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Innovation and business survival: A long-term approach

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ABSTRACT

This paper explores the influence of innovation on the probability of survival of two hundred top British firms founded throughout the nineteenth and twentieth centuries. To this end, we have collected the firms' significant innovations and classified them by Schumpeterian types, patented and non-patented and domestic and imported. The number of patents registered by the firms throughout their lifetime −a rough measure of their incremental innovation activity– has also been recorded. In addition, twelve control variables −five characteristics of the firms and seven of their business leaders– have been included. Both log-normal and gamma duration models have been used in the analysis. They have been estimated, firstly for the whole set of firms and, secondly, for the manufacturing and the service firms separately to control for industry differences. The results of the log-normal and gamma estimations are highly coincident, with some nuances. The significant innovations −particularly new processes, non-patented and domestic ones– have been found to positively influence the probability of business survival. The number of patent applications seems to increase the survival probability of the manufacturing firms, but not of the service ones. Among the control variables, the firm's size, its international dimension, and the age of the business leader at entry seem to be the most influential ones on business survival, although there are some differences between manufacturing and services. The main results are robust to the division of the sample by entry period.

1. Introduction

Most firms aspire to last for long, but only some of them manage to survive more than a few years. Thus, durability is a clear indicator of business success, the key one according to Barnard (1938). Not surprisingly, business survival has attracted the interest of many scholars since a long time ago. Among the variety of factors considered to influence business longevity,[1] innovation is a prominent one. Many studies analyzing the relationship between both variables have been published, but the theme is far from exhausted as some conflicting results have appeared and many aspects of that relationship remain unexplored. This is in part due to the difficulty to obtain data on innovation, especially in disaggregated terms. In addition, data are usually available only for short periods of time, hindering long-term analyses, particularly valuable when studying longevity.

The present paper aims to delve in the two aforementioned directions. To this end, we have constructed an ad hoc data set of innovations introduced by the arguably top two hundred British companies of the nineteenth and twentieth centuries. Therefore, the study does not deal with average firms, but with a selected group of outstanding ones. They were outstanding in several aspects, including durability, compared with the average firm, but at the same time they were very diverse, also in terms of longevity. Our purpose is to study the factors influencing that survival diversity. In particular, we will test whether the selected firms' longevity was related with their innovation activity (level and type), controlling for some features of the companies and of their founders/leaders.

The rest of the paper is organized as follows. Section 2 contains an overview of the previous literature, including an explanation of our motivations and contributions. In Section 3, the sources, data and approach of the study are described. The explanatory and control variables and the empirical duration models used are explained in Section 4. The results of the estimations of the econometric models and a robustness check are presented in Section 5. Section 6 concludes.

2. Related literature and research motivation

Business survival has been found to be influenced by many factors,

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[1] The terms 'survival', 'longevity' or 'durability' will be used indistinctly throughout the paper.

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such as the characteristics of the market (Audretsch and Mahmood, 1995; Mata et al., 1995; Agarwal and Gort, 2002), the industry life cycle (Agarwal, 1997), the sector's technological intensity (Schumpeter, 1942; Audretsch, 1995; Mata et al., 1995; Aghion et al., 2001), the size and age of the firm (Evans, 1987; Geroski, 1995; Sutton, 1997; Cefis and Marsili, 2005), its profitability and financial constraints (Headd, 2003; Bellone et al., 2008), its innovation activity (Hall, 1987; Ericson and Pakes, 1995; Esteve-Pérez et al., 2004; Cefis and Marsili, 2005), its pre-entry experience (Boeker, 1988; Klepper, 2002; Thomson, 2005), as well as the founder's personal features (Vivarelli and Audretsch, 1998; Arrighetti and Vivarelli, 1999; Headd, 2003; Persson, 2004; Colombo and Grilli, 2005; Arribas and Vila, 2007; Saridakis et al., 2008).[2] Factors like size, age or profitability of the firm have received prominent attention by empirical studies on survival, but the interest in innovation has increased recently.

Several studies have shown a positive influence of innovation on survival, although others have not found a clear relation or have detected conflicting effects (Jensen et al., 2008; Buddelmeyer et al., 2010; Børing, 2015). This is partially explained by the variety −in nature and quality– of the innovation measures used, which also makes comparisons across studies difficult (Buddelmeyer et al., 2010, p. 265). Specialists have highlighted the necessity of fitter and more disaggregated data at the firm level to solve the conflicting results and to better understand how innovation affects survival (Cefis and Marsili, 2006; Børing, 2015).

Most studies on the relationship between innovation and business survival have used R&D and/or patent data (e.g., Geroski, 1995; Audretsch, 1995; Esteve-Pérez et al., 2004; Buddelmeyer et al., 2010; Tsvetkova et al., 2014; Ugur et al., 2016; Kim and Lee, 2016). The problems of such indicators as measures of innovation imply certain limits in the analyses based on them,[3] notwithstanding the valuable insights they have provided. Although all measures of innovation are imperfect (Neely and Hii, 1998, p. 37), innovation counts is probably the best one as it is not a proxy but a direct reflection of the innovation activity (Geroski, 1994, pp. 7–12; Neely and Hii, 1998, p. 36). But these indicators are particularly scarce, a reason why business survival studies using them are less abundant. Nevertheless a growing number of them have appeared in the last years (Cefis and Marsili, 2005, 2006, 2011, 2012; Klepper and Simons, 2005; Fontana and Nesta, 2009; Børing, 2015; Sharif and Huang, 2012).[4]

The latter studies have obtained the data on innovation outputs from Community Innovation Surveys (CIS) (Cefis and Marsili, 2005, 2006, 2011, 2012; Børing, 2015), specialized journals and company reports (Klepper and Simons, 2005; Fontana and Nesta, 2009) or ad hoc company surveys (Sharif and Huang, 2012). Like them, the present one analyzes the influence of innovation outputs on business survival at the firm level, but unlike them (except Klepper and Simons, 2005) it adopts a long-term approach, so the sources used by the mentioned studies −covering a short time span– are not useful for our purposes. In order to get the kind of data we need, we have resorted to the prosopographical method, that is, to a systematic collection of information from business biographies, which will be described in Section 3.

