SURVIVAL DYNAMICS IN PORTUGAL, A REGIONAL PERSPECTIVE

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Abstract: We address the post-entry performance of Portuguese firms for the seven NUT II regions in Portugal, by investigating the structural characteristics of survival, using both non-parametric methods and semi-parametric methods, during the period 1985-2007. In order to approach the prevalence of some stylized facts and determinants of new firm survival, a new entrepreneurship database was produced, using the administrative data of Quadros de Pessoal, following the Eurostat/OECD´s "Manual of Business Demography Statistics". In the non parametric estimation, we use Kaplan-Meier survival functions and the Nelson-Aalen hazard rates. The semi-parametric estimation relates the survival capacity with seven explanatory variables and sector and year dummies. The main contribution of this work is the application of a recent internationally comparable methodology for entrepreneurship to provide a regional overview of firm and survival dynamics for all NUT II regions, over an extended period of time, while guaranteeing regional, national and international comparability. To our knowledge, there is not such a study that contemplates all this aspects and grants international comparability, over such a long time frame, made for any country.

Keywords: Survival Analysis, Firm dynamics, Entrepreneurship, Regional Analysis

JEL Classification Codes: C14, C41, L25, L26, R11

1. Introduction

This work addresses the post-entry performance of new Portuguese firms by investigating the regional structural characteristics of the hazard and survival functions, using non-parametric and semi-parametric survival analysis.

Most empirical studies on regional variations in entry and exit rates at the international level are either based on survey data like the Global Entrepreneurship Monitor (Acs et al., 2008), business data, business registration data (Klapper et al., 2008; Klapper et al., 2009) or a mix of the previous (Baterlsman et al., 2005a; Baterlsman et al., 2005b). In Portugal, extensive research has been done in firm dynamics using *Quadros de Pessoal* (Mata and Portugal, 1994; Mata et al., 1995; Mata, 1993; Mata and Machado, 1996; Baptista et al., 2008; Cabral, 2007; Cabral and Mata, 2003; Baptista and Carias, 2007; Baptista and Mendonça, 2007; Sarmento and Nunes, 2010; Nunes and Sarmento, 2009 and 2010).

Both seminal and most recent literature agrees that size affects the survival rates of new firms (Mata et al., 1995; López-Garcia and Puente, 2006). This generated one of the most striking stylized facts in the literature of industry dynamics (Audretsch and Mahmood, 1994). Concerning the concept of initial firm size, several studies have reported that the probability of firm exit from the market was decreasing with initial size. According to the literature, there are several reasons behind this. The most prevalent relate to the efficient scale needed to operate efficiently in a market, to the capital intensity production technology, to the firms' capacity to access financial markets and to the "inferior" management ability of small entrepreneurs.

Regarding the first reason, Audretsch and Mahmood (1994) have considered that larger firms are more likely to be closer to the necessary minimum efficient scale to operate efficiently in a market. Even if larger firms find themselves to be less efficient than they had expected, they may become smaller before they do exit the market (Mata and Portugal, 2004). Additionally, larger firms diversify more than smaller ones, which also contributes to reduced market risks. Moreover, the stock of capital accumulated by firms should also be considered. Small firms are less capital intensive, so variable costs represent a larger share of capital costs. Thirdly, internal financial constraints and internal capital markets imperfections are also commonly pointed out as reasons for the smaller size of entrants. Firms enter small not because they choose to, but because new firms under invest as they are financially constrained, which leads to a negative impact on firms' survival probabilities (López-Garcia and Puente, 2006). The last reason pointed out previously relates to the entrepreneur management ability. In fact, being an entrepreneur has higher opportunity costs when the economy's wages grow, and lower quality managers are more likely to miscalculate their true value label (Mata and Portugal, 2004).

Mata, Portugal and Guimarães (1995) and Geroski, Mata and Portugal (2003) underline the previous observations relating to the importance of initial firm size in explaining the survivor probability of firms. However, they argue that current size is a better predictor of failure than initial size. After controlling for initial size, measuring current size amounts to measuring firm performance. According to them, the fact that a firm has grown is the past, signals that it has been performing well and therefore its probability of exit is low. Moreover, Mata, Portugal and Guimarães´s (1995) findings indicate that after controlling for size differences, past growth does matter for survival, suggesting a partial adjustment process of firm size in the post-entry period. Although accepting their arguments López-Garcia and Puente (2006) highlight the fact that current size could be endogenous to the firm dynamics, since firms that are about to abandon the market, grow smaller before exiting and vice-versa.

