Firm Entry and Exit in Brazil: cross-sectoral evidence from manufacturing industry

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Resumo

Quais os determinantes de entrada e saída de firmas no Brasil? Como a natalidade e a mortalidade de firmas afetam a produtividade da indústria manufatureira no país? Este artigo procura responder estas questões utilizando dados de painel para 104 setores da indústria manufatureira brasileira (3 dígitos) para o período 1996-2002. Os resultados das estimações mostram que a participação das exportações no produto setorial é um importante determinante das taxas de entrada e saída. Os resultados sugerem ainda que em anos de declínio do PIB per capita a propensão a exportar está associada com a entrada de firmas, enquanto em anos de crescimento do PIB o crescimento setorial é positivamente associado com a entrada liquida de empresas. Finalmente, os resultados mostram que a saída de empresas (e em menor grau, a entrada e entrada líquida) é um determinante robusto da produtividade total dos fatores entre os setores no Brasil.
Palavras-chave: entrada e saída de empresas; produtividade, indústria brasileira

Abstract

What are the determinants of firm entry and exit in Brazil? How do entry and exit rates affect productivity? This paper tries to answer these questions using panel data for about 104 Brazilian manufacturing sectors (3-digit level) for the period 1996 to 2002. Our results show that the share of exports in sectoral output is one main determinant of entry and exit rates. The results also suggest that in years of real per capita GDP decline, export propensity is associated with entry rates, while in years of GDP expansion, sectoral growth is positively associated with net entry. Finally, our results show that exit (and to a lesser extent, entry and net entry) is a very robust determinant of total factor productivity across industrial sectors in Brazil.
Keywords: firm entry, firm exit, productivity, Brazilian industry

Categorias JEL: L6,C33,O12
Área ANPEC: Economia Industrial e da Tecnologia – Área 8

Firm Entry and Exit in Brazil: Cross-Sectoral Evidence from Manufacturing Industry[¥]

1. Introduction

Since at least the work of Joseph Schumpeter, the process of firm creation and firm destruction has been at the very heart of the process of economic development. Newly created firms always innovate (at some level), their mere existence increase competition and put pressure on incumbents to improve their performance. For developed countries, there is a well-established literature looking into the main determinants and overall consequences of the process of entry and exit at the firm, sector, industry and country levels (Geroski, 1995). A similar literature is now starting to emerge for developing countries. One initial hypothesis motivating this newer branch of literature is that entry rates would be lower in developing countries and that this could turn out to be extremely helpful in explaining the large cross-country variation we observe in levels of productivity per worker. One reason for the expectation that entry would be systematically lower in poorer countries is that barriers to entry and exit seem to be much more powerful and complex than in developed countries. Consider the effects of, for instance, financial sectors that are underdeveloped, skilled labour that is often in short supply and rule and regulations that are cumbersome and unpredictable. Yet the first figures suggest that the difference of the entry and exit rates is considerably smaller than initially thought (Tybout, 2000).

The finding that entry and exit rates are not that different in developed and developing countries raises two general groups of questions: one on measurement (are we measuring entry and exit rates appropriately and in a sufficiently diverse number of developing countries?) and another on the process itself (what are the main determinants of entry and exit rates in developing countries and how do they differ from those in developed countries?)

In this paper, we try to answer three specific questions: (a) What are the features of the process of firm entry and exit in developing countries? (b) What are the determinants of firm entry and exit rates? And (c) How do entry and exit rates affect average sectoral productivity? To do so, we put together a unique data set with annual observations covering about 100 Brazilian manufacturing sectors (3-digit classification) for the period from 1996 to 2002. Our data set is the result of the combination of two sources: CEMPRE and PIA. The CEMPRE (firm registry) data set provides gross entry, gross exit and net entry rates at the level of three-digit industrial sector, annually from 1996 onwards. The PIA data set is an annual industrial survey that provides, inter alia, concentration ratios, export propensities as well as the information required to estimate total factor productivity. The merging of these two data sets allow us a very first glimpse into the determinants of entry and exit (broadly defined as encompassing gross entry, gross exit and net entry) in Brazilian manufacturing, in the period immediately after successful macroeconomic stabilization.1

[¥] We would like to thank Sumon Bhaumik, Simon Commander, Saul Estrin, Stephen Gelb, Stephanie Levy, Marta Prevezer, Klara Sabirianova and seminar participants at the London Business School for comments on a previous draft. We are grateful to the Centre for New and Emerging Markets (CNEM) at the London Business School and to the UK's Department for International Development for financial support. We thankBrazilian Statistical Office (IBGE), for valuable data assistance. We are responsible for any remaining errors

[1] Over two terms, from 1994 to 2002, the government of President Fernando Henrique Cardoso implemented a number of crucial reforms, notably, price stabilization, the privatization of state owned enterprises and the consolidation of previous trade liberalization efforts (Campos et al., 2003).

