CESIS Centre of Excellence for Science and Innovation Studies

CESIS Electronic Working Paper Series

Paper No. 228

R&D strategies and Entrepreneurial Spawning

Martin Andersson*, Apostolos Baltzopoulos and Hans Lööf****

*JIBS and CESIS, ** Division of Economics KTH and CESIS

April, 2010

The Royal Institute of Technology
Centre of Excellence for Science and Innovation Studies (CESIS)
http://www.cesis.se

R&D strategies and Entrepreneurial Spawning

Martin Andersson*, Apostolos Baltzopoulos and Hans Lööf****

*JIBS and CESIS, ** Division of Economics KTH and CESIS

April 13, 2010

Abstract

This paper analyzes how different R&D strategies of incumbent firms affect the quantity and quality of their entrepreneurial spawning. By examining entrepreneurial ventures of ex-employees of firms with different R&D strategies three things emerge: First, firms with persistent R&D investments with a general superiority in sales, exports, productivity, profitability and wages are less likely to generate entrepreneurs than firm with temporary or no R&D investments. Second, start-ups from knowledge intensive business service (KIBS) firms with persistent R&D investments have a significantly increased probability of survival. No corresponding association between the R&D strategies of incumbents and survival of entrepreneurial spawns is found for incumbents in manufacturing sectors. Third, spin-outs from KIBS-firms are more likely to survive if they start in the same firm, indicating the importance of inherited related knowledge. The findings suggest that R&D intensive firms spur fewer entrepreneurs, but their entrepreneurial spawns tend to be of higher quality.

Keywords: entrepreneurship, self-employment, R&D strategy, innovation, new firms, spin-off, spin-out

JEL: J24, L26, M13, O31, O32

1. Introduction

A stylized fact that appears in various branches of economic thought is that new firms are an engine of technological change, employment and growth (Baumol, 1990; North, 1994; Acs, 2006). But the impact and survival differ considerably across new entrants. Start-ups by ex-employees of incumbent firms are found to be a distinctive class of new firms. Bhide (1994) reports, on examining survey-data, that 71 % of all founders of fast-growing companies replicated or modified an idea encountered through previous employment. Several studies confirm that employee start-ups play an important role in the evolution of industries, and that the knowledge they inherit from incumbents is important for their quality (US automobile industry, Klepper, 2002; laser industry, Klepper and Sleeper, 2005; semiconductors, Malone, 1985; disk drive industry, Agarwal et al., 2004).

The superior performance of employee start-ups naturally stimulates questions about the type of firms that are more likely to spawn new entrepreneurs. One of the central questions in entrepreneurship research indeed concerns the characteristics of incumbents that influence the quantity and quality of employee start-ups. Yet, the empirical evidence on such characteristics is limited. For instance, in a recent survey of the literature, Klepper (2001) concludes that evidence on employee start-ups is rare and that existing studies often reach different conclusions.

The purpose of this paper is to shed more light on the relationship between attributes of incumbent firms and their entrepreneurial spawning. We focus on how the R&D strategies of incumbents influence the quantity as well as the quality of *de novo* employee start-ups. Quantity refers to the frequency of entrepreneurial spawns and quality to survival rates. Employee start-ups with higher likelihood of survival are assumed to be of higher quality. We investigate the effect of three different R&D strategies that describe frequency of a firm's R&D investments over time: (i) no R&D, (ii) temporary R&D and (iii) persistent R&D.

There are several motivations for our focus on R&D strategies. It is widely maintained that start-ups are stimulated by the stock of accumulated knowledge of incumbent firms (Acs et al., 2009). When employees leave to start a new firm, they walk out with tacit knowledge and know-how on routines, resources, customers, etc., connected to the incumbent. In this way, employee start-ups inherit knowledge from incumbent firms. Such knowledge inheritance is expected to have a positive influence on both the quantity and quality of entrepreneurial spawns (Klepper, 2001; Klepper and Sleeper, 2005). Firms with different types of R&D strategies may readily be assumed to develop different levels of experience, skills and knowledge. Because of this, they may be associated with distinct potentials to generate high quality employee start-ups, where firms with persistent R&D could be regarded as 'hotbeds' for entrepreneurial spawns.

An opposite perspective suggests that innovative firms that invest persistently in R&D are less likely to spawn entrepreneurs. Agarwal et al. (2004) maintain that successful firms are more capable at capitalizing on new ideas and knowledge developed in the firm which should reduce start-up activity by their employees. Studying the disk drive industry in the US, they find support for this prediction. Moreover, Lööf and Johansson (2010), find significant differences in Swedish firms' performance related to their long-run R&D-strategy. Firms that undertake R&D persistently have higher sales, productivity and profitability per employee. From this perspective, employees of such well-performing firms that pay high wages and offer stable employment may perceive the opportunity cost of starting an own firm as high, which would lower the probability of employee start-ups.

Although the nature of association between knowledge inheritance and employee entrepreneurship are topics of active research, the lack of systematic evidence and agreements is striking. We contribute to this literature by presenting an empirical analysis of the relationship between R&D strategies and the spawning of entrepreneurs, using a novel comprehensive dataset on incumbent firms and start-up activities of their employees.

The analysis makes use of unique Swedish matched employer-employee data material comprising firms included in the Community Innovation Survey (CIS4), which covers both manufacturing and services sectors. We observe about 350,000 individuals in about 2,200 incumbents and about 3,000 start-ups. We identify, over a sequence of years, employees that stay in the old firm, switch to another firm, exit from the labour market, or transcend into entrepreneurship. Applying a multinomial logit model, the empirical analysis first estimates the influence of the R&D strategy on the probability of such a transition, while controlling for ample characteristics of the individuals and of the parent firm as well as regional milieu characteristics. We then use survival analysis to assess how the R&D strategy of the parent influences the survival of employee start-ups. The R&D strategy information is obtained from the CIS4 survey.

Our work is concordant to recent papers by Klepper and Sleeper (2005) and Agarwal et al. (2004). Though our analysis is similar to these studies in terms of questions asked, it distinguishes itself from previous literature in several respects, and the nature of our data allow us to address some of the limitations that Agarwal et al. (2004) associate to their study.

First, to the best of our knowledge, this paper represents the first attempt to use data from the increasingly popular Community Innovation Survey (CIS) as the point of departure and study relationship between the surveyed firms and new firms whose founders have pre-entry experience from the incumbent CIS-firms.

Second, our study is not restricted to a specific industry. We investigate spawning and survival for firms in both manufacturing sectors (NACE 15-36) and the services sector normally labelled Knowledge Intensive Business Services (KIBS) comprising NACE (72-74). We split the data into two different groups and compare results in an integrated empirical framework. This allows us to contrast KIBS and manufacturing sectors.

Third, we do not limit our analysis to any specific type of employee start-up. We study employee start-ups in both the same sector (2-digit NACE) as the parent firm, labelled spin-outs following Agarwal et al (2004), and in other sectors. Hence, employee start-ups may or may not take place in the same sector as the incumbent. Following previous literature, we test for survival differences between spin-outs and other types of employee start-ups.

Fourth, in addition to the R&D strategy variables, we control for ample attributes of the incumbent firms (e.g. size, sector affiliation, performance history). Furthermore, we control for characteristics of the regional milieu in which the incumbent firm and the employee start-up is located. There are several arguments in the literature why location characteristics may impact the decision to start a new firm as well as the firm's survival (see e.g. Feldman 1999).

Furthermore, existing literature on the links between incumbents and new businesses based on microeconomic methodology, typically uses the firm as the unit of analysis (for instance Agarwal et al 2004 and Klepper and Slepper 2005). In contrast, we observe the incumbent firm, the start-up firm and all unique individuals employed in the incumbents and their choice of staying at their current employment, switching to another firm, starting a new business or exiting from the labour market. This allows us to control for characteristics of the employees (such as age, education, wage, gender, tenure), which may influence the start-up decision as well as opportunity costs of starting a firm (eg. wage), as well as for firm characteristics.

Our main findings can be summarized as follows: regarding the quantity of entrepreneurial spawning we present evidence that firms with persistent R&D in both manufacturing and KIBS sectors are less likely to spawn entrepreneurs. These results hold across different model specifications, and corroborate the findings of Agarwal et al. (2004), who report that firms with high levels of both technological and market knowledge produce fewer spin outs, since they are better equipped to capitalize on new ideas and knowledge developed in the firm. Though we do not have explicit measures of technological and market knowledge, it is likely that firms who perform R&D persistently have large stocks of accumulated technological and market knowledge.

As regards the quality of employee start-ups, no significant difference in the survival rate can be found between entrepreneurs spawned from firms with different R&D strategies among incumbents in manufacturing sectors. However, for the survival of employee start-ups from KIBS firms, previous employment within an incumbent that persistently invested in R&D is positively associated with survival. In addition, if the entrepreneurial spawning takes place within the same KIBS-industry, it is more likely that the new firm (a spin-out) will survive, indicating the importance of related knowledge. Finally, our analysis shows that spin-outs related to innovative firms have a stronger survival capacity than spinouts from non-innovative firms.

The remainder of the paper is organized in the following fashion: Section 2 presents the theoretical background and derives the hypotheses to be tested. Section 3 presents the data and discusses the identification of *de novo* employee start-ups in the paper. The empirical methodology and the model specifications are presented in Section 4, along with a motivation of control variables. Section 5 presents the results and Section 6 concludes.

2. R&D Strategies and the Quantity and Quality of Entrepreneurial Spawning

Modern entrepreneurship research focuses on the process and potential of discovering and exploiting entrepreneurial opportunities (Shane and Venkataraman 2000). Studies show that this may have various dimensions such as institutional (Glaeser et al 2003, Aidis et al. 2009), regional (Davidsson et al. 1994, Malecki 1997), or individual (e.g. Casson 2003). A growing literature addresses characteristics of firms that spawn new entrepreneurs (e.g. Agrawal et al. 2004, Klepper and Sleeper 2005, Elfenbein et al. 2009). Our work here adheres to this latter literature and focuses on the influence of R&D strategies on the quantity and quality of entrepreneurial spawning by incumbent firms. We discuss the quantity and quality, respectively, in the following two sections.

2.1 R&D strategies and the frequency of entrepreneurial spawning – the quantity argument

There are many general arguments why an individual’s recognition of entrepreneurial opportunities and engagement in entrepreneurship may be associated with her prior or current employment. Employment within an incumbent is a main channel for learning about technologies and production processes as well as about markets, customer preferences and business processes. Thus, the incumbent firm is a potential source of knowledge and ideas upon which a new firm may be established.

