Differentiating the Role Played by Founders' Human Capital in the Performance of Firms

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1. Introduction

The resource-based view of the firm posits that the ability of firms to survive and to compete successfully is strongly influenced by the extent to which firms develop distinct capabilities. Teece et al. (1997) argue that human capital forms the basis of firms' dynamic capabilities to learn and adapt to new circumstances. Mata and Portugal (2002) find that the education of a firm's workforce can be regarded as a measure of ownership advantages. Entrepreneurial characteristics also play an important role in explaining why some firms survive and grow, while others fail. Brüderl et al. (1992) argue that greater human capital enhances the productivity of the founder, which results in higher profits and, therefore, lower probability of exit. In a recent work, Baptista et al. (2007) find that various forms of entrepreneurial experience (e.g. industry-specific; managerial; and business ownership) contribute positively to the likelihood that a firm will survive the critical first years after start-up. This contribution is found to be more significant than that of workforce human capital. However, as firms survive and grow, organizational structures become more complex and the magnitude of the role played by the capabilities of founders is likely to wane, while the human capital of top and divisional managers should gain in importance. Penrose (1959) stresses that the supply of managerial services is an important constraint on firm growth. Adner and Helfat (2003) define managerial human capital, social capital, and cognition as dynamic managerial capabilities affecting corporate performance.

Nevertheless, evidence on the influence of entrepreneurial attributes on firm performance is still scarce (Manjón-Antolín and Arauzo-Carod, 2008). In this paper, we address this subject by studying the performance of Portuguese firms, established between 1991 and 2003, in knowledge based sectors. Knowledge based firms are

more likely to be created in order to explore entrepreneurial opportunities based on new knowledge and technologies than other firms (Shane and Venkataraman, 2000). Therefore, knowledge and human capital are of greater importance for knowledge based firms. We examine the impact of human capital on firm performance, including in our analysis only firms in knowledge based sectors, differentiating the impact of the employees' and business owners' human capital. We distinguish between different types of human capital (Becker, 1993): general, industry-specific and entrepreneurship-specific (Bosma et al., 2004; Baptista et al., 2007; Ucbasaran et al., 2008).

Data come from the 'Quadros de Pessoal' (QP) survey, a longitudinal matched employer-employee dataset covering the Portuguese economy, for the period 1986-2003. Information on workers and business owners include age, gender, schooling, tenure, and job/hierarchical assignment. The nature of the data allows us to construct variables that assess both the pre-entry and post-entry experience of business owners. We use these data to determine the role played by business owners' human capital and the role played by employee human capital in shaping a firm's performance, using two different measures of performance: sales and survival. In addition, we differentiate the effects of founding and current conditions. The analysis includes variables accounting for the experience and capabilities of founders and employees of firms, and controlling for environmental and firm-level factors.

Our results show that high education of the entrepreneur's and high specialization of the workforce are important determinants of survival of firms. However, our results also indicate that firms with more specialized employees and business owners tend to perform worse in terms of sales. Managerial experience plays a very important role in determining firm performance over time. Entrepreneurs' previous experience in

managerial positions in paid employment, and the presence of more employees with previous managerial experience have significant positive effects on firm performance.

The remaining of the paper is organized as follows. The following section discusses the background to the present study. Section 3 presents the data. The specification of the empirical models is presented in section 4. Section 5 presents and discusses the results. Finally, section 6 offers some concluding remarks.

2. Theoretical Background

2.1 The role of human capital in performance

We address the following research question: what is the role played by business owners' human capital in determining firm performance in knowledge based sectors, and how does the significance of this role evolve over time? Human capital relates to skill and knowledge and is embedded in individuals. Past research explores the relationship between human capital accumulation by entrepreneurs and the survival and performance of the firm (Gimeno et al., 1997; Brüderl et al., 1992; Bosma et al., 2004). Factors associated with the entrepreneur can play a significant role in explaining why some firms survive and grow, while others fail. Brüderl *et al.* (1992) argue that greater entrepreneurial human capital enhances the productivity of the founder, which results in higher profits and lower probability of exit. Higher productivity of the founder means that the business owner is more efficient in organizing and managing operations or is able to attract more customers, negotiate better contracts with suppliers, and raise more capital from investors. Jovanovic's (1982) model of market selection claims that firms (or entrepreneurs) learn about their efficiency from noisy signals provided by the market. It is also possible to claim that entrepreneurs with greater human capital will be less uncertain about their efficiency

and will be able to learn faster about market conditions, therefore reducing the probability of exit (see, for instance, Frank, 1988).

Teece et al. (1997) argue that human capital forms the basis of the firms' dynamic capabilities to learn and adapt to new circumstances. Knowledge, embodied in human beings, is deemed to be the foundation for firm-specific assets that are sources of competitive advantage (Teece, 1998). Owners' human capital should be more pertinent to young firms' profit potential than that of employees, since owners have greater incentive to use their human capital for firm growth. Highly educated employees may move to more attractive positions elsewhere, while ownership ties a professional to property thus decreasing the incentive to leave (Pennings et al., 1998). In addition, the human capital of the entrepreneur can be directed related to the innovative activity of the firm. Entrepreneurs with higher education or more work and managerial experience are more likely to be innovators. Consequently, firms which are managed by entrepreneurs with higher human capital will show higher levels of innovative activity (Cooper et al., 1994).

Effects of entrepreneurial human capital on firm survival may occur prior to business foundation. Based on their higher earnings and more prestigious professional status as employees, individuals with higher human capital are in a position to raise more financial capital and set-up larger and better-equipped businesses (Colombo et al., 2004). They may also be more able to detect profitable unexplored market opportunities, and to obtain relevant information about market conditions (thereby reducing uncertainty about their efficiency). Bosma et al. (2004) find that the level of talent of small business founders is not the only determinant of performance; experience in the specific industry and earlier experience in starting up a business strongly contributes for the performance of small firm founders. Dahl and Klepper

(2007) claim that the pre-entry background of the founders affects the firms' chances of survival. Recent research has attempted to develop a structure for theory-building and applied work about the role played by pre-entry resources and capabilities in driving both entry decisions and post-entry performance (Helfat, 2000; Helfat and Lieberman, 2002; Helfat and Peteraf, 2003). Klepper (2002) argues that pre-entry assets affect both entry decisions and subsequent success. The role played by pre-entry resources and capabilities has been the subject of significant research on corporate diversification and industry evolution (see, for instance, Montgomery, 1994; Markides and Williamson, 1996; Klepper and Simons, 2000; Helfat and Lieberman, 2002). It can be claimed that experience acquired prior to founding the business enables entrepreneurs to better recognize and exploit opportunities (Shane, 2000; Eckhardt and Shane, 2003). This knowledge might be unique to entrepreneurs, making entrepreneurial entry a superior choice for opportunity exploitation (Alvarez and Busenitz, 2001).