Quadros de Pessoal (Employment Administrative Records), which is the main data source in Portugal for the universe of active employer enterprises, has been subject to the application of the entrepreneurship definitions and methodology of the Manual on Business Demography Statistics (OECD/Eurostat, 2007). The *Quadros de Pessoal* is an annual survey conducted in Portugal by the Portuguese Ministry of Labour and Social Security (*Gabinete de Estratégia e Planeamento do Ministério do Trabalho e da Segurança Social)*, which provides a rich and comprehensive longitudinal matched employer-employee dataset. The entrepreneurship database obtained from the *Quadros de Pessoal*, after applying the Eurostat/OECD (2007) methodology, consists of an annual average of 215,903 active employer enterprises over the period 1985-2007, with an annual average of 36,803 births and 23,743 deaths.

The main contribution of this work is the application of a recent internationally comparable methodology for entrepreneurship and the usage of this analytical arsenal, to provide firm and survival disaggregation from a regional perspective, over a period of eighteen years.

The next section presents the non-parametric survival analysis in Portugal. It is followed by a section presenting a semi-parametric analysis of survival, where estimations for the NUT II Portuguese regions are provided. The last section concludes.

2. Non Parametric Survival Analysis

2.1 Survival and Hazard Functions

The survivor function reports the probability of a firm of surviving beyond time t (the moment of observation), that is the probability that there is no failure event (a "death") prior to t. The function is equal to one at time t=0 and decreases towards zero as time (t) goes to infinity. T is a non-negative variable, denoting the time to a failure event ("death"). The survivor function is thus represented by:

$$S(t) = 1 - F(t) = \Pr(T > t)$$

With $F(t) = \Pr(T \leq t)$ being the cumulative distribution function.

The hazard function or the conditional failure rate is the instantaneous rate of failure. It is the (limiting) probability that the failure event ("death") event occurs in a given interval, conditional upon the subject having survived to the beginning of that interval, divided by the width of the interval:

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

Where $f(t) = \frac{dF(t)}{dt} = \frac{d\{1 - S(t)\}}{dt} = -S'(t)$ is the density function.

The hazard rate measures the rate at which risk is accumulated and can vary from zero (no risk at all) to infinity.

The integral from 0 to t of the hazard rates is known as the cumulative hazard function($H(t)$). It records the number of times failures were observed over a given time period.

The non-parametric Kaplan-Meier estimator was applied for the estimation of the survivor function $S(t)$. For a dataset with observed failure times, $t_1,...,t_k$, where k is the number of distinct failure times observed in the data, the Kaplan-Meier estimate at any time t is given by:

$$\hat{S}(t) = \prod_{j \mid t_j \leq t} \left(\frac{n_j - d_j}{n_j} \right)$$

Where n_j is the number of enterprises at risk at time t_j and d_j is the number of failures at time t_j.

The most common estimator for the cumulative hazard rate is the non-parametric Nelson-Aalen estimator, which is defined by the sum of the instantaneous ratio of the failures over the number of enterprises at risk. This estimator is thus given by:

$$\overline{H}(t) = \sum_{j|t_j \leq t} \frac{d_j}{n_j}$$

2.2. Empirical Results for the Non Parametric Survival Analysis

In Table 1, we provide estimations for the hazard duration and survival functions for the all Portuguese economy. The survival function shows the probability of survival, considering that the firm has been active during a certain period. The hazard function shows the probability of "death" throughout a given period of time.

According to this table, during the period from 1987 to 2005, approximately 86% of all the employer enterprise births remained active after one year of activity. These results are in line with the OECD´s estimates, where around 60% to 80% of newly born enterprises survive beyond the first two years of activity, and only around 40% to 50% of total enterprises survive beyond the seventh year of activity. Eurostat (2009) also reported for the whole business economy, that roughly half of the enterprises survive during their first 5 years.

This data also reveals that after six years of activity, almost 50% of the Portuguese enterprise population was still active. The estimated median duration of a new born enterprise lies between 5 and 6 years (Figure 1). After 18 years of activity, only 22% of employer enterprise start-ups were still alive or equivalently, almost 78% had already exited the market.

