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The trajectory of the ability to innovate and the financial performance of the Brazilian industry☆,☆☆

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ABSTRACT

This research analyzes the cumulative trajectory of Brazilian industry's ability to innovate and the impact of this resource on firms' financial performance. From a broad base of data taken at the firm level, a cross-sectional analysis and a longitudinal analysis were combined, through structural equation modelling, in the construction of the trajectory of resource innovation with the combined use of the following techniques: a multilevel model, latent trajectory analysis, and an autoregressive model. The empirical model shows that the ability to innovate consists of factors that are associated with internal, external, and human resources. The influence on financial performance is positive and significant when the analysis involves the long term. The autoregressive effect of the ability to innovate in time is not significant, suggesting that the innovation process is cumulative, interactive, and nonlinear. These results are relevant to emerging countries that require continued public policies and a greater intensity of business investment in the innovation process, aiming at the longevity of companies.

1. Introduction

Recent studies in innovation have sought to evaluate the cumulative trajectory of this organizational ability, whose bases turn towards the construction of technological paradigms, regimes, and standards (Castellacci, 2008; Figueiredo, 2010; Forés and Camisón, 2016; Sundbo and Gallouj, 2000).

In parallel to academic studies, analyses by market professionals and public managers focus on understanding how to foster and develop strategies that are oriented towards innovation, whose results contribute to the growth of companies and the development of countries (Damanpour et al., 2009; Hu, 2014, 2008; Kostopoulos et al., 2011; Lancker et al., 2016; Samara et al., 2012). However, as a result of its analytical complexity and its evolutionary nature as a process of knowledge accumulation and refinement, managing the ability to innovate is presented as one of the main challenges of organizational studies (Bessant, 2008; Cantwell and Fai, 1999; Dewangan and Godse, 2014; François et al., 2002; Kash and Rycroft, 2002; Olaru and Purchase, 2015; Rousseau et al., 2016; Silverberg and Verspagen, 2005).

The difficulty in modelling innovation as an organizational resource is expressed in the controversial results regarding its influence on the business and economic performance of firms (Cozzarin, 2004; Gunday et al., 2011; Jiménez-Jiménez and Sanz-Valle, 2011; Kim et al., 2016; Liao and Rice, 2010; Lööf and Heshmati, 2006, 2002; Prajogo, 2016).

More specifically, this scenario is relevant to emerging markets, whose insertion into global value chains depends on the degree of innovation and competitiveness of their companies, which brings with them institutional, environmental, and social demands that must be overcome (Castellacci and Natera, 2016; Paunov, 2012; Wu et al., 2016; Xie et al., 2016).

As one of the major emerging economies, in real terms, Brazil experienced an increase of 135% in investments in innovation between 2000 and 2013 (MCTI, 2016). In 2013, the expenditure on science, technology, and innovation was 1.24% of the gross domestic product (GDP) compared to an average of 1.9% for the top 40 countries with spending on innovation (UNDP, 2013). However, investments in innovation have not yet had a significant impact on the country. From

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2000 to 2012, for example, Brazil ranked only 70th in the Global Innovation Index 2015 (WIPO, 2015) and 74th in the Global Competitiveness Index (84th in the Innovation sub-item) (WEF, 2015), with a participation in international trade of only 1.22% in 2015 (WTO, 2015).

Given the need to analyze investments in the formation of the ability to innovate with the financial performance of companies in emerging economies, the following question motivates this study: How does the cumulative process of the ability to innovate influence the financial performance of Brazilian industrial companies?

Despite the limitations of research on this subject for the country (de Guimarães et al., 2016; Figueiredo, 2010; Santos et al., 2014), the Brazilian case can serve as a benchmark for other emerging countries, notably in Latin America, which demand higher investments in innovation to increase their competitiveness and economic development.

The specific condition of the Brazilian case, which may serve as a comparison for other emerging countries, has been characterized by: low intensity of business investments in R & D (Cyrino et al., 2017), emphasis on directing investments to acquire machinery and equipment (Frank et al., 2016); lack of insertion of researchers, with master and doctorate degrees, in companies (Santos et al., 2014); little interaction between companies and universities and research institutes to generate innovation (de Moraes Silva et al., 2017). As the largest volume of expenditures on science, technology and innovation conducted by the country comes from the government and the interaction among triple helix agents (university, private sector and government) is limited, the aggregate results of innovation are modest (Cyrino et al., 2017). This environment may be similar to the context of many developing countries, which strive to get a competitive advantage from innovation.

The differences in the technological trajectories of each country or sector are viewed as one of the variables that explain the heterogeneity of the results of innovation, even among developed countries (Atalay et al., 2013; Castellacci and Natera, 2016; Jackson et al., 2016; Samara et al., 2012; Wu et al., 2016). However, there is still no empirical model that shows the cumulative process of innovation and the effects on financial performance (Liao and Rice, 2010; Olaru and Purchase, 2015).