A stream of research in organizational ecology focuses on the transfer of routines and experience from a founder's previous employer to his or her new firm (Phillips, 2002). The argument that the blueprints of a parent firm are passed on to new organizations through their founders is the cornerstone of a number of works by, among others, Carroll (1984), Hannan and Freeman (1986), and Romanelli (1989). A central argument of this research is that the success of new organizations is fundamentally shaped by the pre-entry experiences of their founders. Dahl and Reichstein (2007) find that industry experience as measured by the accumulated employment experience of owners affects new firm survival positively. A critical subject for research is to examine for how long do conditions such as founder human capital influence firm performance. It should be expected that, as a firm grows and

extends its activities to new products and markets, employee human capital (particularly for those employees in management positions) should gain in importance, while founder human capital should become less relevant. However, if founders do indeed impart a lasting imprint to the organizations they create, the impact of founder human capital should remain significant long after the firm was founded.

Becker (1993) distinguishes between general and specific human capital. While general human capital consists of skill and knowledge that are useful in different firms, and transferable across different situations, specific human capital includes skills and knowledge less transferable and useful only in the context that provides it. In this paper, we distinguish three types of human capital regarding the entrepreneur: entrepreneurship-specific; industry-specific; and general human capital. There are two main forms of human capital accumulation, formal and informal. Formal means of human capital accumulation include education, while informal human capital accumulation occurs through work and managerial experience.

Education is related to knowledge, skills, problem-solving ability, discipline, motivation, and self-confidence (Cooper et al., 1994). Higher levels of education may give the entrepreneur greater ability to solve problems, make decisions and choices. Better educated entrepreneurs may also have better social networks, as a result of their longer stay in the education system, and that may be useful for the development of their businesses (Ucbasaran et al., 2008). Through formal education, individuals acquire fundamental abilities to learn about markets and technology, and better recognize opportunities in the surrounding environment (Shane, 2000). However, better educated individuals also have a higher opportunity cost in staying in employed positions. This means that there is a higher threshold level of performance in order to

stay with a business, which can lead to a negative or non-significant relationship between education of the entrepreneur and survival of the firm (Cooper et al., 1994). Sluis et al. (2005) conclude that entrepreneurship performance, regardless of the performance measure used, is significantly and positively affected by formal schooling. Results obtained by Bosma et al. (2004) also reveal that better educated entrepreneurs make larger profits. This reasoning suggests the following hypothesis:

H1: The higher the level of education of the Business Owner the better will be the performance of the firm.

The concept of entrepreneurial human capital is implicit in a number of studies of new firm success. These studies examine the effects on the likelihood of survival of different features such as the founders' education, career history, family and occupational background (Boswell, 1972; Bates, 1985, 1990; Preisendörfer and Voss, 1990; Brüderl *et al.*, 1992; Cooper *et al.*, 1994; Gimeno *et al.*, 1997; Dahl and Reichstein, 2007). In this paper, we consider entrepreneurial human capital to be composed of experience in management and experience as a business owner. Management know-how embodied in the entrepreneur can be a central resource for a new venture, since founders usually play an important role in the structuring and management of new businesses. Knowledge of how to manage a business has a strong tacit form and can be gained informally by observing and making business decisions. Management know-how of the entrepreneur may therefore result both from previous business ownership experience and experience as a paid employee performing managerial and supervision tasks. Business ownership and managerial practice provide the individual with experience in leadership situations and the necessary skills to organize new businesses (Shane, 2000; Eckhardt and Shane, 2003). In addition, people who have performed managerial duties are more likely to be better positioned

to detect opportunities and raise capital (Colombo *et al.*, 2004). Thus, we derive the following hypothesis:

H2: Greater entrepreneurial human capital of the Business Owner will positively affect firm performance.

In addition to managerial know-how, the availability of know-how specific to the industry may be an important determinant of success for a new business. Industry-specific knowledge may come from previous experiences working in the same industry. This is knowledge that is strongly tacit and cannot easily be transferred from the people so endowed. Business owners who have worked in the same industry probably have obtained industry-specific human and social capital, i.e. knowledge of the specialized market and technology, plus a network of professional and social contacts that facilitate the acquisition and management of both technical and human resources. In addition, people who have worked in the industry may have already established relationships with customers, suppliers, or stakeholders. This experience provides access to knowledge on markets, products, processes and technology that are specific to the sector. Previous research has shown that experience of the business owner in the same industry in which he starts the new businesses improves firm performance (Bosma *et al.*, 2004, Baptista *et al.*, 2007). We then formulate the following hypothesis:

H3: Industry specific experience of the Business Owner will affect firm performance positively.

A number of authors pointed out that a firms' knowledge resides in its human resources (Grant, 1996; Conner and Prahalad, 1996) and it is the firm's human capital that provides the basis for sustained competitive advantage arising from activities

involving the use of complex technology (Youndt et al., 1996). Grant (1996) states that knowledge exists within individuals and that an important way to acquiring knowledge and develop the ability to generate new knowledge is through formal education. This suggests that schooling is an indicator of the quality of human capital. Mata and Portugal (2002) argue that the education of a firm's workforce can be regarded as a measure, albeit imperfect, of firm-specific resources and capabilities. Dahl and Klepper (2007) find that employees hired by the business owners in the earliest stages of business formation are a key element of future firm success. As they suggest, more talented labor can develop ideas, such as organizational methods or innovative concepts, leading to increased firm performance. Thus it is not only the characteristics of the founders that matter for the success of new firms, but also who they hire.

We distinguish four types of human capital regarding the firms' workforce: general education; specialized training; managerial experience; and industry-specific experience. Firms with more college graduate employees should perform better, have greater chances of survival, and be better able to attract investment. Hence, education is an indicator of the quality of general human capital (Brüderl et al., 1992). We therefore expect that firms with greater levels of employee human capital should have a greater probability of survival. Thus, we test the following hypothesis:

H4: Education of the firms' employees will affect firm's performance positively

In addition, we distinguish those who perform highly specialized activities from the total workforce. New firms who have more highly qualified personnel will be better able to develop knowledge and competences that will enable them to survive and perform better. Accordingly, we derive the following hypothesis:

H5: Level of specialization of the firms' employees will affect firm performance positively

Adding to the managerial experience of the entrepreneur, a new business will benefit and increase its chances of success by having management know-how available through the employment of people who embody this kind of tacit knowledge (Cooper et al., 1994). Employees with managerial experience should be better able to perform supervisory duties and to organize tasks in a more efficient way. Thus, we put forward the following hypothesis:

H6: Managerial experience of the workforce will affect firm performance positively

In line with managerial experience, firms with greater availability of know-how specific to the industry will benefit from greater knowledge of products and processes, as well as of consumers and suppliers, and thus will be better prepared to face the market. The lack of industry-specific know-how is a major determinant of the "liability of newness," which presumably arises because of a lack of stable supplier and customer relationships, inadequately developed internal processes, and problems in acquiring resources (Stinchcombe, 1965). Thus, we formulate the following hypothesis:

H7 – Industry specific experience of the workforce will affect firm performance positively.

