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Social systems evolving?reviewing Leydesdorff?s the knowledge-based economy
Dolfsma

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Social systems evolving—reviewing Leydesdorff's the knowledge-based economy

Wilfred Dolfsma

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Is the biological metaphor the proper one for evolutionary economics to pursue, given that it leads one to incorporate more from biology as an academic discipline than would be called for? Is the economy, the subject of analysis for economists, not fundamentally different from a biological or a natural system? These are the topics of ongoing discussion within the field of Evolutionary Economics that I will address only indirectly here, reviewing Loet Leydesdorff's (2006a) recent book. They do linger in the background, however, needless to say.

Leydesdorff's book offers significant theoretical insights and counter-points to the strand in evolutionary economics that aims to stay close to Darwin's thinking (Hodgson and Knudsen 2006; special issues of the Witt 2006, and the Klaes 2004). Rather than addressing this body of literature head on, dismantling it first before presenting his own views, Leydesdorff develops an alternative perspective of how social systems evolve, largely without extensive reference to this literature. And as well he might, as there is a long history of thought in the social sciences that he draws on besides the field of evolutionary economics.

In many respects, this book is the culmination of thinking in systems' theory, science studies, scientometrics and related fields. It is unfortunate that these lines of research have not reached evolutionary economics. In addition to a

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21 profound theoretical discussion in seven of the 11 chapters, empirical work
22 in the field of evolutionary economics is presented. The three chapters that
23 discuss empirical work offer a new direction for analysis. Empirical research
24 in the field of evolutionary economics has been restricted to some degree
25 to simulations, case studies, or to work that is not tightly connected to an
26 evolutionary model.

27 The book is the culmination of several years of very intensive and ground-
28 breaking work that is deserving of being noticed outside of the fields of
29 science studies and scientometrics, where it has received a lot of attention.
30 As with any incursion of relatively new ideas into a field, there are bound
31 to be misunderstandings. Leydesdorff's own idiosyncratic vocabulary will not
32 improve that much. Still, perseverance, both on the part of the reader digging
33 into this kind of work, as well as on the part of Leydesdorff seeking to add
34 meaning to his work for relative outsiders (cf. also Leydesdorff 2006b), will
35 bear fruit. This book review, then, is partly meant to bridge the two life worlds
36 of evolutionary economics, on the one hand, and systems theory and science
37 studies, on the other.

38 **1 Are social systems different?**

39 For Loet Leydesdorff, the Knowledge-based Economy is not equated to that
40 part of the economy involved with ICT or technology. It is not about inno-
41 vation and technical development per se, or the role of knowledge workers.
42 Rather, Leydesdorff makes a more general theoretical point. He looks at the
43 economy as a complex system that may endogenously evolve coordination
44 systems in addition to the market mechanism whereby action, expectations,
45 and meanings are aligned with each other. Rather akin to the polyphonic kind
46 of singing, most notably from the Italian island of Sardinia, whereby a group of
47 singers cooperate such that a new voice seems to appear, Leydesdorff argues
48 that when three or more subsystems interact, an 'overlay' can emerge that
49 autonomously but not purposefully coordinates the subsystems, much like an
50 invisible hand.

51 While at the level of systems one may not speak of actors purposefully
52 pursuing a goal, anticipation of future states of affairs emerging in the systems
53 do help constitute stable meanings, communication and outcomes, retaining
54 some elements and not others. In this respect, too, the selection mechanism
55 is endogenized. This meets a fundamental critique leveled at evolutionary
56 economics also by Andersen (1994), not addressed till now: variation and
57 selection are not completely separate, and the selection environment is not
58 undifferentiated. This is not to deny the physical or biological nature of
59 agents (individuals) in a system, but does suggest that they are not limited
60 by these dimensions of their existence. Social systems and biological systems
61 are different because, in the former, meanings are created as effects of and
62 preconditions for communicative behavior (p. 180). This line of argument

does raise some serious questions about issues that are rather central to 63
evolutionary theory. For instance, the idea that (anticipations of) future states 64
of the world can affect the present seems to be incompatible with the 'arrow 65
of time' and so touches on the conception of causality—not an uncommon 66
position in the current state of affairs in physics (van Fraassen 1985). 67

The existence and workings of such a knowledge-based economy needs to 68
be explained and cannot be alluded to, as especially many policy makers are 69
wont to do, to figure as explanans. For reasons of theoretical and empirical 70
tractability, Leydesdorff discusses how three subdynamics interact and mutu- 71
ally shape one another. Especially where subdynamics interface, disturbances 72
(innovations) may be expected—a theoretical generalization of the critique of 73
the linear model of innovation does not and has never worked (Dolfsma 2008). 74
The potentially different selection mechanisms in the different systems (profit 75
seeking in the economy, technological excellence in technology, political clout 76
in the political or geographical spheres) may interact to produce a non-linear 77
dynamics. In simulation, the circumstances under which such a dynamics 78
may stabilize locally or even globally are investigated. Thus, for instance, the 79
question whether or not a country or a region is a stable innovation system 80
may be investigated. 81

