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SCHOOL OF
ECONOMICS &
MANAGEMENT
UNIVERSIDADE DE LISBOA

MASTER IN
FINANCE

MASTER'S FINAL WORK
DISSERTATION

GAZELLE ENTREPRENEURS

CRISTINA MENDES FERREIRA

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“Be the change that you want to see in the world.”

Mahatama Gandhi

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Abstract

Gazelle firms are young high growth ventures. They have less than five years old, employ more than ten workers and their annualized growth is greater than twenty percent per year over a three-year period. Given their importance in the economy, previous studies have evaluated the main determinants for their short-term growth. This study takes a novel approach and evaluates gazelles' long-term performance, in terms of job creation and survival. More specifically, we analyze if gazelle firms continue to outperform the other start-ups in the long run or if their growth is temporary.

To provide new insights, we used a matched employer-employee dataset (QP-"Quadros de Pessoal"). Our data enable us to identify gazelle start-ups and their founders. We select all start-ups established between 2000 and 2005 and we track them for a seven-year period. We identify 175 gazelle start-ups and 37,700 non-gazelle start-ups.

Our results suggest that gazelle firms perform better on the long run. In comparison with the non-gazelle start-ups, their size increased by 144, 130, 86, 69, 52, 37 and 19 percent in years 4 to 10, respectively. However, we have not found statistical evidence of gazelle firms being more likely to survive on the long run, thus we cannot conclude that gazelle firms are less likely to survive on the long run.

JEL Classification: M10, M13, L25, L20.

Keywords: high-growth companies, gazelles, long run performance, firm survival.

Resumo

As empresas gazela são empresas jovens de alto crescimento. Estas têm menos de cinco anos de idade, empregam mais de dez trabalhadores e o seu crescimento anualizado é maior do que vinte por cento por ano, durante um período de três anos. Dada a importância destas empresas na economia, alguns estudos anteriores avaliaram os principais determinantes para crescimento destas empresas a curto prazo. Este estudo tem uma abordagem nova e avalia o desempenho a longo prazo das gazelas, em termos de criação de emprego e sobrevivência. Mais especificamente, analisamos se as empresas gazela continuam a superar as outras start-ups em fase de arranque, a longo prazo ou se o seu crescimento é temporário.

Para proporcionar uma nova visão, foi utilizado uma base de dados empregador-empregado (QP- "Quadros de Pessoal"). Os nossos dados permitem identificar as empresas gazela e seus fundadores. Nós selecionamos todas as start-ups estabelecidas entre 2000 e 2005 e seguimo-las por um período de sete anos. Identificamos 175 empresas gazela e 37.700 empresas não-gazela.

Os nossos resultados sugerem que as empresas gazelas têm um melhor desempenho a longo prazo. O tamanho das empresas gazela aumentou em 144, 130, 86, 69, 52, 37 e 19 porcento entre os anos 4 e 10, respetivamente, em comparação com as empresas não-gazela. No entanto, não há evidência estatística que permita concluir que as empresas gazela têm uma maior taxa de sobrevivência no longo prazo.

Classificação JEL: M10, M13, L25, L20.

Palavras-chave: empresas de alto crescimento, gazelas, desempenho de longo prazo, sobrevivência da empresa.

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List of Abbreviations

CAE.Rev2.1	Portuguese Classification of Economic Activities, Revision 2
LPM	Linear Probability Model
NUTS II	Nomenclature of Territorial Units for Statistics 2
QP	Quadro de Pessoal
R. A.	Autonomous Region
OECD	Organisation for Economic Cooperation and Development

1 | Introduction

A small number of young high growth firms has received considerable attention in the existing literature. They are known as gazelle firms and they are seen as the "heroes" from the macroeconomic point of view as their presence is associated with innovation, growth and job creation. Policy makers also increasingly recognise the special role of these fast growing firms.

The literature generally refers to high-growth firms[1] as firms with relative high grow rates regardless of age and size, whereas gazelle firms are high grow young firms (Henrekson and Johansson, 2010). Although there is still some controversy regarding the growth and age definitions, existing literature defines gazelles[2], as "a business establishment which has achieved a minimum of twenty percent of sales growth each year over the interval (for five years), starting from a base year revenue of at least $100,000" (Birch et al. 1995, p.46). Gazelles differ from the "mice"- small firms with less than twenty employees, and "elephants" - large firms with more than five hundred employees. More recently, OECD (2007) defines gazelle firms as firms with less than five years old, with an average annualized growth rate greater than twenty percent per year over a three-year period, and with ten or more employees at the beginning of the period.[3] In this study, we use OECD definition.

Despite the heterogeneity across the studies, the majority of the studies find that gazelle firms are younger on average (Henrenkson and Johansson, 2010). They have

[1] OECD defines high growth enterprises as firms with average yearly growth rate of twenty percent or more over a three-year period, with ten or more employees in the first year. Growth is measured by the number of employees and by turnover.

[2] Also known as Birch firms. There are also known as gorilla's firms which are the extremely fast gazelles e.g. Apple, Microsoft, Intel etc. (Brinkley, 2008).

[3] INE (2014) uses a similar definition of young high growth firms. Gazelles are defined as firms, with at least ten employees, that achieve an average annual growth rate of twenty over three years, measured in terms of number of employees or turnover.

different sizes, although small firms are overrepresented, and are present in all industries (Parker et al., 2010).

While the positive short-term effects on economic growth are undeniable, the long-term economic gains from gazelle firms are less obvious (Stangler 2010). Previous research has evaluated the main determinants of their short-term growth but fewer have evaluated their long-term determinants. This study contributes to latter topic by answering the following research questions: What happens to gazelle firms after their first three years? Do they continue to grow or do they fail?

To answer these questions, we use a matched employer–employee dataset (QP– "Quadros de Pessoal"). Our data enable us to identify gazelle start-ups and their founders and track them for a long period of time. Our data also include detailed information on the characteristics of the founders and start-ups initial conditions.

Our results suggest that gazelle firms perform better on the long run. In comparison with the non-gazelles' start-ups, they create 144, 130, 86 and 69 percent, more jobs in year 4, 5, 6 and 7, respectively. However, we have not found statistical evidence of gazelle firms being more likely to survive after the first seven years.

Gazelle firms play a key role in the economy by reducing unemployment and creating jobs. Understanding the grow trajectories of these firms will allow policy makers to design better policy frameworks. Previous studies show that policy makers should focus on stimulating entrepreneurship in general, helping firms to survive, and allowing firms with potential to become high-growth firms (Mazerov and Leachman, 2016).

The remainder of this study is structured as follows. Section 2 provides an overview of the relevant literature regarding the gazelle's characteristics and their long run performance. We also review the role of these companies in the economy and their

temporary growth. In section 3, we provide a description of our dataset and descriptive statistics. Section 4 discusses our methodological approach, and section 5 presents our results. Finally, section 6 concludes.

2 | Literature Background and Hypothesis

Over the recent years, gazelle firms have been the main topic of several studies. On the one hand, the literature has highlighted the contributions of gazelles, as firms which provide high returns to shareholders (Acs et al. 2008) and create more jobs than other start-ups (Henrekson and Johansson, 2008). On the other hand, previous research evaluates gazelle's main characteristics and the main drivers for their short-term growth.

In this section, we summarize the relevant literature on their economic effects, characteristics and performance.

2.1 | Economic Contribution of Gazelles

Gazelle firms contribute more significantly to economic growth than other firms especially in periods of recession (Senderovitz et al., 2012). As such, Bos and Stam (2011) argued that gazelle firms are early movers on recognizing and realizing industry opportunities. These firms are important vehicles for employment (Bos and Stam, 2011) as they account for a disproportionate share of jobs created, productivity and sales (Henrenkson and Johansson, 2010).

Their economic and social impacts include productivity increases by reallocating resources from displaced firms to the stronger firms; spillover effects of rapid growth on other firms; and improvements on innovative activity. High-growth firms are also responsible for a disproportionate amount of innovation (Mason et al., 2009). Mason et al., (2009) suggest that young high-growth firms invest in resources and capabilities related to innovation. For example, firms that developed innovative products have a 4.4 percent average growth rate in employment while non-innovative firms show an average growth rate of 2 percent. (Mason et al., 2009).

2.2 | Who are gazelle firms?

Previous studies have evaluated gazelle firms' characteristics in terms of size, age, industry, region and innovative activity.

Gazelle firms are young firms on average with less than five years of age (Daunfeldt et al. 2010; Anyadike-Danes et al. 2009). Acs and Mueller (2007) stated that the age is the real issue in business dynamics as most new firms are small, Daunfeldt et al. (2010) also suggested that firm age, rather than firm size, is the main determinant of the rapid growth. Furthermore, Haltiwanger et al. (2013) suggested that young firms create more jobs than small firms. However, Parker et al., (2010) and Moreno and Casillas (2000) argued that age is not a factor that distinguishes these companies from the rest. The most important is their innovative activity (Coad, 2009).

Some studies argued that gazelle firms are concentrated on specific industries. However, industry is not a relevant key determinant of growth (Bos and Stam, 2011). Gazelle firms usually are not high-tech firms. In contrast, they operate in the private services sector (Henrekson and Johanson, 2010; Acs and Mueller, 2006), and are present across all industries (Bos and Stam, 2011; Nightingale and Coad, 2013; Senderovitz et al, 2012).

In terms of size, the majority of studies found that smaller companies grow faster, which means that size is inversely related to firm growth (Bigsten and Gebreeyesus, 2007). However, other find that gazelle firms tend to be of all sizes (Henrekson and Johansson, 2010). In absolute terms, larger firms are important job contributors (Henrekson and Johansson 2010 and Mason et al., 2009), however small businesses achieve higher growth as they can duplicate their dimension in a short period of time (Daunfeldt et al. ,2010 and Moreno and Casillas, 2000).

Others studies argued that gazelle growth depends on the innovation activity of the start-up (Holzl and Friesenbichler, 2007; Audretsch, 2012 and Mason et al., 2009). Gazelle firms combine new inputs, develop new products which enable them to perform better than most firms and create new markets by destroying an existing one (Holzl and Friesenbichler, 2007). In fact, gazelle firms are innovative in the Schumpeterian sense. They require a competitive advantage in order to achieve an above average growth rate, which is achieved through new products, technical change or new processes (Holzl and Friesenbichler, 2007). Moreover, their success is rooted in product diversification and internationalization. Most of their sales come from international markets, as such gazelle firms experience stronger export growth than other firms (Holzl and Friesenbichler, 2007). According to Kuratko (2016), these firms are leaders in innovation, they produce twice as many products per employee as larger firms do and they are responsible for 55% of the innovations in different industries.