2.2. The effect of initial and current conditions on performance

 Business conditions at the time of start-up may affect the likelihood of survival of a firm not just during its first few years, but also later in its lifetime. Initial decisions by entering firms may not be easily changed, thus having an effect on firm

performance that extends through time. In particular, entry size is likely to reflect the beliefs held by firms about their ability to compete. Jovanovic (1982) argues that new firms start small and gradually adjust capacity as the initial uncertainty about their own efficiency gradually disappears. Each period that the firm survives, it learns more information concerning its true efficiency. Using this new information, the entrepreneur revises his beliefs concerning expected future profits. If the new information implies very poor future performance, then the entrepreneur will choose to leave the industry. Frank (1988) argues that the scale of initial operation offers evidence as to the beliefs held by the entrepreneur. Entrepreneurs with more optimistic expectations of success should enter at larger scales and be willing to endure poor performance for a longer time. Also, firms may be precluded from adjusting initial decisions due to the existence of adjustment costs. These costs are not solely financial and may reflect technological conditions requiring a minimum scale of operations, and difficulties in reducing personnel. Hence, initial conditions may influence a firm's performance for a long time. In particular, the fact that a firm survives for a long time does not necessarily reflect good performance.

Several studies confirm the impact of initial conditions on the performance of organizations. Eisenhardt and Schoonhoven (1990) argue that founding team decisions permanently affect firm performance. Cooper et al. (1994) found that the initial stocks of financial human capital were good predictors of firm performance. Studies of survival, including Brüderl et al. (1992); Audretsch and Mahmood (1994); Sharma and Kesner (1996); Geroski et al. (2007) and Baptista et al. (2007), found start-up conditions significantly affect survival chances.

Most specifications of survival/exit models including founding conditions do not make provisions for the possibility that their effect on survival might change in the

years after birth. Mata et al. (1995) estimate a model of survival using initial and current size simultaneously, finding that both coefficients were significant, and the one associated with current size is greater in magnitude. The effects of founding conditions on firm performance were found to be increasingly important over time by Eisenhardt and Schoonhoven (1990), but not so by Bamford et al. (1999). In both studies the proportion of total variance explained by the model was used as the main criteria to judge the impact of founding conditions. At start-up the human capital of the entrepreneur is usually a determinant of firms' performance (Bosma et al, 2004). In addition, early hiring decisions of new firms will influence their performance and will be difficult to change once the firm is older. Therefore we formulate the hypothesis:

H8: Start-up conditions affect firm performance throughout its entire lifetime.

3. Measuring performance

3.1 Survival

The firm survival is the first measure of performance considered in this study. The estimation of survival models is conducted using semi-parametric proportional hazard models of the type proposed by Cox (1972). This method allows the analysis of the duration of samples of firms that belong to different cohorts, thus allowing for the identification of the lifetime of firms, even though they have different time origins. In addition, this methodology is suitable to work with right-censored data (Hosmer and Lemeshow 1999). Our model incorporates the main features of discrete duration models as described by Lancaster (1990), where the logarithm of the probability that a firm exits at time t, given that it survived in $t-1$, is explained by a vector of covariates x plus a set of parameters identifying the baseline hazard function, according to the following specification:

$$\lambda(t \mid x) = \lambda_0(t)\exp(x\beta) \tag{1}$$

The use of the partial likelihood function does not require that the baseline $\lambda_0(t)$ has to be specified, which allows to obtain estimates for β and avoid the risk of mis-specifying the baseline hazard function.

Different specifications of equation (1) can be written depending on the beliefs on what causes exit (Geroski *et al.*, 2007). One of the simplest versions of (1) is a model where x is a vector of variables which describe the current idiosyncratic and market conditions facing every firm which operates in the same market, which we will denote by x_t. Using x_0 to denote founding conditions leads to the following equation:

$$\lambda(t \mid x) = \lambda_0(t)\exp(x_t\beta + x_0\gamma) \tag{2}$$

With the use of this equation the impact of the start-up conditions on survival is studied through the estimation of parameters γ.

Since we have a panel, and variables that can change their value throughout time, we can consider a model where the covariates interact with any function of time, such as in the following expression:

$$\lambda(t \mid x) = \lambda_0(t)\exp(\gamma x_0 + \delta x_0 t) \tag{3}$$

This estimation of the hazard ratio allows observing the effect of founding conditions throughout time.

3.2 Sales

A second measure performance or success of firms is the yearly sales of the firm. One of the issues concerning firms' sales is that we only observe sales until the firms exit the database. Firms can exit the database because they choose to exit, because they fail or because they have been merged or acquired by another firm. In

addition, firm survival does not necessarily imply economic performance, which implies that even though firms survive they may not be have a better performance in terms of their sales (Gimeno *et al.*, 1997). Nevertheless, profits may be seen as a criterion for survival, and there might be a selection for firms who survive. We use pooled and fixed effects estimations, and test for selection on exit. We start by estimating a pooled least squares regression:

$$S_{it} = \alpha + X_{it}\beta + u_i \qquad\qquad i = 1,2,\ldots,N \qquad\qquad (4)$$

where S_i is the logarithm of sales for firm i; X_i is a vector of characteristics of the firm including the education variables, the entrepreneurial human capital variables, industry-specific human capital variables, firm characteristics, and the macro-levels variables. This regression can show us if the human capital variables have an effect in determining the sales of each firm. However, a pooled ordinary least square regression does not allow us to capture the variations over time, or to control for firm unobserved heterogeneity that may affect the dependent variable.

Since we have a panel of firms, we can correct for firms' unobserved heterogeneity, using a fixed-effects estimation, as follows:

$$S_{it} = \alpha + \beta X_{it} + a_i + \mu_{it} \qquad\qquad i = 1,2,\ldots,N \quad \text{and} \quad t = 1,2,\ldots,T \qquad\qquad (5)$$

where a_i is the unobserved individual effect, and μ is the error term uncorrelated with each explanatory variable across all time periods. In this case, time t equals the age of the firm after entry.

