E C O N O M I C S B U L L E T I N

A Note on Gibrat's Law, Gibrat's Legacy and Firm Growth: Evidence from Brazilian Companies

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Abstract

The aim of this work is to test the Gibrat's Law hypothesis for Brazilian firms. Gibrat's Law establishes that firm growth is a random walk, it means that the probability of a given proportionale change in size during a specified period is the same for all firms in a given industry. This work uses information from manufacturing and services sectors, and it uses two different variables to compute firm growth: The growth of employment and the growth of value added. Gibrat's Law was rejected for the complete sample of manufacturing and services firms - the smaller companies grow at larger rates. On the other hand, Gibrat's Law is supported in both sectors when a subsample of large and well-established companies is used (Gibrat's Legacy). These results corroborate the recent stylized facts of the literature.

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1 Introduction

The goal of this work is to test the Gibrat's Law (Gibrat (1931)) hypothesis for the Brazilian companies of industrial and services sectors. Gibrat's Law can be described in the following words: "'the probability of a given proportionale 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),p.1031).

We can highlight three points in the empirical literature on firm growth: (1) "'Gibrat's Law has been rejected by recent studies. Firms' growth does not appear to be independent of initial size; in fact, small and young firms have a higher growth rate than their larger and older counterparts. However, earlier studies, based on small subsamples of well-established, mature, large firms, tended to confirm the Law."'Lotti et al. (2007); (2) "'Several surveys on intra-industry dynamics have reached the conclusion from a large body of evidence that Gibrat's Law does not hold. However, almost all of these studies have been based on manufacturing or large scale services such as banking and insurance industries. There are compelling reasons to doubt whether these findings hold for small scale services."'Audretsch et al. (2004); (3) Little empirical evidence is available for developing economies.

The motivation of this work is to provide empirical evidence of firm growth for a big developing country, not just using information about manufacturing, but also using data from services sector. The choice of an adequate measure of firm growth's is always complicated, so this paper uses two different measures: the growth of employment and the growth of value added.

The results of this paper support the stylized facts of the empirical literature: (1) Gibrat's Law was rejected when considering the entire sample of firms; (2) It was verified that smaller companies grow at larger rates; (3) Subsamples of well-established and large firms confirmed the Gibrat's Law. On the other hand, different from Audretsch et al. (2004), it was not found any evidence of heterogeneity between manufacturing and services sectors in terms of Gibrat's Law analysis.

2 Data and Methodology

The data used in this paper is an aleatory sample designed from a larger linked employee-employee data set composed by three different sources, RAIS, PIA, and PAS which I use to compute firm growth between 1998 and 2002 and their control variables. Information from 4,990 manufacturing firms, and 2,699 services companies is used in order to test the Gibrat's Law for the Brazilian case.

RAIS (Annual Social Information Report) is an annual census of all firms and their employees in Brazil. There is detailed information about each employee (wages, hours worked, education, age, tenure, gender, etc) and each firm (industry, region, size, establishment type, etc), including a unique identifier for each firm.

The second data source is PIA (Yearly Industrial Research - from IBGE, Brazilian Institute of Geography and Statistics), which covers all manufacturing sector firms with at least 30 employees and a random sample of 10% of firms with between 5 and 30 employees.

The third data is PAS (Yearly Industrial Research - from IBGE, Brazilian Institute of Geography and Statistics) - this research has the same sample characteristics of PIA.

From PIA and PAS I use firms' value added and firm size variables, and from RAIS I use average human capital control variables[1].

The central relationship to be tested in this paper is the logarithmic specification of Gibrat's Law:

$$lnS_{it} = \beta_0 + \gamma_1 lnS_{it-1} + \epsilon_{it} \tag{1}$$

Where S_{it} is the size of firm i at time t, S_{it-1} is the size in the previous period, and ϵ_{it} is a random variable distributed independently of S_{it-1}. In order to make the interpretation of the results easier, the equation (1) can be written in a parameterized way as follows:

$$\Delta lnS_i = \beta_0 + \beta_1 lnS_{it-1} + \epsilon_{it} \tag{2}$$

Where $\Delta lnS_i = lnS_{it} - lnS_{it-1}$, and $\beta_1 = (\gamma_1 - 1)$. The validity of the Gibrat's Law depends on the significance of β_1: if $\beta_1 = 0$ the Gibrat's Law is supported; if $\beta_1 < 0$ smaller firms grow at a higher rate than their counterparts, while the opposite occurs if $\beta_1 > 0$. The econometric specification to be used is:

$$\Delta lnS_i = \beta_0 + \beta_1 (lnS_{i,1998}) + \beta_2 (lnS_{i,1998})^2 + \beta_3 F_{i,1998} + \epsilon_{i,2002} \tag{3}$$

This specification includes a quadratic term of firm size and a vector $F_{i,1998}$ composed by control variables related to characteristics of firm i in 1998.

3 Results

The descriptive statistics of variables are reported in the table 1 at the end of the article. The statistics are presented separately for manufacturing and services sectors. In terms of comparative analysis one can highlight that the employment level (value added levels) in 1998 and 2002 and the employment (value added) growth rate in the period are larger for the services (manufacturing) sector. Actually, the value added growth for services sector was null between 1998-2002.

