# THE ECONOMICS AND STRATEGIC MANAGEMENT DEBATE ON FIRM PERFORMANCE AND TECHNOLOGICAL CHANGE

*Mario Gómez Aguirre*[1]
*José Carlos Rodríguez*[2]

**Resumen**

*Este artículo analiza el debate que establecen la teoría económica y el análisis de gestión en relación al desempeño de la firma y el cambio tecnológico. La perspectiva teórica seguida en este artículo va desde el enfoque sugerido por la teoría de la firma de Penrose, la hipótesis de la capacidad de absorción, el análisis de la firma basado en sus recursos, las explicaciones schumpeterianas y de la teoría evolucionista acerca de la innovación que generan la posibilidad de identificar algunos principios teóricos complementarios (o alternativos) al enfoque neoclásico. Se concluye que el comportamiento de la firma se caracteriza por seguir una trayectoria dependiente como proceso evolutivo basado en el principio de que la generación del conocimiento es acumulativa y colectiva que no necesariamente evoluciona suavemente.*

## Introduction

The analysis of the firm has traditionally been developed from two different perspectives: economic theory and strategic management. The economic theory perspective concerns with the relations established between firms within different market structures. The objective of this approach is to determine the equilibrium market prices within these alternative market structures. In so doing, the neoclassical microeconomic theory assumes agents with perfect rationality that maximize profits or an utility function. On the other hand, the strategic management analysis

[1] Instituto de Investigaciones Económicas y Empresariales, Universidad Michoacana de San Nicolás de Hidalgo.

[2] Instituto de Investigaciones Económicas y Empresariales, Universidad Michoacana de San Nicolás de Hidalgo

is primarily concerned with the internal decision-making process carried out by firms. In opposite to the neoclassical theory, in the strategic management analysis, technical change is a key variable to determine firm behavior. Indeed, the strategic management analysis considers technical change as an important piece in the theory that explains how organization boundaries are established.

However, in the economic literature, it is possible to find two different approaches to analyze technical change: the neoclassical theory and the classical school of economics. In the classical economics, technology is an integral part of the whole system, and a primary source of change, as well. Adam Smith and David Ricardo considered technology as an effective way to reverse some negative effects observed in the process of obtaining profits. The introduction of a new machine, for example, implied the possibility that technical change could generate a deeper division of labor and hence a higher level of productivity (Coombs *et al.* 1987). In opposition to the classical approach, the neoclassical theory of production focuses on the analytical understanding of firm's choices among a given set of technological alternatives. Beije (1998), Nelson and Winter (1982) and Rosenberg (1982) stress the idea that the neoclassical theory of the firm is fundamentally a theory of markets. The assumptions established by the neoclassical theory about firm behavior are necessarily the axioms required by this analysis in order to support the theory. The neoclassical authors stress the idea that this theory is a simple partial equilibrium theory of production with an implied theory of prices. Nevertheless, each of these approaches has their own analytical frameworks structuring the theoretical discussion between the classical theory and the neoclassical economics (Mulder *et al.* 2001): maximization and rationality, heterogeneity among economic agents, uncertainty, and irreversibility and path dependency. In consequence, the classical and the neoclassical economics arrive to different conclusions in relation to the importance of technical change in the development of the economic system.

In this sense, and as part of the classical tradition, the evolutionary theory is considered as part of this approach in relation to the analysis of firm behavior. The evolutionary theory is actually associated to the Schumpeter's ideas on technological change and market dynamics, as

well as Nelson and Winter's seminal works on firm behavior. Evolutionary authors suggest that the equilibrium of the firm is not characterized to be stable, but possess a changing trajectory. Similarly, it is possible to include into this approach some important ideas developed by the Austrian school and Penrose-Schumpeter theoretical framework related to the importance of technological change and the dynamics of market competition[3].

This paper is organized into four sections. Section 1 contains a global analysis of technical change from the perspective of neoclassical economics. The neoclassical analysis on technical change is important as it gives a starting point to further theoretical developments on firm behavior. Section 2 contains a description of the strategic management analysis of the firm. In this section it is stressed the importance of technological preferences and R&D investment decisions as part of the strategic management research agenda. Section 3 includes a synthesis of the Schumpeter-Penrose's principles on technical change and competition dynamics. Similar propositions are developed in relation to the Austrian school. In this section it is argued that these contributions give a more complete and realistic comprehension of the phenomenon of technological change and innovation. Finally, section 4 analyzes technical change from the perspective of the evolutionary theory. In this section, it is concluded that firms' heterogeneity and capabilities determine their actions. In fact, this principle is at the origin of the explanations on how procedures and decision rules differ amongst firms. Consequently, since mutation (innovation) and adaptation (imitation) characterize firms in modern societies, it is argued that an evolving theoretical framework can be adequate and complementary to the Schumpeterian-Penroseian perspective to analyze firm behavior and technical change.

[3] From the perspective of classical economics and the Schumpeterian tradition, Andersen (2001) emphasizes the role played by technology and innovation to determine the structural economic dynamics. In this work, technological change is endogenously determined and it is the result of a learning process, and economic agents are bounded rational. The objective of the analysis is thus to develop a micro-foundation theory for a general evolutionary model of structural economic dynamics.

