Determinants of Survival of Newly Created SMEs in the Brazilian Manufacturing: An Econometric Study

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Abstract

The paper investigates the survival of newly created small and medium enterprises in Brazilian manufacturing taking as reference the 1996-2005 period. The econometric analysis relies on time-varying version of the proportional hazard rate model that controls for unobserved heterogeneity. The evidence mostly corroborates previous findings for developed countries. Salient results include the positive role played by firm size, industry size and industry growth on survival and yet the negative influence exerted by industrial concentration and entry rate.

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1. Introduction

The potential role of smaller firms in fostering employment creation is a salient motivation for the recurring interest on that segment. The discussion, centered around developed countries, has triggered controversies associated with measurement and estimation issues [see e.g. Davis et al. (1996) and Davidsson et al. (1998)]. Evidence appears to indicate, as expected, that the job creation effect is likely to be stronger in service industries. Nevertheless, more recent studies provide appealing evidence on particularly high job creation by small firms in general as suggested by Hijzen et al. (2010) and Neumark et al. (2011).

In this sense, the present paper considers a related relevant issue in terms of the survival of small and medium enterprises-SMEs in the Brazilian manufacturing industry. Indeed, beyond the job creation aspect, a well known stylized fact pertains the large mortality of smaller firms a few years after the start-up [see Bartelsman et al. (2005)].

The motivations underlying the present study reflect two main aspects:

(a) The literature and available evidence concentrate on developed countries. Exceptions are given by the descriptive study by Najberg et al. (2000) that indicates important employment impact by smaller firms in Brazil along the 1995-97 period or in terms of growth patterns for small firms in southern Africa as studied by McPherson (1996). However, a substantial mortality appears to prevail for that segment. Therefore, the study of a large emerging economy like Brazil that is characterized by the co-existence of modern and traditional sectors can be interesting. In fact, the macroeconomic stabilization after 1994

greatly reduced economic uncertainty and the reduction of institutional obstacles for creating new firms since the 2000s appear to show a more favourable business environment. Moreover, more simplified tax procedures were implemented for small businesses in a more recent period;[1]

(b) Most of the previous studies on survival we had access to select one year to identify the entrants, and construct the survival pattern using fixed covariates. In our paper, we could use panel data and time-varying covariates, what constitutes another novelty to be taken into due account;

The remainder of the paper is organized as follows. In section 2 we will present as brief review of the relevant literature. Section 3 will deal with methodological aspects of our exercise including the relevant econometric issues involved. Section 3 contains the promised application to Brazilian data, and section 4 will offer final comments.

2. Firm survival: conceptual aspects

2.1 – A brief review of the literature

We will start this section by summarizing some well known stylized facts about entry [see Geroski (1995)] that can further motivate the present study. Specifically, (i) entry is common, with large number of firms entering most markets in most years; (ii) most of the total variation in entry is within industry variation rather than between industry variation; (iii) entry and exit rates are

[1] As indicated by the private entity for support of SMEs in Brazil [Serviço Brasileiro de Apoio às Micro e Pequenas Empresas-SEBRAE]. In particular as for 2009, the average time for legally establishing a new firm was about 20 days in contrast with an average of 152 days in a more distant past.

highly positively correlated with net entry rates being modest fractions of gross entry rates, and (iv) the survival rate of most entrants is low, and even successful entrants may take considerable time to achieve a size comparable to average incumbent. That is to say, entry *penetration* is more modest yet, and *barriers to survival* and/or experience should be taken into account as well as the fact that "the response by incumbents is selective". Among these facts/results, it is important to stress that (positively) (v) entry, either directly or indirectly (trough on incumbents), is associated to innovative activities, and (less positively) that (vi) costs of adjustment are significative. We will provide additional comments on what was presented but the reader should also consult Sutton (1997, 2007), to assess such a vivid chapter on Empirical Industrial Organization literature.