2 Lock-in and break-out 82

A locked-in, stable configuration may also break-out from its development 83
along a path. While the well-known model developed by Paul David of path 84
development and lock-in explains how lock-in may occur, no satisfactory 85
explanation of a break-out from a lock-in has yet been supplied. Leydesdorff 86
argues that break-out will only be likely when a third system upsets the 87
stable relation between two systems, keeping each other in a mutual deadlock. 88
Allowing commercial, private use of communication technology by the US 89
government has created circumstances for the Internet to develop and for IT 90
and CT to be brought together to expand at increased speed (cf. Van den Ende 91
and Dolfsma 2005). 92

Complex systems such as the economic system need to be conceptualized in 93
terms of the interaction of a number of different sub-dynamics that may, given 94
certain conditions, allow for a stable configuration to emerge. Systems may 95
self-organize, as sub-systems interact at a specific moment in time, as well as 96
over time (recursion). In addition to market coordination and alignment in the 97
political arena, the 'systemic organization of knowledge and control' (p. 15) 98
offers a third coordination mechanism. Three, or possibly more, sub-systems 99
interacting can thus create institutionalized, stable structures. Subsystems 100
cannot be observed directly, however, as that would entail that one does 101
not realize that the institutions in existence are but one instantiation of a 102
range of possible other instantiations that have not materialized. Systems and 103

104 their functions need to be theorized, or, in Leydesdorff's terms, hypothesized
105 (p. 179). The position Leydesdorff (2006a, p. 103) takes might seem extreme
106 to some:

107 Empirical observable phenomena inform us about cases that have
108 occurred historically, but not about what could have occurred. The
109 historical observables themselves cannot provide sufficient control for the
110 quality of theorizing about meaning.

111 Starting from given historically emerged institutional structures would,
112 however, entail ignoring the probabilistic nature of a system. This takes the his-
113 torical development of a particular institutional furniture as the only possible
114 development. Historians refer to this as Whig-history. By contrast, modelling,
115 simulation and analysis of vast databases is what needs to be undertaken. In
116 line with early suggestions of Giovanni Dosi (1991, p. 6), Leydesdorff thus
117 takes seriously the proposition that "The world is 'full of opportunities' of
118 which only a very small share is exploited at any one time". Hence, what is
119 selected from is a broader set of alternatives than what actually materializes or
120 has ever actually materialized.

121 If taken seriously, this position, analytically, means that one needs to adapt
122 one's empirical analysis. The *expected* information, as in a distribution, of
123 messages that emanate from the interaction between subsystems must be
124 accounted for. Instead of taking any setting as given, one must try to grasp the
125 total possible set of structures. This may be traced in terms of non-parametric
126 statistics and mathematics. Leydesdorff in particular proposes the use of
127 (probabilistic) entropy statistics for empirical work (Theil 1972). Probabilistic
128 entropy offers a measure of the extent to which a system is structured such
129 that exchange of information, within and between its subsystems, is likely to
130 occur. In and through the exchange of information, at the level of the system,
131 information is codified and meaning emerges. Knowledge, then, is meaning
132 which makes a difference, a difference in stabilizing the system. Leydesdorff
133 takes his cues here from information science and artificial intelligence, and
134 from Shannon and McGill, in particular. Theil, of course, is an economist who
135 used entropy as a concept, but this was not imitated much.

136 It is only in relation to a relatively stable system that can meaningfully
137 organize information that such an investigation be conducted (p. 51). For
138 instance, the analysis in Chapter 8, where the workings of the knowledge-
139 base of the Dutch economy is investigated in terms of the interaction between
140 technology, economy, and geography, can only be undertaken if the system
141 is sufficiently stable to supply information about economic units. Thus, the
142 totality of firms registered at the Chambers of Commerce, some 1,131,688
143 units, allows Leydesdorff to see along which dimensions the potential for
144 structured exchange of information is most conducive to the workings of the
145 invisible hand in the knowledge economy.

146 As the interactions between subsystems are increasingly able to anticipate
147 correctly possible future developments, the system is self-organized (p. 61), yet
148 remains prone to failure (p. 64).

3 Selection

149

This book, then, asks some awkward questions about the current state in evolutionary economics, but is mostly an invitation for a broadly based new impetus for empirical research. Rather than a close and theoretical investigation of variation and retention, in particular the third mechanism of selection may need more investigation.