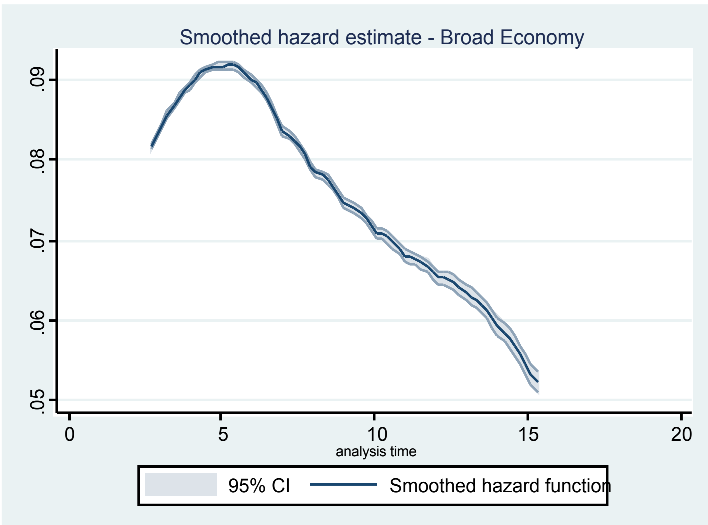
Table 1 - Life Table for Employer Enterprise Births, 1987-2005

Time	Observations	Deaths	Censured Observations	Kaplan-Meier		Nelson Aalen	
				Survivor Function	Failure Function	Hazard Rate	Cumulative Hazard Rate
				%	%	%	%
Years	nº	nº	nº	P(S)	100-P(S)	P(D)	$\sum P(D)$
1	451.041	63.088	24000*	86.0%	14.0%	14.0%	14.0%
2	364.233	46.351	22000*	75,1%	24,9%	10,9%	26,7%
3	295.786	32.973	28000*	66.7%	33.3%	8.4%	37.9%
4	235.002	23.655	24000*	60.0%	40,0%	6,7%	47,9%
5	187.102	17.353	19000*	54.4%	45.6%	5.6%	57.2%
6	150.840	12.966	12000*	49.7%	50.3%	4.7%	65.8%
7	125.525	10.059	11000*	45,8%	54,2%	4,0%	73,8%
8	104.121	7.735	9.613	42.4%	57.6%	3.4%	81.2%
9	86.773	6.089	7.943	39,4%	60,6%	3,0%	88,3%
10	72.741	5.068	7.491	36.6%	63.4%	2.8%	95.2%
11	60.182	4.172	11000*	34,1%	65,9%	2,5%	102,2%
12	45.130	3.037	6.150	31.8%	68.2%	2.3%	108.9%
13	35.943	2.422	5.626	29,7%	70,3%	2,2%	115,6%
14	27.895	1.681	5.546	27.9%	72.1%	1.8%	121.7%
15	20.668	1.133	4.733	26.4%	73,7%	1,5%	127,1%
16	14.802	805	5.361	24.9%	75.1%	1.4%	132.6%
17	8.636	490	4.418	23.5%	76.5%	1.4%	138.2%
18	3.728	228	3.500	22.1%	77.9%	1.4%	144.4%

Source: Own calculations based on *Quadros de Pessoal*, GEP, MTSS.
Notes: * Approximate values.

In Figure 1, we depict the smoothed hazard estimate or unconditional hazard function for the total economy.

Figure 1 – Smoothed hazard estimate for the total economy, 1987-2005



Source: Own calculations based on *Quadros de Pessoal*, GEP, MTSS.

This function exhibits an inverted U-shape, with a maximum around the sixth year of activity. This means that, after a firm enters the market, the conditional probability of failure increases continuously until the sixth year, and declines steeply thereafter. Such pattern is similar to that found in other economies, such as Italy (Audretsch et al., 1999), the UK (Bhattacharjee, 2005), Germany (Wagner, 1994), UK, Italy and the US (Bartelsman et al., 2005) and Spain (López-Garcia and Puente, 2006). In all these cases, the maximum of the unconditional hazard function is reached before the sixth year, indicating that Portuguese firms keep on failing for a longer period, before the hazard rate starts declining.

Table 2 presents the results for the non-parametric estimation, for each of the seven Portuguese NUTII regions. This framework explores the relationship between age and the regional hazard of exit.

Table 2 - Survival Table for Employer Enterprise Births by NUTII region, 1987-2005

Time	Norte	Centro	Lisboa e Vale do Tejo	Alentejo	Algarve	Açores	Madeira
1	85,6%	87,4%	85,5%	85,8%	85,6%	85,1%	86,1%
2	75,1%	77,7%	75,1%	75,5%	75,5%	74,2%	76,0%
3	66,5%	70,1%	67,0%	67,0%	67,7%	67,0%	68,3%
4	59,8%	64,0%	60,5%	60,4%	61,2%	59,9%	61,3%
5	54,1%	58,9%	55,0%	54,9%	55,8%	54,5%	56,2%
6	49,4%	54,5%	50,4%	50,7%	51,1%	50,5%	51,6%
7	45,3%	50,7%	46,6%	46,9%	47,2%	46,7%	47,5%
8	41,7%	47,5%	43,2%	43,4%	44,2%	43,7%	44,6%
9	38,7%	44,5%	40,2%	40,5%	41,1%	41,2%	41,7%
10	35,8%	41,9%	37,6%	37,7%	38,5%	38,9%	38,6%
11	33,0%	39,5%	35,1%	35,2%	36,2%	36,3%	36,6%
12	30,5%	37,4%	32,8%	33,0%	34,0%	33,9%	34,3%
13	28,1%	35,3%	30,8%	31,0%	32,0%	31,3%	31,7%
14	26,4%	33,4%	29,0%	29,3%	30,2%	29,4%	29,9%
15	24,8%	31,8%	27,4%	27,8%	29,0%	28,2%	28,2%
16	23,2%	30,4%	26,1%	26,2%	27,8%	26,4%	26,9%
17	21,9%	28,9%	24,6%	24,9%	25,4%	25,4%	26,6%
18	20,7%	27,4%	22,9%	23,2%	23,9%	23,8%	25,4%