Table 1
Summary of Selected Bibliography

Author(s)	**Motivations**	**Data**	**Model**	**Results (for Hazard rates)**
Audretsch, Mahamod(1995)	Associate post entry performance to technol. and market environments	US Manufacturing establishments 1976-1986	Cox Proportional Hazard (PH)	(-) for structure of ownership (not favouring new branches) and start-up size
Harhoff (1998)	Employment generation of small and medium establishments, liquidation vs exit, and institutional environment	West-Germany industry, construction and services	Cox PH	(-) for age of owner, diversification, branch, age of firm, size, and sectoral dummies
Stone (1998)	Survival of multinational firms´ subsidiaries	Establishments of multin. Firms in NE of United Kingdom (1970-1973)	Cox PH, with and without Weibull baseline	(-) for age of establishment acquired, dummies for the original country, regional dummies, sectoral dummies, industry growth, concentration (CR5), and size.

Fatopoulos (2000)	Effects of localization on survival	Industry in Greece (1982-1984)	Cox PH	(-) for size, growth, sunk costs, leverage and capital intensity, profits and dummy for Atens.
Audretsch, Houweling, Thurik (2000)	To study entry and exit in Netherlands, examining possible departure of industry dynamics from "stylized facts" due to effects of specific policy (Polder Model)	2017 firms with less than 20 employees for the 1978-1992 period	Logit Regression for different time intervals	(-) for firm age and size, lower for R&D intensive inds and where scale economies play important role. Results are compatible with "stylized facts".
Segarra, Callejon (2002)	Entry, exit, churning and survival as aspects of competition	Industry in Spain for the period (1994-1998), with 1994 as reference year	Cox PH	(-) for industry growth, size of entrants and mobility.
Perez, Llopis, Llopis (2004)	Age and size as determinants of entry, exit, survival and the process of competition	Industry in Spain, for 1990-1999, and firms with more than 10 employes	Cox PH, with time varying covatiates (?)	(-) for size of firms, R&D and age.
Bartelsman, Scarpetta, Schiavardi (2005)	Comparative study on firm size distribution, firm demographic and post-entry performance of 10 OECD countries, with country specific, sectoral and time effects.	Firm level data and complete coverage of the firm population, for the 1989-1994, with country sector as unit of analysis. USA as country of reference.	Survival functions and fixed effects regression of hazard rates for the panel, with country and industry dummies, duration and square duration as covariates	Hazard rates decline more steeply in most countries than in the USA. Firm churning is similar, but infant mortality lower in USA Post-entry employment growth amongst surviving firms bigger in USA than in Europe. (-) size of incumbents and (-) absence of barriers to entry.
Cantner, DreBler, Krüger (2006)	To study the infant automobile industry in Germany	Four entry cohorts of firms for 1886-1939 period	Gomperts Hazard and Cox PH	(-) early enter (lower prob of exit at later stages (10 years). A firm in the fourth cohort has prob of only 10% of survival (10 years)

To motivate the inspection on the contents of Table 1, we will refer to two articles carefully reviewed by Geroski, *op.cit.*. Mata and Portugal (1994), examine the Portuguese case, with data for 1981 and 1988, following a cohort of firms that had started operation in the same year (1983). The first part of their

results are based on survival rates (and the use of Kaplan-Meyer estimator), and show that survival increases monotonically with firm size. Secondly, assuming a baseline function for the hazard function, they were able to show that among survivors, the tendency is to grow rather than to shrink, and that post-entry mobility seems to decrease with size, results that they point out as consistent with previous interpretations (among others) that post-entry performance embody a process of learning, an interpretation also shared by Audretsch and Mahamood (1995). Using the Cox Proportional Hazard Rate model, Mata and Portugal could also show that the average size of the entrants have a positive effect on survival, and that substantial hazard rates are associated with industries characterized by high entry rates. These results were elaborately obtained without taking into account firms´ start up size, and when this variable is taken into account explicitly, they found that the larger the size the lower is the risk of failure. In a similar vein, Audretsch et.al. *op.cit.* point out that firms can decrease the risk of failure through size enlargement, and that the gap between the minimum efficient scale and start up size tends to worsen survival prospects. The authors also found that the condition of being a branch of existing firms decrease the risk of failure, while high industry profit margins hinder survival (an indication of incumbents´ power to deter entry). With these comments in mind, the contents of Table 1 are self-explanatory. However, in the summary we have omitted two relevant facts that merit close attention. After reviewing the American experience on entry, Bartelsman et. al., *op.cit*. point out that market based financial systems may promote entry, especially of innovative firms (eg. with limited cash flows and lack of collateral). On the other hand, if administrative costs are fixed then the higher the bureaucratic impediments to