## 1. The Neoclassical Approach

This section presents the neoclassical economic notions of technical change. The limits of the neoclassical analysis in terms of technical change and static equilibrium as an incomplete explanation of the complex process of market competition are emphasized[4]. It is argued that the neoclassical economic theory has conventionally treated technical change as an exogenous process. In this sense, this approach has given limited attention to R&D activities, and knowledge is treated most of the time as a public good (Cohen and Levinthal 1990; Mulder 2001). The neoclassical approach suggests that firms may acquire at no cost the best technology available. As a result, many authors have pointed out that the neoclassical analysis on firm behavior does not give a complete explanation about the complexity of market dynamics and the decision-making process carried out by the firm.

Dosi *et al.* (1992) and Mulder *et al.* (2001) suggested that there are at least two reasons to search for an alternative approach to the neoclassical theory of the firm. First, there exists clear evidence suggesting that technical change has been a crucial engine to explain economic growth, and thus it would be necessary to provide a more realistic explanation corroborating actual historical processes in terms of technical change. Second, the assumptions established by the neoclassical theory are not always supported by available evidence. Certainly, the neoclassical propositions of homogeneity and equilibrium are not always adequate assumptions to illustrate the actual innovation process. Nevertheless, the assumptions of profit-maximization in a competitive environment with no economic profits are constantly present at the core of the neoclassical analysis. Establishing these assumptions, the neoclassical theory of production seeks to explain how inputs are transformed into outputs. In this sense, Nelson and Winter (1982) analyze the neoclassical assumptions of profit-maximization and perfect competition suggesting that they contain three separable components. First, there is a specification of what firms are seeking to maximize or

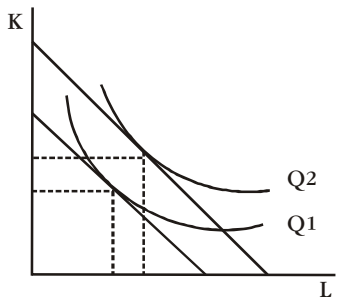
[4] Although this has been the treatment traditionally made in economic theory, it is important to point out that recently there have been some attempts to conceptualize technological change as an endogenous process. Examples of these efforts in the economic literature are the works of Romer (1986, 1989, and 1990), Lucas (1988), and Grossman and Helpman (1991).

minimize (profits, present value or costs). Second, there is a specification of a set of things that firms know how to do (production techniques or any other activity for determining specific behavior rules). And third, there are some assumptions about actions taken by the firm (these actions can be viewed as a result of many other choices or actions that optimize the degree to which its objectives are achieved). Additionally, the neoclassical theory of production specifies a production function to give a complete answer to the question of how these assumptions work[5]. To correctly function, these assumptions require to define a production function (Beije 1998): (1) there is only one homogenous product in the market, (2) the firm has perfect information about inputs and outputs prices, (3) the firm is a price-taker, (4) demand and supply are always in equilibrium in relevant markets, (5) the firm is owned-managed, and (6) the firm is seeking to maximize profits or minimize costs.

As a result of this scheme, these authors suggest that the neoclassical firm demonstrates to be always technically and economically efficient (Beije 1998; Nelson and Winter 1982). Indeed, the neoclassical theory guarantees that firm's production function will yield the maximum level of output, given a combination of inputs. However, at the core of this analysis underlies the idea that the firm will be capable to make the best choice from the most efficient techniques available at that time. In conclusion, it seems that the neoclassical theory achieves to explain firm efficiency to be *ad hoc* as it is directly obtained from the assumptions established at the beginning. It is possible to represent these principles using an isoquant. (Figure 1). For each isoquant, there exists the possibility of different combinations of inputs yielding the same level of output. The closer an isoquant is to the origin, the more efficient the technology is used by the firm, and thus it will require at least less of one of the two inputs specified on the isoquant. However, technical change is shown as a shifting movement from Q2 to Q1 on this diagram.

[5] There are many kinds of production functions, and thus alternative ways to representassociated technological functions in the neoclassical theory. In this section we used the Cobb-Douglas production function as it is easier forachieving the most important conclusions in this theory.

FIGURE 1. TECHNICAL CHANGE IN THE NEOCLASSICAL THEORY




$Q = f(K, L)$

where:
Q = output
k = capital
L = labor

As it was already pointed out, one of the most important conclusions of the neoclassical theory is that technical and economic efficiency are jointly achieved as a stable equilibrium. But, how or why is the firm efficient? Or in other words, how or what ensures that the firm will chose the most efficient technology available in the market? Actually, there are no conclusive answers to these questions from the perspective of the neoclassical theory. Rosenberg (1982), for example, has pointed out these critiques and has stressed the importance to take into account the historical processes in order to analyze firm behavior. Many authors agree with these critiques (Beije 1998; Cohen and Levinthal 1989; Dosi *et al.* 1992; Nelson and Winter 1982; Mulder *et al.* 2001). These authors demonstrate that equilibrium in the neoclassical theory of production is achieved only if diminishing returns are exactly offset by technological advances. Moreover, technological change is assumed to be exogenous to the economic process. From these principles, it follows that the neoclassical theory of production concerns only the economic effects of technical change (Dosi et al. 1992). The number of innovations (or any other output to measure R&D efforts) in neoclassical economics are completely absent in this analysis, and thus technical change only relates to process innovation and not to product innovation (Mulder *et al.* 2001).

