Introduction

Special Issue on the Evolutionary Analysis of Innovation

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Technological change and innovation are now at the core of economic analysis. In mainstream microeconomics, firms' behaviour with regard to innovation is usually modelled as the decision on investment in research and development (R and D), which may either lead to increases in productivity, or product quality. In models of this kind, the traditional concept of pure competition loses its meaning because firms are able to differentiate their products, and thus the market structure becomes one of monopolistic competition, and profits no longer vanish in the long run (e.g. Scherer and Ross, 1990). In the analysis of economic growth, similar developments led to what is often called the 'revolution' of new growth theory. Here, the investment of firms in R and D leads to mostly positive externalities, and thus increasing returns to scale arise at the macro level (e.g. Romer, 1990).

However, at the same time that these developments in mainstream economics were taking place, an alternative approach to the economic analysis of innovation and technological change was emerging. Contributors to this approach would argue that the toolbox of economic theory, with its strong emphasis on purely rational behaviour and equilibrium, is too restrictive to provide a useful analysis of the complicated phenomenon of technological change. The reason for this lies in the inherently uncertain nature of technological change. Thus, authors in this tradition would argue that firms may invest in technological search or R and D without having a clear expectation of the exact outcome of the process. Even a stylized representation of the investment decision in which firms are assumed to have an idea of the probability distribution of possible outcomes was often considered too restrictive (e.g. Dosi, 1988).

Theorists in this tradition would thus argue that Simon's concept of 'bounded
rationality' is more appropriate in cases where decisions about technology investment are being modelled. Instead of the usual fully rational behaviour in which a firm maximizes some explicit objective function, firms were assumed to behave according to 'rules of thumb' or 'routines' which arise from practical experience and are subject to periodic change due to feedback from the market or organisational change. Instead of the usual market equilibrium in economic models, the new approach argued that there was constant adjustment and selection, with some firms successfully entering the market and others forced to leave due to unsuccessful business. A comparison with the biological concept of natural selection and evolution was found to describe this process well, and thus the new field became known as 'evolutionary economics'. The book by Nelson and Winter (1982) was the first to present this argument in a broad and convincing way. They showed that a model in which firms under bounded rationality behave according to such simple routines is able to generate a macro-pattern which is broadly comparable to the predictions of the, then dominating, Solow model of economic growth.

Since Nelson and Winter's seminal contribution, the field has evolved further, and it has now gone beyond a mere reproduction of the outcomes of mainstream theory. For example, there has been much work about the question whether or not economic evolution has a 'goal'. Mainstream economics would argue it has, i.e. the market, when left on its own, in general produces an outcome which is optimal to all agents participating in the economy. Evolutionary economics, on the other hand, would argue that, just as biological evolution does not optimize but adapt, economic evolution does not in general produce an optimal outcome. Lock-in to suboptimal states (Arthur, 1988; David, 1985) is thus one example of the richness of outcomes in evolutionary models of the economy as compared to mainstream economic theory.

This special issue reports on a number of papers that fit into this tradition of modelling economic processes as evolutionary in nature. All of these papers, except one, were originally presented at a conference in August 1996 organized by the research institutes MERIT and METEOR of the Faculty of Economics and Business Administration of the University of Maastricht (the Netherlands).¹

Taken together, they form an important contribution to the field of evolutionary economics. The papers show the potential of this field to account for a large number of interesting real-world situations, such as lock-in, consumer-producer interaction, skewed distributions of firm sizes, etc. They also show the relatively large diversity that still exists in the field, with very many different modelling strategies co-existing. As such, this special issue should be seen as a step forward in a field that is still in the relatively early stages of its development, but which has already shown a large potential for explaining the importance of the relationship between technology and the economy.

The first paper in this special issue, by Andersen, provides an historical overview of the evolution of the most important fields of technology, using patent statistics. It thus provides some of the stylized facts theory must account for.

¹ I thank Gerald Silverberg for jointly organizing the scientific program of this conference, and MERIT and METEOR for financial support.
The next three of these theoretical papers follow closely some of the more established approaches in the field. The first paper, by Jonard and Yildizoglu, extends the original Nelson and Winter model with a spatial structure. Their model describes the conditions under which lock-in effects and persistent technological diversity emerges. In the second paper, Mazzucato analyzes the impact of positive and negative feedback mechanisms (between costs and market performance) on market structure, thus linking up to earlier models by Arthur. Her model shows, quite surprisingly, that multiple equilibria and instability may arise in cases of dynamic decreasing returns. A third approach, the master equation approach (e.g. Weidlich and Braun, 1992), is explored in the paper by Cantner and Pyka. Their model is one of firms’ investment in technological capabilities and the impact this has on industry structure.

The last two papers in the special issue are aimed specifically at providing a stylized interpretation of two of the most striking phenomena in the empirical analysis of industries, i.e. the industry life cycle, and the skewed distribution of firm sizes. The first of these two papers, by Windrum and Birchenhall, develops a model in which a population of consumers and a population of firms co-evolve, with the two populations learning from each other. The model shows that the ‘dominant design’ concept, which is often put forward as an explanation of the product life cycle, is only one of the many possible outcomes of industry development. In the last paper of the special issue, Kwasiłnicki presents a model in which a skewed distribution of firm sizes is the joint result of entry and technological change.

References