install new firms, the higher will be the disincentives to entry on the part of new and smaller firms. This, according to the authors, is the case of most European countries, a fact that is vigorously stressed by Cabral (2007) in his pertinent review of stylized facts with the focus on the Portuguese industry.

A final comment is in order. One of the main critical observations made by Geroski, *op.cit.*, on the empirical researches relates to the short-run methodologies frequently used. We think that the study of Bartelsman et.al. is an outstanding counterpoint to this critic, and as mentioned in the introduction, we will try to keep track of their orientations to do a better job than otherwise.

2.2 - Econometric issues

Survival models have become widespread in empirical works [see Lancaster (1982), Van der Berg (2001), Wooldridge (2002) and Greene (2003) for conceptual overviews]. The topic is typically addressed by means of the closely related concept of a hazard function that allows us to capture the probability of (a firm) exiting the initial state within a short interval, that is: an instantaneous exit given that it has survived up to the starting time of the interval. The building block underlying hazard models is the notion of a random variable T that reflects the duration of an state (in the present case survival of newly created firms in the franchising segment) and is assumed to have a probability density function f(t) and cumulative distribution function F(t) that readily give rise to the survival function given by:

$$S(t) = 1 - F(t) = P(T \geq t) \qquad (1)$$

Similarly, we can define the hazard rate as given by:

$$\lambda(t) = \lim_{\Delta t \to 0} \frac{P\langle t \le T \le t + \Delta t \,|\, T \ge t \rangle}{\Delta t} = \lim_{\Delta t \to 0} \frac{F(t+\Delta t) - F(t)}{\Delta t \; S(t)} = \frac{f(t)}{S(t)} \quad (2)$$

The hazard rate indicates the chances of survival for an additional infinitesimal interval conditional on having survived at least until period t and the last equality reflects the use of the conditional probability expression and the definition of a derivative. A related and influential econometric model is given by Cox´s Proportional Hazards Model [Cox (1972)] and assumes the following parameterization for $\lambda(t)$:

$$\ln \lambda(t) = \ln \lambda_0(t) + Z\beta \qquad (3)$$

Where λ_0(t) stands for the baseline hazard function, Z is a vector of explanatory variables (covariates) and β is a vector of parameters. An interesting feature of the model that motivate its name is that the effect of a covariate operates in multiplicative fashion on λ_0(t) so that a unit change in a covariate leads to a proportional effect on the hazard rate. The simpler implementation of the model consider covariates that are not time-varying. That formulation typically reflects limited data availability. Mata and Portugal (1994), for example, had to rely on covariates based on the first year of the data. Though the analysis concentrates on a hazard model it can readily provide interpretations in terms of survival if one reverses the interpretation of the signs of the relevant coefficients.

In contrast with the majority of previous empirical works, we will consider time-varying covariates and benefit from the panel structure of the data by considering the random effect estimator advanced by Meyer (1990). It can be shown that the probability that a spell lasts until t+1 given that it lasted until t can be expressed in terms of the hazard:

$$P[T_i \geq t+1 | T_i \geq t] = \exp[-\exp(z_i(t)'\beta + \gamma(t))] \qquad (4)$$

