Corporate growth and size across Portuguese regions

Natália Barbosa

University of Minho, School of Economics and Management, Gualtar, 4710-057 Braga, Portugal. Email: natbar@eeg.uminho.pt

Vasco Eiriz

University of Minho, School of Economics and Management, Gualtar, 4710-057 Braga, Portugal. Email: veiriz@eeg.uminho.pt

Abstract

This paper analyses the patterns of corporate growth of manufacturing firms across Portuguese regions. In particular, we compare corporate size and growth rates in order to investigate (i) whether regional differences in terms of mix of economic activities, interpreted as generating localization economies, exert any influence on corporate growth and size and (ii) whether there is evidence of persistence in corporate growth across regions. Using an extensive dataset of Portuguese manufacturing firms and applying parametric and semi-parametric approaches, we found that corporate size, measured by total assets, follows approximately a log-normal distribution in seven of the eighteen analyzed regions. This result suggests that in those seven regions, corporate growth rates are unrelated to corporate size and therefore firms have equal probabilities of attaining a particular growth rate within any given period. However, by estimating corporate growth as a function of lagged values of corporate size we uncovered that Portuguese manufacturing firms experience serial correlation in their growth patterns in all regions. This offers evidence on the persistence of corporate growth at regional level, indicating that corporate growth depends on firm's previous success.

Keywords: corporate growth, size, regional variations, Portugal

1. Introduction

The relationship between corporate growth and corporate size has been extensively scrutinized after the seminal work of Gibrat (1931). Early studies (*e.g.* Mansfield, 1962) have offered evidence that the size of firms followed a quite stable and approximately lognormal distribution, from which corporate growth rates and size are independent. In particular, these studies concluded that the corporate growth rate ought to be a random process, which would inevitably produce a lognormal distribution for corporate size. This result became known as Gibrat's Law.

However, empirical evidence provided by recent studies, based on more complete data sets (see, among others, Evans, 1987; Hall, 1987, Davis and Henrekson, 1999; Machado and Mata, 2000; Lotti *et al.* 2003; and Audretsch *et al.* 2004), casts doubts on the validity of the Gibrat's Law and the resulting lognormal distribution for corporate size. In particular, a series of studies covering a broad range of countries and industries and including different types of firms in the sample show a decreasing relationship between corporate growth and size, suggesting that the distribution of corporate size is not stationary over time and may differ from the lognormal distribution. Other studies (e.g., Heshmati, 2001; Piergiovanni *et al.*, 2003) offer mixed evidence on the growth-size relationship and on the validity of the Gibrat's Law.

A closer inspection of a large number of articles focusing on the growth-size relationship reveals that virtually all the knowledge about the validity of the Gibrat's Law is based on studies that examine the actual corporate size distribution and/or the growth-size relationship either at the industry or at the economywide level. Remarkably little is known about the regional dimension of the process of corporate growth and size. Studies examining the growth-size relationship at a spatial level splitting firms into disaggregated territorial levels are in fact quite scarce. Exceptions are Calvo (2004) and Ganugi *et al.* (2005). However, differences in the growth-size relationship among regions may reflect underlying structural differences shaping the dynamics of firms in one region in a way that is fundamentally different from other regions. Whether the dynamics of firms for a region mirrors that in other regions is an open question where little is known. In particular, the question of which factors affect corporate growth is

central to any understanding of the process of economic development and thus to the creation of successful national and regional economies. Thus, this paper attempts to fill this gap by linking the dynamics of firms to their geographical location. Specifically, we examine the nature of firm size distributions and growth-size relationships at the regional level in order to analyse whether corporate size and growth are related to the presence of geographical effects.

The rationale for the focus on geographical effects is to assess the extent to which the characteristics of regional economics related to different patterns of industrial development and different availability of public goods complementary to corporate growth process can provide additional insights on the variation in corporate growth and size across regions. In fact, as we will discuss in the following section, there are compelling theoretical reasons to expect the relationship between corporate size and growth to be different among regions.

Using a sample of Portuguese manufacturing firms active between 2000 and 2004 and applying parametric and non-parametric techniques to examine corporate size distribution and the growth-size relationship across regions, we expect to shed some light on the following questions: i) is the overall inverse relationship between size and growth – found by most of the studies addressing that relationship – confirmed for Portuguese regions?, ii) are there regional-specific effects determining the growth-size relationship? and, iii) in what extent the observed firm size distribution and the growth-size relationship depend on a pre-existing distribution of abilities and public goods at regional level?

This paper is organized as follows. The next section presents the theoretical framework and links corporate growth to regional characteristics that might shape the dynamics of firms. The data are described in section 3. Section 4 provides empirical evidence on the shape of empirical distributions of corporate size using non-parametric methods, while section 5 contains a discussion on the observed corporate growth-size relationship across Portuguese regions. Finally, section 6 provides the main conclusions.