Some firms may be more or less prone to spawn entrepreneurs than others. With regard to R&D strategies and the quantity of spawns, there are two basic and partly contrasting perspectives. The first centers on the role of knowledge and ideas for new firm formation and suggests that incumbents with significant investments in R&D should be associated with more frequent spawns. The second emphasizes the superior performance of R&D firms and associates this to higher opportunity cost of leaving the firm for entrepreneurship.

Starting with the first perspective, one of the most prevalent views in the literature is that incumbent firms that invest in knowledge and innovation are more prone to generate entrepreneurial spawns. Klepper and Thompson (2007), identify three classes of models of employee start-ups. In the first one an employee decides to capitalize on a chance discovery of potential value. Although the incumbent firm might be better suited to appropriate the gains of the discovery information asymmetries allow the employee to break off and form his own startup. In the second model the discovery is common knowledge among both the firm and its employees but the incumbent is either not interested or not capable to implement the novel idea because e.g. it might cannibalize existing rents or the idea is not close enough to the incumbent's main line of business. In the third model there is no innovative finding but the employees of an incumbent acquire through their work the necessary market knowledge to independently compete in the industry of their employer and decide to start their own firm.

Though these different classes of models may differ in terms of the reasons for exploring a novel idea or new knowledge outside the firm in which the idea or knowledge was developed, they all recognize knowledge as the trigging factor.

R&D strategies are relevant in this context since R&D is the greatest general source of new economic knowledge (Cohen and Klepper, 1992a, 1992b). In the 'knowledge spillover theory of entrepreneurship', henceforth KSTE, developed by Acs et al (2009), entrepreneurial opportunities are created endogenously "when incumbent firms invest in, but do not commercialize new knowledge" (ibid p.17). According to this theory, "…entrepreneurial activity will be greater where investments in new knowledge are relatively high, since start-ups will exploit spillovers from the source of knowledge production (the incumbents)" (ibid p.17). Although this framework does not directly focus on the relationship between incumbent R&D and employee start-ups, the general implication is a positive relationship between a firms' R&D strategy and its probability of entrepreneurial spawning. Employees of firms that persistently undertake R&D are more likely to be exposed to new knowledge and ideas and are thus in a better position to recognize entrepreneurial opportunities emanating from unexploited knowledge of the incumbents.

Previous research on spin-offs lends support to the hypothesis that R&D investments and innovation trigger employee start-ups. Klepper (2001) concludes that a general result of studies on spin-offs – defined as employee start-ups in the same sector as the parent firm – is that more innovative and successful firms spawn more entrepreneurs. Studying the laser industry in the US, Klepper and Sleeper (2007) present similar results, but also show that the spin-off rates reduce as the industry mature and knowledge becomes more embodied in physical rather than human capital, and as such is less accessible to employees. Moreover, Gompers et al. (2005) find that incumbent public companies are an important source of entrepreneurs that start new firms. They conclude that their results "suggest that the breeding ground for entrepreneurial firms are other entrepreneurial firms" (ibid p.35).

The second perspective emphasizes an opposite effect of R&D strategy on entrepreneurial spawning. It refers to opportunity costs and incumbents' ability to exploit the knowledge emanating from their R&D activities. The literature on firm growth and performance suggests that firms that persistently innovate and conduct R&D exhibit sustained high performance (Cohen 1995, Sutton 1997, Caves 1998, Griliches 2000). Examining large U.K. firms over relatively long periods of time (20 and 38 years respectively) Geroski, Machine and Van Renen (1993) find substantial permanent differences in the profitability of innovating and non-innovating firms. Lööf and Johansson (2010) study a panel of about 3,000 Swedish firms over a 10-years period and suggest a generic difference in productivity between firms that undertake persistent R&D and other firms. Controlling for both observable and unobservable heterogeneity, they find that the former firms have superior productivity, profitability and wages. Leaving such well-performing firms that pay high wages and offer stable employment for an uncertain and risky entrepreneurial venture may simply not be attractive for employees. They may perceive the opportunity cost of starting an own firm as high, which lowers the probability of employee start-ups.

A related argument is that innovating firms may be better equipped to exploit new knowledge. The literature suggests that many of the factors that create long-term competitiveness are knowledge-based and firm-specific (Pavitt 1991, Scott 1994, Klette and Johansen 1998) and require both technological know-how and market pioneering know-how (Agarwal et al 2004). Incumbents that persistently innovate are likely to develop better capabilities to exploit R&D, and are hence expected to be more prone to commercialize new knowledge. This leaves fewer entrepreneurial opportunities unexplored and reduces employee start-ups. A similar prediction occurs in the KSTE, where the effect of new knowledge on entrepreneurship is smaller the more efficient incumbents are in exploiting R&D (Acs et al 2009).[1] Agarwal et al (2004) find support for this line of reasoning in their study of the disk drive industry in the US. They show that incumbent firms that have high levels of both technological and market-pioneering knowledge spawn fewer entrepreneurs.

In summary, the two perspectives discussed above show that the expected relationship between the R&D strategies of incumbent firms and the quantity of entrepreneurial spawning in the form of employee start-ups is not straightforward. It is difficult to hypothesize which one dominates empirically. Hence, we formulate two alternative hypotheses:

Hypothesis 1a: *R&D strategies associated with persistent R&D in incumbent firms spur entrepreneurial spawning.*

Hypothesis 1b: *R&D strategies associated with persistent R&D in incumbent firms reduce entrepreneurial spawning.*

2.2 R&D strategy and the survival of employee start-ups – the quality argument

We now turn to the second issue addressed in this paper: the survival of employee start-ups. While the discussion on the frequency of entrepreneurial spawning emphasizes quantity, the question of survival of employee start-ups focuses on the quality of start-ups. Employee start-ups with higher survival rates can be expected to be of higher quality.

While ambiguities exist regarding the relationship between R&D strategy and the quantity of spawning, the literature is rather clear in how R&D strategy is expected to influence the survival of employee start-ups. Employee start-ups are assumed to inherit knowledge from their parent firms that should give them a competitive edge. Innovative incumbents with significant knowledge investments, such as R&D, have richer resources from which employees can draw, and this is expected to increase the quality of the entrepreneurs they spawn (cf. Klepper 2001). The competitive advantage of firms that conduct R&D persistently consists of a bundle of interrelated and firm-specific supply-oriented knowledge (technology) and demand oriented knowledge (market knowledge).

There is quite extensive research suggesting that the previous work experience plays a significant role for entrepreneurship and in particular the quality in terms of survival of new entrants. Prior knowledge influences the probability of recognizing entrepreneurial opportunities and it conditions the way in

[1] One could also conjecture that persistently innovating firms have well developed intellectual property rights competences as well as incentive structures for the personnel, which increase their ability to exploit R&D and thus leave less room for unexploited opportunities.

which an idea is used (Shane, 2000).[2] Empirical analyses also suggest that industry experience enables entrepreneurs to identify and materialize entrepreneurial opportunities of higher quality (Buenstorf, 2007; Elfenbein et al., 2009).

A related argument for why knowledge-intensive incumbents with persistent R&D would spawn entrepreneurs of higher quality may partly be derived from hypothesis 1b. If these firms perform well and pay high wages, such that the perceived opportunity costs of leaving them for entrepreneurship is high, then employees could be expected to only choose to transcend to entrepreneurship if they have a good business idea. The high level of opportunity cost could theoretically act as a form of threshold, sorting out 'good' business ideas.

Based on the arguments above, we formulate our hypothesis on the relationship between R&D strategy and the quality of employee-start-ups as evidenced by survival rates as follows:

<u>Hypothesis 2:</u> *R&D strategies associated with persistent R&D in incumbent firms increase the survival rate of the firms they spawn.*

As stated in the introduction, we do not restrict our analysis to any specific type of employee start-up. We study employee start-ups in both the same sector as the parent firm, labelled spin-outs following Agrawal et al (2004), and in other sectors. Hence, employee start-ups may or may not take place in the same sector as the incumbent. However, previous research shows that employee start-ups in the same sector as the parent firm (incumbent) are distinguished from others in several respects.

The post-entry performance of start-ups by individuals with industry experience is generally higher in comparison with start-ups by individuals without experience (Buenstorf, 2007). Several authors have shown that spin-outs are particularly successful in terms of survival and performance (Klepper 2002, Moore and Davis 2004, Agarwal et al. 2004, Klepper and Sleeper 2005). Agarwal et al (2004) find for instance that the likelihood of survival is grater for spin-out entrants than for all other types of entrants, when spin-out is defined as entrepreneurial ventures by ex-employees competing in the same industry as the incumbent firm. The general argument is that spin-outs draw directly on the knowledge resources of the parent firm in the same sector (cf. Klepper 2001).[3] Against this background, the third hypothesis of the study reads as follows:

---

[2]This is reflected by the use of concepts such as 'knowledge corridors' and 'path dependence' in entrepreneurship contexts (Shane 2003, Venkataraman 1997).

[3] A number of studies also suggest that founders of new firms not only benefits from previous experiences but receive support from their previous employer (Bernardt et al., 2002; Tübke, 2004; Lindholm, 1994)Using empirical data from the Panel Study of Entrepreneurial Dynamics, Kostner (2009) provide opposite results

Hypothesis 3: *Employee start-ups in the same sector as the parent firm, i.e. spin-outs, have higher survival rates than do employee start-ups operating in sectors other than the parent firm.*

2.3 Manufacturing versus KIBS sectors

Until now we have not addressed potential differences between manufacturing and KIBS sectors, though we analyze both separately in the empirical part. We study employee start-ups from incumbents in manufacturing and KIBS sectors, respectively. The split between these two sector aggregates is interesting for several reasons.

First, KIBS represents a growing segment of the economy in many OECD economies (Peneder et al. 2003, Schettkat and Yocarini 2006). While manufacturing employment is stagnant or shrinks, KIBS employment has grown at 2-digit rates over several years in many countries. A general shift to KIBS sectors, driven by e.g. shifts in demand, could stimulate the rate of spawning as well as the survival of spawns.