In terms of location, gazelle firms do not seem to be concentrated in particular regions or near areas with higher levels of technology, instead they locate closer to the city center in large cities. (Audretsch, 2012 and Senderovitz et al., 2012). Gazelle regions are “regions that have a predominance of rapidly growing companies” (Acs and Mueller 2006, p.94). These regions usually include universities and research facilities and have high share of employment available.

Table 1, further summarizes the academic findings regarding the gazelle entrepreneurs.

2.3 | Gazelles and their long term performance

According to the previous literature, gazelle firms do not survive in the long run. (Gjerlov-Juel and Guenther, 2012). Within five years, more than half fail and others leave the market few years later (Mazerov and Leachman, 2016). The literature shows that survival does not depend on the previous growth performance. In fact, some argued that there is a limit to growth, and after this limit is achieved it becomes inefficient to grow even further (Penrose, 1995). As such, high growth rates are not persistent overtime (Coad, 2009).

Promoting young high growth firms does not guarantee the creation of sustainable jobs and firms in long run (Stangler, 2010). New firms create new jobs, but they also destroy employment in other firms (Stangler 2010). As such, some studies argue that on the long run, gazelle firms destroy not only the jobs that they created (as they fail) but also the jobs in other firms (Haltiwanger et al., 2013). Stangler (2010) showed that in the first two years, a third of gazelle start-ups in the US failed and, in five years, just 48 percent survived. However, the growth of the surviving firms was more than enough to offset the firms that have failed.

Gazelle firms are known as a "temporary phenomenon"[4] in the life of a firm, especially if they are small firms (Holzl, 2008 and Buss, 2002). This means that a successful gazelle will develop from a small /medium size firm into a large one and stabilize, in the long run (Holzl and Friesenbichler, 2007).

Growth rates are usually interpreted as a sign of competitive advantage and efficient production. However, there are usually two sides behind high growth rates. On the one hand, gazelle firms can take the advantage of economies of scale and skills

[4] Temporary phenomenon is based on the three dimensions of a firm: size, age and growth.

brought in by employees (Gjerlov-Juel and Guenther, 2012). On the other hand, growing too fast might have a negative effect on firm's long term performance which makes it difficult to establish solid and efficient organizational routines, therefore it will be more difficult to maintain high growth rates over time (Amat and Perramon 2010). These difficulties are caused by the so called "success traps" argued by Ahuja and Lampert (2001). And this happens when a firm focus only in a certain strategy which has been successful.

In the same reasoning, some studies link the accumulation of experience with productivity growth (Eriksen, 2010). This leads us to the organizational learning theory from March (1991) which implies a negative relation between employee turnover and firm performance. In other words, employer turnover leads to a loss of accumulated experience in the firms and consequently a weaker productivity. According to Eriksen (2010, p.5) the employee turnover leads to a loss of accumulated experience given that the firm loses the services of the individuals that are "bearers of its experience, and moreover, it takes time, effort and money for new hires to acquire the same level of knowledge as departing employees".

According to March (1991) the main goal of a firm is to achieve a sustainable competitive advantage. The trade-of between the strategies of exploitation and exploration are complementary and both essential to the success of the firm. Exploitation includes activities related with selection, implementation, execution and efficiency while exploration involves research, flexibility, experimentation, discovery, innovation risks and uncertainty. March (1991) argued that firms which are focused on exploration require higher initial costs without getting benefits on short term. The phase of exploitation is generally characterized by a strong emphasis in economic growth through the usage of

the existing knowledge and learning processes. Moreover, the focus in the reduction of costs might generate economies of scale, which will decrease the average cost of each unit produced. For these reasons, March (1991) highlighted the importance of achieving the balance between exploration and exploitation within an organization in order to survive. The author also added that organizations learn from individuals and vice-versa. When a knowledgeable employee leaves, the organization loses firm-specific human capital. In addition, because of being constantly hiring new employees the ability to retain past learning reduces.

Using the same reasoning, Penrose (2009) suggest that high initial growth leads to an inefficient integration of new employees, and therefore perform inefficiencies, stagnation and loss of competitive advantage. Therefore, employee turnover has a negative effect on employee outflow, which leads to human capital losses, increases in turnover costs (i.e. recruiting expenses, training, learning contextual skills and development costs) and productivity declines (Eriksen, 2012, Glebbeek and Bax, 2002 and March. 1991). Despite the strong focus on the turnover costs, there are also benefits. Employee's turnover may solve bad performance, increases firms' skills, refresh their initial knowledge, especially for innovative purposes (Gjerlov-Juel and Guenther, 2012).

Gazelle firms experience employee outflow and human capital decreases (Gjerlov-Juel and Guenther, 2012). But the high initial inflow of new employees is the biggest challenge for these firms because they affect organization stability (organizational form, routines and norms) and efficiency leading to a negative performance on the long run. Several factors inhibit growth on the long run, for instance, issues related to the firm, the micro and macroeconomic environment and the technology. Among those factors, Holzl and Friesenbichler (2007) pointed out resistant to change, ownership structure

(family business have less ambition to grow); age (younger founders have the ambition to grow) and the economic reasoning related with the adjustment costs and lack of capital. Audretsch (2012) adds to the list the characteristics of founding teams (the stability of the team members, the heterogeneity of their background); international market orientation; access to resources. Forsberg and Mattsson (2006) pointed that large fixed cost, unsuccessful investments in the market, rapid economic turnover/sales, inefficient cash flow and cash reserves as other factors that affect high growth. The most important external factors are economic recession, loss of important clients and the difficult to get loans.

To sum up, previous literature suggested that the majority of gazelle firms will either fail or reduce their growth rate thus we hypothesize:

Hypothesis 1: Gazelle firms perform worse in the long run in terms of job creation and survival.

3 | Data and Descriptive Statistics

3.1 | Data

Our analysis draws on a matched employer-employee database (QP - "*Quadros de Pessoal"*). The matched employer-employee database is a mandatory survey that gathers comprehensive information on an average of 220,000 firms and two million individuals per year, which covers all Portuguese private sector for a longer period from 1986 to 2012. It is submitted annually to the Portuguese Ministry of Employment and Social Security by start-ups with at least one employee. Individuals and firms are cross referenced by a unique identifier. Also, the database makes it possible to link founders with their start-ups and evaluate them for a long time span. It has comprehensive information at the individual and firm level. Every year, firms report year of creation, size, and industry, number of establishments, initial capital, and ownership structure. At the founder level, the database contains information on gender, age, date of hire, education, occupation, working hours, and earnings per hour.

3.2 | Sample

From the QP, we start by selecting all start-ups established between 2000 and 2005 and track them for the next seven years. Therefore, we will have six cohorts, respectively: 2000-2007; 2001-2008; 2002-2009; 2003-2010; 2004-2011 and 2005-2012. Next, we identify the gazelle firms and non-gazelle firms. For that purpose, we use OECD (2007) definition. Gazelle firms are firms established initially by ten or more employees, with twenty percent average growth rate in the first three years. We exclude from our sample start-ups established in the agriculture and fishing sector and located in Madeira and Azores islands.

Then, for those start-ups, we identify their founders and their background history. We restrict our sample to founders aged between 20 and 65 years old and we exclude start-ups which we could not identify the owner and their background history. We only consider organically growing firms and thus exclude all firms that experienced mergers and/ or acquisitions as Holzl and Friesenbichler, (2007). Our sample includes 175 gazelle firms and 37,700 non-gazelle firms totalling 37,875 start-ups and 67,926 entrepreneurs.

3.3 | Descriptive Statistics

Table 2 presents the description of our variables and Table 3 summarizes the descriptive statistics of our sample. Start-ups in our sample are small, employing initially on average 3.8 workers.

As expected gazelle firms are larger initially employing 2849 employees while in the following years, we see that number of employees increases for gazelle firms but decreases for non-gazelle firms (Table A. 1 and Table A. 2). Gazelle firms and non-gazelle firms survive on average 7.6 and 6.2 years, respectively. Most of the start-ups are established in the “Services" sector (54 percent), and the remaining are dispersed by "Construction" (26 percent), "Manufacturing" (11 percent) and "Other services" (9 percent) sectors. Services includes the ISIC codes 50-74, Manufacturing includes the ISIC 15-37 and Other services includes 41, 80, 85 and 90-93 ISIC codes corresponding to activities such as: education, health and electricity. Gazelle firms are most notably in “Construction” (56 percent) and “Services” (27 percent) sectors, while non-gazelle firms are overrepresented in “Services” (55 percent) sector. These start-ups are mostly located in three regions: "Norte", “Centro” and “Lisboa” with (38 percent), (27 percent) and (22

percent) respectively. More than half of the gazelle firms are located in the "Norte" and "Lisboa" (23 percent) regions. Non-gazelle firms are more dispersed in terms of locations, (Figure 1 and Figure 2).

In our sample, founders are predominantly men (70 percent) aged approximately 37 years old. They are less likely to be foreign (4 percent). In terms of education, 22 percent of the entrepreneurs have very low education, 40 percent have low education, 22 percent have medium education and the remaining 16 percent are high educated. The percentage of founders with high and medium education is higher in non-gazelle firms than in gazelle firms (22 and 16 percent versus 16 and 14 percent, respectively). More than 42 percent of all start-ups in our sample are established by one founder. In terms of experience, we conclude that 18 percent of the founders previously worked on the same industry and 27 percent worked before in the same region. In gazelle firms, the percentage of founders with industry and region experience is higher when compared with non-gazelle firms (37 and 34 percent versus 27 and 18 percent, respectively).

Figure 3, shows the average number of employees for gazelle and non-gazelle firms. Table A. 1 and Table A. 2 shows the same but in terms of regions. We can conclude that the region "Lisboa" is most notably since employs the highest number of employees in the first three years and also at year ten. "Norte" and "Centro" are also the regions that have created more jobs, after "Lisboa", but they also decreased the number of employees in the period observed, however the region "Centro" was the one which decreased less, ending up with 284 employees (Norte ended up with 736 employees). This decrease happens after the three first years observed. Moreover "Lisboa" was the only region which has increased exponentially the number of employees ending up with 10345, while

"Algarve" ended with none employees. This increase more than offset the decrease in the rest regions when compared with moment zero and moment ten, we can double check in figure 3 the exponential pattern.

On contrarily, non-gazelle firms increased the number of employees until year one however, it is most notable the biggest decrease in all regions particularly after year seven. The regions "Norte", "Centro" and "Lisboa" were most notably while "Alentejo" and "Algarve" were the regions that did not create many jobs in the scale observed.