Our main finding is that the share of exports in sectoral output is a main determinant of entry and exit rates. And this is particularly so for those sectors in which a higher proportion of exports go to Mercosul countries. They also suggest that in years of real GDP decline export propensity is associated with entry rates, while in years of GDP expansion sectoral growth is positively associated with net entry. We find little support for the effects of concentration and capital-output ratios. Finally, our results show that gross exit (and to a lesser extent, entry and net entry) is a very robust determinant of total factor productivity in Brazilian manufacturing.

The paper is organized in two parts. Section 2 presents a detailed picture of firm entry process in Brazilian manufacturing, using annual data for about 100 sectors over a period of seven years from 1996 to 2002. Section 3 discusses the determinants of the entry process as well as its effects on productivity, over time as well as across sectors. Section 4 concludes.

2. Describing Firm Entry and Exit in Brazilian Manufacturing

In this paper we use two databases. First, the Annual Survey of Mining and Manufacturing Industries (PIA) conducted by Brazilian statistical bureau's (IBGE) from 1996 to 2002. This survey provides economic and financial information of all formally established firms with a labor force of 30 or more workers and employees[2], and a random strata of small firms (with less than 30 workers). The second database is the firm's register CEMPRE. Covering the period from 1996 to 2002, this register is managed by IBGE on the basis of information from the tax register CNPJ, from the labor ministry's Annual Listing of Social Information - RAIS, and from additional sources. CEMPRE covers the population of firms, providing information on number of firms, people employed, and wages and other remunerations; it is then used only to access the enterprises' demography statistics. It is worth to acknowledge that PIA and CEMPRE are strictly related to each other since CEMPRE is used by IBGE as the base for sample selection of PIA: in 2002, from 148,169 firms listed in CEMPRE, 40,369 were selected to the sample of PIA.

From the enterprise-level information of PIA database, we use sector-level "aggregations" obtained through IBGE special tabulations[3]. From CEMPRE dataset, we get sector-level entry and exit statistics[4]. We then use data on sectors of activities following the three digit National Classification of Economic Activities (CNAE) code[5], considering only the Manufacturing Division with 104 sectors. Mining data is disregarded in this paper.

For each manufacturing sector i, in every year of period t =1996,….,2002, we consider product ($Y_{i,t}$), and three conventional aggregate inputs: capital ($K_{i,t}$), labor ($L_{i,t}$), and intermediate input ($M_{i,t}$).

[2] It is important to acknowledge that PIA is a census of medium and large firms.

[3] To "aggregate" firm-data into sector-level data, IBGE provides special tabulations obtained through sector-level estimations. These estimations are founded on the association of a basic sampling weight for each firm covered by the PIA's survey; this weight is defined as the ration between the size of the population and the size of the sample in a given strata. IBGE does not give information of sectors with less than 3 firms.

[4] Sector level statistics from CEMPRE are not estimations, since CEMPRE covers the population of firms. Entering and exiting firms are identified in the CEMPRE dataset by comparing the firm identity number (the CNPJ tax register) over time. In this turn, there is a limitation in the CEMPRE data that will affect the entry/exit results. Ownership changes or legal reorganizations lead to changes in firm identity number between years, so the entry and exit statistics used in this paper reflect changes in the "birth" and "death" of the firms as well as changes in firm ownership. Then, the demographic statistics here presented superestimate the real flows of entry and exit of firms. In spite of this limitation, CEMPRE dataset presents a great advantage which is the possibility to observe the whole population and to follow the firm's evolution, regardless of its size.

[5] CNAE is considerably less detailed (283 classes) at the finest grid than the US systems SIC (490 classes) and NAICS (495 classes). In general, CNAE tends to be more oriented towards the input commodity, whereas NAICS generally classifies sectors by the output or final good. However, CNAE and US systems can be compatible, mainly at fairly aggregate levels.

