

Book reviews

From conceptual modeling to quantitative measure

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***The Knowledge-Based-Economy: Modeled, Measured, Simulated* by Loet Leydesdorff**

Universal Publishers, Florida, 2006, 385 pages, €16.95, ISBN 1-58112-937-8

The notion of knowledge-based economy has been introduced in recent years in the economics of science and innovation, to indicate a qualitative transition in economic conditions where knowledge production has become central for the economic dynamics and development. As such, it has also been widely used in political discussion especially at the European level.

However, already some of its fathers have remarked that, if this concept is not to become a sort of buzzword without a precise meaning, both a sound conceptualization of what is meant by it and a set of tools to measure this phenomenon empirically are required. On both requirements, Loet Leydesdorff, professor at the Amsterdam School of Communications Research, has provided outstanding contributions during its whole scientific career.

First of all, he has developed in the last two decades a strong theoretical view of the knowledge-based economy, based on Luhmann systems theory and on the centrality of communication for the co-evolution of knowledge systems, economic markets and political systems. Second, he successfully proved that, exactly based on this conceptual modeling, it is possible to design quantitative measures of some aspects of the knowledge economy and has thus provided a number of original contributions to quantitative science and technology studies, for

example, in the analysis of scientific fields and networks using bibliometric indicators and in the measurement of the dynamics of the knowledge economy and of triple helix interaction.

This new book covers these two dimensions of Loet's work. Thus, the reader is firstly given an introduction to the concept of knowledge-based economy and its implications to the dynamics of social systems. Leydesdorff argues that the emergence of knowledge production and control as a third coordination mechanism to the social system alongside economic exchange and political control leads to a profoundly different dynamics from in market-based systems.

Further, Leydesdorff identifies the specificity of knowledge in its ability to codify meanings and thus to reduce uncertainty in the (collective) representation of the social system by becoming increasingly selective as to the information to be retained as relevant; across time, this provides a capacity to produce informed expectations of possible futures, which are then fed back into historical processes. It is exactly this reflective and anticipatory capacity that accounts for the stability of the evolutionary trajectory of the knowledge-based economy, leading to self-organizing patterns like that observed in the triple helix. These arguments are discussed in detail in the second chapter, where the author provides a more complete discussion based on the Luhmann sociological theory of communication.

Among the most fascinating aspects of this analysis is the use of mathematical simulations to display the specific features of so-called anticipatory systems, that is, systems that, by containing a representation of themselves, are able to predict their future state and, to some extent, to reconstruct it. Leydesdorff thus brings Luhmann's theory a step further, going from general theorizing to modeling and operationalization.

The next series of chapters deepen the analysis of the anticipatory character of social systems and situate

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it in the context of functional differentiation of society; thus, the anticipation is profoundly modified in a functionally differentiated system such as modern society, since subsystems are not synchronized and meaning is differently codified in each of them. Accordingly, the system cannot be any more organized hierarchically, but becomes self-organizing.

The centrality of communication in this process explains why the diffusion of new means of communication, such as the printing press in the 15th century, has led to structural transitions of social systems. Here, Leydesdorff provides us with a fascinating interpretation of social history in terms of increasing complexity and of the reinforcement of the reflexive dynamics allowed by faster means of communication. The transition to a global knowledge-based economy, where the social system is not any more hierarchically structured in nation states, is thus closely linked to the diffusion of new communication means allowing a much faster exchange of knowledge.

These theoretical reflections are the basis of the well-known triple helix model, which Leydesdorff has elaborated from the 1980s together with Henry Etzkowitz. Triple helix adds to the (traditional) institutional differentiation among universities, industries and governments, including their functional interfaces such as funding agencies or technology transfer offices, a reflexive layer where these institutions are interpreted and reshaped by human agents.

Thus, quite naturally, the last chapters of the book provide, after a thorough discussion of the triple helix model and of some recent criticisms of it, a framework for quantitative measurement of the triple helix phenomenon based on information theory and the idea of measuring mutual information among

the three subsystems. The focus is here more on the general methodology for constructing some indicators and on examples of their application than on a detailed discussion of data issues, for which the reader is invited to refer to more technical contributions.

However, already these applications give a glimpse of how, starting from a conceptual model, it is possible to design some simple, yet significant, quantitative measures from data that are to a large extent already available, such as publications and citations data, regional economic data or even information retrieved from Web search engines. As an application, the book contains two (already published) studies on the knowledge base of the Dutch and of the German economy respectively.

Finally, it should be said that the book as such has not the aim of providing original research results, since it is composed to a large extent of contributions that have been published in different journals and books during the last few years, but that have been thoroughly revised to fit them into a coherent line of argumentation. However, it provides the reader with a fairly concise introduction to the intellectual trajectory and research program of Leydesdorff, displaying clearly the internal coherence between its theoretical work on social systems on the one hand and the contributions more oriented towards the production of indicators and measurement of the science system on the other hand.

Even if I am usually rather skeptical about reprinting exercises, I think that this book is quite a useful read, especially for people engaged in quantitative science and technological studies, who need to consider the importance of sound theory and conceptual modeling for their work.

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