Finally, in Figure 4 we can find the proportion of gazelle and non-gazelles firms which survived in terms of region. A considerable number of gazelle firms are still running after the first seven years of activity. This is notable in activities related with "Services" and "Construction ", they are mostly located in "Norte", "Lisboa" and "Centro". We can also have the same conclusion regarding non-gazelle firms. In the period observed, 111 gazelle firms from a total of 175 and 19,741 non-gazelle firms survived from a total of 37,700. That is 63 percent and 52 percent, respectively.

4 | Empirical Methodology and Results

Our empirical strategy evaluates how gazelle firms perform compared with other start-ups. We assess the performance by looking at size after the first three years and survival in the long run.

4.1 | Size

To evaluate if gazelle growth is temporary, we estimate the following equation:

$$Sizet_{ijy} = \alpha_r + y_y + \theta_r + \beta_1 Gazelle_j + \beta_2 Initial\ Size_f + X'_i \delta_1 + \delta_2 \text{founder}_i + \epsilon_{ijy} \quad [1]$$

where *i* denotes the founder, *j* is the start-up firm, *y* denotes the entry year, *r* is the start-up location (NUTS II region) [5] and k the industry (ISIC code at two-digit level)[6].

The dependent variable, $Sizet_{ijy}$ is the logarithm of the number of employees of a start-up in year t (t=4, ... ,10). For example, Size4 is the logarithm of the number of employees of a start-up in 4th year of activity.

Our variable of interest is $Gazelle_j$, a dummy variable equalling one if it is a gazelle firm and zero otherwise. Our hypothesis suggest that beta should be negative and statistically significant. We include $Initial\ Size_f$ which is the logarithm of the initial number of employees of the start-ups.

X'_i is a vector of founder characteristics: founder's age and founder's age squared in the entry year of the start-up; gender, equals 1 for men and 0 for women; education is measured by four categorical variables: High education, which is a dummy variable equalling one for founders with bachelors, masters or doctoral degrees; Medium

[5] The Nomenclature of Units for Territorial Statistics (NUTS) is a regional classification developed and regulated by the European Union. Following NUTS II division, Portugal is divided in seven regions: Norte, Centro, Lisboa, Alentejo, Algarve, Açores and Madeira.

[6] The International Standard Industrial Classification of All Economic Activities (ISIC), Rev.3.1 is an industry classification developed by United Nations which is the same as the Portuguese Classification of Economic Activities (CAE) Rev. 2.1. There are 39 ISIC 2-digit categories in the data, covering essentially Agriculture, Fishing and Mining (ISIC 1-14), Manufacturing (ISIC 15-37), Construction (ISIC 45) and Services (ISIC 50-74).

education, is a dummy variable equalling one for individuals reporting a high school diploma or vocational school degree; Low education, is a dummy variable equalling one for individuals that attended junior high school; and Very Low education, is a dummy variable equalling one for individuals who never attended or completed the elementary school; foreign, which equals 1 for foreign and 0 for Portuguese nationality; industry experience, equalling 1 for founders that previously worked in the same industry (on the same 4-digit industry code) and 0 otherwise; and regional experience corresponds to 1 if the founders have previously worked in the same municipality; and 0 otherwise.

We include a dummy variable for sole entrepreneur, meaning that the variable equals one for ventures established by one founders and zero otherwise. We include entry fixed effects, y_y to control for the macroeconomic context, θ_r accounts for industry fixed effects, α_r and for region fixed effects. Standard errors are clustered at the start-up level. The omitted category are very low educated female founders.

Table 4 presents the coefficient estimators for the effects of gazelle on size after the first four years using the Ordinary Least Squares (OLS). Columns (1) to (7) show the yearly number of employees from the fourth year until year ten, respectively. For the period considered, gazelle firms' grow more than non-gazelle firms did. Nevertheless, after the seventh year, this effect is weaker and is less significant. The size of the gazelle firms increased 144 percent in the first four years however, in the last year observed they only increased 19 percent comparing to non-gazelle firms. Therefore, there is evidence that our first hypothesis that suggested gazelle firms perform worse in the long run in terms of job creation is not supported.

As expected, we find that demographic and education characteristics of the founders affect the size of the start-up after the first three years. The same conclusion was

reached by Audretsch (2012) and Henrenkson and Johansson, (2010). For all the years, there is an inverted U shape relationship between founders age and size. If the founder is male, the size of the firms increases by 5 percent on the fourth year and 2 percent on the tenth year. The coefficients – high education, industry and region experience are positively related with the firms' size while the number of founders, the nationality are inversely related with the size of the firm. Founders with high education, industry and region experience are more likely to establish larger firms. Compared to very low educated founders, high educator founders, increase the size of the firm by 3.3 percent on year ten.

As expected, the initial number of employees affect the size of the start-up after the first three years. The initial number of employees increases the size of start-ups by 0.6 percent and 0.2 in year four and ten, respectively. We conclude that the initial number of employees affects the firms' size in the long run.

In addition, Table 5 and Table 6 show the number of employees in year four and ten, respectively. We can infer that the variables: initial size, gender and age are positively related with the firms' size in a region perspective in year four.

Gazelle firms grow more than non-gazelle firms in "Lisboa" and the statistical significance decrease when comparing year four and year ten.

In year ten, the regions "Alentejo" and "Algarve" have a negative effect, meaning that gazelle firms grow less than non-gazelle firms. This can be explained by the lack of population and the seasonality effect. The coefficient initial size is positively and statistically significant related with firms' size, while founder is negatively and statistically significant for all regions in both years.

Comparing both years, we can find that the coefficients high education and gender are positively and statistically significant in year four for "Norte", "Centro" and "Lisboa" regions, while in year ten the coefficient High education is only statistically significant in "Norte".

To sum up, we can conclude that the initial number of employees affects positively the size of gazelle firms, in a region perspective and "Lisboa" is the region where this effect is higher.

4.2 | Survival

To analyse survival, we start by estimating a logit model using the following equation:

$$Survival_{ijy} = \alpha_r + y_y + \theta_r + \beta_1 Gazelle_j + X'_i \delta_1 + \delta_2 Initial\ Size_f + \epsilon_{ijy} \quad [2]$$

where *i* denotes the founder, *j* is the start-up firm, *y* denotes the entry year, *r* is the start-up location (NUTS II region) and k the industry (ISIC code at two-digit level). Again, we control for entry, industry and region fixed effects.

The dependent variable, $Survival_{ijy}$, is a dummy variable equalling one if the start-up is still running after seven years and zero otherwise. Our hypothesis suggest that beta should be lower than zero suggesting that the probability of a gazelle firm to survive is lower, *ceteris paribus*.

X'_i is a vector of founder's characteristics, which includes age, education, nationality industry experience and regional experience, as previously mentioned in section 4.1. We include $Initial\ Size_f$ which is the logarithm of the initial number of employees of the start-ups.

Table 7 shows the marginal effects for start-ups survival using the Logit Model. We present on Column (1), the results using a sample with all firms; in Column (2) and (3) we present the results for gazelle firms and non-gazelle firms respectively.

It seems to be the case that gazelle firms are more likely to survive after seven years of activity, i.e. gazelle firms increase the probability of survival by 2.1 percent. However, there are evidence that the coefficient that measures this is not statistically significant. Therefore, we have not found statistically evidence of gazelle firms being more likely to survive on the long run, thus we cannot conclude that gazelle firms are less likely to survive on the long run.

We can conclude that the relation between "age" and survival is a quadratic function, meaning that there is always a positive value for "age" when the effect of "age" on "survival" is zero; before this point[7], "age" has a positive effect on "survival" and after this point, "age" has a negative effect. In our case, for all firms, the coefficients for "age" and "age^2" are positive and negative, respectively, meaning that we have a parabolic shape and until the maximum point founder's age is beneficial for firms' survival and after that point founder's age becomes negatively relative with firms' survival. However, with gazelle firms we have a U-shape function since the coefficients are negative and positive, respectively, and this captures an increasing effect of "age" on survival.

Gender, region experience, industry experience affects positively firms' survival and they are statistically significant. They increase the probability of survival by 2.1, 1.9 and 3.9 percent for all firms, respectively. The same happens with education, but only for high educated founders (2.3 percent), while low and medium educated founders have a

[7] This point can be achieved by the coefficient on "age" over twice the absolute value of the coefficient on "age^2 ".

negative relationship firms' survival. Foreign founders are also negatively related with survival.

Initial size increases the probability of start-ups survival by 7.6 percent. However, the determinants of survival are different for gazelle and non-gazelle firms. For example, the initial size is only positively and statistically significant for non-gazelle firms. The initial size affects negatively the survival of gazelle firms. This means that a high initial size is more beneficial for non-gazelle firms. For gazelle firms, the coefficient "gender" is negatively related while positively related for non-gazelle firms. Moreover, the coefficients - industry experience and region experience have a positive sign, however they are only statistically significant for non- gazelle firms when compared with gazelle firms.

Table 7, in column (4), presents an additional regression, which introduces the interaction variable initial size*gazelle to our initial equation. The interaction variable added is negatively related and is not statistically significant. The effect of the initial number of employees in firms' survival is negative by 0.05 for gazelle firms and 0.08 for non-gazelle firms.

Adding this interaction, we conclude that the initial number of employees in gazelle firms is positively related with firms' survival. More, we found statistical evidence that gazelle firms increase the probability of survival by 38 percent. The conclusions for the remain coefficients doesn't change our results. Thus, the results do not support our hypothesis which suggest that gazelle firms are more likely to fail on the long run than non-gazelle firms.

Furthermore, we analyse the firms' survival by regions, Table 8. We cannot conclude that gazelle firms are more likely to survive in "Algarve", "Lisboa" and in "Norte" regions because we have not found statistically evidence.

The initial number of employees are positively and statistically significant in a region perspective. The coefficient increases the probability of start-ups survival by 11.3 percent in "Algarve", 3.1 percent in "Lisboa" and 8.1 percent in "Norte". For all the regions, there is an inverted U shape relationship between founder's age and size. The variables –gender, industry and region experience are positively related with firms' survival in all regions, while medium education and foreign are negatively related.

As a robustness check, we perform a Linear Probability Model (LPM) and a Probit Model. Both models suggest similar results regarding firm's survival. Table A. 3, Table A. 4 and Table A. 5 in the appendix present the results for the two estimations.

We also use a duration model to estimate start-ups survival. The Cox proportional model is the most used multivariate approach for analysing survival data because the estimated hazards are always positive, it requires fewer assumptions and the model is robust. The model is built from two parts: the baseline hazard function [describes how the hazard changes over time at the baseline (the baseline is where all explanatory variables are zero)] and the effect of parameters (is how the hazard changes in response to explanatory variables). "The hazard function is the instantaneous probability of leaving a state of conditional on survival to time t "(Cameron and Trived 2005, p.576).

