

**Determinants of Firm Start-Up Size in  
the Brazilian Industry: an  
Empirical Investigation  
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# **Determinants of Firm Start-Up Size in the Brazilian Industry: an Empirical Investigation<sup>\*</sup>**

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## **Abstract**

The article investigates the determinants of newly created industrial establishments in Brazil in 1997 taking as reference explanatory variables referring to market structure and industry dynamics, stronger effects are detected for larger firms. Minimum efficient scale, industry size, industry growth and turbulence display the expected positive effects on firm size, but the intensity of those are more pronounced for larger firms. The suboptimal scale variable, on the other, hand exhibits a counterintuitive positive effect and perhaps other types of barrier to entry that are not related to scale aspects may be important in the Brazilian case.

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## **1. Introduction**

Entry is often evoked as a long-run equilibrating and disciplining mechanism in terms of stimulating efficiency and curbing abnormal profits [see Geroski (1991, 1995) and Siegfried and Evans (1994) for overviews]. Beyond mostly static characterizations of industry behavior, it is necessary to explicitly explore dynamic changes in industrial structures. For that purpose, recent more comprehensive databases are becoming increasingly available and a set of stylized facts on the entry and exit of firms and on the performance of newly created firms is gradually emerging. A growing skepticism, however, has been developing on the prevalence of inter-industry regularities [see e.g. Bresnahan (1989) and Schmalensee (1989)]. In the context of industrial dynamics indicators, there is some evidence of industry-specific patterns as indicated by Dunne et al. (1988) and Façanha and Resende (2004) for the U.S. and Brazilian manufacturing industries respectively. Heterogeneity appears, therefore, to be a central issue in industry dynamics assessments [see e.g. Dosi et al (1997)] and an adequate empirical treatment must be able to properly recognize such feature.

Some salient patterns in industry dynamics are suggested by the empirical literature. For example, a large number of newly (predominantly small) firms are created at each period from which a substantial proportion exit their markets within a short period [see Cable and Schwalbach (1991) and Mata (1995)]. Moreover, the probability of survival appears to be positively associated with the initial scale of the firm [see e.g. Mata and Machado (1994) and Audretsch and Mahmood (1995)]. These stylized facts provide an important motivation for investigating the determinants of newly-created firms' start-up size. The empirical literature on the topic comprises a handful of papers including Mata and Machado (1996) for Portugal, and yet Görg et al (2000) and Görg and Strobl (2002) for Ireland. These

papers made use of quantile regression that allowed for different behaviors depending on the portion of the conditional distribution of firm start-up size. The evidence identified some similarities across the two countries with respect to the role of selected market structure and industry dynamics variables, but in fact both are small economies on the periphery of Europe. In the present paper, the Brazilian case is investigated with a similar approach. There are at least two reasons that may render this country interesting. First, it has a large diversified but heterogeneous manufacturing industry, where traditional and modern competitive establishments exist depending on the industry sector. This scenario will allow to verify the robustness of the tentative regularities regarding the determinants of firms' start-up size in the context of a complex developing economy. Second, the Brazilian economy was plagued with macroeconomic instability for a long time, but the important shift towards trade liberalization in 1990 and the price stabilization that followed the Real Plan in 1994. The posterior reduction of macroeconomic uncertainty established a favorable environment for empirical microeconomic investigations.<sup>1</sup> The paper is organized as follows. The second section briefly comments the econometric technique of quantile regression and the data construction procedures. The third section presents the empirical results and undertakes comparative assessments with previous studies on the topic. The fourth section brings some final comments.

## **2. Firms' Start-Up Size: Empirical Framework**

### **2.1- Quantile Regression: Basic Aspects**

The study of the determinants of new firm's start-up size for the manufacturing industry poses a substantial empirical challenge as explanatory factors pertaining market structure and industry dynamics are likely to display

large variation across distinct sectors. The technique of quantile regression that was advanced by Koenker & Bassett (1978, 1982) provides a robust alternative to ordinary least squares-OLS when the error distribution departs from normality. Moreover, unlike OLS estimators that consider a single central tendency that is assumed to be valid for the whole sample, RQ allows for distinct effects of the explanatory variables depending on the portion of the conditional distribution of the dependent variable.<sup>2</sup> In a linear regression model, QR estimators can be obtained as the solution of a linear programming problem specified as follows:

$$\min_{\beta} \left[ \sum_{i^*} \theta |y_i - x_i' \beta| + \sum_{i^{**}} (1-\theta) |y_i - x_i' \beta| \right] \quad (1)$$

where  $i^* = i \mid y_i \geq x_i' \beta$  e  $i^{**} = i \mid y_i < x_i' \beta$

The estimator, therefore, treats asymmetrically different portions of the error distribution. Mata and Machado (1996), Görg et al (2000) and Görg and Strobl (2002) make use of QR to investigate the determinants of new firms' start-up size of firms. The empirical model of those works essentially follow the formulation proposed by the first two authors and is considered in the present application:

$$\text{SIZE} = a_1 + a_2 \text{MES} + a_3 \text{SUB} + a_4 \text{IND} + a_5 \text{TURB} + a_6 \text{GROW} + \varepsilon \quad (2)$$