Source: Own calculations based on *Quadros de Pessoal*, GEP, MTSS.

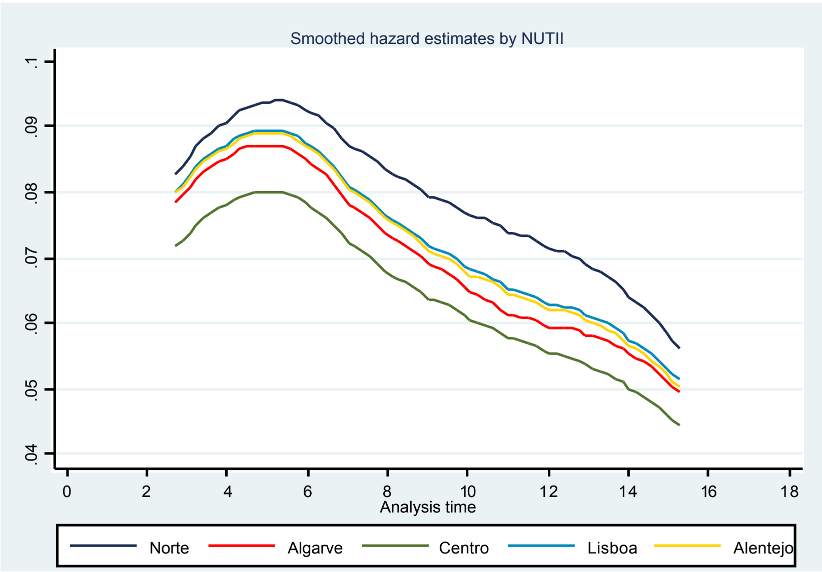
In line with the results shown previously for the total economy, over 85% of newly born employer enterprises remain active during their first year of activity in all regions. The one-year survival rate varies from a low of 85% in the Açores, to a high of 87,5% in the Centro region, meaning that the new born enterprises died more prematurely in Açores than in other Portuguese regions.

Table 2 also reveals that the survival gap between the two extreme regions grows systematically with time. Within 6 years of activity, the region Norte is the only one with less than 50% of enterprise survival probability, lagging behind all other regions in terms of enterprise survival.

On the other hand, Centro has a higher survival rate than the economy's average. It is the region where more firms manage to survive longer throughout the period considered in this study.

There are also clear disparities between regions, in particular between Norte and Centro, in terms of median duration survival. At the end of the analysis period, Norte is the region that presents the lowest survival rate, with only 20,7% of the firms' population managing to survive after eighteen years of activity. In Centro, in turn, 27,4% of active start-ups are still alive after 18 years. The median duration of firms at the regional level (Figure 2), is below seven years for most regions, except for Centro (around the eight year).

Figure 2 – Smoothed hazard estimate by NUTII, 1987-2005



Source: Own calculations based on *Quadros de Pessoal*, GEP, MTSS.

The disparities among the Portuguese regions are confirmed by equality tests. Both Log-rank and Wilcoxon (Breslow) tests allow for the rejection of the hypothesis of survival equality among regions[1].

[1] The hypothesis being tested considers that there are no subgroup differences in survivor functions. We find the probability that the observed differences occur by chance is below 0,0. This piece of evidence is not included in the present work, but is available at request.

3. A Semi-Parametric Survival Analysis

Next, we present an overview of the theoretical foundations of the Cox Proportional Hazard Model.

