

Analysis of technological innovation from business economics and management

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Abstract

This paper identifies and analyses the main contributions to the analysis of firms' innovative activities of five approaches related to business economics and management: industrial organization, transaction costs economy, positive agency theory, resource-based view and evolutionary theory. Complementarity can be noted among these approaches. They can all be applied for analysing a specific aspect of innovative activity. However, the contributions of evolutionary theory seem to comprise the most comprehensive approach for studying the firm's innovative process from an internal point of view and dealing with its complex characteristics.

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1. Introduction

There seems to be consensus, both in the academic and in the business spheres, that one of the firm's main resources is its technological knowledge and together with this its capability to generate innovations. However, analysis of innovation is complex, since technological knowledge has special characteristics that differentiate it considerably from other resources, given its intangible nature. This makes its analysis difficult from the point of view of neoclassical economics, whose excessively simplistic approaches¹ mean that more comprehensive paradigms and perspectives must be developed.

With Schumpeter's works (1934, 1942), greater attention began to be given to technological change. Its fundamental role in economic development is admitted, related to the figure of the entrepreneur as innovating agent. This author proposes two factors, the size of the firm

and market concentration, as direct determinants of technological progress, factors that subsequently would be taken up by industrial organization. However, analysis in this setting, although important, continues to show, as will be analysed below, certain deficiencies, which other theoretical contributions attempt to overcome. Of these, because of their impact on analysis of innovation, four important perspectives of the organizational economics proposed by Barney and Ouchi (1986) are considered: transaction costs economy (Williamson, 1975, 1985), positive agency theory (Eisenhardt, 1989; Jensen and Meckling, 1976), evolutionary theory (Nelson and Winter, 1982) and the resource-based view (Wernerfelt, 1984).²

This study seeks to carry out an in-depth and at the same time synthetic review of the main approaches used by business economics and management to deal with the analysis of the phenomenon of technological innovation. The aim is to clarify their main contributions and, considering their partial perspectives, delimit the theoretical framework that currently offers most expectations for the analysis of innovation.

This is an important task since, given the current significance of technological innovation and its complexity, there is a need to define a common theoretical framework on

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¹ Neoclassical microeconomic theory conceives technology as one more parameter of the production function. It is represented as a given static combination of production factors, defined in relation to the elaboration of certain outputs, with a nature exogenous to the firm and uniform distribution among the entities.

² As Mahoney and Pandian (1992, p. 363) point out this theory can also be included in organizational economics.

which to base empirical studies. An agreement on this matter would make it possible to homogenize the results obtained and eliminate the contradictions currently existing as a result of the approach of the different studies. It would give considerable impulse to research on innovation and greater practical usefulness to its results. Despite the importance of achieving this common theoretical framework, a notable lack of studies in this direction is observed, especially of those devoted to analysing the application of approaches from business economics and management to the study of innovation. All of this reveals the interest of this paper.

Following the Oslo Manual (OECD, 1997), technological innovation is defined as the generation of new products and processes or of significant technological improvements in current products and processes. Besides R&D, it differentiates six types of innovating activities: acquisition of disembodied technology and know-how, acquisition of embodied technology, tooling up and industrial engineering, industrial design, production start-up and marketing for new or improved products (OECD, 1997, pp. 59–60).

The paper is structured as follows. First, the contributions of industrial organization to the study are reviewed, as a key approach in order to understand the effect of external factors. In Sections 3 and 4, respectively, an analysis is made of transaction costs economy (useful for explaining, through concepts such as uncertainty, information asymmetry, specificity, opportunistic behaviour and bounded rationality, how to carry out the coordination of the innovative activity), and of positive agency theory (as a framework for analysing the effects on innovation of the divergence of interests among the economic agents of the firm). Section 5 contains a review of the resource-based view, which reveals the great importance of the firm's internal resources, especially those of an intangible nature, such as innovative activities. Section 6 is devoted to the evolutionary theory, which provides key concepts for analysis of the innovation process, such as diversity, dynamism, path dependence, accumulative nature, tacit, complex and systemic components of knowledge and patterns of innovation. After the approaches have been reviewed, in Section 7 a theoretical framework for analysis of innovation is proposed. It seeks to integrate the different perspectives, although the evolutionary theory is the fundamental basis. Finally, the main conclusions derived from the analysis are given in Section 8.

2. Industrial organization

As Molero (1990, p. 41) pointed out, the studies carried out on innovation since 1950s can be grouped around two large perspectives: a macroeconomic one, which analyses the importance of technological progress for economic growth, and a microeconomic one, characterised by the study of the determinants of technological innovation. This second perspective is set within industrial organization,

and the main core of studies devoted to the analysis of this activity has traditionally been developed under this approach. Indeed, for this discipline, one of the major research issues has been the relationship between innovation and market structure.

Industrial organization supposes, deterministically, that the differences in the firms' innovative activities can be explained by the structural characteristics of the industry, under the paradigm 'structure–behaviour–results' (Bain, 1959; Mason, 1957). This considers that technological progress lies in the results, and R&D investment in behaviour, whereas the structure is formed by the characteristics of the industry in which the activity is carried out (Douma and Schreuder, 1992, p. 123). Under this framework, the determinants of innovation are analysed, especially those of a sectoral nature, related to market structure, such as the intensity of growth in demand, technological opportunity or concentration. The approach analyses these factors in depth and indeed considers that, within the factors that determine R&D innovation activities, the structural characteristics of the sectors explain the firms' differences in R&D investment.

Thus, and given that this perspective focuses especially on the effect of external factors to the firm, related to the market and competition, most empirical literature has focused on the relation between these factors and innovation. On the one hand, it analyses the effect of sectoral structural characteristics, such as technological opportunity (Scherer, 1967; Meisel and Lin, 1983), economic opportunity (Schmookler, 1962; Lunn and Martin, 1986) or market concentration (Horowitz, 1962; Dasgupta and Stiglitz, 1980). And on the other, it studies the influence of public technology policy, mainly of financial incentives (Griliches, 1986; Berger, 1993; Koga, 2003).

However, the effect of the internal factors, many of which are intangible and accumulative, is scarcely analysed, being limited to size and other variables such as diversification or financial resources, typically correlated with size (Horowitz, 1962; Acs and Audretsch, 1988). Neither is analysed the configuration of the innovative process, according to the different contexts in which it is developed, nor how the firm's innovative behaviour affects the market structure. Other approximations must be used in order to be able to analyse how technological change occurs and how it is developed.

3. Transaction costs economy

Within this theory, the exchange of intangible assets, such as technology, has special connotations differ from tangible ones. The imperfections of the market mean that a large part of their value may escape the investing firm's power and come under public control.

First, a great deal of technological knowledge has a tacit and accumulative nature. It is generated and increased from

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