4.   Data

The main source of data used for empirical estimation in the present paper is the Quadros de Pessoal (QP) database, gathered by the Portuguese Ministry of Social Security on the basis of annual mandatory information submitted by firms. This is a

longitudinal matched employer-employee database which includes extensive information on all private firms, establishments, workers and business owners in the Portuguese economy since 1982. There are on average over 145 thousand firms, 170 thousand establishments and two million workers in each annual return which are fully linked through the use of a unique identification number, thus allowing for the recognition of both new entrants and exiting firms, as well as the opening and closure of subsidiary establishments. For each firm, data are available for size, age, location, sector and number of establishments. Data on business owners and employees for each firm and establishment include gender, age, occupation, tenure, schooling, and job level.[1] The nature of the data set allows us to construct variables that assess the pre-entry and post-entry experience of business owners and employees, and construct cumulative experience variables.

We follow firms that started their activity after 1991. Given that we observe entry by the existence of new identifiers in the yearly data, we use data from 1991 to 2003 to make sure that entry in the data base truly corresponds to market entry. We identify entry by observing the appearance of a new firm identification number in the data set.[2] Firm failure is identified by permanent exit from the database. In addition, we consider only firms who started with 50 employees or less since most new firms are small (Cabral and Mata, 2003). In addition, our data does not allow controlling for mergers and acquisitions, and limiting our analysis to small firms is a way to guarantee that we are only observing new firms.

We followed the OECD classification of knowledge based industries, aggregated by technology level, which is defined as the sum of high technology and medium-high

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[1] See Cabral and Mata (2003) for a description of the quality and coverage of the data.
[2] As an additional control we compare entry date with the lowest employee admission date and considered a true entry if the admission date did not differ for more than two years from the firms' entry date identified.

technology manufacturing, post and communications, finance and insurance and business services (OECD, 2002).

Variables

The descriptive statistics of the variables used are presented in Table 1. To capture the human capital of the business owner, we use a set of education and work experience measures. To measure education levels of the business owners, we used a binary variable with value 1 if at least one business owner has a university degree and zero otherwise. We use two additional binary variables for business owners with a high-school diploma, corresponding to 12 years of education, and another for business owners with nine years of education, which corresponds to the compulsory education. In our data 24% of firms have at least one business owner with a university degree at start-up, 23% have a business owner with the high-school diploma and 16% the compulsory education.

Insert Table 1 about here

Knowledge of entrepreneurship can be acquired through direct business ownership experience. Entrepreneurial capital is proxied by measuring experience in business ownership and experience in managerial positions (see Brüderl *et al.*, 1992). We use two variables accounting for entrepreneurial capital: 1) experience as business owner, measured with a binary variable equal to one if the business owner had experience in business ownership in the previous 3 years and zero otherwise; 2) managerial experience of the business owner, measured with a binary variable equal to one if the business owner had experience in managerial positions as paid-employees, in the previous three years and zero otherwise. In our data, 46% of the business owners

started their firm with some previous recent entrepreneurial experience, confirming that many entrepreneurs are habitual, that is, tend to be business owners of more than one firm in their careers. To capture industry-specific human capital we introduce one variable: business owners sector experience, a binary variable equal to one if the business owners has worked in firms in the same 2-digit level sector in the previous three years and zero otherwise; 74% of the firms have business owner start their firms in the sector where they were working in the last three years. We also introduce the total labor market experience of the business owner, which measures the potential experience of the individuals in the labor market, and it is calculated by taking out from the individuals' age the years of education (plus 6).

To capture the human capital of the firms' employees, we use a similar set of variables. We introduce the number of employees with higher education, as a percentage of the total number of employees. As shown in table 1, firms in knowledge based sector have on average 14.8 % of employees with a university degree, value which is slightly lower at start-up (11.9%). As we did for the business owners, we include also the share of employees with high-school diploma (12 years of education) and the share of employees with compulsory education (9 years). To account for the ability to absorb and create new knowledge, and for the level of specialization of the firms' workforce, we use the share of employees in occupations in physics and engineering sciences, life sciences and health, as a proportion of the employees (using the ISCO-Code for occupations). In table 1 we observe that firms at start-up have on average 4.6% of these professionals amongst their workforce and that this percentage remains stable over time. To measure the employees' work experience we built a set of variables that accounts for their previous experience in other firms. We introduce managerial experience of the firms' paid employees, measured with a binary variable

equal to one if 50% of the firms' workforce had any experience in managerial positions in the previous 3 years and zero otherwise. For 88% of firms, at least 50% of the workforce has experience in managerial positions when the firm starts, and the values decrease slightly after start-up. In addition, we measure employees' sector experience, a binary variable equal to one if 50% of the firms' workforce had any experience in the same sector in the previous 3 years and zero otherwise. As observed in table 1, 85% of the firms in our data have workforce with previous sector experience at start-up.

We use a set of variables concern firm specific characteristics. The logarithm of sales is used as a measure of performance. As a measure of capital we use the share capital (or equity capital) in the firm. In addition, we include a zero-one indicator for firms that have some share of foreign capital, given that the existence of foreign capital is likely to influence the human capital of the firms. We use as industry specific variables a zero-one indicator to distinguish manufacturing firms from services, and the minimum efficient scale (MES) of the sector, to control for industry specific characteristics. The larger the MES in an industry the higher is the cost of adjustment for new firms, leading to lower survival probabilities. To take in account macroeconomic conditions, the yearly unemployment rate was introduced.

Survival Rates

We have 25,480 firms in our dataset, for which the average duration of life is 3.1 years. Since the available data run through until 2003, information is right-censored. The survival rates of firms in our sample are presented in Figure 1. Observation of figure 1 shows that there are differences in the survival chances of firms that have a business owner with a university degree and firms that do not, and that these differences are persistent over time. For example, after two years 60% of the firms

with a business owner holding a university degree have survived and 50 % of firms without business owners holding a university degree have survived. Figure 1 also shows that firms that have more than 50% of paid-employees with a university degree present higher survival chances than firms with less educated employees, however this difference seems to decrease over time. The difference is not so clear when considering firms with more than 50% employees in occupations in physics and engineering sciences, health and life sciences, for which survival rates tend to be similar to firms who have fewer employees with those skills. Still, there is a slight advantage in survival rates of firms with more specialized amongst their workforce.

