
Introduction

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Wolfram Elsner is a Professor of Economics at the University of Bremen. He has worked outside academia for ten years in economic planning and development on community and state ministry levels. His research focuses both on evolutionary economics (specifically informational economics, social dilemma decision settings and institutional emergence) and on applied industrial and regional developments (including local clusters and networks and open-source business models).

1 The rise of the knowledge-based economy

The increasing importance of knowledge for almost all economic affairs is a global phenomenon, which severely challenges economics since around the last 25 years. The World Bank has stated in its 1998–1999-development report:

“For countries in the vanguard of the world economy, the balance between knowledge and resources has shifted so far towards the former that knowledge has become perhaps the most important factor determining the standard of living ... Today's most technologically advanced economies are truly knowledge based.” (World Bank, 1999)

Permanent change in the impact, speed and direction of innovation processes leads to continuous development and qualitative change strongly visible especially in industrialised economies. On the one hand, new companies and often even new industries emerge, whereas established firms are confronted with severe transformation processes. On the other hand, these changes exert a crucial impact on the development potential of regions and whole economies. In this perspective competition is no longer only price competition, but increasingly bears an extremely important innovation dimension. Competition for innovation determines the international market position of firms as well as the competitiveness of regions and national states within the framework of a growing international division of labour.

So-called key technologies such as Information and Communication Technologies (ICT) and modern biotechnology play a decisive role in these development processes. Industries applying and improving these technologies are in the centre of interest for financiers, politicians, industrial actors and in particular for creative entrepreneurs. The development in these industries will not only lead to important innovations in science and technology, but they are also the foundation for economic, social and organisational changes in the 21st century.

Beyond these processes stands the transformation of economies to so-called knowledge-based economies. The decisive difference with respect to traditional manufacturing-based economies has to be seen in the dominant role for economic welfare, which is played today by knowledge creation and diffusion processes. However, only to push forward the scientific and technological frontiers (exploration) is not sufficient to cope with these pervasive developments. What additionally counts is to be prepared for permanent transformation processes of the whole economic system, which is strongly connected with the effective exploitation and use of the various kinds of new knowledge in a preferably broad set of economic activities.

Of course, the knowledge effects are most obvious in knowledge-intensive industries such as ICT and biopharmaceuticals. Also in knowledge intensive service industries, like business consultancy and financial industries, they become more and more visible. In fact, at least indirectly all sectors of an economy are affected by the increasing importance of knowledge (e.g., new labour organisation, the increasing use of information, communication and network technologies, life-long learning, etc.). To highlight these developments some authors even use the term of a weightless economy (e.g., Quah, 1995) emphasising the fact that today knowledge and information account for the major value share of economic transactions.

2 Economics and the knowledge-based economy

Traditional neoclassical analysis cannot deal with the rich complexity and dynamics characterising the knowledge-based economy stemming from manifold forms of direct interdependence, externalities, collectivities and coordination requirements (Elsner, 2005). It is beyond the scope of this introduction to discuss in detail the criticism of the restrictive assumptions underlying the mainstream economic reasoning. A major discussion on the basis of evolutionary economics can be found, among others, in Dopfer (2001), Clark and Juma (1987), Silverberg (1988) and Saviotti (2003). Here it is sufficient to mention three major points, which are of outstanding importance in the discussion of economic development processes. These points are also constitutive for that strand of literature, which is concerned with industry evolution and technological progress and can be coined Neo-Schumpeterian economics (see Hanusch and Pyka, 2006a). Here, instead of the incentive orientation of neoclassical industrial economics, a knowledge orientation is underlying the investigation of industries and innovation processes in particular.

- First of all, Neo-Schumpeterian economics wants to explain how innovations emerge and diffuse over time. A specific feature of these processes is uncertainty, which cannot be treated adequately by drawing on stochastically distributions, which refer to the concept of risk. Therefore, one has to get rid of the assumption of perfect rationalities underlying traditional models; instead the concepts of bounded and procedural rationality are invoked. Consequently, actors are characterised by incomplete knowledge bases and capabilities.
- Closely connected, the second point concerns the important role heterogeneity and variety plays. Owing to the assumption of perfect rationality, in traditional models homogeneous actors and technologies are analysed. Heterogeneity as a source of learning and novelty is by and large neglected or treated as an only temporary deviation from the representative agent and the optimal technology.
- Finally, the third point deals with the time dimension in which learning and the emergence of novelties take place. By their very nature, these processes are truly dynamic, meaning that they occur in historical time and under path dependence. The possibility of irreversibility, however, in both institutionalised problem solving and speeding-up of innovation and lock-ins on inferior paths does not exist in the mainstream approaches, relying on linearity and optimal equilibrium states.