Where $\gamma(t) = \ln(\int_t^{t+1} \lambda_0(u)du)$

The following step is to properly factor the likelihood function in terms of observations that are subject or not to censoring in the last year of the sample period. In order to conceive his estimator Meyer (1990) builds on Prentice and Gloeckler (1978) and Heckman and Singer (1984). Unobserved heterogeneity is assumed to take a multiplicative form in the hazard function, so that:

$$\lambda_i(t) = \theta_i \lambda_0(t) \exp(z_i(t)'\beta) \qquad (5)$$

With θ_I denoting a random variable that is independent of $z_i(t)$. Assuming a parameterization in terms of a gamma function with mean one (by normalization) and variance σ^2, the author justifies a likelihood function as given below:

$$L(\gamma, \beta, \sigma^2) = \sum_{i-1}^{N} \ln\{[1+\sigma^2 \sum_{t=0}^{k_i-1} \exp(\gamma(t) + z_u(t)'\beta)]^{-\sigma^{-2}} - \delta_i[1+\sigma^2 \sum_{t=0}^{k_i-1} \exp(\gamma(t) + z_i'\beta)]^{-\sigma^{-2}}\} \qquad (6)$$

where $k_i = \min(\text{int}(T_i), C_i)$ with C_i standing for the censoring time; moreover $\delta_I = 1$ if $T_i \leq C_i$ and 0 otherwise. The parameters γ and β can be consistently estimated with the proposed method that is implemented with the routine pgmhaz8 in Stata 11.0 SE in the next section.

3. Empirical Analysis

3.1- Data construction

The main data source is provided by the Relação Anual de Informações Sociais [RAIS, Ministry of Labor and Employment, Brazil] that collects annual information on formal establishments in Brazil and is a rich source for survival studies. In fact, Mata and Portugal (1994) considered analogous source for the

case of Portugal. We were granted special access to the identified microdata along the 1995-2005 period that provides total employment at each year's December 31th. It is important to stress that the referred sector has a census character and that non-responses lead to heavy fines. The numerical identifier has the initial 8 digits that indicate the firm and the remaining digits pertain to a particular plant. In the present study the focus is on newly created small and medium enterprises-SMEs in the manufacturing industry and those are identified by comparison with the previous year and therefore the analysis concentrate on the 1996-2005 period. The criterion for defining SMEs was the total number of employees below 250 and the allocation of a firm to a particular 4-digits industry reflected the dominant sector in terms of the firms´s employment. Thus, we consider the new firms in 1996 that belong to that size class and follow those firms up to the last year of the sample in 2005. This procedure led a total initial number of 27654 new firms in 1996 upon which 7036 were still active in the last sample year of 2005. The possibility of mergers and acquisitions is not likely as one is dealing with SMEs. Nevertheless, we had access to partial information from a competition government department [Secretaria de Direito Econômico, Ministry of Justice-Brazil]. However, information only refers to larger firms and beared no relevance in our sample. A final care was taken on ruling out possible acquisitions of SMEs by some large firm. Given the absence of detailed information on that aspect we excluded the handful of firms exhibiting salient outliers in terms of growth by a factor greater than 5 upon the initial size of

less than 250 employees.[2] It is reassuring that the results are quite robust and essentially the same in any case.

In addition to the survival information, some covariates were constructed upon the same data source but in the case of alternative data sources they will be specified. It is worth mentioning that majority of survival studies in developed countries considered covariates that were not time-varying and thus relied on covariates referring to the initial year of the sample. In the present paper, a more general model is adopted. The following variables are considered in the empirical model and analogous to those considered by Mata and Portugal (1994) and noting that sectoral variables where considered in terms of 4-digits sectors [classification CNAE4-Instituto Brasileiro de Geografia e Estatística-IBGE]:

. Size: logarithm of firm size (of its total number of employees). Firm size is reported in different studies to have an important role in facilitating survival possibly in connection with scale efficiency aspects;[3]

. Growth: annual industry growth (in terms of the log difference in successive years for total employment in the sector), A more dynamic industry is likely to favour survival of newly established firms;

. Entry rate: measured as the proportion of new firms in a given year relative to the total stock of the previous year. This variable is likely to reflect competitive pressures accruing from new competitors;

[2] A similar criterion was considered by Kosová and Lafontaine (2010) in the context of U.S franchising.

[3] For this variable, we considered firms with at least 1 employee, as those listed with 0 employees were managed by an unspecified number of owners, whereas for explanatory factors such as entry rate one considered the totality of firms in the sector. Once more it is reassuring that the empirical results remain essentially similar irrespective of those filters.