Insert Figure 1 about here
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5.   Results

We estimate the Cox regression to assess the effect of human capital on the exit hazard rate of new firms in knowledge based sectors, using the current and initial values of the variables (as in expression (1) and (2)). We also estimate a Cox model where we introduce an interaction with time (as in expression (3)). In addition, we use the sales volume as a dependent variable to explain growth of firms in terms of sales, and run pooled and fixed effect estimations (according to expressions (4) and (5)).

Exit Hazard Rate

Table 2 present results obtained for the probability of exit, estimated with Cox proportional hazard, where the initial conditions of all variables are used. Results in this table indicate that the education of the business owner improves significantly survival changes of firms: a business owner with a university degree at start-up is 22% less likely to exit. Experience as a business owner in last three years at start-up

increases the hazard of exit by 9%., revealing a negative effect on survival probabilities. One would expect that an individual with previous experience would have higher survival probabilities, given that he would have more knowledge on how to set up and run a business. However, the data suggest otherwise. It is possible that an experience in business ownership, even a failed one, may cause overconfidence, leading to entry mistakes (Cabral, 1997; Camerer and Lovallo, 1999; Geroski and Mazzucato, 2001).

Insert Table 2 about here

With respect to employee human capital, the share of employees with a university degree increases the likelyhood of exit by 0.3%. This results may be a consequence of interaction with the education of the business owner, given the evidence that for Portugal, more educated business owners tend to higher more educated employees (Baptista *et al.*, 2008). On the other hand, the variables accounting for managerial and industry specific experience revealed a negative effect on the probability of exit. Firms with more experienced workers in the sector are 17% less likely to exit, and firms with more employees with managerial experience are 84% less likely to exit. This may mean that experience of the workforce is a better predictor of survival than their specialization and education level.

In what concerns the control variables, they have the expected results. The unemployment rate as a negative effect of firm survival, as expected, higher unemployment levels leads to higher failure (Audretsch and Mahmood, 1995)

Table 3 includes in the estimation initial and current conditions. Variables relative to the business owners are only at the start-up point, since they are not likely

to change over time. The results presented reveal that both initial and current conditions have an impact in determining the probability of exit new firms face. The current share of employees with higher education increases the likelihood of exit by 0.1%. The experience of the workforce in firms remains as a core determinant of firms' survival; firms with more experienced workers in the sector are 48% less likely to exit, and firms with more employees with managerial experience are 89% less likely to exit. In addition, macro-economic conditions play a role in determining exit of new firms. Unemployment rate increases by 6% the likelihood of exit at start-up, and this effect is even stronger when looking at the current unemployment rates.

Insert Table 3 about here

Table 4 presents the Cox regression introducing interaction with time. The coefficients of the interaction with time will reveal if the effect of each variable will tend to disappear with time (negative coefficient or a lower hazard ratio), will tend to increase with time (positive coefficient or a higher hazard ratio), or will have no effect. In Table 4 we observe that the education of the business owner looses effect on failure when including time interaction, not revealing a long lasting effect on survival probabilities of firms. Experience as business owner reveals a positive significant effect on the likelihood of exit (28%), as in Table 2. Nevertheless, the coefficient with time interaction reveals a negative significant signal, which means that this effect tends to disappear over time.

Insert Table 4 about here

The sector experience of business owners at start-up resulted in a negative coefficient, revealing a positive impact on survival probabilities of new firms in knowledge based sectors. In addition, interaction of this variable with time led to a positive coefficient, which means that the hazard ratio increases with time, and that the effect of this experience will remain over time. These results confirm the importance of experience of the business owner in the survival of firms and show that this role is maintained throughout the firms' life time, more specifically the effect of industry specific experience (Baptista *et al.*, 2007).

The results obtained for the workforce are in line with what was obtained in the simple regression of Table 2. The share of employees with higher education and in specialized professions has a positive influence on firm exit, influence negatively the survival probabilities of firms, and this effect does not remain significant over time. In this particular estimation, the share of employees in specialized occupations increases the likelihood of firm exit by 0.5%, effect which tends to disappear over time. The existence of a higher share of experienced workers, both in managerial positions and in the same sector, increases the firms' likelihood of survival significantly in all the estimations. Interaction of these variables with time show that the sector experience of the workforce remains as a determinant of survival probabilities throughout time. The results show that the characteristics of the workforce are important determinants of survival and that a very experience workforce increases the changes of survival of newly founded firms. These results confirm the importance of the firms' first employees, and the long lasting effect of hiring choices of entrepreneurs, as addressed by Dahl and Klepper (2007).

Sales

In Table 5 the results of a pooled estimation with sales performance are presented.[3] Education of the business owner influences sales positively, meaning that firms with a business owner with a university degree have a 9% increase in sales. This result is in agreement with Bosma *et al.* (2004) who obtained a significant effect of the founders' education on firms' profit. On the other hand, existence of business owners with high-school level of education or the compulsory education leads to lower sales (a negative effect of 13 and 18%, respectively). Business ownership experience gives origin to an increase of 21% in sales. In addition, managerial experience of the business owner in the previous three years increases 6% of firms' sales. Similar result is observed by labor market experience, which revealed a positive effect in sales (0.8%). As for the employees' human capital variables, education and specialization have positive coefficients in the pooled estimation, showing that they positively influence firms' sales. On the opposite, the existence of a high share of experience employees led to a negative coefficient, revealing a negative effect on sales. Firms who have more that 50% of their employees with recent sector experience present 5% lower sales and, firms with more that 50% of their employees with managerial experience present a decrease in sales of 13%. Even though this result may appear somewhat strange, these variables measure experience in other previous firms. Therefore this result might be a consequence of age of the workforce. On the other hand, more experienced workers might have acquired routines that are difficult to break and this may be incompatible with the environment of a start-up. In what concerns firm specific characteristics, results show that bigger firms present higher sales (83%). In addition, the share capital also has a positive effect on sale

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[3] To verify if there is selection for firms who survived, we estimated a Heckman selection model. Estimation is run on sales; selection is tested using as dependent variable a binary variable which assumes value 1 for surviving firms, and value 0 otherwise. Independent variables on the selection equation are the same as used in the Cox estimation presented in Table 2.The results revealed that there is no selection on sales, and that the simple pooled estimation can be applied.

levels of firms. The existence of foreign capital in the firm leads to an increase of 75% sales.