There may be more selection mechanisms for firms than bankruptcy as the quintessential selection mechanism for evolutionary economists. Not being able to tap into (sufficient; venture) capital, because such resources are not available in the geographical vicinity, means that a firm is unable to grow, or may not reach a minimum efficient scale, and so a possible future development is selected out. The diversity of bankruptcy law (Efrat 2001), the different outcomes for the firm filing for bankruptcy and the possibility of sequential entrepreneurship, provide evidence for the less-than-obviously objective selection mechanism implied. This casts some doubt on the causal claims that can be linked to this (cf. Hodgson 2006). Anticipation of the likely effects of bankruptcy will have an effect on entrepreneurial behavior now, even before the man-made law is applied. Governments, in re-drafting the law, as the US government has in 2005, will anticipate what effects it will have on bankruptcy filings. In doing so, the motives agents have will feature, too—motives ranging between self-interested utility maximization to the wish to avoid the shame of going bankrupt (Dolfsma and McMaster 2007).

Curiously, then, by ignoring agency through a focus on the level of systems and the structures that allow for communication and knowledge exchange, Leydesdorff allows for agency to play a role. In the perspective developed, the crucial role that introduces agency, through the backdoor, almost, is that of anticipation. For systems and agents in a system to be able to anticipate a future, they must have a model of their system and its interactions with the environment (p. 81). This provides meaning for the systems—thus making social systems distinct from biological systems, and making a system reflective. Indeed, a social system cannot be defined without specifying its boundaries and its environment (p. 150). Anticipations can then also select or play a role in selection processes (p. 128). Bankruptcy may thus be prevented, depending on the reasons behind it. If incompetent or culpable behavior by management was involved but if the fundamentals of the firm or the industry look promising, Venture Capitalists or the State can, for example, step in to avert it from going out of business.

4 So what?

186

Does all of this matter? Will it allow for insights that would not be otherwise obtainable? I believe it does. Theoretically, the analysis of interactions between three or more dimensions (systems) allows one to address the possible non-linear dynamics of a knowledge economy head-on. Significantly, from the

191 perspective of evolutionary economics, it provides insights into the question
192 when paradigmatic development is likely to occur, both technologically and
193 economically.

194 What may be more persuasive to some are the empirical findings pre-
195 sented. Interaction structures between the dimensions of University, Industry
196 and Government, for instance, are investigated in Chapter 8, using different
197 data sources. Using citation patterns in journal articles in the sciences, it is
198 found that Japan is much more networked than other countries. University–
199 Government relations are much more established than University–Industry
200 relations in Europe. Might this be implicated in the failure of the EU to meet
201 the Lisbon goals? Cooperation across national boundaries is least developed
202 in France and Russia.

203 Using data for all firms in a country, hypothesizing that the interactions
204 between Geography, Technology and Organization dimensions are of impor-
205 tance, Chapters 9 and 10 offer a way to operationalize the Innovation Systems
206 of the Netherlands and Germany. The literature on regional and national inno-
207 vation systems has been in need of an impetus (Balzat and Hanusch 2004), and
208 Leydesdorff might provide just this. So, at the national level, the Netherlands
209 can be considered an innovation system, but this is not true for Germany. Also,
210 interestingly, it is specifically medium-tech manufacturing industries, rather
211 than high-tech ones, that contribute to the knowledge economy.

212 These findings, based on a theoretical perspective that is foreign to some
213 extent for many economists, can be made understandable to them and to policy
214 makers, too, are startling and significant.

215 **5 Some final and some critical notes**

216 Before reading, one needs to be aware this is by no means an ordinary book.
217 It is likely to have two kinds of readers. A first group of readers is relatively
218 large and tries to read bits and pieces but will soon be scared away by the
219 idiosyncratic use of terms (from the perspective of an economist), and by
220 the sometimes unexpected accreditation of thoughts to particular scholars.
221 The possibility that Leydesdorff is in the midst of developing a system of
222 thought that is profound is what the other group of readers will have in mind
223 when they continue to study it. The latter group will be struck by the lack
224 of attention to the specificities of the separate subsystems: are they really
225 that neatly separable? If theoretically relevant, is the economic system best
226 characterized in neoclassical economic terms? Can systems be conceived of as
227 having subsystems?—Probably yes, but does this lead to an infinite regress: is
228 it turtles all the way down? The latter type of readers are, however, likely to
229 bear with the author, I believe, since this book is likely to give social scientists
230 keenly interested in the issue of what makes social systems evolve the most
231 stimulating read they have had in years. Even if one does not buy into the
232 argument, one cannot avoid this book.

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