2. Theoretical background

The point of departure of this study is the well-known Gibrat's Law that postulates the growth of firms as a random process. There may be a large number

of systematic factors affecting growth, but jointly they have only a limited impact on corporate proportionate growth. In other words, "the probability of a given proportionate change in size during a specified period is the same for all firms in a given industry – regardless of their size at the beginning of the period" (Mansfield, 1962: 1030-1031). This implies (i) the independence of corporate growth rates from corporate size (see, among others, Sutton, 1997, and Geroski, 2000, for a survey), and (ii) the convergence of the firm size distribution to the lognormal distribution.

Regarding the validity of this law, a growing number of empirical studies indicate two conclusions. On the one hand, the lack of any relationship between the (log) size of firms and their average rate of growth is only attained for large firms. When young and relatively small firms are taken into account, the Gibrat hypothesis is not confirmed (c.f. Lotti *et al.*, 2003). On the other hand, evidence on the dependence of the growth variance on size (e.g., Audretsch *et al*., 1999) clearly violates the Gibrat's Law. More recently, Cabral and Mata (2003) showed that, in more complete data sets, a lognormal distribution is no longer the appropriate distribution to describe corporate size. Rather, they found that the corporate size distribution seems quite skewed to the right, although evolving over time toward a more symmetric one.

The unsupportive evidence on Gibrat's Law suggests the need to take into account relevant information on firm- and industry-specific characteristics that may explain the evolution of the corporate size distribution and the growth-size relationship. In fact, Machado and Mata (2000) reported that failure to control for industry-specific characteristics impacts on the magnitude of the departure from the lognormal distribution. Some of these firm- and industry-specific characteristics are the innovating activity (Almus and Nerlinger, 2000; Freel, 2000), age (Heshmati, 2000; Cabral and Mata, 2003), firms' diversification (Bottazzi and Secchi, 2005, 2006), institutional change (Audretsch and Elston, 2006), and industry life-cycle (Klepper and Graddy, 1990). The geographical location of firms is, however, a quasi-neglected firm-specific characteristic that may help to understand the evolution of the corporate size distribution and the growth-size relationship.

Surprisingly, few studies have sought to examine the patterns of corporate growth across regions by including geographical variables for testing Gibrat´s

law. There are, however, some interesting recent exceptions. For instance, Calvo (2004), who distinguished developed from less developed regions according to the degree of technological development of Spanish regions, argued that agglomeration effects at regional level impact on corporate size and growth. He concluded that small firms located in the most developed areas of Spain grow faster than large firms, while in the less developed regions Gibrat's law is not rejected suggesting the independence of corporate growth rates from corporate size. Using a sample of Italian mechanical companies active between 1997 and 1999, Ganugi *et al.* (2005) found an inverse relation between mean and variability of growth rates and corporate size in all Italian macro-regions (North-West, North-East, Centre and South) and a weak persistence of growth rates. Both empirical results should be interpreted as rejecting Gibrat's law at regional level, suggesting that geographical effects drives corporate growth.

Those geographical effects are related to knowledge spillovers stemming from different types of agglomeration economies. The concept of agglomeration emphasizes that firms in a region or local may benefit from industry specialization, availability of specific infrastructures, labour, concentration of business services, or other locational characteristics based on economies that are external to firms but internal to the region or local. For instance, Guimarães *et al.* (2000) pointed out that there is compelling evidence that urban diversity economies, not simply the localization of specific industries, drive economic growth and exert a strong pull on firms location in Portugal.

The new economic geography literature (e.g., Glaeser *et al*., 1992) clearly accentuates that industries in different regions may have different growth rates because knowledge spillovers work out more effectively in some regions than in others. This diversity is due to different types of knowledge spillovers, both horizontal and vertical, that may emerge in different regions. Moreover, the intensity of local competition may differ between regions, impacting differently on corporate growth. Using a model of regional growth that deals with the impact of local competition and different types of knowledge spillovers on innovation and growth, Van Stel and Nieuwenhuijsen (2004) found that economic growth in manufacturing and construction industries is mainly determined by the intensity of local competition, while diversity economies yielding vertical spillovers are particularly important for growth in service sectors. They also found that

agglomeration effects related to industry specialization (a proxy for horizontal spillovers) have no significant effect on regional growth.

In fact, regional differences in terms of the availability and cost of resources, workforce qualifications, innovation conditions, the presence of specialized services and venture capital, industry specialization, and knowledge stock have been identified as the main determinants of regional variation in firm formation rates (e.g., Armington and Acs, 2002; Acs, 2006; Fritsch and Falck, 2007), firm survival (e.g., Littunen, 2000; Acs *et al.,* 2006; Fritsch *et al.*, 2006) and growth (e.g., Hart and McGuinness, 2003; Smallbone *et al.*, 1997). In particular, Acs (2006: 105) argued that "the ability to transform new knowledge into economic knowledge requires a set of skills, aptitudes, insights and circumstances that is neither uniformly nor widely distributed in the population". Moreover, regions broadly similar in terms of demand, industry specialization, and industrial diversity may show important differences in firm formation rates, survival and growth that can be attributed to specific qualities of their human capital or other dynamic resources and, the propensity of local knowledge stock to spill over and stimulate corporate growth (Acs *et al.*, 2006). Therefore, to conclude, the region or location matters to corporate size and growth as it offers the resource base and the environment conditions needed for corporate growth.