Insert Table 5 about here

The fixed effect estimation on sales is presented in Table 6.[4] This estimation accounts for firm unobserved heterogeneity, as expressed earlier in equation (5). The results express the effect of the variation of each variable within the firm. In what regards the human capital of the business owners, the variables accounting for high-school and compulsory education led to a negative coefficient. Given that these are firm fixed effects, this result means that changes in the level of education of the business owner lead to an decrease in sales. It is not very likely that the education of individuals will change over time, but it is very likely that the business owners themselves change. Therefore, this means that firms changing to business owners with high-school or compulsory levels of education see their sales decrease by 10 and 11%. In what concerns the experience variables, they show that increases in experience of the business owner also lead to increases in sales. Once more, the work experience of the workforce in previous firms led to a negative coefficient, implying a negative effect in sales. This means that changes in the experience of the workforce towards individuals with more experience in previous firms leads to a decrease in sales. It is likely to assume that what matters for the performance of firms is the experience

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[4] For the fixed effect, sample selection is only a problem when it is related to the idiosyncratic error term. We can test for selection bias following the procedure described in Wooldridge (2002, pp. 579). We add the lead value of the selection indicator in $t+1$ to the equation. In this case, the selection indicator assumes value 1 if the firm still exists in $t+1$. We introduce our selection variable, estimate the model by fixed effects and perform a t test for the significance of the selection indicator. Under the null hypothesis, the error term is uncorrelated with the selection indicator, and so selection in the previous time period should not be significant in the equation at time t. The results reveal that, if there is any selection, it is not related to the idiosyncratic error term.

gathered on the job, and more related to experience within the firm itself. The remaining variables confirm the results obtained with the pooled estimation, confirming the role of experience and education within the firm in the sales levels of firms. The results also show that changes in the share capital and firm size lead to increases in sales.

Insert Table 6 about here

Discussion

Overall, results confirm the importance of different forms of human capital on firm's survival and sales. The general form of human capital of the business owner, measure through formal education and possible labor market experience seems to have an impact on firms' survival chances after start-up. In the estimations presented, education of the business owner has a positive impact on survival probabilities of new firms in knowledge based sectors and a positive effect on firms' sales, thus providing support for hypothesis 1. The variable accounting for experience as business owner revealed to have a significant positive impact of the performance of firms, measured through sales and survival, implying that new firms managed by people with previous experience as business owners will tend to outlive other firms, and outperform the others in terms of sales. Concerning industry specific and managerial experience, they both show a positive effect on survival chances of firms however these effects are not completely visible in the dynamic estimations. Nonetheless, the same variables showed a positive effect on firms' sales. As summarized, the variables accounting for entrepreneurial and industry experience of the business owners are not permanently

significant in all estimations made, giving only partial support to hypothesis 2 and hypothesis 3.

As for the employees' human capital, the results revealed that the level of education may negatively affect the probability of survival of new firms. These results are unexpected, given the previous evidence showing a positive effect of the education of employees in survival of new firms (Mata). Nevertheless, Teixeira (2002) obtained similar results showing that plants in textile firms which hired workers with higher levels of education presented lower survival probabilities. A possible explanation for these apparently strange results is that the employees' characteristics maybe consequence of the characteristics of the entrepreneur. Previous evidence suggests that different types of entrepreneurs will make different hiring choices, and the employees characteristics may be a consequence of bad hiring decisions at start-up. In addition, these results may also be consequence of the Portuguese labor market, characterized by a low mobility of workers. People tend to remain for a long time in the same job, and this is especially true for people with less education, which is unable to find more attractive positions elsewhere. Moreover, employees with more experience may have acquired routines that may impede their learning process in a new firm. Furthermore, the Portuguese workforce is also characterized by low levels of education, which may make other factors to be more important sources of competitiveness of firms. Nevertheless, in terms of sales, firms with higher levels of education of the workforce tend present higher sales. This difference in results obtained does allow for validation or rejection of hypotheses 4, 5, 6 and 7.

The estimations made with the initial and current conditions have shown that their effect can be different. The education of the business owner does not appear to

have a long lasting effect on survival probabilities of firms. As for the experience as business owner, estimation results show the coefficient with time interaction reveals a negative significant signal, which means that the effect of this experience tends to disappear over time. On the other hand, sector related experience seem to have a permanent effect over time. The effect of the education of the employees on firm survival will not remain significant over time. These results show that start-up conditions are important, but it is not clear if their effect fades at a decreasing rate. Therefore, we cannot totally confirm hypothesis 8.

6.   Concluding Remarks

There is a large body of literature on firm performance, focusing on the firm and industry characteristics. There are also a growing number of studies focusing on the role of the individual and on entrepreneurs' performance focus on the individual. In this paper we tried to make a contribution in this stream of literature by focus on entrepreneurs' characteristics while using the firm as unit of analysis. We introduced the distinction between the entrepreneurs' and the employees' human capital, and verified separately their effect on firm performance measured through survival and sales. In addition, we study the effect of initial and current conditions on survival.

What we found is that firms from more educated business owners are more likely to succeed. Results also indicate that business owner with previous managerial experience and who start the business in sectors they are more likely to survive and present better sales performance. In addition, the results presented indicate that more experience workforce may lead to higher survival probabilities, even if leading to lower sales increase. This maybe consequence of the acquisition of routines and old practices by more experienced employees. It may also be due to the low mobility of the Portuguese labor market, which leads to the low rotation of workers in firms.

For policy makers, these results suggest that policies stimulating new firm creation must concentrate on start-up conditions and planning. Also that measures encouraging new firm creation should focus on more educated and experience founders. For manager practitioners these results provide evidence on the importance of their decisions in early stages of the business formation because the impact will last the entire lifetime of firms.

