Chapter XX
Evolutionary Modeling and Industrial Structure Emergence

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ABSTRACT

In the first part of the chapter, an outline of the evolutionary model of industrial dynamics is presented. The second part deals with a simulation study of the model focused on identification of necessary conditions for emergence of different industrial strictures. Textbooks of traditional economics distinguish four typical industry structures and study them under the names of pure competition, pure monopoly, oligopoly, and monopolistic competition. Variations in behavior modes of differently concentrated industries ought to be an outcome of the cooperation of well-understood evolutionary mechanisms, and not the result of juggling differently placed curves representing supply, demand, marginal revenue, marginal cost, average costs, and so forth. Textbook analysis of industrial structures usually omits influence of innovation on market behavior. Evolutionary approach and simulation allow for such analysis and through that allow enriching the industrial development study. One of the important conclusions from this chapter is that evolutionary analysis may be considered as a very useful and complementary tool to teach economics.

INTRODUCTION

Almost all evolutionary economics (on EE foundations, see Dopfer, 2005) models worked out in past decades are dynamical ones and are focused on far-from-equilibrium analysis. There is no place to review and to characterize evolutionary models in economics in detail.[1] In a nutshell the other main features of evolutionary models may be summarized as follows:

- development seen in historical perspective; macro-characteristics flow from aggregation of micro-behaviors of economic agents;
- population perspective;
- diversity and heterogeneity of behavior;
- search for novelties (innovation), hereditary information;
- selection which leads to differential growth; and
- spontaneity of development.

Some of those features seem to be crucial to call a model an evolutionary one, in our opinion to those crucial features belong: diversity and heterogeneity of economic agents (firms) and their behavior, search for innovation based on a concept of hereditary information (knowledge), and selection process which leads to diversified rate of growth and spontaneity of development. Heterogeneity and variety can therefore be considered as an important characteristic of evolutionary approaches to technological change (Nelson, 1995; Saviotti, 1996). An interesting question in relation to economic evolutionary models is presence of decision-making procedures. In many models that procedure is not present; in many others it has a more or less complicated form.

In the remaining part of this chapter, we outline an evolutionary model[2] and present a selection of current simulation results of that model. The main aim of this chapter is to show that evolutionary modeling can be used not only as an efficient research tool in economic analysis, but also as supporting tool in the economic education.

THE EVOLUTIONARY MODEL OF INDUSTRIAL DYNAMICS

The model describes the behavior of a number of competing firms producing functionally equivalent products. The decisions of a firm relating to investment, price, profit, and so forth are based on the firm's evaluation of behavior of other, competing firms, and the expected response of the market. The firm's knowledge of the market and knowledge of the future behavior of competitors is limited and uncertain. Firms' decisions can thus only be suboptimal. All firms make the decisions simultaneously and independently at the beginning of each period (e.g., once a year or quarter). After the decisions are made, the firms undertake production and put the products on the market. The quantities of different firms' products sold in the market depend on the relative prices, the relative value of products' characteristics, and the level of saturation of the market. In the long run, a preference for better products, namely those with a lower price and better characteristics, prevails.

Each firm tries to improve its position in the industry and in the market by introducing innovations in order to minimize the unit costs of production, maximize the productivity of capital, and maximize the competitiveness of its products on the market.

Simulation of industry development is done in discrete time in four steps:

1. search for innovation (i.e., search for new sets of routines which potentially may replace the old set currently employed by a firm);
2. firms' decision-making process (calculation and comparison of investment, production, net income, profit, and some other