3.1. Modeling with the Cox Proportional Hazard Model

The statistical representation of the relation between the survival time of a firm and specific variables is known as the hazard rate model of the duration of the life of a firm. According to the model a given firm j faces a hazard rate (h_j) that is a function of a baseline hazard rate (h_0), which all firms face, transformed by a set of explanatory variables (X) through a vector of parameters (β). The hazard rate model can be written in the form $h_j(t) = f\left(h_0(t), \phi(X,\beta)\right)$. Under this model, two firms with the same birth date will face a different hazard function if, and only if, their other characteristics are different. By definition, the model seems a natural solution to understand the temporal pattern of survival and to identify the covariates that could be related significantly to survival. Additionally, it is also a good solution for working with longitudinal datasets, characterized by right censored data and other types of selection issues.

An empirical application of the model implies the specification of a functional form for the hazard function. One of the most common options is the proportional hazard model: $h_j(t) = h_0(t)\phi(X,\beta)$. The name derives from the fact that the hazard that a firm faces is proportional to the baseline hazard. In other words, the shape of the hazard function is the same for all individuals, and variations in the explanatory variables will translate into parallel displacements of this function, thereby affecting only the scale of the hazard function and not its shape. Given the fact that the hazard is a conditional probability and, therefore, must be positive, a convenient functional form for $\phi(X,Y)$ is exponential. Hence the hazard a subject j faces is written in the following form: $h_j(t) = h_0(t)e^{(X,\beta)}$. Note that this particular functional form offers the advantage of a very convenient interpretation of the estimated coefficients, since $\beta = \frac{\partial \ln \phi(X,\beta)}{\partial X}$. This means that the coefficient of one explanatory variable is the constant proportional effect of a unit increase of this variable on the conditional probability of exiting.

The assumption made for the functional form of $\phi(X,Y)$ is widely accepted, the same does not happening for the functional form of the baseline hazard, since different parametric specifications of the hazard function display different duration dependence behaviors. Positive (negative) duration dependence implies that the likelihood of failure at time t, conditional on the duration up to t, is increasing (decreasing) in t. *A priori* it is not obvious which distribution is most appropriate even when economic theory provides some clues concerning the way the baseline hazard varies over time. In case of doubt, one line of action to consider is to make no assumption about the functional form of the baseline hazard. Such a method was first suggested by Cox (1972) and the resulting models are called semi-parametric. Cox (1972) also suggested that the proportional hazard model could be easily extended to account for time varying covariates. This is what we will approach next.

The 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 series of explanatory covariates X_{t-1} plus a set of parameters identifying the baseline hazard function, according to the following specification:

$$\log h(t \mid x_t, x_0) = \lambda_t + \beta x_t + \gamma x_0, \; for \; t = 1, \ldots, k$$

The use of the partial likelihood function does not require that $h_o(t)$ must be specified, which allows the estimation of β and γ and avoids the risk of misspecifying the baseline hazard function. The model described previously, considers two types of heterogeneities that may cause exit, and that need to be considered: current heterogeneities between firms, that is heterogeneities based on differences that exist in period t, and heterogeneities that occur from differences that existed in the moment when firms were created (t=0). Heterogeneities due to differences in founding conditions include those conditions that are cohort specific, i.e., which take a common value for all firms in the same cohort, such as macroeconomic or industry-wide factors and those which are firm-specific (Baptista and Mendonça, 2007).

In our case (e.g. as in López-Garcia and Puente, 2006) the survival is a continuous phenomenon, but the available information is reported annually in the month of October, transforming time in a discrete variable. To circumvent this, we have grouped the data, by creating 11 interval specific dummy variables (one for each spell year at risk) and will be using a discrete hazard model. The most common discrete time representation of an underlying continuous time Cox proportional hazard model is the complementary log-log (cloglog model), which is what will be used in the following estimations. The major advantage of using the hazard model is that each firm contributes several times to the likelihood function, each time it is at risk.

3.2. Explanatory Variables

We have considered in the chosen estimation framework, seven explanatory variables (Table 3), beyond sector and year dummies, which will be briefly described next.

Table 3 – Explanatory Variables Considered in the Model

Variable	Definition	Measurement
Start-up Size	Number of employees at the birth year of the firm.	Logarithm of the number of employees.
Current Size	Number of employees at the current year.	Logarithm of the number of employees.
Industry Entry Rate	Industry entry rate calculated for sectors defined at a 2-digit CAE level.	Logarithm of the industry entry rate, defined as the number of entrants divided by the total number of firms in industry.
Concentration (HHI)	Herfindhal-Hirschman Index (HHI) calculated for industries at a 2-digit CAE level.	Logarithm of the HHI.
Growth	Logarithmic difference of industry employment in two consecutive periods.	Logarithm of the number of employees at year *t* minus the logarithm of the number of employees at year *t-1*.
Entry Rate X Growth	Interaction variable, defined as the product of entry and growth.	Product of logarithms.
Turbulence	Sum of entry and exit rates calculated for sectors defined at a 2-digit CAE level.	Sum of logarithms of the industry entry rate with the industry exit rate.
Sector Dummies	Dummies for 4 broad sectors: Agriculture, Construction, Manufacturing and Services.	
Regional Dummies	Dummies for 7 NUTII Regions: Norte, Centro, Lisboa e Vale do tejo, Alentejo, Algarve, Açores and Madeira	
Year Dummies	Dummies for each current year.	