Thus, with the aim of analyzing the cumulative trajectory of innovation and its impact on financial performance, this study proposes an exploratory model of the cumulative process of business innovation based on investments in innovation by Brazilian industry between 2000 and 2011.

This article is organized as follows. The next section provides the theoretical foundations that justify the model structure and allow the results to be discussed. The third section presents the survey and construction process of the variables. The fourth section presents the analysis of the results, comparing them with the literature. Finally, the fifth section discusses the implications of the study for the theory of innovation and the development of public policies and business strategies.

2. Theoretical framework

The trajectory of innovation was formalized by Pavitt (1984), who showed differences in innovation investments and in innovation results among different sectors. The understanding of the differences in efforts and innovation results for each sector brought new prospects for the economic evaluation of innovation. Several quantitative studies whose data for analysis are aggregated by countries have been developed (Castellacci and Natera, 2016; Hatzikian, 2013; Hinloopen, 2003; Kirner et al., 2009; Solow, 1957).

The heterogeneous results confirm the difficulties in relating innovation investments to financial performance (Castellacci, 2008; Kleinschmidt, 1991; Liao and Rice, 2010; Santos et al., 2014). Crossan and Apaydin (2009) explain these differences by means of a framework that is divided into the determinants and the dimensions of innovation, with the determinants being distributed into group, organizational, and process levels and dimensions being stratified into process and results.

The methodological limitation in understanding the extent of the innovation process and the differences in its results in terms of sectorial characteristics is one of the current challenges of this area of knowledge (Atalay et al., 2013; Ryu and Lee, 2016). For instance, Weber and Schaper-Rinkel (2017) investigate quality innovation and performance in Swiss hospitals, Wang et al. (2015) analyze open innovation and performance in high tech companies.

The ability to innovate is an organizational resource that is continuous and non-discrete in nature; moreover, it has cumulative characteristics because its formation requires the development of knowledge in an interactive and recursive manner and is dependent on the social networks in which each firm is inserted (Dewangan and Godse, 2014; Figueiredo, 2010; Hatzikian, 2013; Kash and Rycroft, 2002; Lancker et al., 2016; Sundbo and Gallouj, 2000). Thus, there is a learning curve in the innovation process, which means that the results of this resource are best observed in the financial performance of companies (Cimoli and Dosi, 1995; Linton and Walsh, 2004; Teece, 2010; Velu, 2015).

The formation of the ability to innovate requires different types of investments (machinery, knowledge, people, materials, etc.) (Figueiredo, 2010; Urgal et al., 2011); manifests itself at all levels of the organization (strategic, tactical, and operational) (Teece, 2010); has results that are expressed in different ways (financial, market, operational) (Dewangan and Godse, 2014) and that can be compared in different ways (business, market, country, world) (Crossan and Apaydin, 2009); and must be analyzed considering the time variable, given that there is a cumulative factor of innovation efforts (Cantwell and Fai, 1999).

Internal research and development (R & D) is the classic variable for measuring investments in innovation and a source of mandatory ability to innovate for companies that take offensive and defensive strategies of innovation (Baumann and Kritikos, 2016; Bäck and Kohtamäki, 2015; Colombo and Rabbiosi, 2014; Freeman and Soete, 1997; Howell, 2016; Hung and Chou, 2013; Kim et al., 2016). However, the ability to innovate is not restricted to these investments (Hatzikian, 2013; Lööf and Heshmati, 2006).

A second variable that is widely used to measure innovation is human capital, which is scaled in different ways (e.g., the number of engineers and/or technicians, length of experience, the institutional education level (doctorate, master's degree, bachelor's degree), the number of people dedicated to R & D) (Hatzikian, 2013; Kim et al., 2016; Lööf and Heshmati, 2006).

Innovation, as an intangible resource, comprised by different internal and external sources to the organization, as well as, a result of a cumulative process of knowledge, allows the study of the different strategies and results, since the activities that constitute innovation are heterogeneous and exploited differently by firms (Tavassoli and Karlsson, 2015).

In this context, companies present different levels of innovation, reflecting their absorptive capacity and the persistence of innovation results, e.g., Bartoloni and Baussola (2017) and Maslach (2015). These concepts have been explored in the recent literature, and one of the central axes is the cumulative process of knowledge and learning from internal and external sources that provide better innovation and entrepreneurial performance (Lewin et al., 2011; Rangus and Slavec, 2017; Tavassoli and Karlsson, 2015; Tsai, 2001).

Our study shows that linking innovation with the financial performance of companies requires the need to understand innovation as an organizational resource that brings together tangible and intangible elements, internal and external, to companies. This argument is compatible with other studies (Lichtenthaler, 2016; Wang et al., 2017). However, differently from the studied literature, we present the capability to innovate as a cumulative resource, i.e., the investments and the structure directed to innovation in the past contribute to the constitution of the resource innovation in the present. The contribution derives not only from an additive process of investments but also