Thus, traditional economic theories summarised here as incentive-based approaches, with their focus on rational decisions only and based on marginalistic reasoning, are excluding crucial aspects of actors' various competences and multifaceted interactions, which have to be performed against the background of the interdependence structures. These interactions are influenced by a couple of factors lying by their very nature beyond the scope of these approaches, for instance, factors such as search and learning, individual and collective motivation, complex coordination through the institutionalisation of behavioural rules, emergent trust, routine-based firm cultures and so on. It is the role of such factors the knowledge-orientation of Neo-Schumpeterian economics explicitly takes into account.

By switching from the incentive-based perspective to knowledge orientation, Neo-Schumpeterian economics realises a decisive change in the analysis of transformations of economic systems. In this light, the introduction of novelties mutate from rational calculus to collective experimental and problem solving processes (Eliasson, 1991). The capabilities of the actors are no longer perfect, instead a gap between the competences of the individuals and difficulties, which are to be mastered, opens up (Heiner, 1983). There are two reasons responsible for this competence-difficulty gap when it comes to innovation. On the one hand, technological uncertainty introduces errors and surprises. On the other hand, the very nature of knowledge prevents an unrestricted access to it. Knowledge in general and new technological know-how in particular is no longer considered as freely available, but as local (technology and network specific), tacit (firm specific, institutionalised and routinised), and complex (based on a variety of technologies, agents, behavioural options and scientific fields). To understand and use the respective know-how specific competences are necessary, which have to be built up cumulatively in the course of time. Cumulation here implies a series of interrelated, and increasingly coordinated, individual decisions among a relevant group of agents. Following this, knowledge and the underlying search and learning processes are important sources for the observed

heterogeneity among agents. Heterogeneity, again, is a necessary prerequisite for innovation, growth and prolific development. It opens up new opportunities for creativity and learning. Accordingly, it is the self-propagating dynamics of the above process, linking knowledge creation to heterogeneity and vice versa, which is driving the transformation of economic systems and development in terms of economic growth.

This process of endogenous restructuring of economic systems, based on knowledge and accompanied by creativity, learning and innovation leading to increasing differentiation and specialisation (Saviotti and Pyka, 2004), is placed centrally in all evolutionary institutional branches of economics, particularly Neo-Schumpeterian economics, but also, e.g., in evolutionary game theory. It has to be understood adequately and constitutes a persistent challenge for theoretical and applied economics. The contributions of this special issue try to face these challenges in a cutting-edge fashion. They concentrate on the specificities of knowledge-based economies in reality; they innovatively introduce new methodologies and empirical tools in order to capture the underlying dynamics and thus help to improve our understanding of the Neo-Schumpeterian dimensions of modern knowledge-based economies.

3 Contents and structure of the special issue

Without doubt among the most important locations of innovation processes, the firm plays a dominant role. The first group of papers focuses on intrafirm processes. The first contribution of this special issue by Nathalie Lazarick and Alain Raybaut entitled ‘Knowledge, hierarchy and incentives: why human resource policy and trust matter’ addresses the important issues of the co-evolution of cognitive mechanisms and the incentives to develop new knowledge. The in-depth analysis of cognitive processes and their pre-conditions on an individual as well as collective level in knowledge-based economies has to be considered at the heart of modern innovation economics in an evolutionary economics tradition (e.g., Dopfer, 2005). At the forefront of this discussion stands the adequateness of firm organisation as well as corporate culture (or routines sets) for survival in knowledge-based environments. For this purpose the authors develop a numerical model that allows the investigation of different scenarios firms can face in modern economies. An important role is attributed to trust, which enables the static organisational dimension to become a dynamic and innovative governance dimension. In this way, institutionalised trust is an important problem solver, a coordination device, which, in turn, facilitates and, sometimes, even enables efficient innovation.