Mathematically, the Cox model is written as:

$$h\,(t|x_j') = h_0(t)\exp(x_j'\beta) \qquad [3]$$

where $h_0(t)$ is the hazard function, x_j' is the vector of explanatory variables and β is the vector of coefficients to be estimated.

Table 9 presents the results of the Cox Proportional Hazard model for start-ups survival. If the coefficient is negative, the hazard function increases the probability of the firm survive at moment t. A low hazard rate is indicative of a firm that is more competitive and more likely to survive.

For a positive β, the hazard function decline the probability of the firm survive at moment t.

Once again, it seems to be the case that gazelle firms are more likely to survive when comparing to non-gazelle firms. Although, the coefficient is negative and not significant at 11.7 percent (-0.117). Therefore, we have not found statistically evidence of gazelle firms being more likely to survive.

In terms of gender, male entrepreneurs have higher survival prospects. Founders with region experience seems to have higher chance to survive, however with no statistical evidence. Education affects the survival prospects given by the negative coefficient. Start-ups with larger size have higher survival prospects.

For gazelle firms, we can conclude that foreign is the only statistically significant variable, however they have fewer chances of survival, however with no statistical evidence. Gazelle entrepreneurs with region experience seems to have higher chance to survive. While entrepreneurs with any level of education and previous industry experience have less survival prospects also with no statistical evidence. The start-ups initial size decreases the chance of failure, however the chance of survival is higher and only statistically significant in non-gazelle firms.

Founders who have previously worked in the same region affect more the survival of start-ups and the chance to survival is higher when compared with gazelle firms. While founders with industry experience have more chance to survive in non-gazelle firms. Start-ups established by one founder increase the chance of survival in all firms, and decrease the survival prospects in terms of gazelle firms. Most of the coefficients, increase the chance to survive in non-gazelle firms.

We have also introduced in the initial equation, the interaction size*gazelle. The coefficient added although presents a negative sign and it is not statistically significant which we cannot argue that the effect of the initial number of employees in gazelle firms have higher survival prospects (Table 9).

Adding the interaction variable, we conclude that gazelle firms seems to be less likely, (by 82 percent) to survive when compared to non-gazelle firms, however we have not found statically evidence to conclude that gazelle firms are less likely to survive in the long run. The conclusions for the remain coefficients does not change our results.

In Table 10, we used the duration model to estimate start-ups survival in terms of location. Moreover, it seems that gazelle firms are more likely to survive when comparing to non-gazelle showed by the negative sign. However, we have not found statistically evidence of gazelle firms being more likely to survive in all regions.

We conclude that start-ups with larger size have higher survival prospects in all regions. The regions “Alentejo” and “Norte” have higher survival prospects than the remain regions. In terms of gender, male entrepreneurs have higher chances to survive in all regions except in “Alentejo”. Start-ups established by one founder increases the chance of survival in all regions.

In terms of region, we also cannot suggest that gazelle firms are more likely to survive than non-gazelle firms what supports our previous estimation.

Conclusion

Gazelle firms and their extraordinary growth is a regular topic in the entrepreneurship literature. In this study, we add to the literature by evaluating gazelle firms' long-term performance, in terms of size after the first three years and survival prospects.

Using a sample of 175 gazelle firms and 37,700 non-gazelle firms, we find that the size of gazelle firms increased in comparison to non-gazelle firms and this is more concentrated in "Lisboa". The grow of gazelle firms was more than enough to offset the decrease found in the main regions. In other words, gazelle firms performed better than non-gazelle firms, however their growth decreased over the years observed. Thus, our hypothesis which suggested, that gazelle firms perform worse in the long run in terms of job creation, is not supported by the applied model.

In terms of survival, the Logit model suggest that there is no difference in the survival prospects of gazelle and non-gazelle firms. However, when we add the interaction variable we find that gazelle firms are more likely to survive comparing to non-gazelle firms. A relevant aspect we can highlight is the negative impact of the initial number of employees on gazelle firms' survival, that may be caused by the hurry to expand, which can lead to errors in hiring decisions and can be harmful in the company environment.

The Cox Hazard Model reinforces the results initially obtained by the Logit model, i.e., we have not found statistical evidence that gazelle firms are less likely to survive when compared to non-gazelle firms by the applied model. As well as the Logit model, our results show that firms with larger size have higher survival prospects and this

can be explained by the advantage of economies of scale, the increase of refreshed skills and innovation processes.

Gazelle firms exist across all industries, however they are more notable in activities related with construction and services and they are mostly located in the urban centers (“Lisboa” and “Norte”). We reached to the same conclusions as Henrekson and Johansson (2010). They argued that gazelle firms are not high-technological firms and appear to be overrepresented in services. Contrarily, non-gazelle firms are more dispersed in terms of region and sectors.

This study presents some limitations. First, our sample of gazelle firms is very small, so future studies should extend the period of analysis to track a larger sample. Second, the time range of the data is small. We only evaluate start-ups established between 2000 and 2005 thus it would be interesting for further studies to evaluate how gazelle firms performed before and after the European crisis. Third, other measures of size should be considered. In our investigation we measured the size of gazelles firms as the number of employees so a further development should be considering also sales and productivity. Fourth and lastly, an interesting topic should be looking at the number of hiring and dismissals of start-ups.

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7 | Figures

Figure 1| Geographical location of gazelle and non-gazelle start-ups

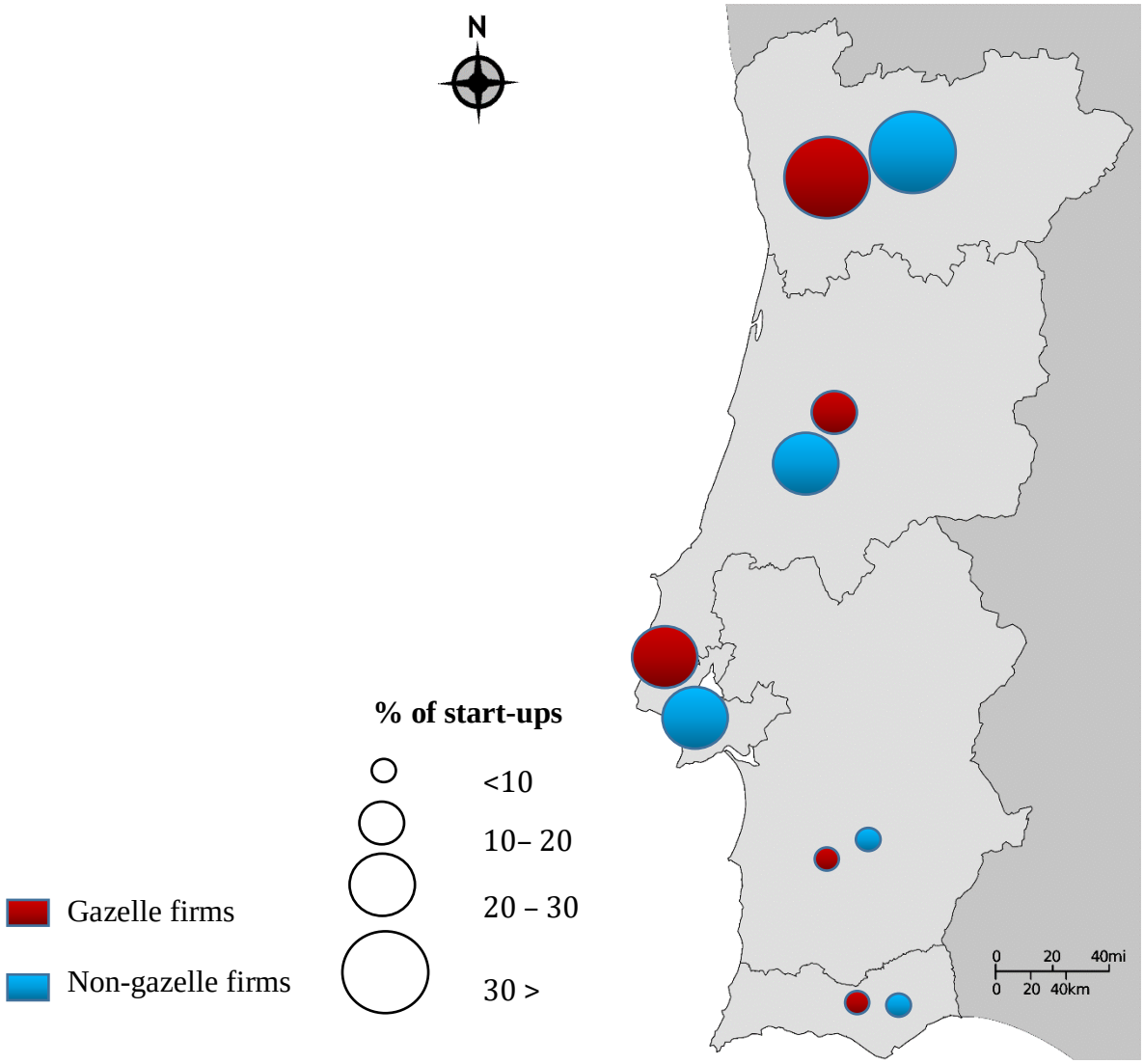


Figure 2| Economic sectors for gazelle and non-gazelle firms.