3. The data

The data used in this paper were obtained from the SABI dataset on corporate activity across Portuguese companies. SABI is a panel dataset of both public and private companies from Portugal and Spain. In particular, the dataset covers nearly 100.000 Portuguese companies and contains a variety of financial and ownership details. The SABI dataset is a subset of the Amadeus database, which is a comprehensive, pan-European database containing financial information on public and private companies in 38 European countries. The original data was provided by Bureau Van Dijk (BvD), a European electronic publishing firm. It specializes in cleaning and organizing data supplied by information providers in various countries to create a broader data set. In the Portuguese case, the national information provider is COFACE Portugal. The national company collects the

data from the national public body in charge of collecting the annual accounts in its country.

From that dataset, we selected Portuguese manufacturing firms (NACE sectors 15-36) that survived over the period 2000-2004. The indication that a firm is a surviving one over the period 2000-2004 is given by the variable status, which identifies active and no active firms. However, there are many firms that fail to disclose financial information for the entire observed period. This implies that the number and identification of observed firms varies across the years. Moreover, when we require financial information for a firm over two or more subsequent years, the number observations is considerably reduced. This explains why the results presented and discussed in section 4 and section 5 are obtained from different sample sizes.

The geographic unit of analysis chosen for this study is the Portuguese districts. The Portuguese territory is split into 18 districts (excluding Madeira and Azores islands), which historically were always the main administrative level of territorial organization. This is a more detailed level than the Nomenclature of Territorial Units for Statistics (NUTS) established by Eurostat to promote the availability and comparability of regional statistics among European countries. The choice of districts as local administrative regions was based on (i) the ease identification and interpretation of empirical results for those territorial units and (ii) the definition and implementation of many public policies based on those territorial units, and (iii) data availability as the SABI dataset identify correctly the district where a firm is located but it fails to reliably locate firms at a more detailed level (such as municipality). Table 1 displays the distribution of observed firms across Portuguese districts.

Table 1: Regional distribution of firms

Districts	2000		2004	
	No.	%	No.	%
Aveiro	1945	11.9	2041	11.9
Beja	136	0.8	213	1.2
Braga	1726	10.6	1777	10.4
Bragança	164	1.0	288	1.7
Castelo Branco	223	1.4	339	2.0
Coimbra	674	4.1	686	4.0
Évora	280	1.7	287	1.7
Faro	857	5.3	631	3.7
Guarda	260	1.6	378	2.2
Leiria	1521	9.3	928	5.4
Lisboa	1990	12.2	2099	12.3
Portalegre	178	1.1	213	1.2
Porto	3177	19.5	4637	27.1
Santarém	843	5.2	498	2.9
Setúbal	972	6.0	626	3.7
Viana do Castelo	428	2.6	371	2.2
Vila Real	269	1.7	320	1.9
Viseu	652	4.0	757	4.4
TOTAL	16,295	100.0	17,089	100.0

Source: SABI database. Authors' calculation.

The regional distribution of observed firms roughly replicates the regional structure of the Portuguese manufacturing industry. The large districts in terms of industrial activity (Aveiro, Braga, Leiria, Lisboa, and Porto) are those most represented in the sample. Moreover, we can see a roughly stable evolution in terms of the proportion of firms across districts over the period 2000-2004. Nonetheless, as in the Portuguese case there is not a national public body in charge of coercively collecting annual accounts of Portuguese companies (in fact, the availability of data on corporate activity is mostly dependent on firms' willingness), variations in the number of firms across districts should be read with caution.

4. Empirical distribution of corporate size: a nonparametric approach

In this section, we analyse the distributional shape of corporate size by looking at their actual shapes and by comparing them with their supposed shapes according to the Gibrat's law. The purpose is to compare the empirical distribution of corporate size with the lognormal distribution, under the hypothesis

that this represents the limit distribution of corporate size if the Gibrat's law holds. Following a long-standing practice in the empirical analysis on the validity of Gibrat's law, we use the logarithm of the size variable. In this analysis, the choice of the size variable is important for corporate size modelling. The most used measures of firm size are total assets and number of employees, which both can be selected from the SABI dataset. However, there are many missing values for the number of employees that compel us to use total assets as the measure of corporate size.

In order to assess whether the logs of size (total assets) converge toward a normal distribution, we employed a simple nonparametric technique of density estimation. In particular, we use the kernel density estimator (Pagan and Ullah, 1999) to assess the relevance of the discrepancies between empirical and log-normal distribution[1]. The main advantage of this estimator is that the density is estimated directly on the data and, hence, there is no need to postulate the true parametric density of corporate size.

The general formulation of a kernel density estimator is

$$\hat{f}(x) = \frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{X_i - x}{h}\right) \qquad (1)$$

where X_i is the observed log of size (total assets) of firm I in a given regions, h denotes the smoothing parameter, n the sample size, and the kernel function K(•) is defined in such a way that $\int_{-\infty}^{+\infty} K(z)dz = 1$. We used the Gaussian distribution as kernel function (as in Cabral and Mata, 2003; Lotti and Santarelli, 2004; Bottazzi and Secchi, 2005) and the optimal smoothing parameter, which minimize the mean integrated squared error if the data were Gaussian and a Gaussian kernel were used.