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The reduced form model seeks to explain the determinants of new firms' start-up size as defined by the total number of employees. The explanatory variables portray factors that reflect in the initial scale that relate to barriers to entry and sector attractiveness and the corresponding expected signs are indicated in parentheses. In particular:

. minimum efficient scale (MES): this variable attempts to capture the importance of scale effects. In a sector characterized by higher MES, newly created firms would (*ceteris paribus*) tend to enter in a higher scale in order to be competitive.

The expected sign is therefore positive. The proxy for MES considered here is the log of the average employment size of the firm.

. suboptimal scale (SUB): this variable aims at capturing cost disadvantages for operating below the sector's MES and is defined by the proportion of the sector's employment that belongs to firms below the MES. One would postulate an expected negative effect on firm initial size as a large value for that variable would indicate that the number of inefficient firms is high in the sector and the relative disadvantage for entering in a smaller scale would be less important. It is worth mentioning that these last two variables emphasize barriers to entry relating to scale aspects.<sup>3</sup>

. industry size (IND): measured in terms of the log of the total number of employees of the sector. This variable proxies the current attractiveness of the market moreover it indicates the degree of interdependence among the firms of sector and related retaliation associated with entering in higher scale. One would expect that the larger the size of the industry the larger should be the initial scale of the new firm;

. industry growth (GROW): this variable in a sense extends the previous one to consider the dynamism of the industry. In a rapidly growing industry the motivation for entering in a higher scale should be higher than in a decadent industry and therefore a positive effect is expected;

. turbulence (TURB): this variable captures simultaneous entry and exit in a given industry sector. The proxy used here and in the referred previous studies consider the product of the entry and exit employment shares in a given sector.<sup>1</sup> As stressed by the previous studies, this variable can be thought as indirectly

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<sup>1</sup> A less used measure was suggested by Beesley and Hamilton (1984) who consider the sum of gross entry and exit rates.

capturing the extent of sunk costs. In a sector with high degree of turbulence one would expect that sunk cost are lower and therefore the incentives for entering in a higher scale should be stronger.

## **2.2- Data Description**

The basic data source was provided by the *Relação Anual de Informações Sociais-RAIS* (Ministry of Labor and Employment, Brazil). All formal establishments are required to annually fill a survey and provide information on the number and qualification of their employees. This source potentially comprises the totality of formal (registered) business establishments in Brazil.<sup>2</sup> The comparison of successive years allow the investigation of different aspects of industry dynamics and also to identify newly created establishments.<sup>3</sup> The manufacturing industry in Brazil comprises over 200000 establishments in each year. Data was available for the period 1995-97. In the present application, a cross-section was generated for 1997 by comparison with 1996 when necessary. The sample of newly created industrial establishments in 1997 amounted to 15673 units. It is important to note that the data base refers to establishments that are throughout in the text referred as firms as in fact is the practice in the related literature. The data excludes owners and eventual informal employees (for example unregistered relatives). In order to obtain a better comparative perspective on previous studies for Ireland and Portugal, we concentrate on industrial firms with 5 or more employees. Previous use of this data source for studies in Industrial Organization has been limited to the studies of Najberg and Puga (2000) and Façanha and Resende (2003). The former work traced the survival of newly created small and

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<sup>2</sup> There are heavy fines for the establishments that fail to provide the referred information.

<sup>3</sup> The necessity of identified microdata for this kind of study did not allow the consideration of a more recent period for which formal authorization for data use was not obtained.

medium establishments up to 1997. It is worth mentioning that a cursory comparison with the cases of Ireland and Portugal indicates that the present sample has a mean value for firm size of 26.87 larger than the figures of 19.13 and 17.21 that were respectively observed for those two countries. Moreover, in the Brazilian case one observes a few entrants with a very large initial scale that surpasses 1000 employees whereas in the Irish case the largest establishment had 557 employees and in Portugal the corresponding figure was 335 employees. A final point that must be emphasized refers to departures from normality by the errors (and therefore by the firm start-up size). In fact, previous papers made evident that such departures are important and thus additionally motivated the use of quantile regression for its robustness in such context. In the present application, evidence towards the rejection of the null hypothesis of normality of firm size is strong. The Kolmogorov-Smirnov test statistics exhibited the value of 52.256 with a p-value = 0.000.

