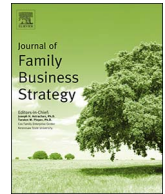


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Unravelling the link between process innovation inputs and outputs: The moderating role of family management

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ABSTRACT

The analysis of technological innovation in a family business context has become a relevant topic in the management literature. However, there is a lack of studies that examine process innovation and the ultimate impact of family management on the relationship between innovation inputs and outputs. Based on a longitudinal sample of 922 Spanish manufacturing firms, this paper empirically explores the moderating role of family management on the relationship between input mix and the occurrence of process innovation. The results show that family management increases the conversion rate of innovation inputs into process innovation outcomes. The study also finds evidence for the existence of a non-linear relationship between innovation input mix and process innovation, indicating that there is both a minimum level and a maximum level in the efficient use of resources in process innovation. Thus, the findings indicate that family-managed firms are more efficient in their use of innovation input resources from a certain reference point.

1. Introduction

In family firm research, technological innovation appears to be a relevant and promising topic because there are strong theoretical reasons to believe that the antecedents and effects of technological innovation are different in family and nonfamily firms (De Massis, Frattini, & Lichtenthaler, 2013). The specific impact of family behaviour and attitudes on the innovation activity of family firms has attracted considerable attention among scholars. Focusing on technological innovation, the prior literature confirms that the competitive advantage of firms is conditioned by both product and process innovations (Damanpour & Gopalakrishnan, 2001). However, the existing research has mainly focused on the analysis of product innovation in family firms (e.g., Cassia, De Massis & Pizzurno, 2011; De Massis, Frattini, Pizzurno, & Cassia, 2015): the potential relevance of process innovation has been largely ignored (Classen, Carree, Van Gils, & Peters, 2014), and more in-depth investigations are needed (Chang, Bai, & Li, 2015).

Process innovation can be defined as the implementation of a new or significantly improved production or delivery method (OECD, 2005), and it requires technical, financial, human and social resources to be accumulated, bundled, and leveraged (Sirmon & Hitt, 2003). Adopting an integrative view, we define innovation inputs as the set of factors or

resources that enable the development of process innovations, and we define innovation output as the development of new methods of production. Given that firms' resources must be managed effectively for their full value to be maximized, the role of managers is crucial to increase the likelihood of gaining the productivity of different input factors when implementing a process innovation strategy.

Drawing on the prior research (Kotlar, De Massis, Fang & Frattini, 2014), we define family management as the active involvement in firm management of the controlling family for all firms that are family-owned. Family involvement in management leads to the development of resources that are unique to the family firm (Habbershon & Williams, 1999). Distinct family resources can be managed and deployed, and this capability generates particular advantages and disadvantages that significantly affect technological innovation processes (De Massis et al., 2015). Hence, family management is highly likely to influence technological innovation (De Massis et al., 2013). Firm managers determine resource allocation within the organization (Hambrick & Mason, 1984); they encourage, select, and nurture innovation activities (West et al., 2003); and they influence decision-making, the use of specific monitoring and the development of capabilities that are valuable for process innovation (Duran, Kammerlander, Van Essen & Zellweger, 2016). Thus, we expect that family management could act as a driver of the willingness and ability to conduct process innovation efficiency, which

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is defined as the relative ability to successfully transform different sorts of valuable, inimitable, and non-substitutable inputs into process innovation.

Despite the relevance of the topic and initial meta-analytic evidence (Duran et al., 2016), no empirical study thus far has focused on determining whether family-managed firms are more efficient than non-family firms in converting a pool of different types of innovation inputs into process innovation outputs. In fact, in addition to R&D intensity, there are other inputs such as human capital (Acs & Audretsch, 1988; Hadjimanolis, 2000) and firm networks (Chesbrough, 2003; Dahlander & Gann, 2010) that can play a key role.

To shed light on this topic, our research addresses the following research question: *Does family management moderate the expected positive influence of innovation inputs on the existence of process innovation?* To answer this question, we applied binary probit regression analysis to a longitudinal sample of 922 manufacturing firms based in Spain using balanced panel data. We draw on resource orchestration (Sirmon, Hitt & Brett, 2011) and focus on how family management can affect a specific firm strategy, specifically process innovation. We strongly believe that resource orchestration enables a holistic view with regard to the integration of inherently different resources in strategic activities such as process innovation.

This study offers relevant contributions to the literature on family business. In contrast to previous research, which has mostly focused on product innovation outcomes, we evaluate whether family-managed firms conduct process innovation efficiently. This is of interest because the phenomenon of process innovation behaviour in family firms has been under-researched. In addition, family firms may pursue distinct innovation strategies for product and process innovations; thus, both types of innovation can inherently depend on different input mixes.