. Entrants´ size: logarithm of the employment in new firms in the industry. The inclusion of this variable was motivated by Mata and Portugal, op.cit., who obtains a favorable impact on survival. We can recognize, however, that entrants`size gives an additional information besides entry rate which doesn`t make reference to size;

. Industry size: logarithm of the number of firms in the industry. The larger that size more likely would be the accommodation of new entrants;

. Suboptimal scale: the proportion of the employment that are in firms below the MES and thus it is an inverse proxy for entry barriers and therefore should have a positive relationship with survival.[4] Mata and Portugal *op.cit.* further considered MES itself as an additional covariate what does not appear to be adequate as both variables rely on a scale argument.

. Concentration: Herfindahl concentration index based on sales (net operational revenues) as provided by an especially requested tabulation from the Pesquisa Industrial Annual [PIA-IBGE].[5] This measure improves on the one constructed by Mata and Portugal *op. cit* that considered concentration in terms of employment. If the industry is dominated by few firms it will more difficult for smaller firms to compete and survive;

. regional dummies for the 5 macro-regions in Brazil (North, Northeast, Midwest, Southeast and South).

It is worth mentioning that some variables are defined for the whole set of firms in the industry whereas other variables refer to the entrants (size and entrants´ size).

[4] The proxy was the median size of the firms in each 4-digits industry. Even though not being an ideal measure it has been suggested in different occasions [see e.g. Sutton (1991)].

[5] Annual survey carried out by the Brazilian statistical bureau since the 80s

The summary statistics of the covariates (before logarithm transformations in some cases) are presented in table 2:

Table 2
Summary statistics

Variable	Minimum	Maximum	Mean	Std. Dev.
Growth	-1.753	1.543	0.020	0.078
Size	1	1982	12.327	32.301
Entry	0	0.436	0.067	0.029
Entrant´s size	1	24799	2717.028	4104.811
Industry size	8	30247	7038.18	8554.244
Suboptimal scale	0.003	0.497	0.081	0.033
Concentration	0.005	0.980	0.066	0.088

3.2- Empirical results

The results from the econometric estimation are presented in table 3. Initially sectoral dummies were considered but substantial colinearity with other sectoral explanatory variables at the sector prevented the use of those. In fact, Mata and Portugal (1994) considered those types of dummy variables to control for unobserved heterogeneity with poor results in occasions. In our case, the panel nature of the data is explored to allow to control for unobserved heterogeneities.

The results are encouraging from a statistical point of view with highly significant individual coefficients. Moreover, the coefficients are economically meaningful with signs that are mostly consistent with prior expectations. In order to facilitate interpretation we will reason in terms of survival and therefore invert the interpretation:

. firm size positively affects the chance of SMEs´ survival. Possible underlying factors relate to scale efficiency. Even though one is considering firms with

initial size of up to 250 employees it appears that the decreasing range of the long-run average cost curve may be eventually be relatively steep;

Table 3
Determinants of firm survival (Time-Varying Hazard Model with Gamma Frailty)

Variable	**Coefficient**	**p-value**
Size	-0.512	0.000
Growth	-0.453	0.000
Entry	1.008	0.008
Entrant´s size	0.025	0.003
Industry size	-0.035	0.005
Suboptimal scale	1.934	0.000
Concentration	0.463	0.001
Dummy (southern region)	-0.272	0.000
Dummy (midwest region)	0.278	0.000
Dummy (northern region)	0.337	0.000
Dummy (southeast region)	0.205	0.000
Constant	-0.969	0.000
Log likelihood: - 43855.267		
Number of obs.: 140319		

. Industry growth positively increases the chances of SMEs´ survival indicating that more dynamic industries are likely to provide a more favourable environment;

. Entry negatively affects the chance of survival indicating that the competitive pressure can be a relevant aspect of the dynamics of entry and survival;

. Complementary to the previous effect one notes the entrants´ size exert a negative effect on survival in the sense that SMEs are likely to suffer a stronger competition when entrants as group operate at a larger scale;

. Industry size positively affects survival indicating that SME´s are more easily accommodated in that case;

Contrary to intuition, suboptimal scale (that is an inverse proxy for barriers to entry) does not appear to favour survival of SMEs. We will take this result as a

specificity of Brazilian industrial sector. Indeed, apart from possible measurement issues one cannot discard competitive fringes possibilities in different industries.