Second, many authors argue that successful entrepreneurship requires complementary types of knowledge. In particular, successful entrepreneurs often need to combine technological and market knowledge (Freeman 1974, Agarwal et al. 2004). There are arguments that an 'average employee' in an incumbent KIBS is more likely to accumulate both types of knowledge as compared to an 'average employee' in manufacturing firms. KIBS sectors are normally populated by small-scale firms. A large literature focuses explicitly on the relationship between firm size and spawning of entrepreneurs, and several studies finds a 'small firm effect' in the rate of spawning (Hyytinen and Maliranata 2008, Rosenthal and Strange 2009, Elfenbein et al. 2009). The argument here is that employees of smaller firms are exposed to the whole business process including customers, making them better equipped to start a firm. On top of the firm size argument, employees of KIBS firms often have higher contact-intensity with customers than employees of manufacturing firms. Partly this is so because many KIBS firms sell consultancy services. Manufacturing firms typically have a more fine division of labour where the employees produce a specialized task.

Based on this, we hypothesize that the 'average employee' of KIBS firms to a larger extent will accumulate both technological and market knowledge as compared to an 'average employee' in

---

showing that independence rather than support from a parent firm appear to be important for staring a successful firm.

manufacturing firms. If both types of knowledge are important for successful entrepreneurship, as argued in the literature, then one could expect that the relationship between R&D strategy and survival is stronger for employee start-ups emanating from KIBS and weaker for those start-ups emanating from manufacturing. The argument for this is that employee start-ups from KIBS firms with persistent R&D are more likely to inherit both technological and market knowledge. We thus formulate the following hypothesis:

Hypothesis 4: *The relationship between persistent R&D of the incumbent firm and survival of the employee start-ups is stronger for those employee start-ups emanating from KIBS incumbents*

3. Data and descriptives

3.1. Description of data

The basic data material in this study is a matched employer-employee dataset comprising audited register information on firms and employed individuals over a sequence of years. These data include balance-sheet data (value-added, sales, employment, wages, etc.) for the firms and a set of characteristics of the employees (age, sex, education, place of work, income, etc.).

In order to identify R&D strategies of incumbent firms we match the basic employer-employee data with the 4th Community of Innovation Survey (CIS 4). This survey contains information on 2,898 randomly selected Swedish firms over the period 2002-2004. The CIS-survey is a Eurostat/OECD initiative for studying innovative activities of European firms. Recently the survey is also being employed by a growing number of countries outside Europe. The firm size is downward censored to 10 employees and about 2/3 of all Swedish firms in this size group responded to the questionnaire. By merging the firm-level CIS 4 with the employer-employee data, we end up with an employer-employee dataset for those firms that are part of the CIS 4. We restrict the analysis to firms affiliated to manufacturing (NACE 15-36) and KIBS (NACE 72-74) sectors and end up with 2,177 firms.

One of the core-questions in the survey is whether the firm has conducted (i) R&D-investments all three years during the period considered, (ii) only during some of the years, or (iii) not at all. Table 1 presents account information on sales, value added and exports per employee, wages, human capital measured as the educational background of the employees (a university education of at least 3 years), physical capital, firm size, sector classification and corporate ownership structure according to the three different R&D strategies in the year 2004.

Table 1 illustrates the stylized facts referred to in previous sections. Firms with persistent R&D are larger, and they are more technology intense and knowledge intense, than other firms and they have more capital per employee. The persistent research investors have better output performance; larger sales, value added and exports per employee and they have higher exports. The table also informs that firms that undertake R&D persistently typically belong to a multinational group, while a majority of those engaged in temporary R&D and no R&D are independent firms or belong to a national Swedish group. In order to investigate whether the cross-sectional pattern reported in Table 1 is true also for the time-series dimension, we use information from Lööf and Johansson (2010) who follow the CIS 4 population (observed in year 2004) over the 10-year period, 1997-2006. Figures 1-5 in the Appendix A3 indicate a significant long-run difference in firm performance between persistent innovators and other firms.

Employee start-ups are defined by looking at employed individuals' transition to self-employment between each year. The total number of employee start-ups in a year t+1 is given by the number of individuals that switch from being employed to being self-employed between year t and t+1. We distinguish between spin-outs, i.e. employee start-ups in the same 2-digit NACE sector as the parent firm, and other types of employee-start-ups by comparing the 2-digit NACE-codes of the firm started by an individual with the 2-digit NACE-code of the firm she was employed by the year before her transition to self-employment.

3.2. Variables in the empirical analysis

The focus of the empirical analysis is to analyze the effect of the R&D-strategy of the incumbent firm on the quantity and quality, respectively, of employee start-ups. Quantity is assessed by analyzing how R&D strategy of the incumbent affects the probability that an employee transcend to self-employment. The role of R&D strategy for quality is analyzed by estimating the impact of incumbents' R&D strategy on the rate of survival of the employee start-ups. In both analyses, we control for characteristics of the individual, the incumbent firm and the region the incumbent firm is locate in.

In the remainder of this section, we present, motivate and define the control variables in the respective analysis, i.e. quantity and quality of employee start-ups. We start by discussing the control variables in the analysis of the probability of a transition to self-employment, and then go on to discuss the control variables in the analysis of survival rates.

Control variables in the analysis of the probability of transcending to self-employment

Firm controls

An important control variable is the *size* of the incumbent firm, measured as the logarithm of the number of employees. A set of related studies (Hyytinen and Maliranta 2008, Baltzopoulos and Braunerhjelm 2010, Elfenbein et al. 2009) suggest that firm size is negatively associated with the propensity of the firm to spawn entrepreneurs. As mentioned in Section 2.3, the argument is that employees of smaller firms are exposed to the whole business process including customers, making them better equipped to start a firm.[4] We expect that smaller firms are more likely to spawn entrepreneurs.

Moreover, we include two dummy variables that capture whether the employment and/or the sales of the firm have been declining over the past two years. The *Declining Employment* dummy equals one if there has been a drop in a firm's employment between time t and t-2 and the *Declining Sales* dummy equals one if there has been a drop in the sales of the firm between t and t-2. These two are rather important controls that help capture any push-out effects caused by a decline in the business of the incumbent firm. Especially the choice to exit can very often be involuntary and this is one way to control for whether the firm is downsizing or not.

Individual controls

We control for the individual characteristics most commonly referred to in the literature of entrepreneurship and labour mobility as important determinants of employment choices (see e.g. Farber 1994, Andersson and Thulin 2008). These are *tenure*, *age*, *age squared*, *gender* (equal one if male, zero otherwise), *wages* and a dummy variable identifying *skilled* labour which equals one if the individual has the equivalent of three years of university education or longer and zero otherwise.

Regional controls

Previous research has shown that characteristics of the regional environment exerts an important influence on both the likelihood of new firm formation and the survival of new ventures (Audretsch and Fritsch 1994, Armington and Acs 2002, Feldman 1999, Andersson and Koster 2010). We therefore control for a set of regional characteristics that are found to be important for entrepreneurship.

[4] It should be noted that the literature provide conflicting evidence on the role of the size. Wong et al. (2007) and Agarwal et al. (2004) find that firm size (employment and sales, respectively) is non-significant with respect to the propensity of individuals leaving their organization to start their own business.

The first is *market-size*, here measured as the log of the local workforce. Market-size can be motivated from several different perspectives (Andersson and Hellerstedt 2009). From a demand-side, the size of the market pertains to the potential to recover fixed costs associated with a start-up. If the market is too limited – in relation to the magnitude of the fixed costs – it can imply that an entrepreneurial opportunity remains unexploited, even though the same opportunity is economically viable in other locations with larger markets. However, market-size is also relevant in an entrepreneurship context for other reasons. First, large markets are generally associated with high accessibility to various inputs, which may be important for start-ups. Moreover, transaction-cost theory frequently point to a relationship between vertical integration and market 'thickness' (Klein et al. 1978, Pirrong 1993, McLaren 2000). The argument here is that in large markets where many firms already have arm's length arrangements, i.e. a thick market, there are many potential customers for a firm. This is advantageous because firms producing specialized and customized inputs, as many initially small new ventures do, are likely to incur sunk costs. Second, if there are few customers, an arm's-length arrangement means that the supplying firm is at the risk of being "held-up" by the customer and may not be able to recoup its fixed costs. From this perspective, both frequency and survival of start-ups can be stimulated by thick and large markets, because problems related to hold-up and asset-specificity are reduced.

In addition to market-size, we include three indices commonly used to capture the effect of so-called MAR and Jacobs externalities as well as regional average firm size. MAR and Jacobs externalities refer to different types of agglomeration economies, where the former emphasize benefits associated with a specialized regional environment (cf. Glaeser et al. 1992) and the former benefits associated with a diversified environment (Jacobs 1969, Frenken et al. 2007).

The effect of MAR externalities is controlled for by the production specialization index (PS) for each industry branch in each region which capture the degree of relative specialization of these industries. The PS-index measures the extent to which region j is specialized towards industry *i*:

$$PS_{ij} = \left[\frac{E_{ij}}{\sum_i E_{ij}} \right] / \left[\frac{\sum_j E_{ij}}{\sum_i \sum_j E_{ij}} \right] \qquad (1)$$

where *E* is employment, i = 1, … , 43 for each industry branch and j = 1, … , 81 for each functional region. A common normalization is to calculate the ratio (PS-1)/(PS+1) which is balanced and restricted between -1 and 1. Values of this corrected PS index larger than zero indicate a higher degree of industrial specialization compared to the national industrial composition, while values smaller than zero indicate the exact opposite.

For capturing the extent of the Jacobian externalities in each region we implement a type of inverse Hirshman-Herfindhal index which controls for differences in sectoral employment shares at the national level and sums for each region, over all sectors, the absolute value of the difference between each sector's share in local employment and its share in national employment. Formally,

$$RDI_j = 1/\sum_i \left| \frac{E_{ij}}{\sum_i E_{ij}} - \frac{\sum_i E_{ij}}{\sum_i \sum_j E_{ij}} \right| \quad (2)$$

where RDI is a regional characteristic. The index increases the more the composition of activities in the region mirrors the diversity of the national economy (Duranton and Puga, 2000).

Finally we control for the strength of the local entrepreneurial culture. Glaeser and Kerr (2009) find that environments dominated by smaller and independent firms are more conducive to entrepreneurship than environments hosting large monopolists. Rosenthal and Strange (2009) find a strong correlation between local average establishment size and subsequent employment growth through startups. The measure we implement is the Average Firm Size index (AFS), which like the PS-index refers to industry *i* in region *j*. It is defined as:

$$AFS_{ij} = \left[\left(S_{ij} / E_{ij} \right) / \left(\sum_j S_{ij} / \sum_j E_{ij} \right) \right] \quad (3)$$

where S is the number of firms, and the rest same as above in (1). High values of the AFS index are indicative of a dynamic local industry populated by many small firms, while low values are indicative of fewer but larger firms that enjoy more market power. The same standardization as in the case of the PS-index is applied by calculating (AFS-1) / (AFS+1).