- $Y_{i,t}$: Sector-level output is defined as the difference between "Gross production value" for sector *i* and "Cost of industrial operations" for sector *i*; this is a constructed variable through PIA and can be considered as a proxy of the sector's value added.
- $K_{i,t}$: PIA (from 1996) does not provide information on capital stock for firm neither for sector; this is so computed using the perpetual inventory method. In order to initialize the sector's capital series, we work with data on the sectors' flow of investment. We use the difference between sector's measures "Acquisition of total assets" and "Sales of total assets" as a proxy of sector investment flow, where "total assets" comprises i) ground and premises; ii) machinery; iii) vehicles; and iv) other assets (including computers, furniture, etc)[6]. We calculate the initial value of capital $K(t=0)$ using a methodology adapted from Young (1995). The author suggests the use of the growth rate of investment in the first five years of the investment series as representative of the growth of investment prior to the beginning of the series, when there is no availability of a long time series data. Specifically, for positive depreciation rates:

$$K(t=0)=\sum_{t=0}^{\infty} I_{-t-1}(1-\delta)^{t}=\sum_{t=0}^{\infty}(1+g)^{-t-1}(1-\delta)^{t}=\frac{I_{t=0}}{(g+\delta)},$$

  where $I_{t=0}$ is the first year of investment, δ is the depreciation rate, and g is the average growth in the first five years of the investment series. Since the short time span available for the investment series, we consider g as the average growth in the seven years (1996-2002) of the investment series. Besides, we consider three different assumptions for δ: 10%,15% and 20%.
- $L_{i,t}$: Sector-level labor input in year *t* is defined as the sum of the "Number of blue collar workers earning wages in December 31 st of the year *t*" for sector *i* and "Number of white collar workers earning wages in December 31 st of the year *t*" for sector *i*.
- $M_{i,t}$: Sector-level intermediate input in year *t* is defined as "Purchase of raw materials, auxiliary material and components" (which includes package material, fuel used as raw material, and lube) for sector *i*.

We converted the nominal values into real values at constant 2002 prices using the deflator IPA-OG, which is a wholesale price index, published by FGV, covering the entire economy, including both imported and domestic goods[7]. Nominal values of output and intermediate inputs are deflated with a disaggregated price index, IPA-OG/sector, while investment flow and capital stock are deflated with an economy-wide price index, IPA-

[6] Our measure of capital stock considers the aggregation of the 4 asset types; therefore, our perpetual inventory calculation considers, from the beginning, the aggregation of all the asset types together, not for each one of these asset types separately.

[7] All economic variables in PIA related to the firm's income statement or to salaries are simple sums of the firm's monthly figures due to Brazil's legislation – that does not allow deflating flow variables. In a context of inflation, this simple methodology depress the January values, while representing just a about the December values. We apply a methodology stated in Muendler (2003) to approximate to a more realistic value for the flow variables. Assuming that the monthly values are not uniformly distributed across the year, we apply the following equation to every flow variable:

$$X_t=\left(\frac{12.\pi_{dec,t}}{\pi_{jan,t}+\pi_{feb,t}+...+\pi_{dec,t}}\right)\widetilde{X}_t,$$

where $\widetilde{X}_t$ is the observed value of the flow variable, X_t is the correct real value of the firm's annual figure, and $\pi_{month,t}$ is the according monthly price index.

OG/general.

In order to estimate the sector-level entry equation, we define variables, for each sector i in year t, as: gross entry rate ($GEnR_{i,t}$); gross exit rate ($GExR_{i,t}$); net entry rate ($NEnR_{i,t}$); concentration ratios ($CR4_{i,t}$) and ($CR8_{i,t}$); growth rate of output ($Gr_{i,t}$); capital /output ratio ($(K/Y)_{i,t}$); total factor productivity ($TFP_{i,t}$); minimum efficient scale ($MES_{i,t}$) ; sales to Mercosul countries ($\text{Mercosul}_{i,t}$); sales to non-Mercosul countries ($\text{N-Mercosul}_{i,t}$).

- $GEnR_{i,t}$: based on business register CEMPRE, it is defined as the number of new firms in year t divided by the total number of firms in year t-1.
- $GExR_{i,t}$: also based on CEMPRE, it is defined as the ratio of the number of firms observed in year t-1 but not in year t, divided by the total number of firms in year t-1.
- $NEnR_{i,t}$: it is the difference between gross entry rate and gross exit rate.
- $CR4_{i,t}$: it is the ratio of the output of the four to the sector *i* total output, in year *t*.
- $CR8_{i,t}$: it is the ratio of the output of the eight to the sector *i* total output, in year *t*.
- $Gr_{i,t}$: it is the sectoral output growth; it is defined as the growth rate of industry value added in year *t* ($Y_{i,t}$); it can be considered as a proxy for market profitability of the sector.
- $(K/Y)_{i,t}$: it is the capital-output ratio, and is measured as sectoral capital stock divided by sectoral value added ($K_{i,t}/Y_{i,t}$)[8].
- $TFP_{i,t}$: we measure sectoral TFP through the use of the approximation of Griliches and Mairesse (1990) as devised by Muendler (2004)[9]; it is defined as

$$\ln TFP_{i,t} = \ln\left(\frac{Y_{i,t} - M_{i,t}}{L_{i,t}}\right) - \sigma \ln\left(\frac{K_{i,t}}{L_{i,t}}\right),$$

for $\sigma = 1/3$.

