



Innovation and firm growth: Does firm age play a role?



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ABSTRACT

This paper explores the relationship between innovation and firm growth for firms of different ages. We hypothesize that young firms undertake riskier innovation activities which may have greater performance benefits (if successful), or greater losses (if unsuccessful). Using an extensive Spanish Community Innovation Survey sample for the period 2004–2012, we apply panel quantile regressions to study the effect of R&D activities on firm growth (i.e. sales growth, productivity growth and employment growth). Our results show that young firms face larger performance benefits from R&D at the upper quantiles of the growth rate distribution, but face larger decline at the lower quantiles. R&D investment by young firms therefore appears to significantly riskier than R&D investment by more mature firms, which suggests some policy implications.

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1. Introduction

In recent years there has been growing attention to the phenomenon of young innovative companies (Schneider and Veugelers, 2010; Czarnitzki and Delanote, 2013; Audretsch et al., 2014). Indeed, the fast-growing, job-creating innovative entrepreneur has so much appeal because of the close resemblance to the Schumpeterian ideal-type (Coad and Reid, 2012; Daunfeldt et al., 2015). Considerable policy interest surrounds the observation that Europe has fewer young large leading innovators (or 'yollies') than the US, and it has been suggested that European policy-makers should seek to increase the number of young large leading innovators (Veugelers and Cincera, 2010). Relatedly, a number of contributions in the Industrial Organization literature have emphasized that it is young firms (rather than small firms) that make the largest contribution to job creation (Haltiwanger et al., 2013; Lawless, 2014; Hyttinen and Maliranta, 2013). One of the

major difficulties faced by young European firms appears to be the existence of barriers to post-entry growth (Bartelsman et al., 2005). In this paper, we contribute to the literature by focusing on how R&D investment affects growth in young firms.

The previous empirical literature has taken a variety of approaches to investigate how the nature of innovation changes with firm age. Theory and evidence have shown that entrants invest more in R&D than incumbents when the task is to enter new markets (Reinganum, 1983; Czarnitzki and Kraft, 2004), which suggests that old firms may be less R&D-intensive than their younger counterparts. Some scholars have even suggested that the innovative contribution of new firms is so valuable that industrial policy should subsidize entrants at the same time as taxing incumbents (Acemoglu et al., 2013). Other scholars have investigated the relationship between firm age and probability of innovation, paying attention to the distinction between product and process innovation (Huelgo and Jaumandreu, 2004a,b; Cucculelli, 2014). Others have presented evidence that the effects of age on innovation are affected by learning (as firms gain experience and build on previous routines and capabilities) and obsolescence (as the directions of search are outdated and are not well-suited to the current technological landscape) (Sorensen and Stuart, 2000; see also Criscuolo et al., 2012). Balasubramanian and Lee (2008) observe that firm age is negatively related to technical quality, and that

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the effect is greater in technologically active areas. Firm age also plays a role on the likelihood of superior organizational outcomes (Argote, 1999), new product development (Hansen, 1999; Sivadas and Dwyer, 2000), investment in R&D (García-Quevedo et al., 2014), innovative outcomes (Tripsas and Gavetti, 2000), and other areas of firm strategy (BarNir et al., 2003). We complement the literature by investigating the moderating role of age on the relationship between R&D investment and firm growth.

Although previous empirical investigations of firm-level innovation have lacked detailed data on firm age (Headd and Kirchoff, 2009; Decker et al., 2014), we analyze a rich new dataset to gain a number of novel insights into the influence of age on innovation, as well as the effects of innovation on firm growth (conditional on age). Our measure of innovative activity is R&D expenditure per employee. We distinguish between young firms (less than 10 years old) and other, older firms. We develop several hypotheses that acknowledge that firms' innovation processes change over a firm's life course, building on notions that as firms get older, they gain experience and become more routinized. We analyze panel data on Spanish innovative firms between 2004 and 2012. The data source is the Technological Innovation Panel (PITEC—Panel de Innovación Tecnológica) which compiles the Spanish surveys of the Community Innovation Survey (CIS). Our regressions focus on three alternative indicators of firm growth: growth of sales, growth of productivity and growth of employment. Panel quantile regressions reveal that youth amplifies the riskiness of innovative activities—young innovative firms may either enjoy large upside gains or large downside losses. Our results suggest that young firms are particularly vulnerable to the risks inherent in innovative activity.

The structure of the paper is as follows. Section 2 outlines the literature related to firm age and innovation. Section 3 presents our hypotheses on the effect of R&D investment on growth as firms age. Section 4 presents the database and some descriptive statistics. Section 5 shows the econometric methodology and variables. Section 6 reports the results of the effect of firm age and innovation on firm performance, and Section 7 concludes.