Table 2.1 presents descriptive statistics for our focus explanatory variables (R&D-strategy) and three sets of control variables. The controls include firms characteristics on size, employment and sales, individuals characteristics on skills, wage, tenure and age. The final set of explanatory variables are regional controls and includes regional size, specialization, diversification and competition. The descriptive statistics reported in the table show that 34 % of the employees are employed in firms that perform no R&D, 11 % in firms that conduct R&D temporarily whereas a majority (55 %) are employed in firms that conduct R&D persistently. It should be noted that 78 % of the employees are employed in manufacturing and 22 % in KIBS. These fractions are nearly identical to the share of manufacturing and KIBS firms in the sample (See Table 1).

Control variables in the analysis of the survival of employee start-ups

The survival model focuses on the influence of R&D strategy of the incumbent on the quality of the new businesses. We control for the two determinants of hazard rates most commonly discussed in the relevant literature on firm survival analysis, the *size of the start-up firm* and the *size of scale economies*. Size of the firm is again the log of the number of employees and scale economies are captured by the log of total regional employment.

Furthermore, we control for heterogeneity among the founders of the firms including once again the variables *male, age,* age^2, and *education*. Finally, we include a *same industry* dummy which equals one if the entrepreneur starts a firm in the same industry he was formerly employed in. Agarwal et al. (2004) refer to this group as spin-outs. Our hypothesis is that spin-outs have higher survival rates.

Table 2.2 presents descriptive statistics for the variables included in this analysis. We see from the table that over 50 % of the start-ups of new KIBS firms enter the same 2-digit NACE code as the father company. Hence, the majority of the start-ups are spin-outs. For manufacturing, the figures are very different. Only 5 % of the employees are starting a business in the same sector as the parent manufacturing firm.

4. ESTIMATION STRATEGY

Two different econometric techniques are implemented to test our hypotheses. First we address the propensity of the people employed in our sample of firms to transcend into entrepreneurship, and second we explore the survival rate of these new start-ups conditional on the characteristics of the spawning firm.

4.1. Multinomial logit model – probability of employee start-ups

In order to formally test the role of the incumbent firm's R&D strategy on its propensity to spawn entrepreneurs we apply an individual level approach similar to the one used by Hyytinen and Maliranta (2008). Instead of considering positive outcomes alone (the spawning of a new firm) the decision of the nascent entrepreneurs to start their own firm is contrasted to that of their colleges that choose differently.

At the end of each time period, each employee faces the choice of what form of employment she would like to have in the next time period. She can decide to *Stay* in her current employment, *Switch* to a different employer, *Exit* from the workforce, or become *Self-employed*. The end-of-the-period choice set of all employees, C = {Stay, Switch, Exit, Spin-off}. In such a setup where the outcome is nominal and the categories are assumed to be unordered the preferred estimator is the multinomial logit, MNL. Assuming that the utility individual *n* obtains from alternative *i* is U_{ni} then the probability that he will choose alternative *i* is $P_n(i) = \Pr(U_{ni} \geq U_{nj}, \forall j \in C, i \neq j)$. We further assume that the utility function has an observable part (V_{ni}) and an unobservable disturbance term (ε_{ni}). If we additionally assume the observable part to be linear, $V_{ni} = x_n' \beta_i + a_i$, where x_n' is the vector of conditioning variables and the disturbance term to be iid and Gumbel-distributed[5], we may estimate the probability of choosing alternative *i* through the MNL choice probability:

$$\text{Pr(n's choice is i)} = P_n(i) = \frac{\exp(x_n' \beta_i + a_i)}{\sum_{j \in C} \exp(x_n' \beta_j + a_j)} \tag{4}$$

The parameters of this model are unidentified unless the parameter vector of one of the alternatives is normalized. We set $\beta_{stay} = \alpha_{stay} = 0$, and the rest of the coefficients measure the change relative to those individuals that choose to remain in their current job.

A basic assumption of the MNL estimation that needs to be considered is the assumption of independence of irrelevant alternatives (IIA). Applied in this case the IIA assumption requires that when choosing for example between Staying and Exiting, Switching to a different employment or transcend to entrepreneurship are not options that will affect that choice. The problem with the IIA assumption is that it cannot be tested with absolute certainty but needs to be considered carefully in each case (Long and Freese 2006). Given the nature of the issue addressed, we argue that the four alternatives we consider are indeed dissimilar enough and it is reasonable to assume that the independence of irrelevant alternatives assumption holds. It is hard to imagine that people deciding to stop working or to retire are considering entrepreneurship or a new job as alternatives affecting their

[5] The assumption that the disturbances are Gumbel distributed is basically an approximation to the normal density, and is used for reasons of analytic convenience. If ε is Gumbel distributed then, $F(\varepsilon) = \exp[-e^{-\mu(\varepsilon-\eta)}]$, $\mu>0$ and $f(\varepsilon) = \mu e^{-\mu(\varepsilon-\eta)} \exp[-e^{-\mu(\varepsilon-\eta)}]$, where η is a location parameter and μ is a positive scale parameter. See Ben-Akiva and Lerman (1985) for a more detailed analysis.

choice (at least not in the immediate future). Therefore in the choice between Staying and Exiting the other two alternatives can indeed be considered irrelevant.[6]

4.2. Semi-parametric hazard analysis – survival of employee start-ups

We follow the example of Audretsch and Mahmood (1994,1995), Mahmood (1992), Mata and Portugal (1994), and Honjo (2000), to mention a few, in applying the proportional hazard model proposed by Cox (1972) to assess survival. There are mainly two reasons why conventional statistical methods, such as OLS, are not appropriate when dealing with survival analysis. First of all the assumed normality of the distribution of the error terms in OLS is not an appropriate one and second of all conventional methods do not correct for the problem of right censoring. Right censoring refers to the fact that our datasets usually span only a limited time interval and we cannot observe the time of death of all subjects in the data. Subjects that are still alive at the end of the observation period are called right censored and the only thing we can know with certainty about them is that their survival time exceeds the period of observation (Cleves, Gould, and Gutierrez, 2004).

Central in any survival analysis are the concepts of the survivor function, $S(t)$, and the hazard function, $h(t)$. If T is a non-negative random variable denoting the time to a death (or any event signifying failure), whose probability density function is $f(t)$ and its cumulative distribution function is $F(t) = \Pr(T \leq t)$ then the survivor function is simply:

$$S(t) = 1 - F(t) = \Pr(T > t) \tag{5}$$

The survivor function returns the probability of survival beyond time t. The hazard function $h(t)$ is the instantaneous rate of failure:

$$h(t) = \lim_{\Delta t \to 0} \frac{\Pr(t + \Delta t > T > t \mid T > t)}{\Delta t} = \frac{f(t)}{S(t)} \tag{6}$$

$$h(t) = \lim_{\Delta t \to 0} \frac{\Pr(t + \Delta t > T > t \mid T > t)}{\Delta t} = \frac{f(t)}{S(t)} \tag{7}$$

[6] However, the irrelevance of starting an own firm in the decision to Switch to a different employer and vice versa might not be so straightforward. Both choices represent a way of leaving one's current job position and seeking a different employment. Hyytinen and Ilmakunnas (2007) consider the two "search processes" of looking for a new employer or looking for an entrepreneurial opportunity and investigate whether individuals tend to engage in the two simultaneously or focus on the one they are primarily interested in. They conclude that individuals will tend to focus on one rather than conduct both "search processes" simultaneously. We consider this finding as strong evidence in favor of assuming that the IIA assumption holds between the choices Switch and Spin-off as well.

A hazard rate equal to zero signifies no risk at all while a hazard rate approaching infinity signifies the certainty of failure at that exact moment. In the Cox proportional hazards regression model (Cox, 1972) the hazard rate for the *j*th subject in the data is:

$$h(t \mid x'_j) = h_0(t)\exp(x'_j \beta) \qquad (8)$$

where, $h_0(t)$ is the baseline hazard function, x'_j is a vector of explanatory variables, and β is the vector of coefficients to be estimated. The main advantage of the Cox proportional hazards model is that the elements of β may be estimated without imposing any assumptions on or estimating the baseline hazard function, $h_0(t)$, which is the hazard function for $x'_j = \mathbf{0}$. This is achieved by using a method of partial likelihood. Clearly, a change in an explanatory variable causes a constant proportional change in the hazard rate (For a more detailed discussion, see Cleves, Gould, and Gutierrez, 2004).

5. Results

Table 3 investigates the relationship between an incumbent's R&D strategy and the propensity of its employees to decide to leave their job to start their own firm while Tables 4 and 5 show the relationship between the incumbent's R&D strategy and the survival rate of the firms started by its ex-employees. The multinomial logit (MNL) estimator reported in Table 3 consider 6,066 new business started over the period 1999-2005 by ex-employees from the close to 2,200 firms observed in the Swedish Community Innovation Survey, year 2004. The Cox model, reported in Tables 4 and 5, estimates the quality (likelihood of survival) of 3,109 entrepreneurs spawned by the CIS-incumbents between 1999 and 2003. It should be noted that 3,109 new firms are the optimal number of observations that can be obtained in our data with information on both entry, survival and exit.

5.1 Propensity to be an entrepreneur

Table 3 tests the hypothesis that persistent firms are less prone to spawning out employee entrepreneurship due to factors such as inertia of knowledge transfer. In order to ease the interpretation of the MNL estimation we present the marginal effects across the four distinct choices. These marginal effects sum to zero across the four alternatives.

One should note that in contrast to the bulk of previous studies, the results in Table 3 is not limited to only spin-outs, but include also new firms outside the core business of the incumbent. Another noteworthy detail is that our data consider both declining sales and declining employment of the incumbent as factors that may affect the choice to leave and be self-employed. We believe that declining employment capture some additional influence of market conditions associated with both the business cycle and lost competitiveness.

Just over 6,000 people from an incumbent CIS-2004 firm, started a new venture during the period 1999-2005. The two upper rows of Table 3.1 (Manufacturing) and Table 3.2 (KIBS) predict their propensity to be an entrepreneur, with respect to the parents' R&D strategy. Three other possible labour market alternatives are also included in the table. The first column presents the marginal effects on the likelihood of the individual employee to *Stay* in his or her current position and columns 2-4 shows the marginal effects on *Switch*, *Exit* and *Self-employed*.