Accordingly, we estimated the distribution of the logarithm of corporate size (total assets) for the eighteen Portuguese districts and the years 2000 and 2004, and checked if a tendency towards a lognormal distribution emerged. The results for each district are shown in Figures 1a-1b. In general, the empirical evidence resulting from the kernel density estimates show significant regional heterogeneity in terms of shape and evolution of the corporate size distribution,

[1] This methodology has been used in several studies that examine the actual distributional shape of firm size. See, among others, Cabral and Mata (2003), and Lotti and Santarelli (2004).

with some districts exhibiting a corporate size distribution far away from the lognormal distribution.

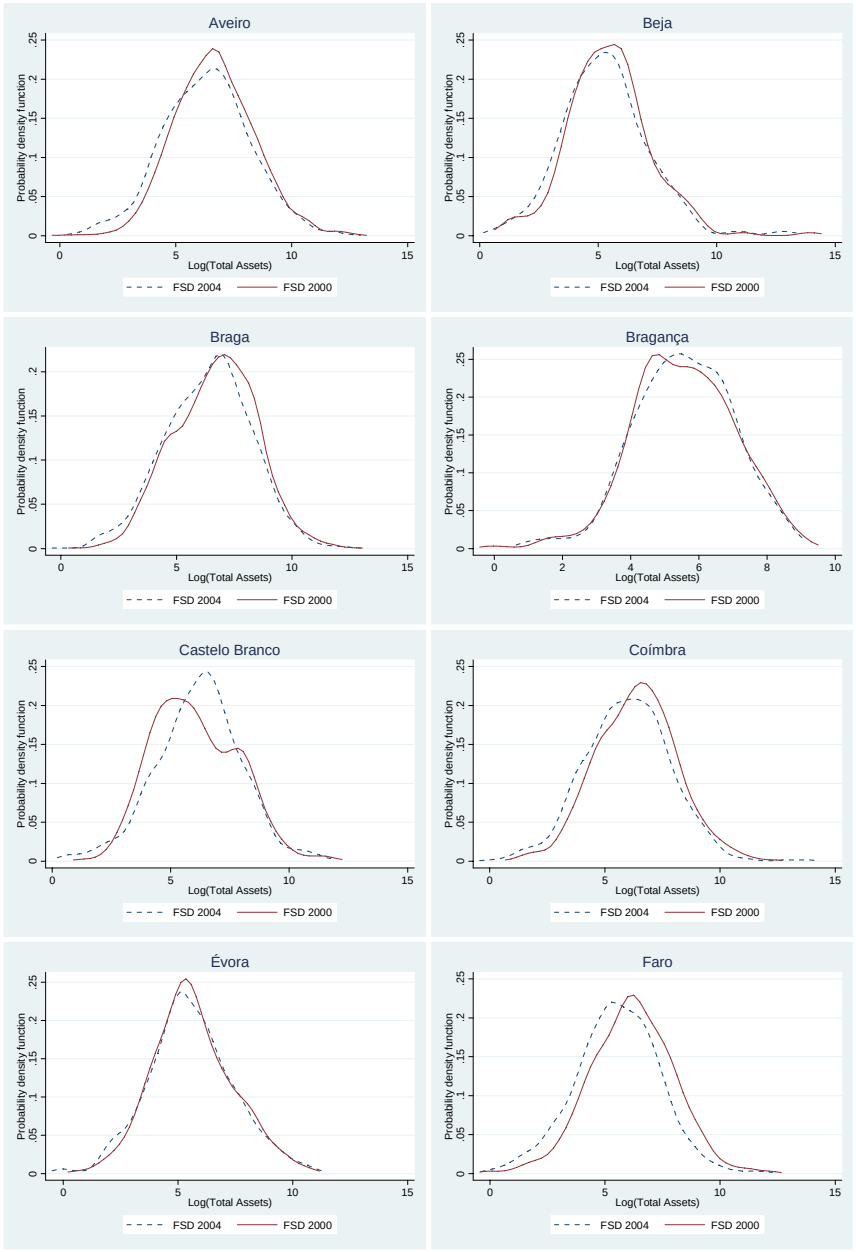

Figure 1a: Kernel density estimation of firm size distribution (FSD) in 2000 (solid line) and 2004 (dashed line) by regions, based on total assets data.