### **3. Empirical Results**

This section presents the econometric evidence obtained in this paper. The econometric estimates were generated with Stata 8.2. In order to get a clearer perspective of the results it is useful to summarize the main results obtained in previous similar studies. Mata and Machado (1996) investigated the Portuguese case whereas Görg et al (2000) considered the Irish case.<sup>4</sup> The results displayed some similarities. For example, the effects of the explanatory variables on the firm start-up size were stronger for higher quantiles with a nearly monotonic pattern. The different explanatory variables exerted, as a rule, the expected effect though the statistical and/or economic significance of some coefficients were sometimes negligible. The poorer results were obtained for industry size (IND) and industry



growth (GROW). For the former, a significant result arose only at the 0.9 quantile in the case of Ireland whereas for Portugal a significant effect was detected only at the 0.15 quantile. For the latter variable, on the other hand, significant effects appear only for higher quantiles (starting at the median case) in the case of Ireland and only for the lower quantiles [0.15 and 0.25] in the case of Portugal. Overall, the postulated explanatory variables appear to exert the predicted effect with the exception of IND and GROW that are relevant for higher quantiles in the case of Ireland and lower quantiles in the case of Portugal. The results for the Brazilian manufacturing industry are presented in table 1.

INSERT TABLE 1 AROUND HERE

A first aspect that arises from the inspection of table 1 is the near monotonic behavior of the coefficients that increase with the considered quantile does not seem to prevail in the Brazilian case. An exception is provided by the behaviour of the MES coefficients. Nevertheless, one can observe a stronger results in terms of the role of industry dynamics and market structure in the higher quantile as more significant coefficients emerge, though at times associated with counterintuitive effects..

We should stress important contrasts with the evidence obtained in the previous related studies.. The minimum efficient scale variable has a significant and positive coefficient in all quantiles.

Industry size has a negative counterintuitive effect in all quantiles and those are statistically significant in quantiles 0.15, 0.25 and 0.9.

When one examines firm growth the expected positive effect is only significant for intermediate quantiles [0.25, 0.5; and 0.75], thus displaying some

contrast with the Portuguese and Irish cases where the effect had prevailed in the extreme quantiles.

The proxy for turbulence, however, as a rule does not exert any effect on the initial firm size at all quantiles with the exception of the counterintuitive negative effect observed at the 0.5 quantile.

Finally, a significant departure from the previous empirical evidence occurs for the suboptimal scale variable. In fact, as a rule the referred coefficient is not significant with the exception of the 0.15 quantile but then one obtains a counterintuitive positive effect.

In order to get a more precise notion of the difference of behavior across distinct quantiles it is important to carry out statistical tests. In that sense, I consider tests based on regressions of the differences in quantiles (interquantile range regressions). The corresponding results are presented in table 2.

INSERT TABLE 2 AROUND HERE

The results are stronger for MES as significant differences arise for all quantile pairs. For IND one observes significant differences for all pairs except for one intermediate pair [0.5 and 0.75]. For turbulence no relevant differences appear in any quantiles pair. When one focus on GROW significant differences appear for all pairs except the higher one [0.75 and 0.9].<sup>5</sup> Finally, the SUB only was associated with significant differences across quantiles for the higher pair [0.75,0.9].

The evidence indicates therefore that the Brazilian case differs from the previous studies on European countries. In terms of similarities one observes a weak role for IND, a strong role for MES. In terms of contrasts one observes a

slightly stronger role for GROW but negligible effect accruing from TURB and SUB.

. The reliance of this work and the previous ones barrier to entry arguments focusing solely on scale factors can be a potentially limiting procedure and more general sources of barriers to entry (referring to product differentiation and absolute cost advantages) should be considered in future research.

#### **4. Final Comments**

There is a perception in the empirical literature that the probability of firm survival is increasing in the start-up size. This point provides a strong motivation for investigating the determinants of that initial scale. The previous empirical literature explored the ability of quantile regression to properly portray heterogeneous industries. The present paper undertook a similar investigation for the Brazilian manufacturing industry that can serve as relevant contrast with the previous applications that focused in small economies in the periphery of Europe. The evidence indicated that patterns that emerge in the Brazilian case are complex with very distinct behaviours across quantiles and a clear and strong monotonic pattern only appears when one considers MES. The previous evidence, that had indicated that industry dynamics and market structure effects are more pronounced for larger firms, is not sustained in the present case. Indeed, one observes also counterintuitive effects. In contrast with previous evidence, the role of industry growth was more important in the Brazilian case and more strongly the suboptimal scale and turbulence variables did not exert the expected effect, though significance was observed only for small and intermediate firm sizes.