By contrast to the neoclassical approach, Nelson (1992, 1994) argues that firm technology is the result of a concrete and specific historical process. Technology is embodied in capital goods, and hence investment is not a reversible process. The capital production factor is not divisible and in real-life situations firm's technological choices are restricted to a limited number of alternative technologies where there is

no perfect substitutability between production factors (Cohen and Levinthal 1989). In fact, evidence is completely contrary to the neoclassical assumptions on firm behavior and technological conditions. From this perspective, Ayers (1978), Nelson and Winter (1982) and Rosenberg (1982) have raised the questions on how firms create a technology process? And why specific firms are capable to adopt a specific technology that some others are not? In fact, the only possible answer to these questions must come from an alternative perspective or an alternative theoretical framework since the process of innovation, imitation and diffusion is not included as part of the neoclassical traditional scheme. Neoclassical economics has also given limited attention to the analysis of R&D activities, and to the creation or development of new products and implementation processes. Furthermore, this theory does not consider R&D activities as one of the most important forms of investment carried out by the firm.

There are other critiques to the neoclassical analysis on firm behavior from the perspective of strategic management. The property and management of the firm is among the most important critiques to this approach. In fact, they have generated some of the most influential theories in management (Coombs *et al.* 1987). In this sense, for example, the control and coordination of management activities within the firm are principally explained by two elements: (1) the power and status given by the organization to its managers, and (2) the importance given to financial compensations received by managers. From this perspective, similar propositions were developed by Penrose (1959) to criticize the neoclassical analysis on firm behavior. This author suggested that the firm should be conceptualized as a bundle of physical and human resources. Under this approach, the growth of the firm is fundamentally conditioned by its managerial resources. Managers are capable to create growth only if they identify and exploit new opportunities for diversification. Diversification is thus the only way to generate higher levels of efficiency and performance into the firm.

## 2.Economic Foundations of Strategic Management

This section contains the theoretical ingredients to analyze technical change and innovation as an endogenous process. We note the importance of the economic analysis and management propositions

in the development of a complementary theoretical formulation on firm behavior. In this approach technical change and innovation are evolving endogenous processes.

A. D. Chandler is recognized as one of the most important original contributors to the field of strategic management. He stressed the importance of technological change in organizations when he analyzed the expansion of existing product lines, the quest for new markets and new sources of supply in distant markets, the opening of new markets by developing a wide range of new products, and the decentralization process of the multidivisional enterprise (Chandler 1962). He argued that technical change was a process partially located in several broad changing institutions, and hence the production and distribution of technological knowledge is more frequently coordinated by institutions different from markets (Chandler 1962; Coombs *et al.* 1987). He also pointed out the importance of changes in business strategy for explaining changes in business organization. In this context, the expansion of business activities can be widely explained from the perspective of technological change (Chandler 1962). New transportation and refrigeration technologies, for example, allowed the geographical expansion of firms and markets. The explanation to this expansion implied more complex administrative tasks and the emergence of a new type of organization (Chandler 1962). He also clarified how the emergence of the decentralized multidivisional structure was the result of the creation of new markets based on new products. In short, this author considered that technology was the base for explaining how business strategy is constantly reshaped (Coombs *et al.* 1987). Moreover, according to this approach, public and private R&D laboratories and universities would actively participate in the process of development, imitation and diffusion of new products. In the same way, this approach also suggests that technical change contributes along with other factors to fix historical boundaries between institutions, but at the same time institutional boundaries influence further technical changes.

There is a parallel between Penrosian principles and the propositions suggested by Chandler. In Penrose's theory, the internal limits of the firm are imposed from the rate at which new managerial resources can be acquired and trained to manage new opportunities (Penrose 1959). From Chandler's perspective, new business

opportunities are the result of technical change experienced by the firm (Chandler 1962). These two principles taken together allow concluding that technological change can be viewed as one of the most important variables in order to explain the firm internal organization and boundaries. In fact, Chandler and Penrose suggest that technical change, business strategy and business organization are closely related variables. However, Penrose's theory establishes a clear and precise relationship between firm's growth, new physical and human resources, improvement of managerial capabilities, diversification, and market development. This relationship determines firm growth, and it imposes internal limits to the rate at which new managerial resources can be acquired and trained to manage new opportunities, offering a dynamic explanation of firm behavior (Penrose 1959).