Source: Own calculations based on *Quadros de Pessoal*, GEP, MTSS.

Note: * The literature has shown that there is a non linear effect of the start-up size on survival, which is normally accounted for via a log transformation. The specification is reasonable given that the value of the likelihood increases.

The first explanatory variable is the firm start-up size. It is measured by the logarithm of the number of employees at the firm's year of birth. A negative influence on the hazard rate is expected, i.e., larger start-ups should face a reduced risk of survival. The second variable relates to the number of employees reported at the year of measurement. Besides these two firm characteristics, the specific conditions of the industry are likely to affect firm survival (López-Garcia and Puente, 2006). Among the measures of firm dynamics is important to control for industry entry and growth rate and its degree of competition. Thus, the third variable has to do with the firm´s entry rate. New firms are more likely to live longer if they enter expanding industries or industries with low entry activity (Mata, Portugal and Guimarães, 1995).

Another important industry characteristic is the degree of competition, which is measured through the Herfindhal-Hirschman Index (HHI). Highly concentrated industries may allow suboptimal scale of new firms and therefore give some room for survival after entry. On the other hand, according to the industrial organization literature, highly concentrated industries might as well represent a higher potential for incumbent's collusion and therefore a more aggressive behavior towards new entries. (Mata and Portugal, 1994, López-Garcia and Puente, 2006).

By definition, at start-up there is no post-entry growth. The effect of growth can only be perceived as firms' age and current size shifts from initial size. At any time after start-up, current size can be viewed as initial size plus the change in size which occurred. As size is measured in logs, this change is the cumulative growth rate since start-up. Therefore after controlling for the effect of start-up size, the coefficients associated with the current size gives up an estimate of the effect of the post-entry growth (Mata, Portugal and Guimarães, 1995).

Turbulence is a natural consequence of the chase for new business opportunities as resources are rapidly reallocated from unsuccessful to successful enterprises and to growing areas of business, therefore being considered a natural source of dynamism. These firm dynamics, that is, the pace at which firms are starting up and closing down is a commonly used measure of the level of entrepreneurial activity in an economy. The sum of birth and death rates (Eurostat/OECD, 2007) is the chosen indicator for the measurement of turbulence.

There may well be differences in survival rates between industries over and above those captured by the industry-specific variables mentioned above. For this reason industry dummy variables are also included in the analysis. Finally, since the overall state of the economy has long been indicated as an important force driving firms out of business, we include year dummies, to proxy the moment of the cycle and, therefore, control for the macroeconomic environment. (López-Garcia and Puente, 2006; Mata, Portugal and Guimarães, 1995).

3.3. Estimation Results for the Portuguese Regions

Table 4 shows the cloglog regression results for the seven NUT II Portuguese regions. The same model was applied to each one of the regions and includes all the variables presented in the above section (with the exception of the regional dummies). It also depicts the results for the total economy, in which regional dummies were also included. All the models control for broad industry dummies and for macroeconomic effects through year dummies. The estimation values of the industry control variables are presented in Table 4. The year dummies values have been introduced but the values are not shown as usually no clear pattern can be discernible from the estimated coefficients (Mata, Portugal and Guimarães, 1995).

The values presented below are the hazard ratios, that is, the ratio of hazard rate when the variable increases by the one unit. A hazard ratio over one implies that an increase in the given explanatory variable increases the probability of exit and, correspondingly, a hazard ratio below one means that an increase in the variable decreases the hazard.

Since the number of firms in each region is quite diverse, ranging from 164.599 firms in the Norte to 7.523 firms in Açores, the conclusions are not straightforward, when we take into consideration the absolute values of the coefficients. Therefore, this analysis must rely more on the overall results than on the absolute values of the hazard coefficients.

As argued in the literature and mentioned previously, the start-up size of a firm improves the chances of survival. However, this is not apparent from Table 4. These results show hazard ratios which are greater than one, not only for the entire economy but also for each of the regions. The explanation is the following, the model does not isolate the effects of the initial firm size from the effects of the current firm size, being this former effect predominant.