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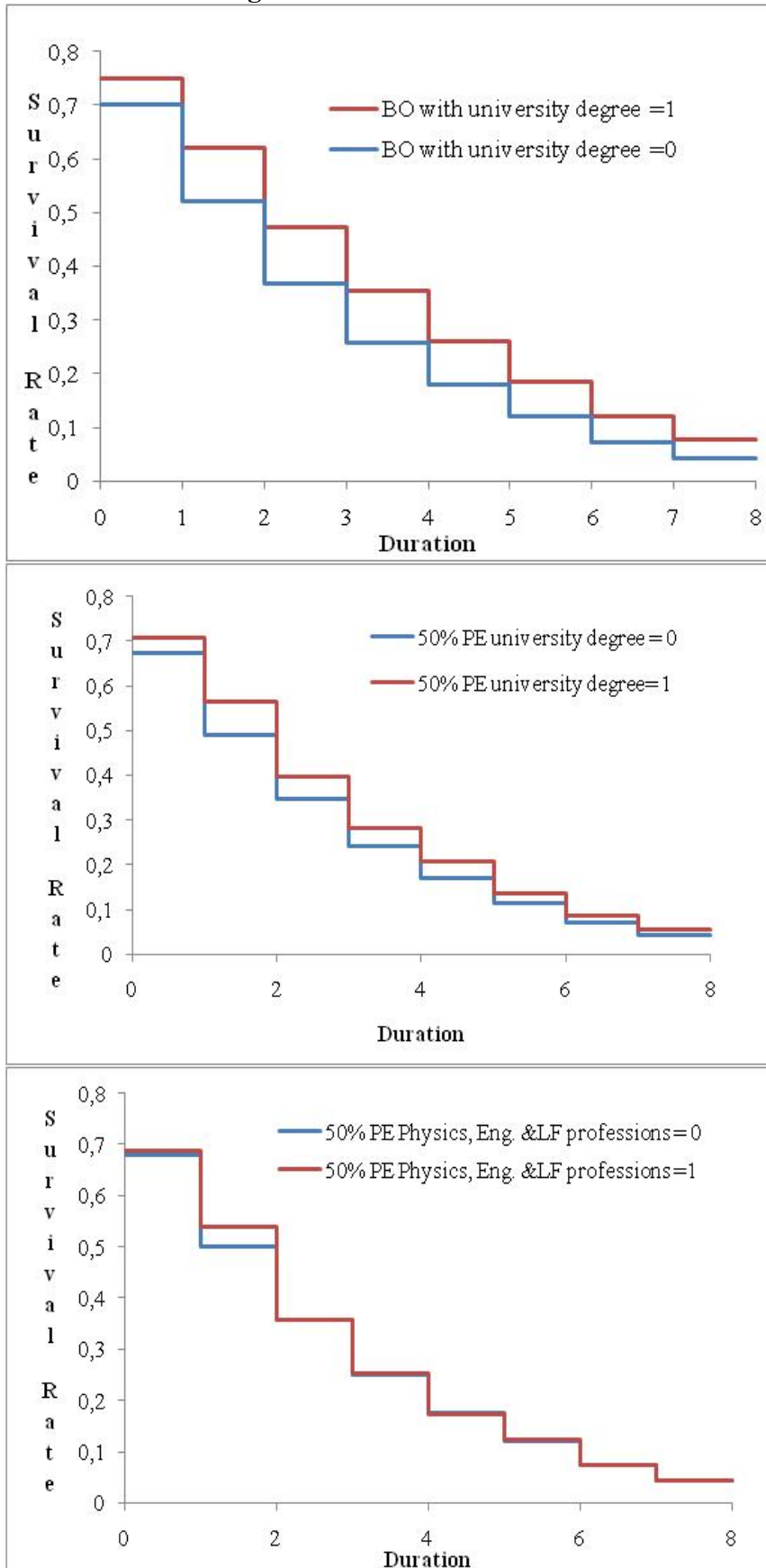**Figure 1**- Survival rates for firms in the data

Table 1- Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
Human Capital of the Business Owner at Start-up				
University degree	0.244	0.429	0	1
High-school diploma (12 years)	0.233	0.423	0	1
Compulsory education (9 years)	0.164	0.370	0	1
Experience as Business owner in the previous 3 years	0.460	0.498	0	1
Sector experience in the previous 3 years	0.743	0.437	0	1
Managerial experience as employee in the previous 3 years	0.498	0.500	0	1
Labor Market experience (years)	13.198	12.509	0	68
Human Capital of the Employees at Start-up				
University degree (%)	14.845	29.102	0	100
High-school diploma (12 years) (%)	29.093	35.484	0	100
Compulsory education (9 years) (%)	16.554	27.970	0	100
Occupations in Physics and Engineering Sciences; Life Sciences and Health (%)	4.577	18.846	0	100
> 50% employees with managerial experience in the last 3 years	0.888	0.315	0	1
> 50% employees with sector experience in the last 3 years	0.851	0.356	0	1
Human Capital of the Employees – Current conditions				
University degree (%)	16.941	29.361	0	100
High-school diploma (12 years) (%)	29.821	33.250	0	100
Compulsory education (9 years) (%)	16.667	25.983	0	100
Occupations in Physics and Engineering Sciences; Life Sciences and Health (%)	4.764	18.561	0	100
> 50% employees with managerial experience in the previous 3 years	0.676	0.468	0	1
> 50% employees with sector experience in the previous 3 years	0.604	0.489	0	1
Firm variables				
Sales volume (log)	11.498	1.386	2.349	22.685
Share capital (log)	8.153	2.952	0	21.819
Firm Size (log of No. Employees)	1.094	0.965	0	8.288
Firm with foreign capital (binary variable)	0.014	0.117	0	1
Industry				
Manufacturing Firm (binary variable)	0.244	0.429	0	1
Minimum Efficient Scale	1.664	3.945	0.1	161.783
Macro-economic				
Unemployment Rate	5.278	0.889	3.889	6.400
Number of observations				57,216

Note: Variables accounting for education and experience are binary variables.
Labor market experience = Age – education – 6 (measured in years)
Minimum Efficient Scale = Average size (in no. of employees) of firms in the 5 digit sector each year divided by average size (in no. of employees) of all firms in all sectors in each year /10.

Table 2. Firm Survival - Estimation of the Cox proportional hazard model: Initial Conditions

	Hazard ratio
Human Capital of the Business Owner at Start-up	
University degree	0.781***
	[0.051]
High-school diploma	1.061
	[0.053]
Compulsory education	0.948
	[0.055]
Experience as business owner in the previous 3 years	1.098**
	[0.042]
Sector experience in the previous 3 years	1.005
	[0.034]
Managerial experience as employee in the previous 3 years	1.019
	[0.037]
Labor market experience	0.999
	[0.001]
Human Capital of the Employees at Start-up	
University degree	1.003***
	[0.001]
High-school diploma	0.999
	[0.001]
Compulsory education	0.999
	[0.001]
Occupations in Physics and Engineering Sciences; Life Sciences and Health	1.000
	[0.001]
> 50% employees with sector experience in the previous 3 years	0.178***
	[0.012]
> 50% employees with managerial experience in the previous 3 years	0.843***
	[0.050]
Firm variables	
Foreign Capital	0.931
	[0.139]
Industry	
Manufacturing Firms	0.936
	[0.044]
Minimum efficient scale at start-up	0.999
	[0.003]
Macro-economic	
Unemployment Rate at start-up	1.223***
	[0.028]
Observations	34498

Standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Initial values of every variable

Table 3. Firm Survival - Estimation of the Cox proportional hazard model: Initial and Current Conditions