In this sense, strategic management assumes that there are important differences in terms of the size among firms competing in specific markets. Rumelt (1994), for example, stresses the importance of different sizes of firms in order to determine firm efficiency. However, from a dynamic perspective, heterogeneous firms and different efficiency levels will be fundamental to determine market structure and the competition process. Furthermore, this principle also demonstrates the existence of substantial and sustained rents and spillovers in the industry. In consequence, a theory of the firm should explain firm behavior in specific and different contextual environments. Indeed, a theory of the firm is necessary for the analysis of strategic management. In this context, Nelson (1992, 1994), Porter (1994), Rumelt (1994), and Williams (1994) have emphasized that a complete explanation of firm behavior should be a synthesis of economic theory and strategic management. In the same way, Coase (1937), Williamson (1975, 1989), Schumpeter (1934; 1942) and Porter (1994) have suggested that any effort to understand the dynamics of the firm within a competitive environment should rely on an adequate theory of the firm and on an associated theory of strategy.

In consequence, an adequate question about firm performance and technological change should be on what is the next step in the construction of an satisfactory economic theory of the firm? The answer to this question is given by Nelson (1992, 1994), Porter (1994), Rumelt (1994) and Williams (1994) who suggest that a theory of the firm should take into account important empirical facts related to the differences

between firms size in competitive markets. In fact, these features should be: (1) relative size amongst firms, (2) persistent size differentials over time, (3) different degrees of efficiency, and (4) generation of substantial and sustained rents. Furthermore, from the perspective of the evolutionary theory, diversity amongst firms can be explained as a result of an evolving process. Teece (2009) and Williams (1994) stress the idea that the firm is a set of evolving capabilities generating a dynamic process in terms of markets. This definition is closely related to the Penrosian concept of the firm as a bundle of physical and human resources (Penrose 1959). In this sense, these authors stress the importance of market evolution to explain firm behavior. Actually, capabilities formation, search behavior and sustainability conditions determine the size diversity of firms. Firm diversity and evolving capabilities are concepts strongly related to this theory. However, different firms concentrate different capabilities, and hence different beliefs and strategies. In fact, this principle means that a firm will be able to access new knowledge depending on its current capabilities. Furthermore, different capabilities give to the firm the possibility to access new technologies, and thus define different strategies. This statement supports the principle developed by Cohen and Levinthal (1989, 1990) in terms of absorptive capabilities and technological change. Technology, capabilities and strategy are concepts strongly related to determine innovation and market competition.

Finally, Nelson (1994) suggests that innovation is a process from which it is possible to explain the social and private performance of the firm. In this sense, Penrose (1959) and Nelson (1992, 1994) developed the idea that any innovation process depends on the organizational capabilities of the firm, since any technological change can be explained as a result of alternative strategies established by firms. Therefore, differences in firms can be explained partially as a result of new production methods and new markets, but also as a result of new forms of organization, and size differences of firms necessarily imply different capabilities, and the possibility of generating new innovation processes.

TABLE 2. THEORETICAL DEVELOPMENTS ON FIRM BEHAVIOR

| Theoretical Development | Source |
|---|---|
| Complementary between economic theory and strategic management to explain firm behavior | Penrose<br>Schumpeter |
| Firm defined as a set of capabilities that change and evolve over time | Penrose<br>Williams |
| Heterogeneity among firms in terms of their size and competencies | Strategic Management |
| Differences among firms as the main source to explain rents generation | Resource-Based Theory |
| Innovation developments as an adequate mechanism to compete in markets | Schumpeter<br>Austrian School<br>Management Theory |
| Organizational capabilities as the most important source of innovation | Resource-Based Theory<br>Penrose<br>Schumpeter |

In short, the development of firm's capabilities should jointly be analyzed from the perspectives economics and management theory. Such an approach promises to be more adequate in order to explain innovation, firm behavior and market competition. Table 2 synthesizes the main contributions made by important authors from economics and strategic management to understand firm behavior and technological change (Penrose 1959; Cohen and Levinthal 1989, 1990; Nelson 1992, 1994; Porter 1994; Rumelt 1994; Williams 1994).

## 3. The Schumpeter-Penrose Approach

In this section, the Schumpeter's (1934, 1942) and Penrose's (1959) theoretical contributions to firm behavior are analyzed. It is emphasized that the notion of technological change and innovation are driving forces to explain firm behavior and performance. It is also analyzed the complementary theoretical contributions developed by the Austrian school in terms of equilibrium, competition, and innovation.

Technical change and innovation are driving forces of firm performance and market competition. Schumpeter, Penrose and theorists of the Austrian school are the starting point of this approach in economics and management. In this sense, Schumpeter (1934) describes the importance of innovation and technical change in market competition. The pioneering contributions of this author suggests that firms innovate in four different ways (Schumpeter 1934): (1) new products and processes, (2) new distribution methods, (3) alternative strategies to penetrate new markets, and (4) new management practices and organizational structures.

In Schumpeter's theory, innovation is not a spontaneous process. Indeed, innovation depends on many factors (e.g., property rights, market structure, entry barriers, etc). However, in this theory, technological change influences the market structure and competition, and hence firm behavior. Schumpeter and Penrose thought that all what is happening inside the firm would be the influence of the economic environment (Penrose 1959; Schumpeter 1934, 1942).