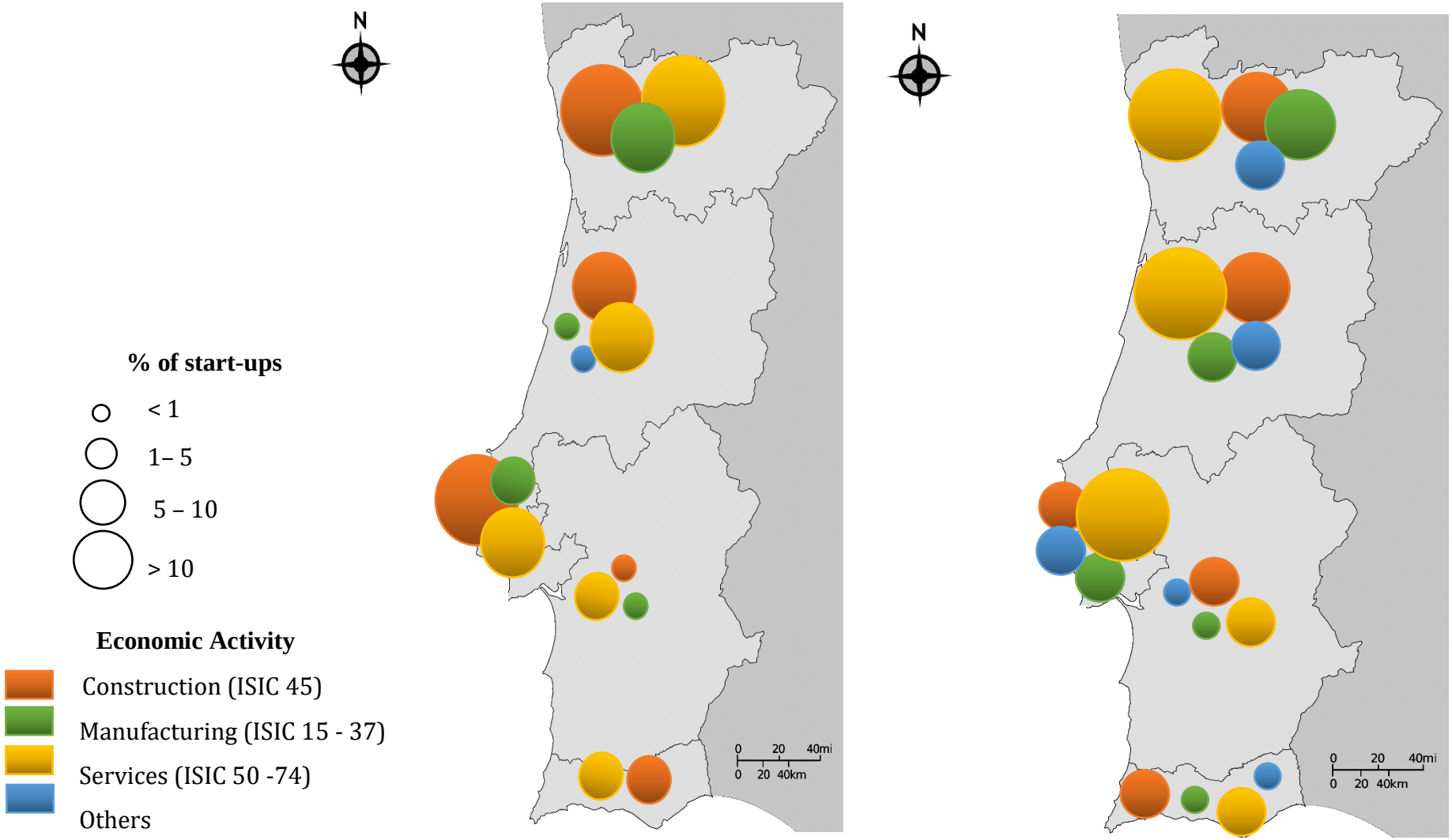


Figure 3| Gazelle and non-gazelle average number of employees

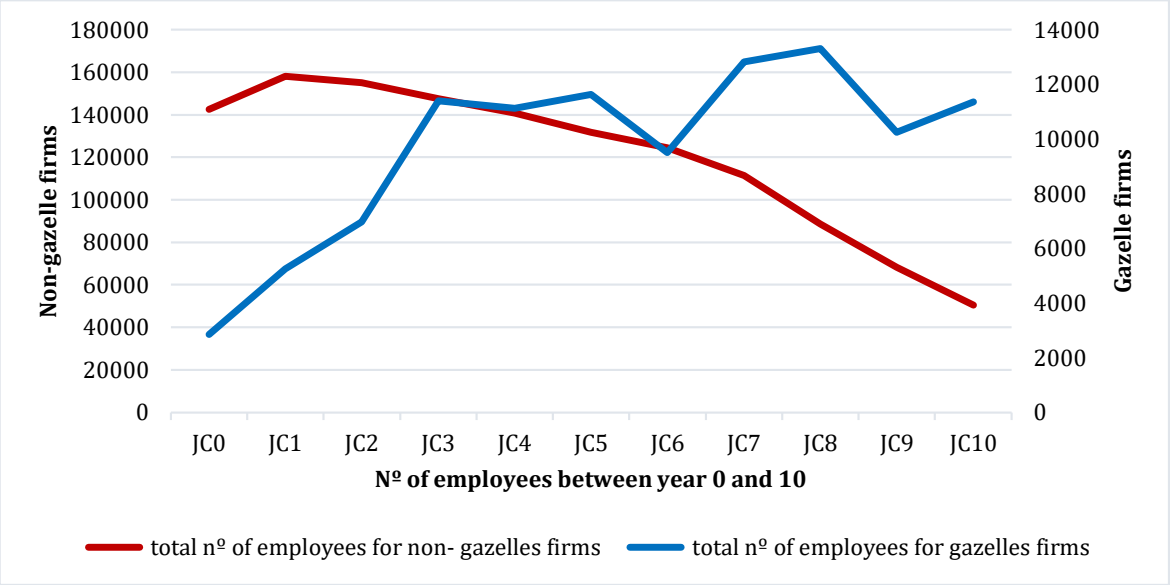
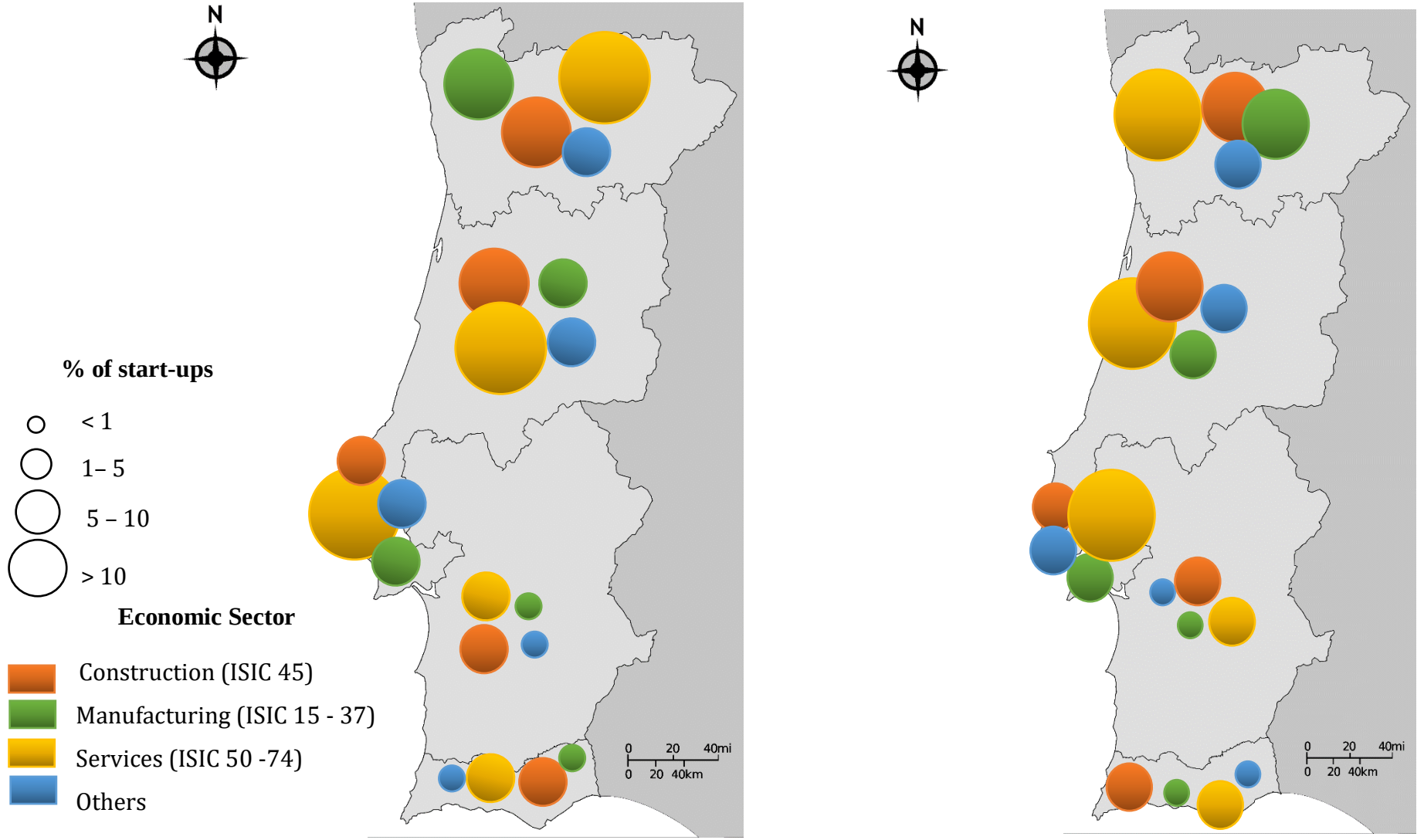


Figure 4| Percentage of gazelles and non-gazelles survival firms



8 | Tables

Table 1| Previous studies on gazelle entrepreneurs

This table summarizes the academic findings regarding the gazelle entrepreneurs.

Authors	Research Questions	Gazelle Definition	Determinants of Gazelle's Growth	Contribution to the Economy	Long term performance
Acs & Mueller, (2006).	The impact on employment five years from now of new firms, rapidly growing firms and plants that entered today.	Gazelles are seen as new rapid growing firms. Small firms that did not grow are called "Mice", and the big firms with a large employment share, but generating little new employment, "Elephants"	**Sector**: Private sector, although they are presented in all industries. **Size**: Most new firms are small **Region**: Most gazelles regions are near the universities and research facilities, in large cities **Age:** Younger on average	Positive short-term employment effects, negative employment effects two years after entrance and pronounced long term effects. Star-ups with greater than 20 employees and less than 500 have persistent employment effects over time and only in large diversified city center.	
Daunfeldt et al., (2010).	Definitions of HGFs in terms of value added and productivity, and analyze how much the different types of HGFs contribute to employment growth, economic growth, productivity growth and sales growth.	Birch's definition	Conclude that firm age, rather than firm size, determines rapid growth and, hence, that firm age is crucial for net employment growth. **Age:** Younger on average	Give a large positive contribution to growth in employment, productivity and sales.	-
Erkko Autio, (2000).	What is the real contribution of small firms to economic growth and employment generation? Are high-growth firms more common in high-technology sectors?	Increases sales by at least 50% during the three consecutive financial years	**Sector:** High-technology sectors do not appear to be overrepresented		-

Table 1| Previous studies on gazelle entrepreneurs (Cont.)

This table summarizes the academic findings regarding the gazelle entrepreneurs.

