Research Policy xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

R&D drivers and age: Are young firms different?

José García-Quevedo[a,b], Gabriele Pellegrino[a], Marco Vivarelli[c,d,e,*]

[a] Barcelona Institute of Economics, University of Barcelona, Barcelona, Spain
[b] Department of Public Economics, University of Barcelona, Barcelona, Spain
[c] Università Cattolica del Sacro Cuore, Milano, Piacenza, Italy
[d] SPRU, University of Sussex, Brighton, United Kingdom
[e] IZA, Bonn, Germany

ARTICLE INFO

Article history:
Received 3 December 2012
Received in revised form 27 March 2014
Accepted 6 April 2014
Available online xxx

JEL classification:
O31

Keywords:
R&D
innovation
young firms
dynamic type-2 tobit estimator.

ABSTRACT

This study examines the relationship between R&D drivers and firm's age, taking into account the autoregressive nature of innovation.

Using a large longitudinal dataset comprising Spanish manufacturing firms over the period 1990–2008, we find that previous R&D experience is a fundamental determinant for mature and young firms, albeit to a smaller extent in the case of younger firms, suggesting that their innovation behaviour is less persistent and more erratic.

Moreover, our results suggest that firm and market characteristics play a distinct role in boosting the innovation activity of firms of different ages. In particular, while market concentration and the degree of product diversification are found to be important in fostering R&D activities in the subsample of mature firms only, young firms' spending on R&D appears to be more sensitive to demand-pull variables.

These results have been obtained using a recently proposed dynamic type-2 tobit estimator, which accounts for individual effects and efficiently handles the initial conditions problem.

1. Introduction

The analysis of the determinants of a firm's R&D activity is a classic concern of the *Economics of Innovation*, dating from the seminal contribution by Griliches (1979) (see also Griliches, 1994, 1996; Mohnen and Hall, 2013). More recently, endogenous growth models have singled out the accumulation of R&D and human capital as the main source of long-term economic growth (see Mankiw et al., 1992; Romer, 1994; Lucas, 2002). In this respect, several studies state that R&D expenditures represent the main engine of technological progress and economic growth (see Nelson and Winter, 1982; Mansfield, 1988; Aghion and Howitt, 1998).

Interest in the field has been reawakened following recent reports and contributions that identify the essential role played by a specific type of firm – the so-called Young Innovative Companies (YICs)[1] – in the renewal of the industrial structure and in contributing to aggregate economic growth. Baumol et al. (2007), for instance, point out that, over the last 15 years, productivity growth in advanced economies has been due in the main to the development of innovative entrepreneurial companies, such as Microsoft, Intel, eBay, Amazon, Google, Apple, Walmart[2] among others. By the same token, Czarnitzki and Delanote (2013) found convincing evidence that young innovative firms grow more than other firms both in terms of sales and employment.

Indeed – in seeking to account for the persistent gap that exists between the EU and the US in terms of innovative performance and productivity – scholars and policy makers often refer to European weaknesses regarding YICs (see Cincera and Veugelers, 2010). In

* Corresponding author at: Facoltà di Economia, Università Cattolica del Sacro Cuore, Via Emilia Parmense 84 I-29122 Piacenza, Italy. Tel.: +39 0523 599301; fax: +39 0523 599303.
E-mail address: marco.vivarelli@unicatt.it (M. Vivarelli).

[1] According to the European Commission's State Aid rules, Young Innovative Companies are defined as small companies, less than 6 years old, 'certified' by external experts on the basis of a business plan as capable of developing products or processes which are new or substantially improved and which carry a risk of technological or commercial failure, or have R&D intensity of at least 15% in the last 3 years or current year (for start-ups). YICs should be considered distinct from the so-called "New Technology-Based Firms" (NTBFs), which are R&D-intensive start-ups in emerging high-tech sectors (see Storey and Tether, 1998; Colombo and Grilli, 2005). Due to data limitations, the focus of this study will be on young firms engaged in R&D activities, which can be considered a category related but not identical to the YICs definition.

[2] Foster et al. (2006) provide convincing evidence about the fundamental labour productivity-enhancing effect exerted by the massive restructuring and reallocation activity underwent in the US retail trade sector in the 1990.

http://dx.doi.org/10.1016/j.respol.2014.04.003
0048-7333/

fact, in Europe, young companies have lower capacities to innovate and higher rates of early failure (see Bartelsman et al., 2004; Santarelli and Vivarelli, 2007; Vivarelli, 2013b), whereas the US economy has been able to generate a steadily increasing flow of young innovative firms that not only survive but which develop new products at the core of emerging sectors. For these reasons, many EU countries have implemented policies to support the creation and growth of YICs, focusing – for instance – on facilitating their access to funding and providing support for the commercialization of innovation (see EC-DG ENTR, 2009; Schneider and Veugelers, 2010).

Despite this policy concern, few studies have explicitly examined the specific characteristics of young firms and their contribution to Europe's innovative performance. Moreover, little evidence has been gathered on a number of important issues that could have major policy implications. What, for example, are the factors that might lead a young firm to engage in R&D? Are there substantial differences in the factors that affect the level of R&D investment in young firms, on the one hand, and mature firms, on the other? Is the R&D process equally persistent in firms of different ages?