Schumpeter's idea on innovation is associated to a two-step alternative evolving process: Mark I and Mark II. In Mark I (Schumpeter 1934) markets have a small number of firms and there are no important technological barriers to entry. By contrast, Mark II (Schumpeter 1942) is characterized by an oligopolistic market structure with R&D activities as the main source of innovation and technological change. In Mark II, financing resources needed to develop innovations is the most important barrier to entry (Malerba and Orsenigo 1997). Nevertheless, Mark I and Mark II taken together may imply a more complete explanation of competition and innovation. Mark I, for example, has an innovative base that is continuously enlarged through an entry process of new innovators, and thus the erosion of competition and technological advantages of established firms. This process of creative-destruction is a core explanation of market dynamics in Mark I. By contrast, Mark II is characterized by an accumulation of technological and innovative capabilities over time. This innovative pattern is mostly observed in oligopolistic structures with important R&D activities. Malerba and Orsenigo (1997) summarize the concepts of Mark I and Mark II in terms of opportunity, appropriability, cumulativeness, and base-knowledge.

Mark I situation is characterized by high opportunity, low appropriability, low cumulativeness, and a low knowledge-base. Meanwhile, the Mark II is characterized by high opportunity, high appropriability, high cumulativeness, and a high knowledge-base. Table 3 summarizes these concepts and definitions.

TABLE 3. SCHUMPETER'S THEORY ON INNOVATION

| | Concept/Definition | Mark I | Mark II |
|---|---|---|---|
| Opportunity | Potential for innovations from each technology adopted | High | High |
| Appropriability | Ability to innovate and to protect innovations from imitations | Low | High |
| Cumulativeness | The possibility of innovators to continue in the future with respect to non-innovators | Low | High |
| Knowledge-Base | The number and types of basic and applied science principles needed to innovate | Low | High |

Source: Malerba, F. and L. Orsenigo (1997).

Mark I and Mark II, taken together, offer a useful explanation on a continuous enlarged innovative base. Through the accumulation of technological and innovative capabilities, the development of the firm and economic growth take place when new products are introduced into the market. This effect will also be achieved if new production processes and organizational techniques are implemented. In this process, the entrepreneur will play a central role, disrupting and moving the firm away from its equilibrium position.

These alternative paths of innovation taken together are highly useful to explain the product life cycle. In this sense, Scherer (1984) has suggested that there are three substantives premises in Schumpeter's writings that can explain innovation and market dynamics. First, technological innovations give to markets the dynamics through a process of creative-destruction (Mark I). Actually, this idea forms the basis for explaining how older products, industry structures, management practices and distribution methods are constantly displaced. Additionally,

this author has also pointed out that Schumpeter's propositions for explaining the causes of growth in real income should be attributed to some kind of technological progress. Second, it is important to keep in mind that, under the Schumpeterian approach, technological progress is a process established by private firms in terms of their organizational and their strategic capabilities. This approach is evidently in accordance to Penrose's theory on firm behavior, and in opposition to the neoclassical perspective of constant equilibrium and neutral technological progress. Finally, from the Schumpeterian perspective a market situation of strong competition does not necessarily lead to the development of organizational and strategic capabilities, and to other forms of innovation. From this point of view, the expectation of a monopoly position is required to develop new organizational capabilities, strategies and innovations (Mark II). Indeed, this principle is closer to some propositions suggested by the Austrian school (Jacobson 1992). Actually, the Austrian school suggests that disequilibrium is an important feature of markets. In this school, the economy is not commonly in equilibrium as it has to manage with a continuous innovation process (Jacobson 1992). As innovation is a permanent process in the economy, markets are rarely in equilibrium. Moreover, in this school, change, uncertainty and disequilibrium are features of firm behavior and market dynamics. And innovation processes and market dynamics are strongly linked through what managers can do to limit competition and control the dynamic environment of the firm. In the contrary, under the Schumpeterian analysis, monopoly power is extremely important to explain profits. In the Austrian school, profits and competition are jointly explained as a result of an innovation process. In short, the Schumpeterian innovation mechanism (Mark II) and the Austrian perspective on competition are thus similar, as both guarantee a level of profits to the firm through innovations.

The Penrose's analysis of firm behavior and markets is an explanation for this dynamic process. This author defines the firm as a collection of productive resources that are organized within an administrative framework (Penrose 1959). She suggests that the firm should be understood as a bundle of physical and human resources that limit their own capabilities and potential (Pavitt 2001). In fact, productive operations of the firm allow managers to obtain increased knowledge

through a learning process that open up the possibility to expand the firm productive opportunities. The expansion of the firm will release excessive managerial resources, giving the possibility for diversification and growth (Penrose 1959). In this sense, the optimal expansion pattern of the firm will be determined by a balance between its internal and external resources (Rugman and Verbeke 2002). However, under the Penrosian perspective, any excess of resource generates the potential for developing new products. This perspective could lead to the construction of a multi-product economic theory of the firm (Teece 1982; 2009). The Penrosian approach to firm behavior suggests that individual firms have distinctive and heterogeneous resource profiles and decide on new combinations of resources and capabilities. Indeed, the possibility to obtain returns determines firm's new capabilities characterized to be firm-specific, valuable to customers, non-substitutable and difficult to imitate (Pavitt 2001; Rugman and Verbeke 2002; Teece 2009). In this sense, Penrose anticipated the concept of organizational routines. Under this perspective, innovation must be understood as a new resource combination that contributes to sustainable superior returns.