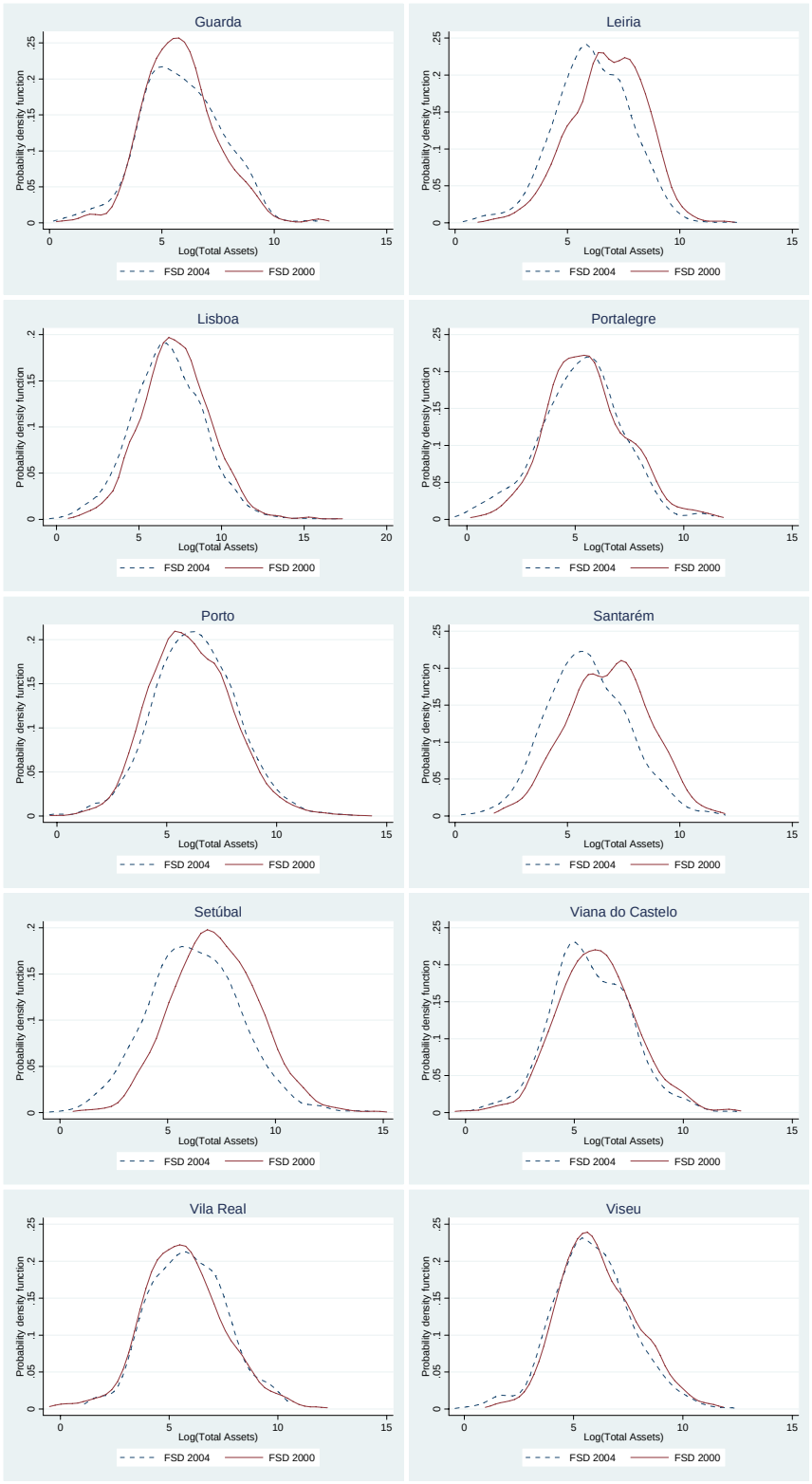

Figure 1b: Kernel density estimation of firm size distribution (FSD) in 2000 (solid line) and 2004 (dashed line) by regions, based on total assets data.

In more detail, the pattern of evolution of empirical corporate size distributions across districts is much less clear-cut. Six out of eighteen districts (Aveiro, Beja, Évora, Lisboa, Portalegre, and Viseu) do not exhibit noteworthy

differences on their empirical corporate size distributions on the two observed years, suggesting that, in those, variations over time on region-specific characteristics do not enable firms to grow differently. Moreover, our results show some cases (Leiria, Santarém, and Viana do Castelo) of bimodal distributions suggesting the existence of different groups of firms with different patterns of growth. For instance, in their study of the worldwide pharmaceutical industry, Bottazzi and Secchi (2005) also observe significant bimodality in the size distribution and they relate this to a growth patterns differences between the industry leaders and fringe competitors. In other districts (Coimbra, Santarém, Setúbal, and Vila Real) the distribution of corporate size noticeably evolves over time toward a lognormal distribution. Clearly, these contrasting results across regions suggest that regional differences in terms of mix of economic activities and public goods complementary to corporate growth influence corporate size.

In order to test statistically the conformity of the empirical distribution to the lognormal distribution, we performed the Jarque-Bera test of normality (c.f. Bera and Jarque, 1981). Table 2 displays the statistics as well as the p-values for the Jarque-Bera normality test applied to corporate size distribution by Portuguese districts. Looking at Table 2, the results indicate a departure of the actual distribution of the logarithm of corporate size from normality for a significant number of districts and show differences across de observed years.