Authors	Research Questions	Gazelle Definition	Determinants of Gazelle's Growth	Contribution to the Economy	Long term performance
Jaap W.B. Bos & Erisk Stam, (2011).	In what extent the gazelles are the drivers of the growth of industries and structural change?	Young, high growth firm. Innovative industries (Eckhard and Shane,2011); A firm with 5 to 10 years old with at least 20 employees	**Sector**: All industries. **Size**: An increase in the presence of gazelles in an industry has a positive effect on the subsequent growth of the industry. **Age:** Younger on average	Gazelles are early movers concerning the recognition and realization of industry opportunities and they seems to be important vehicles for new job creation	
Magnus Henrekson & Dan Johansson, (2009).	In a population of firms, net employment growth is generated by a small nº of gazelles; On average, gazelles are younger than other firms; On average, gazelles are smaller than other firms; Gazelles are overrepresented in high-tech industries.	"A business establishment which has achieved a minimum of 20% sales growth each year over the interval, starting from a base-tear revenue of at least $100,000" OECD proposed defining gazelles as a high-growth enterprise with an average employment growth rate exceeding 20% p.a over a 3-year period and with ten or more employees at the beginning of the period.	**Sector:** All industries; Overrepresented in services. Size: Gazelles can be of all sizes but small firms are overrepresented **Age**: Younger on average	A small number of high-growth firms are mostly important for net job creation.	-

Table 1| Previous studies on gazelle entrepreneurs (Cont.)

This table summarizes the academic findings regarding the gazelle entrepreneurs.

Authors	Research Questions	Gazelle Definition	Determinants of Gazelle's Growth	Contribution to the Economy	Long term performance
Moreno & Cassilas, (2000).	Propose an integrative and explanatory model of the gazelles.	Companies that are capable experiencing a high rate of growth in a very short time.	**Size:** Most gazelles companies are SMEs. They experience a strong growth in their size that in most cases, they may duplicate their dimension in a short period of time. Age: Younger on average	Generate a great number of new jobs. In the USA, these high-growth enterprises are responsible for approximately 70% approximately of the growth of the employment rate in the recent years	
Senderovitz et al., (2012).	Relationship between growth and subsequent profitability for gazelle firms, and how this is moderated by firm strategy.	Small firms growing considerably faster than the average industry level.	**Sector:** All industries **Region:** represented in all regions, although the majority seem to be centered around the capital	Gazelle firms have a large impact on job creation and economic development. positive effects of economies of scale	
Pernille Gjerlov & Christina Guenther, (2012).	How initial growth rates might help to explain performance differences among surviving firms.	Gazelles are defined as a subset of the high-growth firms, excluding firms older than five years.	-	Gazelles are often outperformed by slower growing entrants in the long run. The higher initial growth has persistent negative effects on firms' long run performance, including lower employment growth, higher employee turnover, and most importantly lower survival rates. In sum, reaching a larger size through continuous moderate growth is better than reaching this size quickly through initial high growth rates	

Table 2 | Description of the variables

Variables	Description
Panel A –Firms characteristics	
Initial Size	The Initial Size is the logarithm of the initial number of employees in the start-up.
Size t	The Size t is the logarithm of the number of employees of a start-up in year t (t=4, ... ,10). For example, Size4 is the logarithm of the number of employees of a start-up in 4th year of activity.
Survival	Dummy variable equalling one if the start-up is still running after seven years and zero otherwise.
Panel B - Founders characteristics	
Age	The age at which the entrepreneurs established the start-up.
Gender	Dummy variable, equalling 1 for men; and 0 for women.
Education level	Founder education at the time of establishing the start-up. With this variable we construct four dummy variables: **High education** is a dummy variable corresponding to 1 for founders with bachelors, masters or doctoral degrees; **Medium education** is a dummy variable corresponding to 1 for individuals that attended high school or vocational school degree; **Low education** is a dummy variable corresponding to 1 for individuals that attended junior high school; **Very low education** is a dummy variable corresponding to 1 for individuals that never attended or completed the elementary school; and 0 otherwise.
Experience	Founder industry or regional experience at the time of establishing the gazelle firm. We construct two dummy variables: **Industry experience** equalling 1 for founders that previously worked on the same industry and 0 otherwise. **Regional experience** which corresponds to 1 if the founders have previously worked in the same municipality; and 0 otherwise.
Foreign	Dummy variable, which equals 1 for foreign and 0 for Portuguese.
One founder	Dummy variable, equalling 1 for ventures established by one founder and 0 otherwise.

Table 3 | Descriptive statistics

Panel A - Firms Characteristics

	All Firms			Gazelle Firms			Non-Gazelle Firms		
	Obs.	**Mean**	**S.D[8].**	**Obs.**	**Mean**	**S.D.**	**Obs.**	**Mean**	**S.D.**
Initial Size	37,875	3.84	4.70	175	16.28	11.43	37,700	3.78	4.57
Size 4	37,875	4.01	16.71	175	63.55	183.54	37,700	3.74	10.41
Size 5	37,875	3.79	20.33	175	66.44	234.78	37,700	3.50	11.94
Size 6	37,875	3.54	15.41	175	54.28	171.11	37,700	3.30	9.56
Size 7	37,875	3.28	25.76	175	73.32	358.24	37,700	2.96	7.16
Size 10	37,875	1.63	29.64	175	64.95	427.79	37,700	1.34	4.39
Duration (Years)	37,875	6.20	3.56	175	7.59	2.45	37,700	6.20	3.56

	Freq.	**%**	**Freq.**	**%**	**Freq.**	**%**
Industry[9]	**37,875**	**100.00**	**175**	**100.00**	**37,700**	**100.00**
Construction	9,746	25.73	98	56.00	9,648	25.59
Manufacturing	4,294	11.34	29	16.57	4,265	11.31
Services	20,595	54.38	1	26.86	20,548	54.50
Other services	3,240	8.55	47	0.57	3,239	8.59
	Freq.	**%**	**Freq.**	**%**	**Freq.**	**%**
Region[10]	**37,875**	**100.00**	**175**	**100.00**	**37,700**	**100.00**
Norte	14,236	37.59	89	50.86	14,147	37.53
Centro	10,286	27.16	28	16.00	10,258	27.21
Lisboa	8,336	22.01	41	23.43	8,295	22.00
Alentejo	2,478	6.54	7	4.00	2,471	6.55
Algarve	2,539	6.70	10	5.71	2,529	6.71

[8] S.D. in the table means standard deviation (%).

[9] Following CAE.Rev2.1, we categorized into 4 industrial groups: Manufacturing, Services, Construction and other services.

10 Following NUTS II division. the country is divided in seven regions, where five of them are in the mainland Portugal, and the remaining two are the autonomous regions (Azores and Madeira). We exclude the autonomous regions because of their insignificance.

Table 3 | Descriptive statistics (Cont.)

Panel B - Founders Characteristics

	All Firms			Gazelle Firms			Non-Gazelle Firms		
	Obs.	**Mean**	**S.D.**	**Obs.**	**Mean**	**S.D.**	**Obs.**	**Mean**	**S.D.**
Gender (Men)	37,875	0.69	0.46	175	0.77	0.42	37,700	0.69	0.46
Age	37,875	37.0	10.40	175	34.0	8.51	37,700	37.0	10.41
	Obs.	**%**	**S.D.**	**Obs.**	**%**	**S.D.**	**Obs.**	**%**	**S.D.**
Education	**37,875**	**100.00**	**0.99**	**175**	**100.00**	**0.93**	**37,700**	**100.00**	**0.99**
Very Low Educ.	8,228	0.22	0.41	36	0.21	0.41	8,192	0.22	0.41
Low Educ.	15,087	0.40	0.49	87	0.50	0.50	15,000	0.40	0.49
Medium Educ.	8,388	0.22	0.42	28	0.16	0.37	8,360	0.22	0.42
High Educ.	6,172	0.16	0.37	24	0.14	0.34	6,148	0.16	0.37
Experience									
Region Exp.	37,875	0.27	0.49	175	0.37	0.48	37,700	0.27	0.45
Industry Exp.	37,875	0.18	0.49	175	0.34	0.48	37,700	0.18	0.38
Foreign	37,875	0.04	0.17	175	0.09	0.29	37,700	0.04	0.19
One Founder	37,875	0.42	0.50	175	0.31	0.46	37,700	0.42	0.49

Note: This table reports descriptive statistics for start-ups established between 2000 and 2005, and respective start-ups founder's characteristics. All data was taken from Quadros de Pessoal.

Table 4 | OLS model for start-ups initial size

Variables	(1) Size 4	(2) Size 5	(3) Size 6	(4) Size 7	(5) Size 8	(6) Size 9	(7) Size 10
Gazelle	**1.440*** (20.01)**	**1.300*** (12.42)**	**0.86*** (7.84)**	**0.686*** (4.98)**	**0.523*** (3.91)**	**0.369*** (2.95)**	**0.193* (1.68)**
Initial Size	0.601*** (52.79)	0.538*** (44.06)	0.492*** (39.19)	0.436*** (34.65)	0.340*** (29.16)	0.269*** (25.22)	0.194*** (20.46)
Age	0.0268*** (9.46)	0.0297*** (9.91)	0.0297*** (9.63)	0.0301*** (9.73)	0.0230*** (7.96)	0.0190*** (7.12)	0.0157*** (6.61)
Age²	-0.0316*** (-9.11)	-0.0351*** (-9.56)	-0.0354*** (-9.37)	-0.0361*** (-9.49)	-0.0280*** (-7.84)	-0.0235*** (-7.11)	-0.0195*** (-6.57)
Gender	0.0500*** (5.45)	0.0522*** (5.35)	0.0499*** (4.96)	0.0430*** (4.22)	0.0313*** (3.30)	0.0187** (2.18)	0.0207*** (2.73)
Low Education	-0.00120 (-0.10)	-0.00342 (-0.28)	-0.0144 (-1.13)	-0.0262** (-2.02)	-0.0111 (-0.90)	-0.00204 (-0.17)	0.00527 (0.49)
Medium Education	0.0100 (0.70)	-0.0112 (-0.74)	-0.0238 (-1.52)	-0.0451*** (-2.85)	-0.0297** (-2.01)	-0.00989 (-0.72)	-0.00642 (-0.53)
High Education	0.122*** (7.12)	0.121*** (6.62)	0.103*** (5.42)	0.0813*** (4.25)	0.0565*** (3.23)	0.0521*** (3.33)	0.0332** (2.43)
Foreign	-0.161*** (-6.31)	-0.207*** (-7.92)	-0.216*** (-8.34)	-0.225*** (-9.03)	-0.172*** (-8.16)	-0.140*** (-7.82)	-0.0918*** (-6.48)
Region Experience	0.0210* (1.95)	0.0181 (1.58)	0.0203* (1.71)	0.0309** (2.57)	0.0201* (1.85)	0.0190** (1.97)	0.0162* (1.92)
Industry Experience	0.0723*** (5.47)	0.0828*** (5.88)	0.0830*** (5.69)	0.0871*** (5.90)	0.0595*** (4.47)	0.0402*** (3.42)	0.0160 (1.58)
Founder	-0.174*** (-19.43)	-0.174*** (-18.45)	-0.174*** (-17.99)	-0.173*** (-17.86)	-0.144*** (-16.30)	-0.114*** (-14.25)	-0.0861*** (-12.11)
N	37875	37875	37875	37875	37875	37875	37875