In opposition to the neoclassical theory of the firm and closer to the principles established by the Austrian school, the Penrosian analysis suggests that there is not an optimal equilibrium size for the firm. In fact, firms are capable to expand depending on new combinations of resources. Alternative combinations of resources generate endogenously new capabilities, and thus the possibility that firms grow on an equilibrium basis between gains from diversification and their cost of managing a diversified firm (Rugman and Verbeke 2002). In this process, knowledge plays a central role as it determines the possibility to generate new capabilities. Ultimately, knowledge is the source for diversification and growth of the firm (Pavitt 2001). On the other hand, Penrose's suggestion that managerial resources inherited from the past impose a limit to further developments of the firm, known in the literature as "Penrose Effect", implies that a stable equilibrium can exist only if the size of the firm and its management capabilities grow at the same rate. The growth of the firm is assumed a path-dependent process, and it is function of the possibility to generate new capabilities in an endogenous manner (Pavitt 2001; Rugman and Verbeke 2002). The growth of the firm is essentially an evolving and cumulative learning process in which any increase of

knowledge is useful to create alternative options for further expansion, as well as to increase the firm absorptive capabilities (Cohen and Levinthal 1990; Mahoney 1995). In other words, firm performance is fundamentally a function of its expanding productive opportunities. This Penrosian principle is established on the basis that there exists some kind of flexibility in an uncertain world in order to organize an evolving learning process under a management team and entrepreneurship.

Penrose's work can also be seen as a precursor of the resource-based view of the firm in strategic management. Both approaches consider strategy as a generalization of the principle that there exist differences in firm size, and thus systematic differences between firms to explain alternative strategies. Similarly, different resource endowments explain heterogeneous economic rents amongst firms. Both Penrose's and the resource-based view perspectives explain growth constraints as a result of the difficulties found by firms for expending their management team. Diversification takes place on the basis of the firm's existing stock of resource endowments and competencies (Sanchez 1995).

In this sense, competition in dynamic product markets can be explained from the point of view of the resource-based view and flexible strategy. Recall that from the neoclassical perspective, the objective of the firm consists in the rational combination of production factors, including some kind of services to obtain the maximum level of output. Moreover, production factors are acquired in the market and combined optimally using the best technology available. By contrast, Penrose's theory and the resource-based view suggest that there is an internal learning notion to develop new capabilities (Mahoney 1995; Pavitt 2001; Rugman and Verbeke 2002; Sanchez 1995). Indeed, Cohen and Levinthal (1989, 1990) establish the same principle in their absorptive capabilities model. Services can be produced endogenously and continuously through various intra-firm learning processes that involve new knowledge, and thus there will be the possibility to obtain a new combination of resources in order to expand the firm productive capabilities and opportunities.

Penrose's concepts of learning development and capabilities are closely related to the evolutionary terms of adaptation and imitation.

Penrose (1959), Dosi and Marengo (1994), Castrogiovanni (1991) and Pavitt (2001) stress the idea that an explanation of the economic behavior of the firm should rest on an understanding of its environment. In fact, a firm with an inadequate technological base will not possess the capabilities to diversify, innovate and compete in the market. By contrast, a firm with a strong degree of technological competence will be capable to find new opportunities to expand its activities and to choose carefully between alternative courses for action.

Penrose (1959) has already emphasized the idea that the ability to perceive opportunities in external environment of the firm will depend upon its initial capabilities and available resources. Cohen and Levinthal (1989, 1990) and Pavitt (2001) point out the same principle, suggesting that the firm innovation and learning capabilities will depend on its own external access to knowledge. In short, the firm growth potentiality is created from a technological base and from a learning process established to extend and to adapt new processes of the same kind.

## 4.Evolutionary Economics: Technical Change and Innovation

Evolutionary economics authors have suggested that a finer theory of the firm must be capable to give adequate explanations of the firm behavior and capabilities, and also provide an adequate characterization of the institutional richness and cross-industry variety (Nelson and Winter 1982; Nelson 1992, 1994, 1998). However, there are substantial differences between the explanations given by neoclassical economics and the evolutionary theory in terms of these issues. Evolutionary explanations are compatible with the Schumpeter-Penrosian approach and managerial propositions. In this theory, technical change is the ultimate explanation of firm behavior, and thus it gives the possibility of a more complete explanation of the firm behavior and growth.

From the evolutionary perspective, Nelson (1998) has suggested that in order to understand industrial dynamics and market competition, the theory of the firm should incorporate at least the following elements: (1) the ability to treat technological change as a disequilibrium process, (2) to incorporate into the theory of the firm the capabilities and

differences across firms as a central feature, and (3) to incorporate into this theory a richer body of institutions commonly treated in the standard growth theory (e.g., public research centers, universities, etc). These principles together allow the treatment of technical change as an endogenous process. Since economic growth and technological change are closely related variables, Mulder *et al.* (2001) have pointed out that industries are composed by a great diversity of firms, each one with its own behavioral pattern. However, uncertainty is one of the most important features characterizing firm behavior (Knight 1921), and thus it is a consequence derived from the principle of bounded rationality observed in economic agents (Simon 1982).