Table 2: Jarque-Bera normality test applied to corporate size distribution by Portuguese districts (p-value in parenthesis)

Districts	2000	2004
Aveiro	0.554	19.26
	(0.758)	(0.000)
Beja	25.07	61.68
	(0.000)	(0.000)
Braga	3.992	4.886
	(0.1359)	(0.087)
Bragança	1.987	2.933
	(0.3703)	(0.231)
Castelo Branco	3.587	7.621
	(0.166)	(0.022)
Coimbra	6.262	0.438
	(0.044)	(0.804)
Évora	1.258	3.291
	(0.533)	(0.193)
Faro	5.025	4.665
	(0.081)	(0.097)
Guarda	0.054	20.62
	(0.973)	(0.000)
Leiria	5.800	10.860
	(0.055)	(0.004)
Lisboa	19.67	44.570
	(0.000)	(0.000)
Portalegre	1.156	5.326
	(0.561)	(0.070)
Porto	16.030	84.060
	(0.000)	(0.000)
Santarém	5.925	2.854
	(0.052)	(0.240)
Setúbal	7.145	2.896
	(0.028)	(0.235)
Viana do Castelo	4.650	5.427
	(0.098)	(0.066)
Vila Real	1.177	5.312
	(0.555)	(0.070)
Viseu	5.695	13.330
	(0.058)	(0.001)

The discrepancies between empirical and theoretical density seem to be negligible only for seven (Braga, Bragnaça, Évora, Faro, Portalegre, Viana do Castelo, and Vila Real) out of eighteen districts in both years, suggesting that in those seven regions, corporate growth rates are unrelated to corporate size and therefore firms have equal probabilities of attaining a particular growth rate within any given period. On the other hand, the hypothesis of log-normality of the corporate size distribution is not acceptable for the districts of Beja, Lisboa, and Porto in both of the observed years, casting doubts on the proposition that

corporate growth is a random process. Interestingly, most of he remaining eight districts show a pattern of divergence towards the lognormal distribution. After a lag of four years, districts such as Leiria and Viseu fail to keep the lognormal distribution of corporate size, whereas it initially holds.

These findings are consistent with those emerging from looking at the actual distribution of corporate size. The shape and evolution of the corporate size distribution change from region to region, with only some of them evolving to the lognormal distribution. More importantly, these results suggest that some region-specific determinants of corporate size and growth are at wotk, which, as we have pointed out before, are the result of different patterns of regional development and different stock of resources and environment conditions needed for corporate growth.

5. Corporate growth-size relationship: an econometric approach

A second implication from the Gibrat's law is the underlying corporate growth process including, in particular, the relationship between corporate size and growth dynamics. As the Gibrat's law provides a sort of "null hypothesis" against which observed corporate growth dynamics can be compared, in this section we are interested in examining whether corporate growth follows a purely stochastic process, with growth rates being independent of corporate size. In searching for empirical evidence at regional level for that, and following Chesher (1979), we analyze the corporate growth-size relationship through the estimation of autoregressive models on the corporate size time series.

Consider that corporate growth process in two subsequent periods (*t-1*, *t*) can be characterised by the AR(1) model

$$s_{ij}(t) = \beta s_{ij}(t-1) + \varepsilon_{ij}(t) \qquad (2)$$

where s_{ij} is the normalized (log) corporate size of firm *i* in region *j* and ε_{ij} is an error term. We use the normalised (log) size, computed by subtracting from the (log) size of each firm in region *j* the average (log) size of all firms in that region, in order to eliminate possible trends in the average corporate size. The hypothesis of corporate growth following a purely stochastic process at regional level holds if β is not significantly different from 1. Values of β smaller than 1 imply that small

firms in a region grow faster, on average, than large firms in that firms. The opposite happens when β takes values larger than 1.

In order to obtain reliable estimates of β we have to deal with potential serial correlation and heteroskedasticity of the error terms $\varepsilon_{ij}(t)$. To take the first source of problems into account, we adopt the Chesher's (1979) method by assuming that the error term is characterized by an AR(1) structure

$$\varepsilon_{ij}(t) = \rho\varepsilon_{ij}(t-1) + u_{ij}(t) \quad (3)$$

where $u_{ij}(t)$ are *i.i.d.* disturbances and ρ measures the first order correlation coefficient of $s_{ij}(t)$ over time. Noting that $\varepsilon_{ij}(t)$ may be expressed in terms of $s_{ij}(t-1)$ and $s_{ij}(t-2)$ and, hence, we can rewrite (3) as

$$s_{ij}(t) = \eta_1 s_{ij}(t-1) + \eta_2 s_{ij}(t-2) + u_{ij}(t) \quad (4)$$

where $\eta_1=\beta+\rho$ and $\eta_2=-\rho\beta$. The validity of the hypothesis of corporate growth following a purely stochastic process at regional level and the error terms do not follows an AR(1) process is confirmed if the joint hypothesis $\beta=1$ and $\rho=0$ (or, equivalently, $\eta_1=1$ and $\eta_2=0$) is not rejected. To test that hypothesis, we estimate the model in (4) by Ordinary Least Squares (OLS) and corrected standard errors for heteroskedasticity using the White estimator of covariance matrix. The results are reported in Table 3.