. Industrial concentration negatively affects SMEs´ survival as would be expected in a sector dominated by larger firms;

Altogether, the results are mostly consistent with the previous evidence for developed countries, but a more suggestive account of the results could be developed in the terms that follows.

As previously mentioned, the creation of new SMEs was expressive, certainly an indication of the dynamism of the economy. Among the structural factors that rendered that movement more strength (positively affecting survival) we could mention the concentration of industrial activity in the the southern region of the country, as well as the industry size. On the other hand, new SME ventures would avoid more concentrated sectors, which did not favor survival, as should reasonably be expected. With respect to this decision of entry, besides the attractiveness of more populated sectors (industry size), the industry growth was an important factor leading to entry and survival. And size of the entrant mattered for successful entry, along with the minimum efficient scale. Curiously, or not, barriers to entry did not impede entry. On the contrary, the sectors where there is a high percentage of firms below minimum efficient scale showed themselves favorable to entry. Again, the size of the entrant mattered. But the competitive pressure manifested itself as a strong disciplinary force. Entry rates, and size of the entrants as a whole were not favorable to survival of SME. That is to say, a bigger SME has more chance of survival but many SME do not. “As if” some sort of innovation (unfortunately a dimension of competition that we

could not detect in our study) was required for survival. Indeed, in a recent study for the Brazilian franchising segment (a new innovatory type of business), Façanha et al. (2013) found that size was important for survival of entrants, and also that strong support from the part of the franchisors, in the form of juridical assistance and/or through choice of location point were fundamental determinants of survival.

We believe that this description – specially the emphasis related to size and/or investments on the part of the new ventures - makes some strong points in favour of public policies directed to SME, either through the Brazilian development bank (Banco Nacional de Desenvolvimento Econômico e Social – BNDES), that finances investment firms in Brazil or through Financiadora de Estudos e Projetos – FINEP, specialized in innovative business ventures.

4. Final comments

The paper aimed at investigating the determinants of SMEs´ survival in the context of the Brazilian manufacturing industry. For that purpose, a hazard model with time varying covariates was considered. The results were encouraging from a statistical and economic point of view. Salient results that were in line with previous evidence for developed countries include the positive role played by firm size, industry size and industry growth on survival and yet the negative influence exerted by industrial concentration and entry rate.

Nevertheless a cautionary remark is warranted as despite the more favourable economic environment and the expressive creation of new SMEs one still observes, on the other hand, a large mortality within a few years. The aforementioned figures on that respect were aggregate but the stylized fact is

general to different sectors though subjected to possibly heterogeneous patterns.

More recently, an important switch in the government policy towards SMEs was indicated by the large increase on the amount of loans below market rates that exhibited a growth of 1600.7% between 1999 and 2011. In the latter year the amount of loans reached a magnitude larger than US$ 24 billion indicating that this new support strategy might support more sustainable start-up sizes for SMEs though we do not have information on the age of benefited firms.[6]

A last relevant remark refers to the substantial mortality of SMEs. In a study applied to the segment of franchising, Façanha et al. (2013) identified a crucial role for training on survival. Fortunately, it appears that BNDES also has provided substantial funding to industrial technical training (for the institution SENAI), however the actual impacts of those policies are yet to be assessed and also eventual coordination with the traditional institutions that offer specialized courses to SMEs (SEBRAE) might reveal as desirable.

In this sense, a valuable avenue for future research include descriptive survival analysis at the sectoral level by means of survival functions so as to pinpoint important sectoral patterns and yet an explicit reassessment of hazard models as more recent data becomes available and explicit controls for policies targeted at SMEs can be considered.

[6] The definition adopted by BNDES for firm size is distinct from the present paper but the new importance attributed to SMEs is evident.

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