In 1998 the industrial sector was composed by workers with higher levels of tenure (10 months more than services workers). On the other hand, services workers were older (about 2 years more). The schooling level is similar for both sectors, and the women's participation was larger in the industrial sector (28% against 25% the in the services sector).

The table 2 presents results of firm growth robust regressions. The first and second columns present growth regression coefficients for the manufacturing sector firms - in the first column the employment is used as firm size measure, and in the second one we have the value added as firm size variable. The third and fourth columns present the coefficients obtained from services sector regressions - employment is used as firm size in the third column, and value added is used in the fourth one.

[1]Firms leave PIA/PAS panel for two reasons: (i) That firms reducing employment level below 30 workers, so entering in the pool of random firms sample; and (ii) Exit. In this way, it is not possible to identify survivor (or exit) firms in order to correct the sample selection bias of OLS firm growth regressions (Evans (1987)).

All results presented in the table 2 do not support the Gibrat's Law: $ln(firmsize)_{1998}$ variable presents negative and significant coefficient in every specification and sector - It means that smaller firms grow at higher rates than their counterparts.

The second step is to test the Gibrat's Legacy(Sutton (1997) and Caves (1998)): "'It is defendable not as a general Law, but only as a dynamic rule valid for large and mature firms [2] that had already attained the MES (minimum efficiency scale) level of output, but not for smaller (younger) ones operating at a sub-optimal scale (Geroski (1995)) "('Lotti et al. (2007), p.6).

In order to test the Gibrat's Legacy hypothesis I divide the manufacturing and services samples in large and small firms. The criterion for dividing is whether firms are higher or lower and equal to the average size of the complete sample in 1998: the industrial firm is large if $ln(\text{employment})_{1998} > 4.94$ (see table 1), or $ln(\text{value added})_{1998} > 14.43$, and industrial firms are small if $ln(\text{employment})_{1998} \leq 4.94$, or $ln(\text{value added})_{1998} \leq 14.43$. Analogous criteria are used for services firms sample, where 5.31 and 14.42 are the average values for $ln(\text{employment})$ and $ln(\text{value added})$, respectively.

The table 3 presents results of firm growth robust regressions for manufacturing and services small firms samples. All results shown in the table 3 do not support the Gibrat's Law, since that all coefficients of $ln(firmsize)_{1998}$ are negative and significant. This outcome is expected having the Gibrat's Legacy as hypothesis.

The table 4 presents results of regressions for larger firms. All results shown in the table 4 support the argument that firm growth among large and well-established companies is a random walk, since that all coefficients of $ln(firmsize)_{1998}$ are not significant.

The evidence presented in this work is similar to that obtained for developed countries since that it supports the Gibrat's Legacy hypothesis. In addition, it was not found any evidence of heterogeneity between manufacturing and services firms growth dynamics.

4 Concluding Remarks

This paper tested the Gibrat's Law for Brazilian manufacturing and services sectors, so this work contributes to the applied firm growth literature in two ways, since that there are little empirical evidence for developing countries and services sectors.

Gibrat's Law was rejected for the complete sample of manufacturing and services firms - the smaller companies grow at larger rates. On the other hand, Gibrat's Law was supported in both sectors when a subsample of large and well-established companies is used (Gibrat's Legacy). These results corroborate the recents stylized facts of the literature.

[2]The dataset does not provide information on firm age, so it is not possible to test Learning (Jovanovic (1982)) and Evolutionary (Nelson & Winter (1982)) theories of firm growth and, different from Cabral & Mata (2003) approach, tenure of workers does not provide a good proxy for age firms because of very high workers turnover rates in Brazil (Gonzaga (2004)).

References

Audretsch, D., Klomp, L., Santarelli, E. & Thurik, A. (2004), 'Gibrat's Law: Are the Services Different?', *Review of Industrial Organization* **22**(3), 301–324.

Cabral, L. & Mata, J. (2003), 'On the Evolution of the Firm Size Distribution: Facts and Theory', *American Economic Review* **93**(4), 1075–1090.

Caves, R. (1998), 'Industrial Organization and New Findings on the Turnover and Mobility of Firms', *Journal of Economic Literature* **36**, 1947–1982.

Evans, D. (1987), 'Tests of Alternative Theories of Growth', *The Journal of Political Economy* **95**(4), 657–674.

Geroski, P. (1995), 'What Do We Know about Entry?', *International Journal of Industrial Organization* **13**, 421–440.

Gibrat, R. (1931), *Les Inegalites Economiques*, Librairie du Recueil Sirey, Paris.

Gonzaga, G. (2004), 'Labor turnover and labor legislation in brazil', *Economia: Journal of the Latin American and Caribbean Economic Association* **4**.

Jovanovic, B. (1982), 'Selection and Evolution of Industry', *Econometrica* **50**(3), 649–670.

Lotti, F., Santarelli, E. & Vivarelli, M. (2007), 'Defending Gibrat's Law as a Long-Run Regularity', *IZA Working Papers* **2744**.