Overall, the results show that corporate growth dynamics at regional level are dependent on corporate size. For all districts, we reject the hypothesis that corporate growth follows a purely stochastic process, with growth rates being independent of corporate size. Moreover, the results offer evidence on the correlation, negative or positive, between corporate growth and size at regional, suggesting regional-specific growth-size relationships. In fact, the estimates reveal a noteworthy degree of heterogeneity in the estimated of η_1 and η_2, suggesting that region does matter to corporate growth dynamics. In particular, the estimated η_1 coefficients are clearly far away from 1, ranging from -0.386 to 0.72.

Table 3: OLS estimates of growth-size relationship in (4) along with robust standard errors

	Estimates		F-test	
	η_1	η_2	(H0: η_1=1 and η_2=0)	N
Aveiro	0.136 (0.246)	0.077 (0.481)	297.8 (0.000)	1073
Beja	-0.051 (0.877)	-0.134 (0.481)	71.25 (0.000)	122
Braga	0.428 (0.001)	-0.427 (0.000)	393.1 (0.000)	812
Bragança	0.255 (0.187)	-0.124 (0.462)	44.0 (0.000)	103
Castelo Branco	-0.067 (0.860)	-0.223 (0.481)	97.3 (0.000)	150
Coimbra	0.248 (0.297)	-0.229 (0.300)	100.7 (0.000)	314
Évora	0.295 (0.448)	-0.228 (0.538)	42.3 (0.000)	132
Faro	0.395 (0.385)	-0.379 (0.402)	76.0 (0.000)	221
Guarda	0.381 (0.277)	-0.168 (0.618)	39.6 (0.000)	181
Leiria	-0.093 (0.779)	0.032 (0.923)	195.0 (0.000)	344
Lisboa	-0.156 (0.442)	0.108 (0.599)	371.3 (0.000)	813
Portalegre	0.252 (0.660)	-0.419 (0.481)	71.9 (0.000)	106
Porto	0.338 (0.000)	-0.174 (0.016)	422.4 (0.000)	1537
Santarém	0.030 (0.958)	-0.039 (0.944)	71.9 (0.000)	181
Setúbal	-0.201 (0.497)	0.173 (0.547)	123.6 (0.000)	249
Viana do Castelo	0.720 (0.295)	-0.950 (0.181)	99.1 (0.000)	179
Vila Real	-0.386 (0.167)	0.350 (0146)	64.8 (0.000)	169
Viseu	0.253 (0.373)	-0.101 (0.698)	84.7 (0.000)	335

Nonetheless, we are not able to identify any systematic growth-size relationship across regions. The estimates indicate that in districts with a positive estimate of the first order autocorrelation coefficient - ρ -, which carry information on growth rate autocorrelation, high-growth firms in one period will grow faster in the following period, while in districts with a negative estimate of ρ, high-growth firms tend to grow slower in the subsequent periods. In fact, a negative dependence seems to emerge only for firms located at Aveiro, Leiria, Lisboa, Setúbal, and Vila Real, implying that those districts experience a reversion to the mean (i.e. small firms having higher average growth rates than larger ones). In the other districts, the divergence on growth patterns among firms with different sizes seems to be accentuated over time. These contrasting results across Portuguese districts reinforce the need to analysis which region-specific characteristics impact significantly on corporate growth and size.

6. Concluding remarks

In this paper we have examined the corporate size distribution and the relationship between corporate growth rates and corporate size across Portuguese regions. Using non-parametric and parametric approaches based on firm-level data by regions, we are able to draw some conclusions about the different mechanisms that may be at work in different regions and to show that the corporate growth-size relationship may well be explained by differences in the diversification and specialization structure of regions.

The results suggest that differences in region-specific characteristics seem to engender differences in the way firms grow. In particular, we found that in some districts (e.g., Porto and Lisboa) firms have no equal probabilities of attaining a particular growth rate and, hence, some firms grow faster than others. On the other hand, the empirical analysis carried out reveals that in all districts firms experience serial correlation in their growth patterns, suggesting that if there are relevant changes on region-specific characteristics impacting on corporate growth, those changes do not eliminate the observed dependency of corporate growth rates on size.

References

Acs, Z. J. (2006) "New firm formation and region: Empirical results from the United States", in Santarelli, Eurico (ed.) *Entrepreneurship, Growth, and Innovation: The Dynamics of Firms and Industries*, Springer: 105-133.

Acs, Z. J.; Armington, C.; Zhang, T. (2006) "The determinants of new-firm survival across regional economies", Discussion Papers on Entrepreneurship, Growth and Public Policy, #0407, Max Planck Institute of Economics.

Almus, M.; Nerlinger, E. (2000) "Testing Gibrat's law for young firms – Empirical results for West Germany", *Small Business Economics*, 15: 1-12.

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

Audretsch, D. B.; Elston, J. A. (2006) "Can institutional change impact high-technology firm growth?: Evidence from Germany's Neuer Markt", *Journal of Productivity Analysis*, 25 (1-2): 9-23.

Audretsch, D. B.; Klomp. L.; Santarelli, E. (2004) "Gibrat's Law: Are the services different?", *Review of Industrial Organization*, 24 (3): 301-324.

Audretsch, D. B.; Santarelli, E.; Vivarelli, M. (1999) "Start-up size and industrial dynamics: Some evidence from Italian manufacturing", *International Journal of Industrial Organization*, 17: 965–983.