Looking at the manufacturing industry (Table 3.1), the following facts emerge: First, individuals employed in firms with temporary R&D are more likely to *Stay* and less likely to *Switch* jobs while their propensity to *Exit* or become *Self-employed* does not differ compared to those employed in incumbents that do not undertake R&D. Second, employees in incumbents with persistent R&D are similarly more likely to *Stay* and less likely to *Switch* but also significantly less likely to *Exit* or become *Self-employed*. Considering then Table 3.2, we see that the same results hold for KIBS firms, with the only difference that employees in firms with temporary R&D are this time significantly less likely to *Exit* than employees in firms with no R&D.

Our most interesting result concerns the consistent negative impact of persistent R&D on entrepreneurship in both samples. The coefficient on the decision to start a new firm among employees in firms that undertake R&D persistently is negative and significantly different from the control group (no R&D) and from firms that undertake R&D only temporarily. The evidence from Tables 3.1 and 3.2 appears to support hypothesis 1b rather than 1a: *R&D strategies associated with persistent R&D in incumbent firms reduce entrepreneurial spawning.*

The results with respect to the control variables partly conform and partly do not conform with our expectations. Tenure correlates positively with the stay-alternative and negatively with the likelihood to be an entrepreneur. Allowing for non-linearity, there is a significant quadratic effect for age on the MNL model, indicating that in the relevant range older people are somewhat more likely to be self-employed (but the size of the estimate is closes to zero). Gender is an important determinant of entrepreneurship in the Swedish economy. Everything else equal, males are significantly more likely to switch from employment to self-employment. As could be predicted from arguments pertaining to opportunity costs, a high wage level in the incumbent firm reduces the incentives to entrepreneurial entry.

The results for both samples suggest that the level of the local entrepreneurial culture (measured by the average firm size index), declining employment in the incumbent firm and skill correlate positively with the ex-employees' propensity to become entrepreneurs. Where the two samples differ is the impact of the controls regional size, diversity and specialization. In the manufacturing sample, the propensity to start a new firm is stronger when the regional size is large and the labour market is characterized by specialization, while diversification has a negative correlation. By contrast, in the KIBS sample neither specialization, diversification nor regional size are associated with the decision to start a new firm. The coefficient estimate for firm size is significant only for KIBS and the sign is negative.

Tables A1 and A2 in the Appendix present a robustness test obtained by estimating reduced specifications of the model presented in Tables 3. The focus is on the likelihood of becoming *Self-employed* and the results on the other three choices are omitted to save space. The first column includes only the variables describing the incumbent firms, the second column adds the individual-level controls and the third column is a repetition of the full specification of Table 3. The test reports that the main conclusions from Tables 3.1 and 3.2 are not sensitive to the choice of covariates in the model specification.

To summarize, we have shown that incumbent firms undertaking R&D persistently in both manufacturing and knowledge based business services are significantly less likely to spawn new entrepreneurs than other firms.

.

5.2 The survival of the new entrants

We now turn to the Cox proportional hazard estimates presented first in Table 4. A low hazard rate is indicative of a firm that is more competitive and more likely to survive. The hypotheses to test are that (i) firms started by ex-employees of firms with persistent R&D are more likely to survive compared to start-ups of ex-employees of other firms, (ii) spin-outs (firms in the same 2-digit NACE industry as the originating company) will exhibit higher survival rates. We also assess the hypothesis that the influence of R&D strategy on survival is stronger among KIBS firms.

Before we discuss the estimates, it should be noted that the tables report hazard ratios rather than coefficients. The hazard ratios act as multipliers of the baseline hazard per unit change of the explanatory variables. A hazard ratio equal to 1.00 does not alter the hazard faced by an individual compared to the baseline hazard. A ratio larger than 1.00 increases the hazard (the chance of exit on the next time period), while a ratio smaller than 1.00 decreases the hazard.

In Table 4 the control group facing the baseline hazard is the group of entrepreneurs coming from an incumbent with no R&D. Columns (I) and (II) present two different specifications for firms coming from a manufacturing incumbent. The second specification excludes the skill-variable, which is closely correlated with the innovation strategy. Columns (III) and (IV) apply the same specifications in the case of KIBS.

Starting with the results on the propensity to survive for the new businesses spawned from manufacturing firm, no difference can be found related to R&D strategy. The most important determinant for the survival of new businesses founded by ex-employees from manufacturing firms is the size of the new entrant.

Interestingly, in direct contrast to the results from the manufacturing sample, the results of the hazard analysis for KIBS-firms point to important associations between R&D strategy of the incumbent firm and entrepreneurial quality. Entrepreneurs from KIBS firms with persistent R&D appear to have a knowledge advantage over entrepreneurs from KIBS firms with no R&D. This is the case for new entrants from incumbents with both persistent and temporary R&D. The point estimates of their hazard ratios are below 0.8 which indicates a substantially larger propensity to survive compare to the firms with no R&D (roughly 20%) (see columns 3 and 4). However, the coefficient estimate is significant only for incumbents with persistent R&D. It is significant just outside the 5% level when we control for differences in skill but the coefficient is significant at the 5% level when the skill variables is not included in the regression.

The results with respect to the control variables identify a strong of effect the *same industry* indicator, however significant only for the KIBS-sample. This indicates the importance of related knowledge spillover between the old and the new firm. The initial size of the entrant correlates positively and significantly with the chance to be competitive on the market. Similar to the logit model reported above, age and age-squared are positively and significantly associated with the vitality of the new firm. Table 4 also indicates that entrepreneurs in dense regions are less likely to survive, than those starting a new firm in other regions. This result can only be confirmed in the KIBS-sample. One possible interpretation is that entrepreneurs in large regions more easily can be re-employed.

Table 5 takes a closer look at the association between survival rates, and the same industry indicator for the KIBS-sample. In order to do so, we restrict the observations to spin-outs, defined as firms in the same 2-digit industry as the incumbent company. These are a total of 612 firms entering the market between 1999 and 2003. Table 4 showed that a firm that starts in the same business as the parent is more likely to survive, controlling for R&D-strategy. Both R&D firms and non-R&D firms produce firms of high survival potential as long as those follow the footsteps of their parents. Now we ask if there is any difference in the longevity of spin-outs from firms with different R&D strategies.

Because of the small number of firms started by employees from temporary innovating incumbents (73), in this subgroup, we pool start-ups originating from temporary and from persistent innovating firms together (a total of 244 start-ups) and keep firms originating from non-innovating incumbents (a total of 368 start-ups) in the control group.

When we eliminate observations on new firms starting outside the same 2-digit level as the father firm, the coefficient estimates for innovative firms (0.77 and 0.76) respectively are considerable lower than the bench-mark (1.00 for non-innovative) indicating the benefit of taping from a larger pool of knowledge. When controlling for skill (column 1), however, the estimate is just outside the 10% level, while it is significant at 10% level when skill is removed (column 2). As we have discussed above, skill and innovation strategy are correlated, making it difficult to disentangle the separate influence from each one of them individually. Hence, by including skill we will underestimate the impact of innovation on survival.

The results of the hazard model confirm that R&D strategies associated with persistent R&D in the incumbent firm increase the survival rate of the firm they spawn (hypothesis 2). But this finding is only true for those employee-start-ups emanating from KIBS incumbent (hypothesis 4). Furthermore, employee start-ups in the same sector as the parent firm, i.e. spin-outs, have higher survival rates than do employee start-ups operating in sectors other than the parent firm (hypothesis 3). Finally, our analysis shows that spin-outs related to innovative firms have a stronger survival capacity than spinouts from non-innovative firms.

6. Conclusions

Innovation is closely connected to growth, employment and welfare. It is therefore important to gather additional insight on the mechanisms through which innovations transform new ideas into economic performance. This paper starts by confirming a generic difference in productivity between firms that undertake persistent R&D and other firms. Controlling for both observable and unobservable heterogeneity, the former firms have superior sales, productivity, profitability and wages. Then the paper considers the relationship between the R&D strategy of the incumbent firm and the start-ups by ex-employees and tests several hypotheses using two different empirical models and a dataset comprising both manufacturing and knowledge intensive business services (KIBS). The empirical analysis produces a mixed but robust picture on innovation and entrepreneurial spawning.

The multinomial logit model delivers the prediction that persistent innovators do not encourage the employees to start a new business. Contrary to the view that knowledge and entrepreneurship are positively correlated, it finds that firms with more accumulated knowledge through successive and regular R&D-investments, are less likely to produce new firms through ex-employees. This negative impact can be explained by higher opportunity cost of starting an own firm, when the incumbent pays high wages and offers stable employment conditions. But it also highlights the difficulties of knowledge spillover. To a large extent, a firm's knowledge is embedded in a complicated infrastructure and not easily transferable through labor mobility.

In contrast to the estimated negative association between innovative incumbents and entrepreneurial entry by ex-employees, a hazard analysis shows that an incumbent's innovation strategy plays a pivotal role in the likelihood of survival of a new business, however only for firms spawned from KIBS-incumbents. This conclusion is not sensitive to a particular category of entrepreneurs. The results are consistent whether we consider all new start-ups related to innovative KIBS or narrow down the analysis to only spin-outs within the same 2-digit industry as the KIBS-incumbent. However, the KIBS-data seems to support the hypothesis that employee start-ups in the same sector as the parent, i.e. spin-outs, have higher survival rates than do employee start-ups operating in sectors other than the parent firm. Finally, our analysis shows that spin-outs related to innovative KIBS-firms have a stronger survival capacity than spinouts from non-innovative KIBS-firms.

Overall the analysis suggests that the R&D strategy and other firm attributes interact with individual and milieu characteristics in determining the quantity and quality of entrepreneurial spawning. In particular, the findings show that incumbent firms with persistent R&D investments are an important source of high-quality new entrepreneurs. This result has potential policy implications. Research has shown that it is typically a smaller set of high-quality new firms that generate the largest effect on the economy in terms of e.g. employment (see *inter alia* Fritsch and Schroeter 2009). Our findings suggest that a policy designed to foster such high-quality entrepreneurship should comprise incumbent firms. These are important sources of new high-quality entrepreneurs, and our results point in the direction that an environment conducive for investments in R&D in established firms has a higher potential for generating such high-quality entrepreneurs in the form of spin-offs from incumbents.

References

Acs, Z. (2006). Start-ups and Entry Barriers: Small and medium-sized Firms Population Dynamics. In: M. Casson, B. Yeung, A Basu and N. Wadeson (2006). *The Oxford Handbook of Entrepreneurship*. Oxford: Oxford University Press. 194-224.