	Hazard ratio
Human Capital of the Business Owner at Start-up	
University degree	0.864**
	[0.057]
High-school diploma	1.076
	[0.054]
Compulsory education	0.983
	[0.057]
Experience as business owner in the previous 3 years	1.087**
	[0.042]
Sector experience in the previous 3 years	0.962
	[0.033]
Managerial experience as employee in the previous 3 years	1.005
	[0.037]
Labor market experience	0.998*
	[0.001]
Human Capital of the Employees at Start-up	
University degree	1.000
	[0.001]
High-school diploma	0.999
	[0.001]
Compulsory education	0.999
	[0.001]
Occupations in Physics and Engineering Sciences; Life Sciences and Health	0.998*
	[0.001]
> 50% employees with sector experience in the previous 3 years	0.648***
	[0.049]
> 50% employees with managerial experience in the previous 3 years	0.894*
	[0.052]
Human Capital of the Employees – Current conditions	
University degree	1.001**
	[0.001]
High-school diploma	1.000
	[0.001]
Compulsory education	1.001*
	[0.001]
Occupations in Physics and Engineering Sciences; Life Sciences and Health	1.007***
	[0.001]
> 50% employees with sector experience in the previous 3 years	0.478***
	[0.029]
> 50% employees with managerial experience in the previous 3 years	0.890***
	[0.039]
Firm variables	
Foreign Capital	0.848
	[0.126]
Industry	
Manufacturing Firms	0.976
	[0.047]
Minimum efficient scale at start-up	0.995

	[0.005]
Minimum efficient scale – current conditions	1.009
	[0.006]
Macro-economic	
Unemployment Rate at start-up	1.062**
	[0.028]
Unemployment Rate – current conditions	2.688***
	[0.065]
Observations	33778

Standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4- Firm Survival - Estimation of the Cox proportional hazard model: Initial Conditions and interaction with time

	Hazard ratio
Human Capital of the Business Owner at Start-up	
University degree	0.868
	[0.094]
High-school diploma	1.011
	[0.088]
Compulsory education	0.968
	[0.097]
Experience as business owner in the previous 3 years	1.281***
	[0.083]
Sector experience in the previous 3 years	0.849***
	[0.048]
Managerial experience as employee in the previous 3 years	0.943
	[0.058]
Labor market experience	1.001
	[0.002]
Human Capital of the Business Owner at Start-up – interaction with time	
University degree	0.982
	[0.020]
High-school diploma	1.012
	[0.016]
Compulsory education	0.996
	[0.017]
Experience as business owner in the previous 3 years	0.959***
	[0.012]
Sector experience in the previous 3 years	1.043***
	[0.012]
Managerial experience as employee in the previous 3 years	1.016
	[0.013]
Labor market experience	0.999
	[0.0004]
Human Capital of the Employees at Start-up	
University degree	1.003*
	[0.002]
High-school diploma	0.998
	[0.001]
Compulsory education	1.000
	[0.001]
Occupations in Physics and Engineering Sciences; Life Sciences and Health	1.005***
	[0.002]
> 50% employees with sector experience in the previous 3 years	0.529***
	[0.073]
> 50% employees with managerial experience in the previous 3 years	0.666***
	[0.088]

Human Capital of the Employees at Start-up – Interaction with time

University degree	1.000
	[0.0003]
High-school diploma	1.000
	[0.0002]
Compulsory education	1.000
	[0.0002]
Occupations in Physics and Engineering Sciences; Life Sciences and Health	0.999***
	[0.0003]
> 50% employees with sector experience in the previous 3 years	0.570***
	[0.038]
> 50% employees with managerial experience in the previous 3 years	1.128*
	[0.074]
Firm variables	
Foreign Capital	0.902**
	[0.043]
Industry	
Manufacturing Firms	0.992
	[0.007]
Minimum efficient scale	0.954
	[0.142]
Minimum efficient scale – interaction with time	1.001
	[0.001]
Macro-economic	
Unemployment Rate	1.016
	[0.043]
Unemployment Rate – interaction with time	1.058***
	[0.009]
Observations	34498

Standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5- Sales Performance: Pooled Estimation

	Sales (log)
Human Capital of the Business Owner	
University degree	0.092***
	[0.015]
High-school diploma	-0.133***
	[0.013]
Compulsory education	-0.188***
	[0.014]
Experience as business owner in the previous 3 years	0.210***
	[0.012]
Sector experience in the previous 3 years	0.013
	[0.012]
Managerial experience as employee in the previous 3 years	0.063***
	[0.010]
Labor market experience	0.008***
	[0.0004]
Human Capital of the Employees	
University degree	0.004***
	[0.0002]
High-school diploma	0.004***
	[0.0001]
Compulsory education	0.004***
	[0.0002]
Occupations in Physics and Engineering Sciences; Life Sciences and Health	0.003***
	[0.0003]
> 50% employees with sector experience in the previous 3 years	-0.051***
	[0.017]
> 50% employees with managerial experience in the previous 3 years	-0.138***
	[0.017]
Firm variables	
Share capital	0.093***
	[0.002]
Firm size	0.829***
	[0.006]
Foreign capital	0.752***
	[0.037]
Industry	
Manufacturing firm	0.202***
	[0.012]
Minimum Efficient Scale	0.007***
	[0.001]
Macro-economic	
Unemployment Rate	0.019***
	[0.005]
Constant	8.944***
	[0.034]
Number of observations	57056
R-squared	0.45

Standard deviation in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6- Sales Performance: Fixed effects Estimation

	sales (log)
Human Capital of the Business Owner	
University degree	0.006
	[0.017]
High-school diploma	-0.102***
	[0.013]
Compulsory education	-0.117***
	[0.015]
Experience as business owner in the previous 3 years	0.331***
	[0.009]
Sector experience in the previous 3 years	-0.005
	[0.009]
Managerial experience as employee in the previous 3 years	0.038***
	[0.010]
Labor market experience	0.008***
	[0.001]
Human Capital of the Employees	
University degree	0.001***
	[0.0003]
High-school diploma	0.002***
	[0.0002]
Compulsory education	0.001***
	[0.0002]
Occupations in Physics and Engineering Sciences; Life Sciences and Health	0.002***
	[0.0003]
> 50% employees with sector experience in the previous 3 years	-0.045***
	[0.015]
> 50% employees with managerial experience in the previous 3 years	-0.358***
	[0.015]
Firm variables	
Share capital	0.051***
	[0.003]
Firm size	0.523***
	[0.009]
Foreign capital	0.134**
	[0.058]
Industry	
Manufacturing Firm (D)	-0.106
	[0.069]
Minimum Efficient Scale	-0.004***
	[0.002]
Macro-economic	
Unemployment Rate	0.037***
	[0.004]
Constant	9.931***
	[0.040]
R-squared	0.26
Number of firms	19213
Observations	57056

Standard deviation in brackets; * significant at 10%; ** significant at 5%; ** significant at 1%