academy of Social Sciences. His website is www.geoffrey-hodgson.info.