Acs, Z.J., Audretsch, D.B. Braunerhjelm, P. and Carlsson, B. (2009). The knowledge spillover theory of entrepreneurship. *Small Business Economics*, 32 (1), 15-30.

Agarwal, R. Raj, E. Franco, A. M. Sarkar, MB. (2004). Knowledge transfer trough inheritance: Spinout generation, development and survival. *Academy of Management Journal*, vol 47 (4), 501-522.

Aidis, R., Estrin, S. and Mickiewicz, T. (2009) Entrepreneurial entry: Which institutions matter? CEPR Discussion Paper No. DP7278.

Andersson, M. and Hellerstedt, K. (2009). Location attributes and start-ups in knowledge-intensive business services. *Industry and Innovation*, 16 (1), 103-121.

Andersson, M. and Koster, S. (2010). Sources of persistence in regional start-up rates—Evidence from Sweden, *Journal of Economic Geography*, doi:10.1093/jeg/lbp069

Andersson, M. and Thulin, P. (2008). *Globalisering, arbetskraftens rörlighet och produktivitet.* Underlagsrapport nr 23 till Globaliseringsrådet.

Armington, C. and Acs, Z.J. (2002). The determinants of regional variation in new firm formation. *Regional Studies*, 36 (1), 33-45.

Audretsch, D. and Fritsch, M. (1994). The geography of firm births in Germany. *Regional Studies*, 28 (4), 359-365.

Audretsch, D. and Mahmood, T. (1994). The rate of hazard confronting new firms and plants in U.S. manufacturing. *Review of Industrial Organization*, 9 (1) , 41-56.

Audretsch, D. and Mahmood, T. (1995). New firm survival: New results using a hazard function. *The Review of Economics and Statistics*, 77 (1), 97-103.

Baltzopoulos, A. and Braunerhjelm, P (2010). Spin-offs: Firm, region and industry determinants. CESIS Working Papers Series no 223 .

Baumol, W. (1990). Entrepreneurship: productive, unproductive, and destructive. *Journal of Political Economy*, 98 (3), 893-921.

Bernardt, Y., Kerste, R. and Meijaard J (2002). Spin-off start-ups in the Netherlands. At first glance. http://www.eim.net/smartsite.dws?id=33&bestelnummer=B200106&sooid=8.

Bhide, A. (1994). How entrepreneurs craft strategies that work. *Harvard Business Review*, 72 (2), 150-161.

Buenstorf, G. (2007). Evolution on the shoulder of giants: Entrepreneurship and firm survival in the German laser industry. *Review of Industrial Organization*, 30 (3), 179-202.

Casson, M. C. (2003). *The entrepreneur: an economic theory* (2nd ed.) Cheltenham: Edward Elgar.

Caves, R.E. (1998). Industrial organization and new findings on the turnover and mobility of firms. *Journal of Economic Literature*, 36 (4), 1947-1982.

Cleves, M.A., Gould, W.W. and Gutierrez, R.G. (2004). *An Introduction to Survival Analysis Using Stata*. Stata Press.

Cohen, W. M. (1995). Empirical studies of innovative activity. In (P. Stoneman, ed.), *Handbook of Innovation and Technological Change*. Oxford: Blackwell.

Cohen, W.M. and Klepper, S. (1992a). The tradeoff between firm size and diversity in the pursuit of technological progress. *Small Business Economics*, 4 (1), 1-14.

Cohen, W.M. and Klepper, S. (1992b). The anatomy of industry R&D intensity distributions. *The American Economic Review*, 82 (4), 773-799.

Cox, D.R. (1972). Regression model and life-tables. *Journal of the Royal Statistical Society Series*, B 34, 187-202.

Davidsson, P., Lindmark, L. and Olofsson, C. (1994). New firm formation and regional developments in Sweden. *Regional Studies*, 28 (4), 395-410.

Duranton, G. and Purga, D. (2000). Diversity and specialization in cities: Why, where and when does it matter? *Urban Studies*, 37 (3), 533-555.

Elfenbein, D., Hamilton, B. and Zenger, T. (2009). The small firm effect and the entrepreneurial spawning of scientists and engineers. *SSRN Working Paper, Sept 30.*

Farber, H.S. (1994). The analysis of interfirm worker mobility. *Journal of Labour Economics*, 12 (4), 554-593.

Feldman, M.P. (1999). The new economics of innovation, spillovers and agglomeration: A review of empirical studies. *Economics of Innovation and New Technology*, 8 (1&2), 5-25.

Freeman, C. (1974). *The Economics of Industrial Innovation*, 1st edn, Harmondsworth, Penguin; 2nd edn 1982 London, Frances Pinter.

Frenken, K., Van Oort, F. and Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies*, 41 (5), 685-697.

Fritsch, M. and Schroeter, A. (2009). Are more Start-ups Really Better? – quantity and quality of new businesses and their effect on regional development, *Jena Economic Research Papers in Economics* 2009-070

Geroski, P., Machine, S. and Van Reenen, J. (1993). The profitability of innovating firms. *The RAND Journal of Economics,* 24 (2), 198-211.

Gompers, P., Lerner, J. and Scharfstein, D. (2005). Entrepreneurial spawning: Public coporations and the genesis of new ventures, 1986-1999. *Journal of Finance,* 60 (2), 557-615.

Glaeser, E. L., Kallal, H. D., Scheinkman, J. A. and Schleifer, A. (1992) Learning in cities. *Journal of Urban Economics*, 46 (2), 254-277.

Glaeser, E., Scheinkman, J. and Schleifer, A. (2003). Injustice of inequality. *Journal of Monetary Economics* 50 (1), 199-222.

Glaeser, E.L. and Kerr, W. (2009). Local industrial conditions and entrepreneurship: How much of the spatial distribution can we explain? NBER Working Papers Series.

Griliches, Z. (2000). *R&D, Education, and Productivity*. Harvard University Press, Cambridge, MA.

Honjo, Y. (2000). Business failure of new firms: an empirical analysis using a multiplicative hazards model. *International Journal of Industrial Organization*, 18 (4), 557-574.

Hyytinen, A. and Maliranta, M. (2008). When do employees leave their job for entrepreneurship? *Scandinavian Journal of Economics* 110 (1), 1-21.

Hyytinen, A., and Ilmakunnas, P. (2007) Entrepreneurial aspirations: Another form of job search? *Small Business Economics*, 29 (1), 63-80.

Jacobs, J. (1969). *The Economy of Cities*. Random House: New York.

Klein, B., Crawford, R. and Alchian, A.A. (1978). Vertical Integration, Appropriable Rents and the Competitive contracting Process. *Journal of Law and Economics*, 21 (2), 297-326

Klepper, S. (2001). Employee startups in high-tech industries. *Industrial and Corporate Change*, 10 (3), 639-674.

Klepper, S. (2002). The capabilities of new firms and the evolution of the US automobile industry. *Industrial and Corporate Change*, 11 (4), 645-666.

Klepper, S. and Sleeper, S. (2005). Entry by spinoffs. *Management Science*, 51 (8), 1291-1306.

Klepper, S. and Thompson, P. (2007). Spinoff entry in high-tech industries: Motives and consequences. In Franco Malerba and Stefano Brusoni (eds.), *Perspectives on Innovation*. Cambridge: Cambridge University Press: Cambridge, England: 187-218.

Klette, T.J. and Johansen, F. (1998). Accumulation of R&D capital and dynamic firm performance: A not-so-fixed effect model. *Annales d'Économie et de Statistique*, 49/50.

Klette, T.J. and Kortum, S. (2004). Innovating Firms and Aggregate Innovation. *Journal of Political Economy*, 112 (5), 986-1018.

Koster, S. (2009). Taking the first hurdle in new firm formation. The effects of industry-Specific skills and support on survival during the founding process. *Romanian Journal of Regional Science*, 3 (1), 36-62.

Lindholm-Dahlstrand, A. (1997). Growth and inventiveness in technology-based spinoff firms. *Industrial Management and Economics*, 26 (3),331-344.

Long, J. S. and Freese, J. (2006). *Regression Models for Categorical Dependent Variables Using Stata*, Second Edition, Stata Press, Texas..

Lööf, H. and Johansson. B. (2010). Innovation Strategy and Firm Performance. What is the long-run impact of persistent R&D? CESIS Working Papers Series no 228.

Mahmood, T. (1992). Does the hazard rate for new plants vary between low- and high-tech industries? *Small Business Economics*, 4 (3), 201-209.

Malecki E.J. (1997). Entrepreneurs, networks, and economic development: A review on recent research. In: J.A. Katz (Ed.), Advances in entrepreneurship, firm emergence, and growth. Vol. 3: 57-118. London: JAI Press.

Malone, M. (1985). *The Big Score: The Billion Dollar Story of Silicon Valley*. Doubleday: Garden City, NJ.

Mata, J., and Portugal, P. (1994). Life duration of new firms. *The Journal of Industrial Economics*, 42 (3), 227-245.

McLaren, J. (2000). Globalization and vertical structure. *American Economic Review*, 90 (5), 1239-1254.

Moore, G. and Davis, K. (2004). Learning the Silicon Valley way. *SIEPR Discussion Paper No. 00-45.*

North, D (1994). Economic performance over time. *American Economic Review*, 84 (3), 359-368.

Pirrong, S C. (1993). Contracting Practices in Bulk Shipping Markets: a transactions cost explanation. *Journal of Law and Economics*, 36 (2), 937-976

Pavitt, K. (1991). What makes basic research economically useful? *Research Policy*, 20 (2), 109-119.

Peneder, M., Kaniovski, S. and Dachs, B. (2003). What follows tertiarisation? Structural change and the role of knowledge-based services. *The Service Industries Journal*, 23 (2), 47-66.

Rosenthal, S.S. and Strange, W. C. (2009). Small establishments/big effects: Agglomeration, industrial organization and entrepreneurship. *NBER Working Papers Series*.

Schettkat, R. and Yocarini, L. (2006). The shift to services employment: A review of the literature. *Structural Change and Economic Dynamics*, 17 (2), 127-147.

Scott, J. (1984), Firm versus Industry Variability in R&D Intensity, Z. Griliches (ed.), *R&D, Patents and Productivity*, Chicago: University of Chicago Press and NBER

Shane, S. (2000). Prior knowledge and the discovery of entrepreneurial opportunities. *Organization Science*, 11 (4), 448-469.