Mansfield, E. (1962), 'Entry, Gibrat's Law, Innovation, and the Growth of Firms ', *American Economic Review* **52**, 1023–1051.

Nelson, R. & Winter, S. (1982), *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge, Mass.

Sutton, J. (1997), 'Gibrat's Legacy', *Journal of Economic Literature* **35**, 40–59.

Table 1: Descriptive Statistics

	Manufacturing	Services
Variables		
ΔLn(Employment)	0.09	0.15
	(0.38)	(0.53)
Ln(Employment)$_{2002}$	5.03	5.46
	(0.85)	(1.06)
Ln(Employment)$_{1998}$	4.94	5.31
	(0.82)	(1.03)
ΔLn(value added)	0.06	-0.003
	(1.28)	(0.64)
Ln(value added)$_{2002}$	14.49	14.41
	(1.59)	(1.22)
Ln(value added)$_{1998}$	14.43	14.42
	(1.58)	(1.20)
Average Tenure of Workers (months)$_{1998}$	40.24	29.39
	(21.60)	(20.50)
Average Schooling of Workers (years)$_{1998}$	6.63	6.73
	(1.67)	(1.94)
Average Age of Workers (years)$_{1998}$	31.80	33.60
	(3.46)	(3.97)
(%) Female Workers$_{1998}$	0.28	0.25
	(0.24)	(0.23)
Observations	4,990	2,699

Notes: (1) Standard Deviation in parenthesis; (2) Monetary values in R$ at 1998 prices (INPC deflator);

Table 2: Firm Growth Robust Regression

	Manufacturing $\Delta Ln(S_1)$	Manufacturing $\Delta Ln(S_2)$	Services $\Delta Ln(S_1)$	Services $\Delta Ln(S_2)$
Regressors				
Ln(Employment)$_{1998}$	-0.45		-0.20	
	(0.05)***		(0.06)***	
$[Ln$(Employment)$_{1998}]^2$	0.03		0.01	
	(0.004)***		(0.005)**	
Ln(value added)$_{1998}$		-1.51		-1.05
		(0.02)***		(0.14)***
$[Ln$(value added)$_{1998}]^2$		0.04		0.03
		(0.0008)***		(0.004)***
Observations	4,990	4,990	2,699	2,699

Notes: (1) $\Delta Ln(S_1)$=ΔLn(Employment) and $\Delta Ln(S_2)$=ΔLn(value added); (2) Standard Error in parenthesis; (3) significance: *** 1%, **5%, and *10%; (4) All regressions include a constant, controls for human capital firms' characteristics, dummies for sector (CNAE 3-digit), and dummies for location (27 Brazilian States)

Table 3: Firm Growth Robust Regression - Smaller Firms

	Manufacturing $\Delta Ln(S_1)$	Manufacturing $\Delta Ln(S_2)$	Services $\Delta Ln(S_1)$	Services $\Delta Ln(S_2)$
Regressors				
$Ln(\text{Employment})_{1998}$	-5.07		-2.66	
	(0.65)***		(0.62)***	
$[Ln(\text{Employment})_{1998}]^2$	0.54		0.27	
	(0.07)***		(0.06)***	
$Ln(\text{value added})_{1998}$		-1.46		-5.95
		(0.03)***		(0.76)***
$[Ln(\text{value added})_{1998}]^2$		0.04		0.21
		(0.001)***		(0.02)***
Observations	2,977	2,485	1,553	1,492

Notes: (1) $\Delta Ln(S_1)$=ΔLn(Employment) and $\Delta Ln(S_2)$=ΔLn(value added); (2) Standard Error in parenthesis; (3) significance: *** 1%, **5%, and *10%; (4) All regressions include a constant, controls for human capital firms' characteristics, dummies for sector (CNAE 3-digit), and dummies for location (27 Brazilian States)

Table 4: Firm Growth Robust Regression - Larger Firms

	Manufacturing $\Delta Ln(S_1)$	Manufacturing $\Delta Ln(S_2)$	Services $\Delta Ln(S_1)$	Services $\Delta Ln(S_2)$
Regressors				
$Ln(\text{Employment})_{1998}$	-0.10		-0.16	
	$(0.12)^{NS}$		$(0.17)^{NS}$	
$[Ln(\text{Employment})_{1998}]^2$	0.007		0.009	
	$(0.01)^{NS}$		$(0.012)^{NS}$	
$Ln(\text{value added})_{1998}$		0.12		-0.11
		$(0.29)^{NS}$		$(0.37)^{NS}$
$[Ln(\text{value added})_{1998}]^2$		-0.004		0.002
		$(0.005)^{NS}$		$(0.01)^{NS}$
Observations	2,013	2,505	1,146	1,207

Notes: (1) $\Delta Ln(S_1)$=ΔLn(Employment) and $\Delta Ln(S_2)$=ΔLn(value added); (2) Standard Error in parenthesis; (3) significance: *** 1%, **5%, and *10%; (4) All regressions include a constant, controls for human capital firms' characteristics, dummies for sector (CNAE 3-digit), and dummies for location (27 Brazilian States)