Nelson and Winter (1982) and Nelson (1992) emphasize the importance differentiating amongst different size of firms. This is actually a stylized fact that must be taken into account in any analysis. Firms individually matter significantly to develop an adequate theory of the firm. In the neoclassical perspective, for example, the analysis of the firm is conducted in terms of one "representative" unit and technological change is treated as a stochastic process (Nelson 1994). In evolutionary models, technical advance at the industry level is a cumulative process in the sense that one technical advance sets up the stage for further developments. Moreover, the analysis made of firm behavior by evolutionary authors implies diversity, uncertainty, path dependency, irreversibility and endogenous technological process in relation to firm behavior (Nelson and Winter, 1982; Nelson, 1992, 1994, 1995).

Additionally, from the perspective of evolutionary models, technological change and innovation should be analyzed into an institutional context (Nelson and Winter 1982; Rosenberg 1982). This means that the environment in which technical change is generated, and adopted by firms, is highly important in order to analyze these effects on the economic environment. Indeed, the nature of technological change and innovation is not deducible from a theory of firm, organizations or markets. The evolutionary approach involves the simultaneous use of these theories, in accordance to the line of thinking developed by Nelson and Winter (1982), Penrose (1959), and Rosenberg (1982).

Penrose's work anticipated current ideas of the evolutionary approach on technical change. This approach is strongly related to the

notions of corporate technological trajectories (Dosi, 1982), corporate technological diversification (Pavitt *et al.* 1989; Granstrand and Sjölander 1990; Granstrand *et al.* 1997) and corporate coherence in diversification (Teece *et al.* 1994). Besides, Penrose's work also anticipates the idea that innovation is rooted primarily in an internal learning process within the firm, and thus technological competence evolves gradually and changes much less dramatically than the composition of downstream products or markets (Cantwell 1999).

From the perspective of the evolutionary theory, technical change and innovation is a context-specific and localized phenomenon. It requires the cost of further innovation to be transformed into some other context, but the cost or difficulty of subsequent innovations depends upon the initial degree of technological relatedness or complementarity between activities (Cantwell 1999), and the degree of absorptive capacity (Cohen and Levinthal 1989, 1990). In this sense, Penrose has pointed out the importance of the increasing impetus principle in order to innovate, as well as the role played by technological competition raising the basis to achieve new profits. Furthermore, whether firms have a higher degree of technological complementarity between their profiles of specialization, they will be capable to achieve a greater absorptive capacity for taking advantage of the knowledge created by other firms. In this sense, the firm may search to make use of technology-based alliances and external capabilities (Pavitt 2001). This statement is what Cantwell (1999) calls inter-firm cooperation, and it is in accordance to the principle analyzed in management in terms of no benefits to the first to discover a core technology. Instead, benefits commonly go to firms whose social capabilities are best adapted to absorb and to develop further innovations from new technological opportunities.

## Conclusion

The theoretical perspective followed in this paper goes from the approach suggested in Penrose's theory of the firm, the absorptive capabilities hypothesis, the corporate learning and resource-based approach, Schumpeterian explanations on innovation (Mark II), and the evolutionary theory that gives the possibility to identify theoretical principles complementary, or alternative, to the neoclassical approach.

It is possible to conclude that firm behavior is characterized to be path-dependent and as an evolving process based on the principle of cumulative and collective knowledge process, and not necessarily in a smooth evolving pattern.

## References

Ayers, C. E. (1978). *The Theory of Economic Progress,* Kalamazoo, MI: New Issues Press.

Beije, P. (1998). *Technological Change in the Modern Economy,* Cheltenham, UK, and Northampton, MA: Edward Elgar.

Cantwell, J. A. (1999). "Innovation as the principal source of growth in the global economy", in Archibugi, D. *et al*. (eds.), *Innovation Policy in a Global Economy,* Cambridge: Cambridge University Press.

Castrogiovanni. (1991). "Environmental munificence: A theoretical assessment", *Academy of Management Review* 16: 542-565.

Chandler, A. D. (1962). *Strategy and Structure,* Cambridge, MA: MIT Press.

Coase, R. H. (1937). "The nature of the firm", in G. J. Stigler, and K. E. Boulding (eds.), *Readings in Price Theory,* Homewood, IL: Richard D. Irwin.

Cohen, W. M., and D. A. Levinthal (1989). "Innovation and learning: The two faces of R&D", *The Economic Journal,* 99: 569-596.

Cohen, W. M., and D. A. Levinthal (1990). "Absorptive capacity: A new perspective on learning and innovation", *Administrative Science Quarterly* 35: 128-152.

Coombs, R., V. Walsh, and P. Saviotti (1987). *Economics and Technological Change,* Totowa, NJ: Rowman and Littlefield.