Future directions for research include, as mentioned before, attempts to control for sources of barrier to entry that are not linked to scale factors and also

the introduction of a control variable for ownership. In fact, the choice of the initial scale of a industrial establishment should be different if it is a newly created firm or if it belongs to an already established firm (possibly multinational) should the necessary data become available.

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Table 1 – Quantile Regression Results – Brazilian Industry-1997  
(no. of observations: 15673)

Quantiles	OLS	0.15	0.25	0.5	0.75	0.9
minimum efficient scale	45.011 (0.000)	0.809 (0.000)	1.062 (0.000)	3.851 (0.000)	14.666 (0.000)	49.490 (0.000)
suboptimal scale	77.268 (0.009)	3.246 (0.038)	0.983 (0.461)	3.375 (0.304)	7.276 (0.379)	71.951 (0.071)
industry size	2.248 (0.000)	-0.106 (0.000)	-0.042 (0.011)	-0.100 (0.215)	-0.262 (0.117)	-2.783 (0.000)
turbulence	86.835 (0.033)	0.195 (0.890)	-1.413 (0.366)	-11.693 (0.008)	-12.938 (0.739)	20.281 (0.902)
industry growth	38.873 (0.003)	0.002 (0.997)	1.760 (0.008)	5.107 (0.009)	12.101 (0.001)	1.981 (0.892)
constant	-105.964 (0.000)	3.914 (0.000)	4.371 (0.000)	2.123 (0.068)	-9.518 (0.000)	-49.795 (0.000)
F(5,15667)	193.660 (0.000)	10.374 (0.000)	9.113 (0.000)	33.249 (0.000)	92.254 (0.000)	277.289 (0.000)

Note: p-values appear in parentheses, and standard errors for quantile regressions were obtained by bootstrap simulations with 300 replications



Table 2: Interquantile Range Regression Results

	<b>0.25-0.15</b>	<b>0.5-0.25</b>	<b>0.75-0.5</b>	<b>0.9-0.75</b>
<b>Minimum Efficient Scale</b>	0.252 (0.003)	2.790 (0.000)	10.614 (0.000)	35.024 (0.000)
<b>Suboptimal Scale</b>	-2.263 (0.090)	2.393 (0.356)	3.900 (0.589)	64.675 (0.045)
<b>Industry Size</b>	0.064 (0.014)	-0.582 (0.000)	-0.162 (0.256)	-2.522 (0.000)
<b>Turbulence</b>	-1.608 (0.504)	-10.280 (0.478)	-1.244 (0.973)	33.218 (0.844)
<b>Industry Growth</b>	1.758 (0.005)	3.347 (0.049)	6.944 (0.037)	-10.120 (0.444)
<b>Constant</b>	0.457 (0.226)	-2.248 (0.010)	-11.642 (0.000)	-40.277 (0.000)

Note: p-value in parentheses, and standard errors for quantile regressions were obtained by bootstrap simulations with 300 replications

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<sup>1</sup> There is some evidence that the creation of new small firms is sensitive to macroeconomic fluctuations as for example those related to business cycle and interest rate [see Mata (1996)]. More recently, after the introduction of a flexible exchange rate regime in 1999, macroeconomic uncertainty has been largely associated with the volatility of the expectations of short-run investors

<sup>2</sup> Useful introductions to the topic appear in Judge et al (1988, chapter 22), Buchinsky (1998) and Koenker and Hallock (2001).

<sup>3</sup> Mata and Machado (1996) adopted the proxy for MES suggested by Lyons (1980) that revealed untenable in the present application. In this sense, one considers the proxy suggested by Sutton (1991) and implemented by Görg et al (2000) and Görg and Strobl (2002).

<sup>4</sup> Görg and Strobl (2002) consider a similar study for Ireland but with a slightly different focus as one is especially concerned with the role of ownership (for example multinational) in the determination of firm start-up size. The importance of the type of entrant on entry patterns had also been recognized by Mata et al (1995).

<sup>5</sup> This heterogeneity with respect to the growth in different quantiles was somewhat expected. In fact, Resende (2005) obtained evidence suggesting a strong rejection of Gibrat's law for the Brazilian manufacturing industry taking as reference the same data source.