Bera A.; Jarque, C. (1981) "Efficient tests for normality, heteroskedasticity and serial independence of regression residuals: Monte Carlo evidence". *Economics Letters*, **7**: 313 – 318.

Bottazzi, G.; Secchi, A. (2005) "Growth and diversification patterns of the worldwide pharmaceutical industry, *Review of Industrial Organization*, 26 (2): 195-216.

Bottazzi, G.; Secchi, A. (2006) "Gibrat's and diversification", *Industrial and Corporate Change*, 15 (5):847-875.

Cabral, L.; Mata, J. (2003) "On the evolution of the Firm Size Distribution: Facts and theory", *American Economic Review*, 93 (4): 1075-1090.

Calvo, José L. (2004) "Testing Gibrat's Law across regions: Evidence from Spain", paper presented at the 44th ERSA Conference, Porto, Portugal.

Chesher, A. (1979) “Testing the law of proportionate effects”, *Journal of Industrial Economics*, 27: 403.411.

Davis, S. J.; Henrekson, M. (1999) “Explaining national differences in the size and industry distribution of employment”, *Small Business Economics*, 12: 59-83.

Evans, D. S. (1987) “Tests of alternative theories of firm growth”, *Journal of Political Economy*, 95: 657-674.

Freel, M.S. (2000) “Do small innovating firms outperform non-innovators?, *Small Business Economics*, 14: 195-210.

Fritsch, M.; Brixy, U.; Falck, O. (2006) “The effect of industry, region, and time on new business survival - A multi-dimensional analysis, *Review of Industrial Organization*, 28 (3): 285-306.

Ganugi, P.; Grossi, L.; Gozzi, G. (2005) “Testing Gibrat’s law in Italian macro-regions: analysis on a panel of mechanical companies”, *Statistical Methods & Applications*, 14 (1): 101-126.

Geroski, P. A. (2000) “The growth of firms in theory and practice” in Foss, N. and Malinke, V. (ed.) *New Directions in Economic Strategy Research*, Oxford University Press, Oxford: 168-186.

Gibrat, R. (1931) *Les Inégalités Économiques*, Librairie du recueil Sirey, Paris.

Glaeser, E, L.; Kallal, H. D.; Scheinkman, J. A.; Shleifer, A. (1992) ”Growth in cities”, *The Journal of Political Economy*, 100 (6): 1126-1152.

Guimarães, P.; Figueiredo, O.; Woodward, D. (2000) “Agglomeration and the location of foreign direct investment in Portugal”, *Journal of Urban Economics*, 47 (1): 115-135.

Hall, B. H. (1987) “The relationship between firm size and firm growth in the U.S. manufacturing sector”, *Journal of Industrial Economics*, 35:583-606.

Hart, M. and McGuinness, S. (2003) “Small firm growth in the UK regions 1994-1997: Towards an explanatory framework”, *Regional Studies*, 27 (2): 109-122.

Heshmati, A. (2001) “On the growth of micro and small firms: evidence from Sweden”, *Small Business Economics*, 17: 213-228

Klepper, S.; Graddy, E. (1990) “The evolution of new industries and the determinants of market structure”, *Rand Journal of Economics*, 21: 27-44.

Littunen, H. (2000) “Networks and local environmental characteristics in the survival of new Firms”, *Small Business Economics*, 15 (1): 59-71.

Lotti F., and E. Santarelli (2004), "Industry dynamics and the distribution of firm sizes: A non parametric approach", *Southern Economic Journal*, 70 (3): 443-466.

Lotti, F.; Santarelli, E.; Vivarelli, M. (2003) “Does Gibrat’s Law hold among young, small firms?”, *Journal of Evolutionary Economics*, 13 (3): 213-235.

Machado, J.; Mata, J. (2000) “Box-Cox quantile regression and the distribution of firm sizes, *Journal of Applied Econometrics*, 15: 253-274.

Mansfield, E. (1962) Entry, Gibrat’s law, innovation, and the growth of firms. *American Economic Review*, 52 (5): 1023–1051

Pagan, A.; Ullah, A. (1999) *Non- parametric Econometrics*, Cambridge University Press, Cambridge.

Piergiovanni, R.; Santarelli, E.; Klomp, L.; Thurik, A. R. (2003) “Gibrats law and the firm size/firm growth relationship in Italian services”, *Revue d’Economie Industrielle*, 102: 69-82.

Smallbone, D.; North, D.; Kalantaridis, C. (1997) “The survival and growth of manufacturing SMEs in remote rural areas in the 1990s, in Ram, M.; Deakins, D.; Smallbone, D. (Eds) *Small Firms: Enterprising Futures*, Chapman, London: 47–59.

Sutton, J. (1997) “Gibrat’s legacy”, *Journal of Economic Literatur*e, 35 (1): 40-59.

Van Stel, A. ; Nieuwenhuijsen, H. (2004) “Knowledge spillovers and economic growth: An analysis using data of Dutch regions in the period 1987-1995”, *Regional Studies*, 38 (4): 393-407.