Dosi, G., R. Giannetti, and P. M. Toninelli (1992). "Introduction. Theory and history of technology and business firms: The microeconomics of industrial development", in G. Dosi, R. Giannetti, and P. M. Toninelli (eds.), *Technology and Enterprise in a Historical Perspective,* Oxford: Clarendon Press.

Dosi, G., and L. Marengo, (1994). "Toward a theory of organizational competences", in R. W. England (ed.), *Evolutionary Concepts in Contemporary Economics,* Ann Arbor, MI: Michigan University Press.

Granstrand *et al.* (1997).

Granstrand and Sjölander (1990).

Jacobson, R. (1992). "The Austrian school of strategy", *Academy of Management Review* 17: 782-807.

Malerba, F. and L. Orsenigo, (1997). "Schumpeterian patterns of innovation", in D. Archibugi, and J. Michie (eds.), *Technology, Globalization and Economic Performance,* Cambridge and New York: Cambridge University Press.

Mahoney, J. (1995). "The management of resources and the resources of management", *Journal of Business Research* 33: 91-101.

Mulder, P., H. L. F. De Groot, and M. W. Hofkes (2001). "Economic growth and technological change: A comparison of insights from a neo-classical and an evolutionary perspective", *Technological Forecasting and Social Change* 68: 151-171.

Nelson, R. R., and S. G. Winter (1982). *An Evolutionary Theory of Economic Change,* Cambridge, MA.: Harvard University Press.

Nelson, R. R. (1992). "The roles of firms in technical advance: A perspective from evolutionary theory", in G. Dosi, R. Giannetti, and P. M. Toninelli (eds.), *Technology and Enterprise in a Historical Perspective,* Oxford: Clarendon Press.

Nelson, R. R. (1994). "Why do firms differ, and how does it matter?" in R. P. Rumelt, D. J. Teece, and D. E. Schendel (eds.), *Fundamental Issues in Strategy: A Research Agenda,* Cambridge, MA: Harvard Business School Press.

Nelson, R. R. (1995). "Co-evolution of industry structure, technology and supporting institutions, and the making of comparative advantage", *Journal Business Economics* 2: 171-184.

Nelson, R. R. (1998). "The agenda for growth theory: A different point of view", *Cambridge Journal of Economics* 22: 497-520.

Knight, F. H. (1921). *Risk, Uncertainty, and Profit*, Boston, MA: Houghton Mifflin.

Pavitt, K. (2001). "Can the Large Penrosian Firm Cope with the Dynamics of Technology? Science and Technology Policy Research (SPRU)", *Paper Series* No. 68, University of Sussex.

Penrose, E. T. (1959). *The Theory of the Growth of the Firm,* Oxford: Basil Blackwell.

Porter, M. E. (1994). "Toward a dynamic theory of strategy", in R. P. Rumelt, D. J. Teece, and D. E. Schendel (eds.), *Fundamental Issues in Strategy: A Research Agenda,* Cambridge, MA: Harvard Business School Press.

Rosenberg, N. (1982). *Inside the Black Box: Technology and Economics,* Cambridge: Cambridge University Press.

Rugman, A. M., and A. Verbeke (2002). "Edith Penrose's contribution to the resource-based view of strategic management", *Strategic Management Journal* 23: 769-780.

Rumelt, R. P., D. J. Teece, and D. E. Schendel (1994). *Fundamental Issues in Strategy: A Research Agenda,* Cambridge, MA: Harvard Business School Press.

Sanchez, R. (1995). "Strategic flexibility in product competition", *Strategic Management Journal* 16: 135-159.

Scherer, F. M. (1984). *Innovation and Growth: Schumpeterian Perspective,* Cambridge, MA: MIT Press.

Schumpeter, J. A. (1934). *The Theory of Economic Development,* Cambridge, MA: Harvard University Press.

Schumpeter, J. A. (1942). *Capitalism, Socialism and Democracy,* London: Allen and Unwin.

Simon, H. (1982). *Models of Bounded Rationality,* Cambridge, MA: MIT Press.

Teece, D. J. (1982). "Towards an economic theory of the multiproduct firm", *Journal of Economic Behavior and Organization* 3: 39-63.

Teece, D. J. (1984). "Economic Analysis and Strategic Management", *California Management Review* 26 (3): 87-110.

Teece, D. J. (2009). *Dynamic Capabilities and Strategic Management: Organizing for Innovation and Growth*, Oxford University Press.

Teece, D. J. *et al*. (1997). "Dynamic Capabilities and Strategic Management", *Strategic Management Journal* 18: 509-533.

Williams, J. R. (1994). "Strategy and the search for rents: The evolution of diversity among firms", in R. P. Rumelt, D. J. Teece, and D. E. Schendel (eds.), *Fundamental Issues in Strategy: A Research Agenda,* Cambridge, MA: Harvard Business School Press.

Williamson, O. E. (1975). *Markets and hierarchies: Analysis and antitrust implications: A study in the economics of internal organization*, New York: Free Press.

Williamson, O. E. (1989). "Transaction Cost Economics", in Richard Schmalensee and Robert Willig (eds.), *Handbook of Industrial Organization*, New York: North-Holland.