2. Innovation, firm growth, and the moderating effect of firm age: A literature review

While some studies have focused on how innovation changes with age, other studies – more closely related to our present paper – focus on how age moderates the ways in which firms benefit from innovation. In fact, the empirical literature has found both negative and positive influences of firm age.

Older firms may enjoy advantages stemming from their innovation investments. Research has highlighted the existence of learning effects, which allow mature firms to innovate more effectively as they build on previous routines and capabilities. As time goes by, firms innovate on the basis of existing capabilities and competences, and work to refine older areas of technological opportunity. Furthermore, as time goes by, firms are able to accumulate resources, managerial knowledge and the ability to handle uncertainty (Herriott et al., 1984; Levitt and March, 1988), as well as accumulating reputation and market position, which together help facilitate relationships and contacts with customers, suppliers and potential collaborators. Finally, there is evidence on the positive effect of firm age on the likelihood of superior organizational outcomes (Argote, 1999), new product development (Hansen, 1999; Sivadas and Dwyer, 2000) and innovative outcomes (Tripsas and Gavetti, 2000).

However, older firms may suffer from a number of drawbacks that hinder their ability to translate R&D investment into higher growth rates. It has been pointed out that organizational inertia

may constrain the firm's ability to change. For instance, Majumdar (1997) noted that older firms are liable to experience some form of inertia, which may hinder learning effects. Furthermore, firm experience may generate obsolescence if the directions of search activities upon which mature firms have embarked are not well suited to the contemporaneous technological landscape. Relatedly, Sorensen and Stuart (2000) identify two effects of age on innovation – learning effects and obsolescence effects – and they present evidence supporting both of these contrasting effects in their analysis of semiconductor and biotechnology firms. Balasubramanian and Lee (2008) analyze data on patents of Compustat firms in order to examine how firm age relates to innovation quality, and how this link varies depending on the nature of technology. They found that firm age is negatively related to technical quality, and that this effect is greater in technologically active areas.

Regarding younger firms, there may also be opposed effects. On the one hand, young firms start with neither routines nor capabilities, and must establish these rapidly upon entry (Helfat and Peteraf, 2003). The challenge is for young firms, starting from scratch, to quickly set up not only everyday operating routines but also higher-level innovation capabilities. Young firms may therefore initially lack the internal capabilities to benefit from R&D investment. The classic distinction between local search and distant (exploratory) search (Katila and Ahuja, 2002) is less clear in the context of young firms, because they do not yet have an established stock of production knowledge or innovative routines that would allow them to engage in local search. What is routine and 'local' for established firms may still require lots of planning on the part of new firms—"New firms are hampered by their need to make search processes a prelude to every new problem they encounter" (Garnsey, 1998, p541). On the other hand, these firms may acquire external knowledge by investing in external R&D. In this vein, Pellegrino et al. (2012) investigate the difference between young innovative companies (YICs) and their older counterparts using Italian CIS data. Those authors observe that embodied technical change (that is, investments in innovative machinery and equipment) plays an especially large role for YICs, although there is a conspicuous lack of an effect of internal R&D on innovation intensity in the case of YICs. Taken together, this might indicate that YICs have difficulties in accumulating internal R&D capabilities in the years following start-up, and source other types of innovation inputs.

Consequently, previous empirical evidence indicates that new firms typically need time to accommodate to the situation within which they operate and improve their internal capabilities. They also have to assess how their performance relates to the performance of their competitors and in which ways performance needs to be improved. As Taymaz (2005, p. 430) puts it: "new firms become aware of their actual productivity after observing their performance in the industry". In fact, this is consistent with the finding that new firms generally enter with productivity levels lower than that of incumbents (Jensen et al., 2001; Huelgo and Jaumandreu, 2004a,b; Coad et al., 2013). When the performance of new firms is below that of the existing firms in the market, new firms need to catch up in order to be competitive.

The small but growing literature on how innovative activity changes with firm age has therefore developed along a number of different avenues. We contribute to the literature by presenting new evidence on the moderating role of age on the relationship between R&D investment and firm growth, when growth is measured in terms of sales, productivity, or employment. In particular, we apply panel quantile regression to investigate how the effect of innovation on growth varies across the growth rate distribution. While some previous work has applied (cross-sectional) quantile regression estimators to investigate the effect of innovation on sales growth (e.g. Coad and Rao, 2008) or the effect of young innovative

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