The present study also responds to recent calls for additional research with regard to the antecedents of the conversion rate of innovation inputs into technological innovation output (Duran et al., 2016). Therefore, the study develops a more fine-grained understanding of family-firm innovation by examining the efficiency of family-managed firms in turning different types of innovation inputs into process innovation output. Rather than considering different input resources in isolation, we draw on resource orchestration and investigate if family firms use, in combination, a variety of inputs to conduct process innovation efficiently. The results confirm that while family-managed firms seem to be less innovative than non-family-managed firms in terms of process innovation, their conversion rate is higher. The involvement of family managers positively moderates the relationship between innovation inputs and process innovation, enhancing the relative ability to transform different innovation inputs into process innovation outcomes.

The remainder of the paper is structured as follows. First, based on our literature review, we propose a theoretical framework and set forth the research hypotheses. Second, we describe the research method, presenting the sample and a brief description of the variables used. Third, we present and discuss the results of our analyses. Finally, we conclude the paper by highlighting both the study's contributions to the literature and avenues for future research.

2. Literature review and hypotheses development

2.1. Management of the innovation process

2.1.1. Differences between product and process innovation

As described in the Frascati Manual (OECD, 2002, pp. 18), technological innovation comprises all scientific, technological, organizational, financial and commercial activities, including investments in new knowledge, that can lead to the implementation of technologically new or improved products and processes. These processes include an overhaul of all products and services offered by an organization (product innovation) and all of the ways in which such products and/or

services are created and delivered (process innovation) (Souitaris, 2003).

According to the prior literature (Bigliardi & Dormio, 2009; Clarysse, Van Dierdonck, Gabriels, Lambrechts & Uytterhaegen; 1998; Lundvall, 1992), process innovation can be defined as the adaptation of existing production lines as well as the installation of an entirely new infrastructure and the implementation of new technologies. Process innovation has also been considered in terms of new process technologies that make the production of physical goods more efficient or effective (Fritsch & Meschede, 2001; Añón Higón, 2012). According to OECD guidelines (2005, p. 49), “a process innovation is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software”. With respect to goods, the distinction between process and product innovation is quite evident, as the latter consists of “the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses” (OECD, 2005, p. 53).

Process innovation is essential because it often reduces costs and enhances production efficiency (Chang et al., 2015; Ramos, Acedo, & Gonzalez, 2011), decreasing the required level of input. Process innovations are mainly introduced in the operating core of an organization (Damanpour, 1992), and they demand lower technological advancement and strategic decision-making than product innovation (Tushman & Rosenkopf, 1992). Moreover, process innovation is usually linked to learning-by-doing (Cabral & Leiblein, 2001) and innovation strategies.

As noted above, the analysis of process innovation has been largely ignored in the family-business literature. Thus, this study is specifically focused on process innovation.

2.1.2. Process innovation inputs and outputs

When focusing on the different resources that can foster process innovation, the resource-based view (RBV) highlights the importance of firm resources, whether physical, financial, human or social, as effective inputs or determinants for innovation (Galende & De la Fuente, 2003).

Investments in R&D, in terms of physical and financial resources, play a crucial role in fostering technological innovation (Crossan & Apaydin, 2010) and are essential in enhancing innovation (Block, 2012). Specifically, regarding process innovation, R&D spending can contribute to productivity gains and inventions (Lee, Wu & Pao, 2014). A firm acquires the ability to generate new process innovation by regular allocation of funds in activities that serve to turn them into new processes (Chiesa, 2001). The R&D strategy of a company may stimulate process innovation and is usually considered to be a source of above-average profits (Porter, 1980). A higher R&D intensity heightens the level of research activity within a firm and builds specialized scientific and/or technological expertise, which can translate into significant process innovations (Parthasarthy & Hammond, 2002). Given that R&D “comprises creative work undertaken on a systematic basis to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications” (OECD, 2002, p. 30), it includes relevant activities for process innovation (OECD, 2005). Businesses that develop process innovation must exploit new technologies from other organizations in their own processes. R&D investments may indicate the existence of absorptive capacity, and a firm's ability to recognize, assimilate, and use external knowledge based on its own existing knowledge (Cohen & Levinthal, 1990) may favour firms that adopt process innovation (Reichstein & Salter, 2006). In the same sense, Ganotakis and Love (2012) claim that in-house R&D contributes to process innovation, enhancing the probability that firms will successfully achieve and combine the knowledge necessary to introduce new processes. Chudnovsky et al. (2006) find in-house R&D to improve the likelihood of obtaining process innovation, while Goedhuys and Veugelers (2011)

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