Shane, S. (2003). *A General Theory of Entrepreneurship – The Individual Opportunity Nexus*, Edward Elgar, Cheltenham, UK – Northampton, MA, USA.

Shane, S. and Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *The Academy of Management Review*, 25 (1), 217-226.

Sutton, J. (1997). Gibrat's legacy. *Journal of Economic Literature*, 35 (1), 40-59.

Tübke, A. (2004). *Success factors of corporate spin-offs*. Boston/New York/Dordrecht: Kluweer Academic Publishers.

Venkataraman, S. (1997). The distinctive domain of entrepreneurship research: An editor's perspective. In J. Katz & R. Brockhaus (Eds.), *Advances in Entrepreneurship, Firm Emergence, and Growth*, vol. 3: 119-138. Greenwich, CT: JAI Press.

Wong, P.K., Lee, L. and Foo, M.D. (2007). Technological innovation activities in firms and propensity of individuals starting new business. MPRA Paper 2617, University Library of Munich, Germany

Tables

Table 1

Summary statistic year 2004 for firms observed in the Community Innovation Survey IV (CIS), number of employees in the CIS-2004 firms in years 1999 and 2005, and number of entrepreneurs spawned by the CIS-2004 firms between 1999-2005 and 1999-2003, respectively.

	Non Innovative	Temporary Innovative	Persistent Innovative
Sales/emp (log)	7.24 (0.67)	7.37 (0.62)	7.70 (0.67)
Value added/emp (log)	6.30 (0.53)	6.38 (0.59)	6.70 (0.63)
Export/sales	0.12 (0.23)	0.20 (0.29)	0.36 (0.40)
Wage/emp (log)	5.75 (0.42)	5.81 (0.44)	6.05 (0.55)
Knowledge Capital [a]	0.10 (0.15)	0.12 (0.17)	0.21 (0.21)
Physical capital/emp (log)	3.71 (2.40)	4.11 (2.07)	4.45 (1.86)
Employment	125 (734)	97 (427)	340 (1,048)
Manufacturing	0.76 (0.42)	0.84 (0.37)	0.77 (0.42)
- High technology	*0.06*	*0.06*	*0.12*
- High medium technology	*0.17*	*0.24*	*0.27*
- Medium technology	*0.20*	*0.25*	*0.17*
- Low technology	*0.34*	*0.29*	*0.21*
Knowledge Intense Business Services	0.24 (0.42)	0.16 (0.37)	0.23 (0.42)
Corporate ownership struct			
Independent	0.36 (0.48)	0.27 (0.44)	0.15 (0.36)
Swedish domestic group	0.32 (0.46)	0.34 (0.47)	0.20 (0.40)
Swedish MNE	0.16 (0.36)	0.21 (0.41)	0.36 (0.48)
Foreign MNE	0.16 (0.48)	0.18 (0.39)	0.29 (0.45)
Number of firms	1 180	403	594
Number of employees at 1999	63 245	29 686	142 282
Number of employees at 2005	119 859	36 894	178 939
Entrepreneurs spawned by incumbent firms between 1999 and 2005, number [b]	2 470	836	2 760
Entrepreneurs spawned by incumbent firms between 1999 and 2003, number [c]	1 315	430	1 364

Notes

a: Employees with 3 at least years university education/total employment, b: Sample used in the MNL estimation

c: Sample used in survival analysis

Community Survey IV observe firms' innovation behaviour during the period 2002-2004.
Sales, value added, exports, wage and physical capital are in log of 1000 SEK

Table 2.1
Summary statistics of explanatory variables in MNL estimation, period 1999-2004, 1,669,649 observations.

	Mean	SD	Min	Max
Key variables				
Non innovator	0.34	0.48	0.00	1.00
Temporary innovator	0.11	0.32	0.00	1.00
Persistent innovator	0.55	0.50	0.00	1.00
Firm controls				
Log of size of firm	6.75	1.81	0.00	10.06
Declining Employment	0.49	0.50	0.00	1.00
Declining Sales	0.30	0.46	0.00	1.00
Individual controls				
Tenure	6.68	5.86	0.00	18.00
Age	40.74	11.85	16.00	99.00
Age^2	1 800.39	993.26	256.00	9801.00
Male	0.70	0.46	0.00	1.00
Log of wage	12.33	0.65	4.60	17.01
Skilled	0.14	0.35	0.00	1.00
Regional controls				
Log of regional size	10.83	1.38	5.78	12.98
PS index	0.19	0.36	-0.99	0.95
RDI index	2.50	0.72	1.00	4.20
AFS index	-0.44	0.42	-0.99	0.78
Industry category dummies				
Manufacturing	0.78	0.41	0.00	1.00
KIBS	0.22	0.41	0.00	1.00

Notes
PS is product specialization, RDI is regional diversity and AFS describes the degree of local entrepreneurial culture in the regional environment.

Table 2.2
Summary statistics of explanatory variables in COX hazard estimation, period 2000-2005.

	Mean	SD	Min	Max
Manufacturing[(i)]				
Temporary innovator	0.14	0.34	0.00	1.00
Persistent innovator	0.53	0.50	0.00	1.00
Log of (new) firm size	0.29	0.67	0.00	4.30
Same Industry dummy	0.05	0.22	0.00	1.00
Male	0.79	0.41	0.00	1.00
Age	41.86	11.97	18.00	72.00
Age^2	1895.81	1046.37	324.00	5184.00
Skilled	0.18	0.38	0.00	1.00
Log of regional size	11.02	1.42	6.08	12.98
KIBS[(ii)]				
Temporary innovator	0.14	0.35	0.00	1.00
Persistent innovator	0.28	0.45	0.00	1.00
Log of (new) firm size	0.25	0.56	0.00	4.32
Same Industry dummy	0.53	0.50	0.00	1.00
Male	0.71	0.46	0.00	1.00
Age	41.94	11.25	19.00	77.00
Age^2	1885.10	990.83	361.00	5929.00
Skilled	0.34	0.48	0.00	1.00
Log of regional size	11.59	1.38	6.89	12.98

Notes
(i) 1942 observations
(ii) 1145 observations

Table 3.1

Determinants to four employment choices for next time period: Stay in the same firm, switch to another firm, exit from the labour market or start a new firm. Manufacturing Sector.

Variable	Stay	Switch	Exit	Self-employed
Temporary Innovator [a]	0.200***	-0.149***	-0.038	-0.013
	(0.074)	(0.057)	(0.045)	(0.011)
Persistent Innovator [a]	1.686***	-1.038***	-0.596***	-0.052***
	(0.063)	(0.050)	(0.038)	(0.010)
Tenure	0.6974***	-0.507***	-0.168***	-0.021***
	(0.005)	(0.004)	(0.003)	(0.001)
Age	1.331***	-0.349***	-0. 987***	0.005**
	(0.014)	(0.011)	(0.007)	(0.002)
Age^2	-0.016***	0.003***	0.013***	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Male†	-0.455***	0.235***	0.118***	0.100***
	(0.051)	(0.039)	(0.031)	(0.007)
Log of wage	5.171***	-1.674***	-3.321***	-0.176***
	(0.043)	(0.032)	(0.024)	(0.005)
Skilled	-2.831***	2.034***	0.629***	0.166***
	(0.090)	(0.067)	(0.058)	(0.016)
Log of size of firm	-0.564***	0.259***	0.302***	-0.025
	(0.017)	(0.013)	(0.010)	(0.002)
Declining Employment†	-0.353***	0.120***	0.211***	0.022***
	(0.047)	(0.037)	(0.029)	(0.008)
Declining Sales†	-1.603***	0.910***	0.644***	0.048***
	(0.055)	(0.043)	(0.033)	(0.009)
Log of regional size	-0.432***	0.301***	0.098***	0.032***
	(0.023)	(0.017)	(0.014)	(0.004)
PS index	0.385***	-0.294***	-0.115***	0.025**
	(0.073)	(0.056)	(0.045)	(0.012)
HH index	0.242***	-0.249***	0.031	-0.025***
	(0.037)	(0.017)	(0.022)	(0.006)
COMP index	-2.360***	1.854***	0.276***	0.229***
	(0.080)	(0.071)	(0.058)	(0.014)
Additional controls	Year dummies	Year dummies	Year dummies	Year dummies
Y = Pr(Choice = 1)	0.91562	0.05032	0.03177	0.00227

Notes

***significant at 1%, **significant at 5%, *significant at 10%. P-values are in parentheses.

(a) Reference is non-innovative firms
†dummy variable.
Number of obs: 1,329,698,
MNL Estimation. Marginal effects.
Marginal effects and standard errors (in parentheses) have been multiplied by 100.

Table 3.2

Determinants to four employment choices for next time period: Stay in the same firm, switch to another firm, exit from the labour market or start a new firms. KIBS

Variable	Stay	Switch	Exit	Self-employed
Temporary Innovator [a]	2.413***	-1.584***	-0.858***	0.029
	(0.160)	(0.133)	(0.086)	(0.036)
Persistent Innovator [a]	2.307***	-1.702***	-0.555***	-0.050**
	(0.143)	(0.118)	(0.083)	(0.028)
Tenure	1.143***	-0.909***	-0. 201***	-0.033***
	(0.018)	(0.016)	(0.008)	(0.003)
Age	1.320***	-0.352***	-1.027***	0.059***
	(0.038)	(0.033)	(0.017)	(0.008)
Age^2	-0.013***	0.000**	0.013***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Male†	-1.384***	0.462***	0.600***	0.322***
	(0.122)	(0.101)	(0.066)	(0.024)
Log of wage	5.808***	-1.486***	-4.044***	-0.278***
	(0.102)	(0.084)	(0.047)	(0.016)
Skilled	-0.779***	1.137***	0.607***	0.250***
	(0.158)	(0.130)	(0.090)	(0.034)
Log of size of firm	-0.069*	0.139***	0.013	-0.081***
	(0.037)	(0.032)	(0.021)	(0.006)
Declining Employment†	-0.391***	-0.065	0.361***	0.095***
	(0.147)	(0.123)	(0.082)	(0.028)
Declining Sales†	-1.788***	1.762***	0.031	-0.005
	(0.157)	(0.133)	(0.084)	(0.028)
Log of regional size	-0.739***	0.686***	0.033	0.018
	(0.068)	(0.059)	(0.034)	(0.013)
PS index	0.739	-1.085***	0.716***	-0.007
	(0.073)	(0.413)	(0.249)	(0.090)
HH index	-0.204**	0.083	0.129**	-0.009
	(0.095)	(0.080)	(0.052)	(0.019)
COMP index	1.670***	0.421	-2.309***	0.218**
	(0.397)	(0.336)	(0.218)	(0.076)
Additional controls	Year dummies	Year dummies	Year dummies	Year dummies
Y = Pr(Choice = 1)	0.85795	0.09487	0.04227	0.00489

Notes

***significant at 1%, **significant at 5%, *significant at 10%. P-values are in parentheses.

(a) Reference is non-innovative firms
†dummy variable.
Number of obs: 339,951
MNL Estimation. Marginal effects.
Marginal effects and standard errors (in parentheses) have been multiplied by 100.