Note: The table presents the coefficients of equation (1) using OLS. The dependent variable is the logarithm of the yearly number of employees of a start-up after the first three years until the exit year or until the exit year 2012. The independent variables are presented Table 2. Year, region and industry fixed effects (two-digit level) are included but not reported. Standard errors clustered at the firm level are in parentheses. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 5 | Number of employees in year 4 by region

	Size 4				
Variables	**Norte**	**Centro**	**Lisboa**	**Alentejo**	**Algarve**
Gazelle	**1.336*** (13.39)**	**1.417*** (13.62)**	**1.818*** (9.11)**	**1.394*** (7.61)**	**1.106*** (14.25)**
Initial Size	0.610*** (33.21)	0.655*** (31.89)	0.524*** (20.27)	0.608*** (15.09)	0.584*** (12.87)
Age	0.0264*** (5.57)	0.0317*** (6.38)	0.0274*** (4.08)	0.0300*** (2.87)	0.00157 (0.14)
Age²	-0.0307*** (-5.20)	-0.0379*** (-6.30)	-0.0320*** (-3.91)	-0.0367*** (-2.88)	-0.00429 (-0.33)
Gender	0.0524*** (3.34)	0.0451*** (2.79)	0.0671*** (3.39)	0.00679 (0.19)	0.0615* (1.71)
Low Education	0.0250 (1.30)	-0.0216 (-1.11)	-0.00497 (-0.18)	0.00954 (0.22)	-0.0829* (-1.73)
Medium Education	0.0366 (1.47)	-0.0296 (-1.16)	0.0314 (0.99)	-0.0276 (-0.52)	-0.0110 (-0.20)
High Education	0.140*** (4.70)	0.0856*** (2.70)	0.153*** (4.29)	0.0704 (1.09)	0.105 (1.51)
Foreign	-0.152*** (-2.62)	-0.135** (-2.04)	-0.193*** (-4.54)	-0.218** (-2.30)	-0.0886 (-1.60)
Region Experience	-0.00863 (-0.49)	0.0235 (1.20)	0.0843*** (3.47)	0.00185 (0.04)	-0.00891 (-0.21)
Industry Experience	0.0911*** (4.21)	0.0602** (2.51)	0.0713** (2.44)	0.0759 (1.36)	0.0149 (0.29)
Founder	-0.183*** (-12.12)	-0.163*** (-10.12)	-0.145*** (-7.39)	-0.215*** (-6.33)	-0.190*** (-5.34)
N	14236	10286	8336	2478	2539

Table 6 | Number of employees in year 10 by region

Variables	Size 10				
	Norte	**Centro**	**Lisboa**	**Alentejo**	**Algarve**
Gazelle	**0.209**	**0.235**	**0.464**	**-0.238****	**-0.562*****
	(1.46)	**(0.86)**	**(1.44)**	**(-2.29)**	**(-5.47)**
Initial Size	0.215***	0.225***	0.126***	0.173***	0.197***
	(13.56)	(12.30)	(6.90)	(5.17)	(5.65)
Age	0.0242***	0.0192***	-0.00223	0.0268***	0.0134
	(5.96)	(4.23)	(-0.47)	(3.09)	(1.50)
Age²	-0.0317***	-0.0230***	0.00355	-0.0362***	-0.0139
	(-6.21)	(-4.08)	(0.59)	(-3.30)	(-1.29)
Gender	0.0169	0.0216	0.0267*	0.0288	0.0366
	(1.25)	(1.48)	(1.90)	(1.05)	(1.29)
Low Education	0.0252	0.00163	-0.00585	-0.0721*	-0.0339
	(1.37)	(0.08)	(-0.26)	(-1.82)	(-0.81)
Medium Education	0.00135	0.0251	-0.0170	-0.105**	-0.0648
	(0.06)	(1.06)	(-0.72)	(-2.45)	(-1.39)
High Education	0.0610**	0.0408	0.0280	-0.110**	-0.0290
	(2.53)	(1.50)	(1.07)	(-2.42)	(-0.52)
Foreign	-0.0906***	-0.104***	-0.0898***	0.0254	-0.0867***
	(-2.91)	(-2.61)	(-3.87)	(0.47)	(-2.94)
Region Experience	0.0125	0.00364	0.0351**	-0.0175	0.0627*
	(0.85)	(0.22)	(2.16)	(-0.58)	(1.95)
Industry Experience	-0.00467	0.0446**	0.00460	0.0970**	-0.0235
	(-0.27)	(2.28)	(0.25)	(2.36)	(-0.63)
Founder	-0.0881***	-0.0820***	-0.0647***	-0.0773***	-0.121***
	(-7.02)	(-5.88)	(-4.99)	(-2.94)	(-4.70)
N	14236	10286	8336	2478	2539

Table 7| Logit model for start-ups survival

Variables	(1) All firms	(2) Gazelle Firms	(3) Non-Gazelle firms	(4) All Firms
Gazelle	**0.0214**	**.**	**.**	**0.377***
	(0.57)	**.**	**.**	**(1.66)**
Initial Size	0.0763***	-0.303**	0.0761***	0.0767***
	(14.62)	(-2.49)	(14.55)	(14.67)
Initial Size*Gazelle	-	-	-	-0.130
				(-1.61)
Age	0.0185***	-0.0421	0.0186***	0.0185***
	(10.84)	(-1.55)	(10.87)	(10.84)
Age^2	-0.0204***	0.0608	-0.0206***	-0.0204***
	(-9.60)	(1.63)	(-9.63)	(-9.60)
Gender	0.0242***	-0.0320	0.0247***	0.0242***
	(4.33)	(-0.28)	(4.42)	(4.33)
Low Education	-0.0210***	0.0551	-0.0213***	-0.0210***
	(-2.98)	(0.57)	(-3.02)	(-2.98)
Medium Education	-0.0438***	0.125	-0.0439***	-0.0437***
	(-5.08)	(1.00)	(-5.08)	(-5.07)
High Education	0.0233**	0.00227	0.0231**	0.0232**
	(2.32)	(0.02)	(2.30)	(2.31)
Foreign	-0.143***	-0.240*	-0.141***	-0.143***
	(-10.17)	(-1.93)	(-9.97)	(-10.17)
Region Experience	0.0191***	0.0859	0.0187***	0.0190***
	(3.03)	(0.80)	(2.95)	(3.02)
Industry Experience	0.0391***	0.0566	0.0396***	0.0391***
	(5.28)	(0.55)	(5.33)	(5.27)
Founder	-0.0941***	-0.0913	-0.0938***	-0.0940***
	(-18.55)	(-0.95)	(-18.45)	(-18.53)
N	37868	140	37693	37868

Note: The table presents the estimated marginal effects for the logit model using equation (2) and column (4) shows an interaction variable– size*gazelle. The dependent variable is a dummy variable equalling one if the start-up is still running after seven years and zero otherwise. Year, region and industry fixed effects (two-digit level) are included but not reported. Standard errors clustered at the firm level are in parentheses. Standard errors in parentheses *** p<0.01, **p<0.05, * p<0.1.

Table 8| Logit model for start-ups survival by region

Variables	Logit Model				
	Norte	**Centro**	**Lisboa**	**Alentejo**	**Algarve**
Gazelle	**0.00608**	**-0.100**	**0.0782**	**.**	**0.116**
	(0.12)	**(-1.05)**	**(1.05)**	**.**	**(0.72)**
Initial Size	0.0813***	0.0972***	0.0307***	0.0919***	0.113***
	(9.83)	(9.04)	(2.84)	(4.39)	(5.63)
Age	0.0219***	0.0207***	0.0144***	0.0182***	0.00353
	(7.83)	(6.46)	(3.73)	(2.71)	(0.55)
Age²	-0.0238***	-0.0233***	-0.0162***	-0.0202**	-0.00287
	(-6.74)	(-5.86)	(-3.40)	(-2.44)	(-0.37)
Gender	0.0330***	0.0206*	0.0184	0.0145	0.0306
	(3.55)	(1.94)	(1.57)	(0.66)	(1.46)
Low Education	0.000365	-0.0322**	-0.0313*	-0.0400	-0.0500*
	(0.03)	(-2.44)	(-1.94)	(-1.50)	(-1.88)
Medium Education	-0.0133	-0.0668***	-0.0526***	-0.0593*	-0.0640**
	(-0.91)	(-4.10)	(-2.91)	(-1.79)	(-2.07)
High Education	0.0281	0.000349	0.0402**	-0.0309	0.0355
	(1.64)	(0.02)	(2.03)	(-0.79)	(0.92)
Foreign	-0.131***	-0.209***	-0.145***	-0.0558	-0.102***
	(-4.10)	(-5.94)	(-6.18)	(-1.02)	(-3.35)
Region Experience	0.0120	0.0177	0.0361***	0.0397	-0.000323
	(1.16)	(1.47)	(2.70)	(1.52)	(-0.01)
Industry Experience	0.0423***	0.0526***	0.0229	0.0429	0.0173
	(3.54)	(3.59)	(1.47)	(1.39)	(0.62)
Founder	-0.0961***	-0.0949***	-0.0904***	-0.0887***	-0.0814***
	(-11.54)	(-9.71)	(-8.41)	(-4.42)	(-4.24)
N	14229	10279	8330	2449	2524

Note: The table presents the estimated marginal effects for the logit model using equation (2). The dependent variable is a dummy variable equalling one if the start-up is still running after seven years and zero otherwise. Year, region and industry fixed effects (two-digit level) are included but not reported. Standard errors clustered at the firm level are in parentheses. Standard errors in parentheses *** p<0.01, **p<0.05, * p<0.1.