An important contribution by Cefis and Marsili (2005, 2006) was to show that the effect on survival of product and process innovations −in both cases positive ('innovation premium')– had some significant differences, indicating the interest of disaggregating innovations by types (see also Børing, 2015 and Cefis and Marsili, 2011, 2012). But, according to Schumpeter's (1934) taxonomy, in addition to product and process, there are another three kinds of innovations (organizational, new markets, and new sources of supply), of which relation with business survival has not yet been explored.[5] Thus, building upon the aforementioned contributions, the present study widens the focus to all Schumpeterian forms of innovation, aiming at testing their potentially different effect on business survival.

But innovation can be disaggregated by other criteria also useful to better understand its nature as well as its relation with longevity. This study has included two additional classifications. First, we have distinguished between patented and non-patented innovations. Due to their potential differences in nature, their effect on business survival may differ, but there is almost no evidence about this. It is true that some studies have found differential effects of patents and trademarks on survival (Buddelmeyer et al., 2010; Helmers and Rogers, 2010), showing the interest of disaggregating innovations in this way, but trademarks can only be considered a proxy of certain (marketing) innovations, not a measure of all non-patented innovations. The present study takes a step forward in this sense as it distinguishes between patented and all kinds of non-patented innovations. Secondly, we have also disaggregated the innovations between domestic and imported ones as they may also have different characteristics and a differential effect on survival. We are not aware of previous research on this, so we expect to make a contribution on the matter.

It has been debated whether the economic impact of radical innovations appearing occasionally is greater than that of incremental ones arising much more frequently. Schumpeter (1934) gave more importance to the former, while Usher (1954) emphasized the relevance of the latter, to cite two classical views. Over time, opinion has grown that the cumulative effect of incremental innovations may be the most important (Rosenberg, 1982, pp. 62–70; Fagerberg, 2005, pp. 7–8).[6] But the focus of these analyses has been the effect of the two types of innovation on productivity, few of them having tried to measure their influence on survival (Buddelmeyer et al., 2010). In order to add some evidence on this, we have recorded two different innovation indicators: (1) the significant (radical or important) innovations developed by the selected firms, and (2) the total amount of patents registered by them throughout their lifetime, which may be seen as a rough proxy of their more ordinary (incremental) innovation activity as explained in detail in subsection 4.1.

Most empirical studies on innovation and business longevity have focused on the manufacturing sector (Evans, 1987; Hall, 1987; Audretsch, 1995; Esteve-Pérez et al., 2004; Cefis and Marsili, 2005, 2006; Klepper and Simons, 2005; Fontana and Nesta, 2009; Tsvetkova et al., 2014; Kim and Lee, 2016). This is partially explained by the greater availability of data on that sector, but given the importance of the service industry in modern economies, it seems convenient to analyze it as well. In fact, researchers are increasingly looking at both manufacturing and services (Persson, 2004; Buddelmeyer et al., 2010; Helmers and Rogers, 2010; Sharif and Huang, 2012; Børing, 2015; Ugur et al., 2016), finding significant differences between them in terms of business survival. Following these contributions, our data set also includes both manufacturing and service companies.

[2] For a survey of the literature on business survival from the viewpoint of industrial organization, see Manjón-Antolín and Arauzo-Carod (2008), and Riviezzo et al. (2015) from the management and business history perspectives.

[3] Without going into detail, it can be said that the general limitation of both indicators is that, by definition, they can only reflect part of the innovation activity, so studies based only on them may undervalue the innovation activity of firms, sectors, etc. In addition, R&D is not properly an indicator of innovation but of the effort to increase the scientific and technical capabilities, which may have various orientations. Patents are neither, strictly speaking, an indicator of innovation, although they are so more properly than R&D. In any case, they are also a partial indicator as many innovations are not patented for a variety of reasons (e.g., Cohen et al., 2000). For two useful overviews on the matter, see Griliches (1990) and Geroski (1994, pp. 6–7).

[4] Studies using innovation output measures to analyze business performance indicators different from survival (Gunday et al., 2011; Baumann and Kritikos, 2016) or other aspects like persistence in innovation behavior (Tavassoli and Karlsson, 2015) have also appeared lately.

[5] The analysis of all the Schumpeterian forms of innovations has been highlighted as a lacuna of innovation studies in general (Shane, 2003, p. 34). Certainly the lacuna has begun to be filled by a number of studies (e.g., Ruef, 2002; Gunday et al., 2011; Tavassoli and Karlsson, 2015), but not in the specific case of business survival research as far as we know.

[6] Mokyr (1990, Chapter 11) differentiates between macro inventions and micro inventions (not innovations), concluding that both types are complementary and indispensable for technological progress.