Table 4

Results of the Hazard Rate of survival.

	Manufacturing[(i)]		**KIBS**[(ii)]	
Variable	**(I)**	**(II)**	**(III)**	**(IV)**
Temporary Innovator	1.00	1.01	0.78	0.78
	(0.11)	(0.11)	(0.13)	(0.13)
Persistent Innovator	1.00	1.02	0.79*	0.77**
	(0.08)	(0.08)	(0.11)	(0.10)
Log of (new) firm size	0.66**	0.65**	0.69**	0.69**
	(0.05)	(0.05)	(0.08)	(0.08)
Same Industry dummy	0.88	0.87	0.72**	0.72**
	(0.16)	(0.16)	(0.08)	(0.07)
Male	0.96	0.95	1.06	1.04
	(0.08)	(0.08)	(0.13)	(0.13)
Age	0.85**	0.86**	0.88**	0.88**
	(0.02)	(0.02)	(0.03)	(0.03)
Age^2	1.00**	1.00**	1.00**	1.00**
	(0.00)	(0.00)	(0.00)	(0.00)
Skilled	1.17	-	0.85	-
	(0.11)		(0.11)	
Log of regional size	1.02	1.03	1.13**	1.12**
	(0.03)	(0.03)	(0.04)	(0.05)
Additional controls	Year dummies	Year dummies	Year dummies	Year dummies
Number of observations	1 942	1 942	1 145	1 145

Notes

**significant at 5%, *significant at 10%,

Cox hazard model estimations, hazard ratios.

A hazard ratio smaller than one decreases the risk of closure while a hazard ratio larger than one increases the risk.

(i) Efron approximation used to calculate ties

(ii) Exact-partial method used to calculate ties

Table 5

Results of the Hazard Rate of survival. KIBS firms in the same 2-digit industry as the incumbent company

	KIBS	
Variable	**(I)**	**(II)**
Innovator [a]	0.77	0.76*
	(0.13)	(0.12)
Log of (new) firm size	0.78	0.78
	(0.15)	(0.15)
Male	1.06	1.06
	(0.19)	(0.19)
Age	0.93	0.92*
	(0.04)	(0.04)
Age^2	1.00*	1.00*
	(0.00)	(0.00)
Skilled	0.86	-
	(0.14)	
Log of regional size	1.16**	1.15**
	(0.07)	(0.07)
Additional controls	Year dummies	Year dummies
Number of observations	612	612

Notes
***significant at 1%, **significant at 5%, *significant at 10%,
(a) Temporary and persistent innovators grouped together. Reference group is non-innovators
Cox hazard model estimations, hazard ratios.
A hazard ratio smaller than one decreases the risk of closure while a hazard ratio larger than one increases the risk.
Exact partial likelihood method used to calculate ties

Appendix

Table A1

Dependent variable: Propensity to transcend into self-employment: reduced specifications. Manufacturing Sector.

Variable	Self-employed (I)	Self-employed (II)	Self-employed (III)
Temporary Innovator[a]	-0.039***	-0.022**	-0.013
	(0.013)	(0.036)	(0.011)
Persistent Innovator[a]	-0.113***	-0.082***	-0.052***
	(0.013)	(0.011)	(0.010)
Tenure	-	-0.024***	-0.021***
		(0.001)	(0.001)
Age	-	0.005***	0.005**
		(0.002)	(0.002)
Age2	-	0.000***	0.000*
		(0.000)	(0.000)
Male†	-	0.098***	0.100***
		(0.008)	(0.007)
Log of wage	-	-0.182***	-0.176***
		(0.005)	(0.005)
Skilled	-	0.219***	0.166***
		(0.018)	(0.016)
Log of size of firm	-0.017***	-0.008***	-0.025
	(0.003)	(0.002)	(0.002)
Declining Employment†	-0.003	0.021***	0.022***
	(0.010)	(0.008)	(0.008)
Declining Sales†	0.053***	0.047***	0.048***
	(0.011)	(0.009)	(0.009)
Log of regional size	-	-	0.032***
			(0.004)
PS index	-	-	0.025**
			(0.012)
HH index	-	-	-0.025***
			(0.006)
COMP index	-	-	0.229***
			(0.014)

Notes

***significant at 1%, **significant at 5%, *significant at 10%,

(a) Reference is non-innovative firms
†dummy variable.
Number of obs: 1,329,698
Marginal effects and standard errors (in parentheses) have been multiplied by 100.
Year dummies are included in the regressions

Table A2

Dependent variable: Propensity to transcend into self-employment: reduced specifications. KIBS

Variable	Self-employed (I)	Self-employed (II)	Self-employed (III)
Temporary Innovator[a]	0.019	0.033	0.029
	(0.038)	(0.036)	(0.036)
Persistent Innovator[a]	-0.093***	-0.062**	-0.050**
	(0.028)	(0.027)	(0.028)
Tenure	-	-0.034***	-0.033***
		(0.003)	(0.003)
Age	-	0.059***	0.059***
		(0.008)	(0.008)
Age2	-	-0.000***	0.000***
		(0.000)	(0.000)
Male†	-	0.324***	0.322***
		(0.024)	(0.024)
Log of wage	-	-0.277***	-0.278***
		(0.016)	(0.016)
Skilled	-	0.252***	0.250***
		(0.035)	(0.034)
Log of size of firm	-0.077***	-0.077***	-0.081***
	(0.006)	(0.006)	(0.006)
Declining Employment†	0.105***	0.098***	0.095***
	(0.030)	(0.028)	(0.028)
Declining Sales†	0.013	-0.012	-0.005
	(0.031)	(0.028)	(0.028)
Log of regional size	-	-	0.018
			(0.013)
PS index	-	-	-0.007
			(0.090)
HH index	-	-	-0.009
			(0.019)
COMP index	-	-	0.218**
			(0.076)
Additional controls	Year dummies	Year dummies	Year dummies

Notes

***significant at 1%, **significant at 5%, *significant at 10%,
A: Reference is non-innovator
†dummy variable,
Number of obs: 339,951.
Marginal effects and standard errors (in parentheses) have been multiplied by 100.

FIG A

Fig 1: Sales per employee 1997-2006. 1000 SEK. Current prices

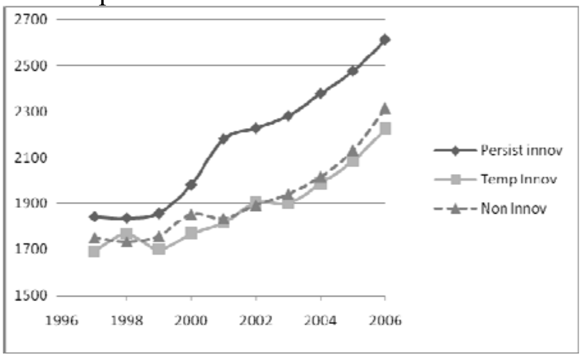


Fig 2: Export per employee 1997-2006. 1000 SEK. Current prices.

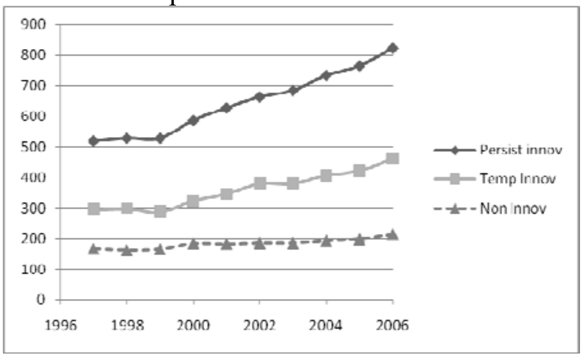


Fig 3: Value added per employee 1997-2006. 1000 SEK. Current prices.

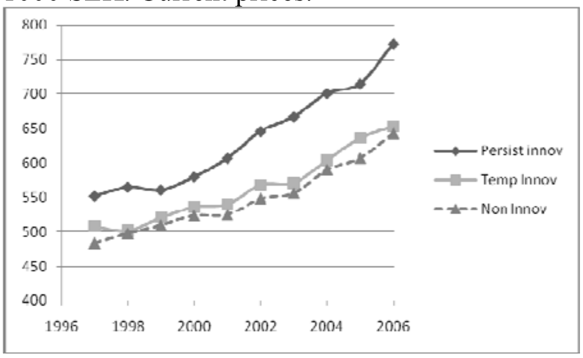


Fig 4: Profit per employee 1997-2006. 1000 SEK

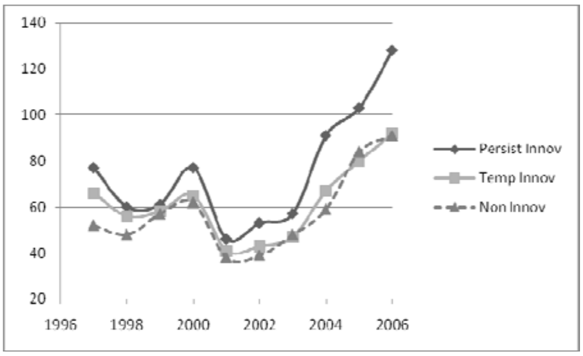
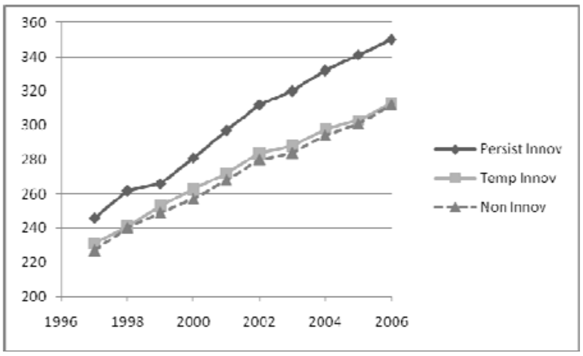


Fig 5: Wages per employee 1997-2006. 1000 SEK



Source: Lööf and Johansson (2010).