Although firms are creators of new knowledge, they act in an environment, which increasingly is characterised by a tight web of cross border interrelations (Castells, 1996). And internationalisation and globalisation do not stop when it comes to knowledge-generation and -diffusion processes. Thus, another group of papers focuses on interfirm processes. In her contribution ‘‘Knowledge capital’ and innovation in global corporations’, Blandine Laperche introduces to the concept of firm’s knowledge capital and the problems and difficulties, which emerge from knowledge sharing and innovation interfirm networking. This, of course, has an impact on the issue of intellectual property rights and their international enforcement necessary for the appropriation of innovation rents. Laperche illustrates potential developments resulting from an international oligopolistic appropriation of new technological and scientific knowledge and does not

forget to add the potential risks and failures, which might emerge from oligopolistic 'closed' coordination or networking.

The overall picture of knowledge-creating firms, acting in sensitive and changing environments, is drawn by Yeoryios Stamboulis in his paper 'Towards a systems approach to innovation systems and policy'. The concept of National Innovation Systems (e.g., Lundvall, 1992) enjoys an increasing popularity in modern innovation research. However, the concept of National Innovation Systems is also criticised owing to its theoretical ambiguities. Stamboulis tries to overcome this critique by drawing on theoretical foundations of organisational learning theory (e.g., Argyris and Schön, 1978). For this purpose he boils down the system architecture and dynamics to the concept of cognitive culture of an innovation system integrating the increasing knowledge and learning intensities of modern knowledge-based economies as well as the idea of collective innovation processes taking place in competitive environments.

The following four contributions of this special issue have to be considered as case studies emphasising features, which are of particular importance in knowledge-based economies. The cooperative knowledge-generation and -diffusion processes in innovation networks building on reciprocal/coordinated/institutionalised/routinised knowledge exchange and long run trust-based relationships are an aspect of innovation processes, which is emphasised in all of the first three contributions. Rachel Levy and Paul Muller analyse an important subset of these cooperative relationships in their contribution 'Do academic laboratories correspond to scientific communities? Evidence from a large European university', namely, the innovation networks of academic institutions. Their focus lies in the identification of scientific communities by applying social network analysis (e.g., Freeman, 2004). According to Levy and Muller's results, scientific communities play the decisive role in academic knowledge creation and are accordingly the relevant unit of analysis.

From the previous contributions, it is obvious that innovation has to be considered as a much broader and process oriented concept in modern innovation economics and does not encompass only technological innovation. Salvatore Bimonte and Lionello F. Punzo address in their contribution 'The *evolutionary* game between tourist and resident populations and Tourist Carrying Capacity' the organisational dimensions of innovation and relate them to environmental issues. A starting point for the connection between innovation economics and environmental economics is given by the concept of sustainability (e.g., Majer, 2005). In particular Bimonte and Punzo are interested in the tourist industry and develop the concept of a sustainable tourist carrying capacity, which is highly relevant not only for tourism in traditional tourist areas but offers potentials for new emerging tourist areas in less developed economies.

Karine Fiore also addresses environmental issues in her contribution 'Irreversibilities and technological change: modularity as a new challenge for nuclear investments' and offers potential answers from an innovation oriented perspective. In particular she addresses the important feature of irreversibility and technological lock-in (Arthur, 1989), which has manifold manifestations in the energy industry, in particular in nuclear power plant technologies. Fiore shows that the potential bottlenecks stemming from irreversible developments and cumulative technology can be reduced with the help of the concept of modularity.

The last paper in this special issue is entitled 'Public policy, governance and innovation: entrepreneurial states in East Asian economic development' and authored by Alexander Ebner transfers the entrepreneur as a key figure in innovation economics from

an individual level to the collective level, namely, the state. Doing this, Ebner acknowledges a challenge in modern innovation economics, which claims to put innovation and future orientation to be central not only for the industrial sector but also for financial markets and very importantly also for the public sector (Hanusch and Pyka, 2006b). Ebner investigates the entrepreneurial states of East Asia and the role of political leadership in setting up the particular innovation systems there, which are so successful in supporting and managing the catch-up process of the East Asian Tiger states in the last two decades.

Together, the seven contributions of this special issue, which are a collection of papers belonging to the Research Area ‘Innovation and Technical Change’ of the *European Association of Evolutionary Political Economy* (EAEPE) and were presented at the Annual meeting 2005 in Bremen (Germany), demonstrate that modern innovation economics in an evolutionary institutional and specifically in a Neo-Schumpeterian fashion has left childbed. It has become a powerful approach for theoretical as well as applied economic analysis in particular of phenomena of the knowledge-based economy.

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