Table 9| Cox Proportional Hazard model for start-ups survival

Variables	(1) All Firms	(2) Gazelle Firms	(3) Non-Gazelle firms	(4) All Firms
Gazelle	**-0.117**	**.**	**.**	**0.819**
	(0.111)	**.**	**.**	**(0.967)**
Initial Size	-0.177***	-0.380	-0.174***	-0.176***
	(0.019)	(0.521)	(0.019)	(0.020)
Initial Size*Gazelle	-	-	-	-0.346
				(0.361)
Age	-0.048***	-0.084	-0.047***	-0.048***
	(0.007)	(0.152)	(0.007)	(0.007)
Age^2	0.054***	0.150	0.054***	0.054***
	(0.009)	(0.230)	(0.009)	(0.009)
Gender	-0.127***	0.251	-0.128***	-0.127***
	(0.021)	(0.424)	(0.021)	(0.021)
Low Education	-0.019	0.691	-0.022	-0.019
	(0.029)	(0.501)	(0.029)	(0.029)
Medium Education	-0.028	0.586	-0.030	-0.028
	(0.033)	(0.608)	(0.033)	(0.033)
High Education	-0.233***	0.975	-0.235***	-0.233***
	(0.038)	(0.744)	(0.038)	(0.038)
Foreign	0.347***	2.317***	0.339***	0.347***
	(0.048)	(0.534)	(0.048)	(0.048)
Region Experience	-0.151***	-0.118	-0.150***	-0.151***
	(0.019)	(0.329)	(0.019)	(0.019)
Industry Experience	-0.168***	0.251	-0.170***	-0.169***
	(0.020)	(0.335)	(0.020)	(0.020)
Founder	-0.210***	0.045	-0.211***	-0.210***
	(0.012)	(0.157)	(0.012)	(0.012)
N	114,811	833	113,978	114,811

Note: The table presents the results of duration (in years) of the firms, according to the Cox Proportional Hazard Model and column (4) shows an interaction variable – size*gazelle. The table present the coefficients rather than hazard ratios. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 10 | Cox Proportional Hazard model for start-ups survival by region

Cox Proportional Hazard Model					
Variables	**Norte**	**Centro**	**Lisboa**	**Alentejo**	**Algarve**
Gazelle	-0.169	-0.084	-0.039	-44.355	-0.119
	(0.164)	(0.406)	(0.158)	(0.000)	(0.358)
Initial Size	-0.127***	-0.280***	-0.154***	-0.312***	-0.260***
	(0.031)	(0.047)	(0.038)	(0.088)	(0.073)
Age	-0.063***	-0.070***	-0.031*	-0.071**	-0.009
	(0.012)	(0.015)	(0.016)	(0.030)	(0.026)
Age^2	0.074***	0.079***	0.032	0.088**	0.010
	(0.016)	(0.019)	(0.020)	(0.038)	(0.032)
Gender	-0.127***	-0.087*	-0.171***	0.024	-0.162**
	(0.037)	(0.046)	(0.041)	(0.092)	(0.077)
Low Education	-0.036	0.033	-0.069	0.088	0.000
	(0.048)	(0.062)	(0.061)	(0.123)	(0.104)
Medium Education	-0.066	0.063	-0.131**	0.084	-0.182
	(0.057)	(0.071)	(0.065)	(0.139)	(0.115)
High Education	-0.217***	-0.231***	-0.328***	0.039	-0.427***
	(0.066)	(0.085)	(0.076)	(0.158)	(0.138)
Foreign	0.351***	0.407***	0.272***	0.015	0.260**
	(0.114)	(0.113)	(0.076)	(0.236)	(0.125)
Region Experience	-0.129***	-0.099**	-0.179***	-0.121	-0.201***
	(0.034)	(0.041)	(0.037)	(0.080)	(0.069)
Industry Experience	-0.166***	-0.194***	-0.101**	-0.167*	-0.197***
	(0.034)	(0.043)	(0.040)	(0.087)	(0.073)
Founder	-0.239***	-0.240***	-0.150***	-0.279***	-0.145***
	(0.021)	(0.026)	(0.024)	(0.056)	(0.049)
N	43,377	29,585	23,564	6,823	7,845

Note: The table presents the results of duration (in years) of the firms, according to the Cox Proportional Hazard Model with an interaction variable – size*gazelle. The table present the coefficients rather than hazard ratios. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

9 | Appendix

Table A. 1| Nº of employees during the period analysed for gazelle firms

Region	Initial Size	Size 1	Size 2	Size 3	Size 4	Size 5	Size 6	Size 7	Size 8	Size 9	Size 10
Norte	1393	2320	3395	4273	3661	3530	3226	2635	1798	1218	736
Lisboa	880	1958	2349	5675	6032	6818	5207	9171	10676	8357	10345
Centro	368	632	811	947	1033	932	803	792	731	604	284
Alentejo	82	135	190	220	210	166	136	130	98	59	2
Algarve	126	205	231	282	186	181	127	103	11	0	0
Total	**2849**	**5250**	**6976**	**11397**	**11122**	**11627**	**9499**	**12831**	**13314**	**10238**	**11367**

Table A. 2| Nº of employees during the period analysed for non-gazelle firms

Region	Initial Size	Size 1	Size 2	Size 3	Size 4	Size 5	Size 6	Size 7	Size 8	Size 9	Size 10
Norte	59774	65716	63842	60925	58366	54770	52446	47872	38144	30271	23038
Lisboa	29196	32778	32205	30446	29196	26937	24135	20387	14940	10542	6921
Centro	35812	39815	39223	37358	35304	33380	31761	29012	23866	19187	14586
Alentejo	8676	9458	9401	9149	8652	8134	8112	6752	5560	4062	2693
Algarve	9034	10227	10403	9727	9368	8626	8022	7490	6051	4247	3092
Total	**142492**	**157994**	**155074**	**147605**	**140886**	**131847**	**124476**	**111513**	**88561**	**68309**	**50330**

Table A. 3| LPM model for start-ups survival

Variables	(1) All firms	(2) Gazelle Firms	(3) Non-Gazelle firms
Gazelle	**0.0188**	.	.
	(0.52)	.	.
Initial Size	0.0765***	-0.288***	0.0764***
	(14.74)	(-2.62)	(14.66)
Age	0.0187***	-0.0353	0.0188***
	(10.85)	(-1.50)	(10.88)
Age^2	-0.0206***	0.0507*	-0.0207***
	(-9.62)	(1.69)	(-9.65)
Gender	0.0242***	-0.000167	0.0247***
	(4.35)	(-0.00)	(4.43)
Low Education	-0.0215***	0.0365	-0.0217***
	(-3.05)	(0.32)	(-3.08)
Medium Education	-0.0447***	0.0682	-0.0448***
	(-5.17)	(0.51)	(-5.17)
High Education	0.0228**	0.0687	0.0226**
	(2.27)	(0.46)	(2.24)
Foreign	-0.140***	-0.273**	-0.137***
	(-10.81)	(-2.10)	(-10.60)
Region Experience	0.0191***	0.0841	0.0188***
	(3.02)	(0.90)	(2.95)
Industry Experience	0.0389***	0.0620	0.0394***
	(5.22)	(0.69)	(5.26)
Founder	-0.0958***	-0.107	-0.0955***
	(-18.37)	(-1.12)	(-18.28)
N	37875	175	37700

Note: The table presents the estimated marginal effects of the linear probability model using equation (2). The dependent variable is a dummy variable equalling one if the start-up is still running after seven years and zero otherwise. Year, region and industry fixed effects (two-digit level) are included but not reported. Standard errors clustered at the firm level are in parentheses. Standard errors in parentheses *** p<0.01, **p<0.05, * p<0.1.

Table A. 4| Probit model for start-ups survival

Variables	(1) All firms	(2) Gazelle Firms	(3) Non-Gazelle firms
Gazelle	**0.0210**	.	.
	(0.56)	.	.
Initial Size			
	0.0757***	-0.323***	0.0755***
	(14.61)	(-2.68)	(14.54)
Age			
	0.0185***	-0.0431*	0.0186***
	(10.81)	(-1.69)	(10.84)
Age²			
	-0.0204***	0.0622*	-0.0206***
	(-9.56)	(1.81)	(-9.60)
Gender			
	0.0242***	-0.0239	0.0247***
	(4.33)	(-0.23)	(4.41)
Low Education			
	-0.0215***	0.0582	-0.0218***
	(-3.05)	(0.61)	(-3.09)
Medium Education			
	-0.0440***	0.115	-0.0442***
	(-5.11)	(0.91)	(-5.12)
High Education			
	0.0222**	0.00844	0.0220**
	(2.21)	(0.06)	(2.19)
Foreign			
	-0.141***	-0.244*	-0.139***
	(-10.27)	(-1.90)	(-10.07)
Region Experience			
	0.0191***	0.0774	0.0187***
	(3.04)	(0.84)	(2.96)
Industry Experience			
	0.0384***	0.0599	0.0389***
	(5.20)	(0.66)	(5.24)
Founder			
	-0.0943***	-0.0918	-0.0941***
	(-18.53)	(-1.09)	(-18.44)
N	37868	140	37693

Note: The table presents the estimated marginal effects of the probit model using equation (2). The dependent variable is a dummy variable equalling one if the start-up is still running after seven years and zero otherwise. Year, region and industry fixed effects (two-digit level) are included but not reported. Standard errors clustered at the firm level are in parentheses. Standard errors in parentheses *** p<0.01, **p<0.05, * p<0.1.

Table A. 5| Robustness check: Logit, LPM and Probit models for start-ups survival

Variables	(1) Logit	(2) LPM	(3) Probit
Gazelle	**0.0214**	**0.0188**	**0.0210**
	(0.57)	**(0.52)**	**(0.56)**
Initial Size	0.0763***	0.0765***	0.0757***
	(14.62)	(14.74)	(14.61)
Age	0.0185***	0.0187***	0.0185***
	(10.84)	(10.85)	(10.81)
Age^2	-0.0204***	-0.0206***	-0.0204***
	(-9.60)	(-9.62)	(-9.56)
Gender	0.0242***	0.0242***	0.0242***
	(4.33)	(4.35)	(4.33)
Low Education	-0.0210***	-0.0215***	-0.0215***
	(-2.98)	(-3.05)	(-3.05)
Medium Education	-0.0438***	-0.0447***	-0.0440***
	(-5.08)	(-5.17)	(-5.11)
High Education	0.0233**	0.0228**	0.0222**
	(2.32)	(2.27)	(2.21)
Foreign	-0.143***	-0.140***	-0.141***
	(-10.17)	(-10.81)	(-10.27)
Region Experience	0.0191***	0.0191***	0.0191***
	(3.03)	(3.02)	(3.04)
Industry Experience	0.0391***	0.0389***	0.0384***
	(5.28)	(5.22)	(5.20)
Founder	-0.0941***	-0.0958***	-0.0943***
	(-18.55)	(-18.37)	(-18.53)
N	37868	37875	37868

Note: The table presents the coefficients of equation (2) using Logit, linear probability and probit models. The dependent variable is a dummy variable equalling one if the start-up is still running after seven years and zero otherwise. Year, region and industry fixed effects (two-digit level) are included but not reported. Standard errors clustered at the firm level are in parentheses. Standard errors in parentheses *** p<0.01, **p<0.05, * p<0.1.