By drawing on a large longitudinal dataset of Spanish manufacturing firms, the objective of this paper – and its main novelty – lies in the assessment we make of the differences that exist between firms of different ages in terms of the drivers that increase the probability of their engaging in R&D activity, on the one hand, and those that determine the intensity of this activity, on the other. A recently proposed dynamic type-2 tobit model (Raymond et al., 2010) is applied to perform the microeconometric analysis.

The remainder of the paper is organised as follows. Section 2 provides a review of the relevant literature. In Section 3 we put forward the hypotheses that will be tested. Section 4 provides a discussion of the econometric methodology adopted. In Section 5 we present the data and the variables used in the empirical analysis. The estimation results are discussed in Section 6, while in Section 7 the main conclusions and findings of the study are briefly summarised.

2. The literature

The first author to conduct a theoretical analysis of the drivers of R&D activities was Joseph Schumpeter. In "Capitalism, Socialism and Democracy" (Schumpeter, 1942), the Austrian scholar claims: 'The atomistic firm operating in a competitive market may be a perfectly suitable vehicle for static resource allocation, but the large firm operating in a concentrated market is the most powerful engine of progress and. . . long-run expansion of total output'. This simple statement has inspired a vast and well-established body of literature, both theoretical and empirical, which has – with some exceptions – confirmed Schumpeter's predictions that internal finance and the degree of market concentration are direct determinants of innovation activity.

As for the first factor, scholars usually refer to firm size as a proxy of firm's financial performance. In this respect as pointed out by numerous studies, larger firms are not affected by liquidity constraints since they enjoy easier access to external finance and larger internal funds by cumulated profits (see Cohen and Klepper, 1996; Mairesse and Mohnen, 2002; Conte and Vivarelli, 2014). As a consequence, firms' propensity to invest in R&D should be positively correlated with their size (see Kamien and Schwartz (1982) for an extensive discussion of the so-called "Schumpeterian hypothesis").

With respect to the second factor, also in this case, several studies state that large incumbent firms with greater market power have a higher incentive to innovate because they can better appropriate returns from their R&D investments (see Gilbert and Newbery, 1982; Blundell et al., 1999).

Together with market power, larger incumbents may also take advantage from a higher degree of product diversification. Here, economic theory focuses onto the close relationship between scope economies and R&D activity: a firm with a diversified portfolio of products can benefit from potential internal knowledge spillovers and so be better positioned to understand the applicability of new ideas (Henderson and Cockburn, 1996).

A further important stream of literature related to the drivers of innovation activity is represented by the demand-pull vs technology-push debate. Since Schmookler's (1962) seminal contribution, many authors have tested the hypothesis that demand drives the rate and direction of innovation. In this line, various theoretical and empirical approaches, both at the aggregate (see Schmookler, 1966; Scherer, 1982; Kleinknecht and Verspagen, 1990; Geroski and Walters, 1995) and at the microeconomic level (see Brouwer and Kleinknecht, 1996, 1999; Piva and Vivarelli, 2007) converged to consider demand and market growth as essential factors for boosting innovation activity based on increasing returns of scale, optimistic expectations and diminishing cash constraints.

The first comprehensive discussion of the technology-push hypothesis was put forward by Mowery and Rosenberg (1979). The core idea is that the rate and direction of technological change is basically affected by advances in science and technology and by the availability of exploitable 'technological opportunities' (see Klevorick et al., 1995). Subsequent studies extended this notion stressing the key role to be played by cumulated knowledge investment in fostering firms' 'absorptive capacity', that is their ability to exploit external technological opportunities (see Mowery, 1983; Pavitt, 1984; Cohen and Levinthal, 1989, 1990; Rosenberg, 1990, 1994).

In essence, the technology-push theory holds that R&D activities are dependent on their own rules of development. Thus, within a firm, R&D activities are highly localised (Atkinson and Stiglitz, 1969) and path-dependent (see Rosenberg, 1982; David, 1985). Closely related to these concepts, is the idea of a dominant 'technological trajectory' according to which innovation, and in particular R&D activities, are processes that show high degrees of cumulativeness and irreversibility and, as a result, are characterised by a higher level of persistence (see Dosi, 1988). These considerations open up the way to a dynamic first order autoregressive [AR(1)] specification of firms' decisions regarding both whether or not to engage in R&D and how much to invest in R&D activities.[3]

However, as Dosi (1988, 1997) points out, patterns of technical change are the result of the interaction between different types of market incentives, on the one hand, and technological opportunities, on the other. Working within this framework, most recent empirical studies tend to combine both demand-pull and technology-push theories into a unified framework (see Crépon et al., 1998, Mohnen and Dagenais, 2002; Dosi and Nelson, 2013). In what follows, both the approaches will be jointly taken into account.

3. Hypotheses to be tested

As discussed in the introduction, the purpose of this paper is to identify any differences that might exist between young and mature firms in terms of the factors that stimulate the probability of their engaging in R&D activity and those that determine the intensity of this investment. Indeed, to the best of our knowledge, no previous studies have specifically compared the R&D drivers in

[3] For a recent paper focused on the autoregressive nature of R&D investments, see Coad and Rao (2010).

Please cite this article in press as: García-Quevedo, J., et al., R&D drivers and age: Are young firms different? Res. Policy (2014), http://dx.doi.org/10.1016/j.respol.2014.04.003