When we observe the hazard ratios for the variable that intends to catch up the current size of the firm, the effect of a firms' current size seems to be predominant. The effect could not be observed in the table since it does not detail the common cloglog estimators, but only shows the hazard ratios. However, when introducing the sum of the start-up and the current size (by denoting S_0 and S_t the initial and current size, respectively, and α and β the correspondent coefficients, the effect of size is expressed by $\alpha S_0 + \beta S_t$), it becomes evident that the current size improves the chances of survival and that the initial size does not. The effect is observed for all the national regions. This result is consistent with the results of Mata, Portugal and Guimarães (1995). According to the authors, firms that have started smaller and have experienced faster post-entry growth, face a higher probability of survival. In fact, our overall effect is line with the previous authors' results.

The international results also indicate that in industries characterized by high entry rates, at the moment of birth, post-entry survival is more difficult. Firms that experience more competition from entrants, have a higher probability of failure. The same is observed here for the entire economy and for all the NUT II regions. However this must be particularly stressed for regions where the entrepreneurial background is not so developed as in other regions, those being the cases of Alentejo, Açores and Madeira.

A high entry rate combined with fast growth rates for any given industry generates, in general, a shorter duration of firms (Mata, Portugal and Guimarães, 1995 and Gort and Klepper, 1982). This somehow expected piece of evidence can be also drawn from our results, even if we could not find statistical significant estimators for some of the regions. It might seem easier to enter the market in earlier stages of the product life-cycle, when markets are expanding, but it becomes particularly difficult to survive.

So far, all our results have stressed the literature's conclusions. However, the same does not happen for the effect of industry growth. What we would expect is that firms operating in industries that are growing faster, would suffer from a smaller probability of failure (since they can penetrate the market without harming the competitors), but our results show otherwise. To help explaining this result, it should be pointed out that industries in the early stages of their life-cycles usually register both high rates of entry and exit (Agarwal and Gort, 1996 and Baptista and Karaoz, 2007). In general, industries with higher than average entry rates also exhibit higher than average exit rates (Cabral, 2007), due to birth and death rates being highly correlated across industries, corroborating the idea that "entry barriers are exit barriers" (Mata et al., 1995). The combined effect of entry and growth could explain this unexpected effect of industry growth on survival probabilities. Industries experiencing higher growth rates are also more turbulent, registering high rates of entry and also of exit (the "revolving door" at work), thus decreasing the likelihood of survival.

Table 4 - Estimation Results for the Total Economy and for each one of the seven Portuguese NUT II Regions

Variable	Portugal (broad economy)	Regions: Norte	Centro	Lisboa	Alentejo	Algarve	Açores	Madeira
Log of Start-up Size	1,334 ***	1,310 ***	1,342 ***	1,414 ***	1,250 ***	1,286 ***	1,139 ***	1,267 ***
	0,007	0,011	0,016	0,014	0,023	0,028	0,041	0,044
Log of Current Size	0,459 ***	0,479 ***	0,418 ***	0,463 ***	0,451 ***	0,444 ***	0,501 ***	0,440 ***
	0,002	0,004	0,005	0,004	0,008	0,009	0,018	0,014
Industry (2digit) Start–up entry rate	1,24 ***	1,233 ***	1,181 ***	1,160 ***	1,515 ***	1,290 ***	1,429 ***	1,613 ***
	0,018	0,028	0,038	0,032	0,077	0,080	0,152	0,164
Start-up Industry HHI (2 digit)	0,988 ***	0,986 ***	0,986 ***	0,992 ***	0,988 **	0,997	1,004	0,975 ***
	0,001	0,002	0,003	0,003	0,005	0,006	0,011	0,009
Turbulence Rate	5,29 ***	11,444 ***	3,664 ***	3,406 ***	1,698 ***	3,574 ***	1,285	14,441 ***
	0,222	0,791	0,344	0,336	0,220	0,699	0,341	4,792
Industry Growth (log)	1,122 ***	1,087 ***	1,140 ***	1,159 ***	1,144 **	1,113 *	1,326 **	1,036
	0,018	0,029	0,044	0,036	0,065	0,070	0,146	0,104
Growth x Entry rate	1,082 ***	1,069 **	1,116 ***	1,091 ***	1,083	1,015	1,272 **	1,033
	0,017	0,028	0,042	0,033	0,061	0,065	0,141	0,109
Sector Dummies								
Agriculture	0,612 ***	0,443 ***	0,706 ***	0,643 ***	0,795 ***	0,823 *	1,178 *	0,841
	0,010	0,016	0.024	0,033	0,034	0,069	0,110	0,156
Construction	0,895 ***	0.858 ***	0,931 ***	0,919 ***	1,155 ***	1,013	1,742 ***	1,343 ***
	0,009	0,012	0.021	0,023	0,049	0,616	0,180	0,116
Manufacturing	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Services	0,705 ***	0,631 ***	0,770 ***	0,799 ***	0,884 ***	0,869 **	0,905	0,792 ***
	0,006	0,007	0,015	0,017	0,032	0,048	0,077	0,062
Regional Dummies								
Norte	(a)	-----	-----	-----	-----	-----	-----	-----
Centro	0,847 ***	-----	-----	-----	-----	-----	-----	-----
	0,006							
Lisboa	1,027 ***	-----	-----	-----	-----	-----	-----	-----
	0,007							
Alentejo	0,926 ***	-----	-----	-----	-----	-----	-----	-----
	0,010							
Algarve	0,939 ***	-----	-----	-----	-----	-----	-----	-----
	0,011							
Açores	0,942 ***	-----	-----	-----	-----	-----	-----	-----
	0,020							
Madeira	1,014	-----	-----	-----	-----	-----	-----	-----
	0,019							
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	447772	164599	97606	109405	33692	25802	7523	9140
LR X2 (34) / LRX2 (28) for regions	47329,9 ***	17871,03 ***	10705,95 ***	11192,01 ***	3695,93 ***	2698,05 ***	860,98 ***	1421,47 ***
Log likelihood	-422915,7	-152494,34	-91424,886	-106768,52	-33112,584	-23204,949	-6744,716	-8283,60

Source: Own calculations based on *Quadros de Pessoal*, GEP, MTSS. Notes: (a) refers to the reference sector; The year dummies “yes” means that they have been included in the estimation; Standard deviation is shown in brackets and *. **, *** means, respectively, 10, 5 and 1% level of significance.

Table 5 presents the pair wise correlation for the explanatory variables in the all Portuguese economy. The correlation between turbulence (sum of the entry and exit rates) and growth rate is indeed positive (58%) and statistically significant at 5% confidence level, corroborating our previous argument. These results can be extended to the regions stressing the conclusion that turbulence is a major driver in Portuguese firms´ survival chances.

Table 5 – Correlation Matrix

	Log of Start-up Size	**Log of Current Size**	**Industry (2digit) start–up entry rate**	**Start-up Industry HHI (2 digit)**	**Log of Industry Growth**	**Growth X Entry rate**	**Turbulence**
Log of Start-up Size	1						
Log of Current Size	0.8253*	1					
Industry (2digit) start–up entry rate	0.0570*	0.1036*	1				
Start-up Industry HHI (2 digit)	0.1122*	0.1417*	0.6323*	1			
Industry Growth (log)	-0.0523*	-0.0409*	0.3552*	0.2619*	1		
Growth x Entry rate	---	---	0.0044*	---	-0.0383*	1	
Turbulence	-0.0268*	-0.0571*	0.5349*	0.3057*	0.5797*	---	1

Source: Own calculations based on *Quadros de Pessoal*, GEP, MTSS.
Note: * refers to the correlations coefficients with 5% statistical significance.

From Table 4, it is also possible to conclude that the turbulence rate presents the most significant effect when analyzing the selected firm and market characteristics. The hazard ratios obtained range from almost 14,5 %, in Madeira, to 1,2% in Açores. Norte has clear regional specificities. A great level of firm turbulence had already been identified (Sarmento and Nunes, 2010) and we now confirm that it is the second region with the highest hazard rate and the first in the Portuguese Continent.

Concerning sector dummies, all the regions, with the exception of Madeira and Açores, show similar results. Manufacturing is the sector which firms have the biggest probability of exit from the market.

4. Final Remarks

In our analysis, we find that around 25% of enterprises entering the market fail within the first 2 years of activity and that more than 50% fail within a period of six years. Breaking down by region, we identify statistically significant disparities.

In line with the literature, we also find that firms that start small and experience faster post-entry growth, face a higher probability of survival. Firm's current size dimension is extremely important to determine the probability of survival, particularly in the Norte and Açores. But in industries characterized by high entry rates at the moment of a firm's birth, post-entry survival is more difficult. This happens mostly in the south and in the Portuguese island the regions with the lower number of active employer firms. A higher entry rate combined with fast growth rates for any given industry also generates a shorter duration of firms. It might seem easier to enter the market in earlier stages of the product life-cycle, when markets are expanding, but it becomes particularly difficult to survive. Firms that experience more competition from entrants, also face higher probabilities of failure.

However, we find a different result from the literature, for the effect of industry growth in survival rates. Firms operating in industries which are growing faster seem to suffer from a higher probability of failure. The combined effect of entry and growth can also help explaining this unexpected effect of industry growth on survival probabilities. This has to do with turbulence and the high rates of entry and exit verified in all the Portuguese regions thorough this period.

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Endnotes

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