- $MES_{i,t}$: it is here defined as the ratio of the total number of employees in the industry *i* to the total number of firms in the industry *i* in year *t*.
- $Mercosul_{i,t}$: is the share of sector *i* sales to Mercosul countries in year *t*. Mercosul is a free trade agreement involving Argentina, Brazil, Paraguay and Uruguay, in effect since 1991.
- $N\text{-}Mercosul_{i,t}$: is the share of sector *i* sales to non- Mercosul countries in year *t*

Basic Statistics

As already stated, we start with a sample of 104 3-digit manufacturing sector. We then drop 5 sectors that report only information on exit and entry statistics (from CEMPRE), but not economic and financial data (from PIA). Next we delete one more sector that has less than 3 firms, for what PIA does not give information. Then we finally consider a sample of 98 3-digit sector. Table 2.1 presents the basic statistics of all the variables using pooled data.

. The average net entry rate of the whole manufacturing industry in this 6 year time was

[8] The capital stock was computed, through the use of the perpetual inventory method, with the depreciation rate of 10%.

[9] To employ this approximation, we consider $Y_{i,t}$ as the "Gross production value", and not as the difference between "Gross production value" and "Cost of Industrial Operations" (which is a proxy of the sector value-added). Capital stock calculation was done trough the perpetual inventory method using the depreciation rate of 10%.

4.06%; the maximum value was 36.17% and the minimum was -22.00%. We find large variations in the entry process across sectors, varying from a high gross entry rate of 44.49% in “Metallic scrap manufacturing” to a low gross entry rate of 0.00% in “Petroleum refining”, among others. The maximum of gross exit rate is 33.33% in “Coal products manufacturing” and the minimum is 0.0% in “Petroleum refining”, among others. Overall, Brazilian manufacturing industry seems to present a quite relevant entry process dynamics; its average gross entry rate is 13.86%, surpassing the average gross exit rate of 9.80% (See Table 2.1). This is a quite similar performance of Europe and USA; Klapper et al (2004) found gross entry rates of 11.07% and 6.65% for the European and North-American manufacturing industry, respectively.

An useful way of summarizing the movement in the entry distributions, which is more appropriated when a large number of sectors are involved, is to group the separate year-basis kernel densities of gross entry, gross exit, and net entry rates for the whole period 1997-2002 (see Figure 2.1, Figure 2.2 and Figure 2.3). There seems to be a leftward shift in both gross entry and gross exit distribution over time, which can indicates that firm creation and destruction are decreasing across sectors. On the other hand, regarding the net entry distribution over time there seems to be an alternated trend; it decreases from 1997 to 2001, but increases in 2002.

3. The Determinants of Entry, Exit and Productivity in Brazilian Manufacturing

The objective of this section is to try to investigate the determinants of the entry process (broadly defined as encompassing gross entry, gross exit and net entry) as well as its effects on productivity, over time and across industrial sectors. Geroski (1995) provides a strong motivation for this exercise. He constructs a list of stylized facts about firm entry in developed countries. He argues that although entry (or firm creation) is very common (that is, large number of firms start production very year) and cross-sectoral variation in terms of entry is very large, “differences in entry between industries do not persist for very long. In fact, most of the total variation in entry across industries and over time is 'within' industry variation rather than 'between' industry variation.” Further, he makes two additional claims that are worth calling attention to: one is that “entry rates are hard to explain using conventional measures of profitability and entry barriers” and the other is that “high rates of entry are often associated with high rates of innovation and increases in efficiency.” These are all features of entry in developed countries. One overarching question behind this exercise is whether these features are also observed in developing countries. In other words, is it also very difficult to explain the variation of entry rates over time and across sectors using conventional measures? Are entry rates also associated with productivity increases in developing countries?

The empirical strategy we use is in two stages. Firstly, we estimate the determinants of entry rates across sectors and over time and, secondly, we estimate whether or not the three facets of the entry process affect productivity. In order to look more closely into the entry process we estimate variations of the following models by Geroski (1995) and Tybout (1996b), respectively:

Entry or exit rates = f (CR4, industry capital output ratio, minimum efficient scale)

Entry or exit rates = f (real output growth, CR4, industry capital/output ratio, year dummies, industry dummies)

These variations are dictated by data availability. Although the PIA data set does not

produce a Herfindahl index of market concentration, it does provide CR4 as well as CR8. In what follows we look at each one of these ratios as a determinant of the entry process and of total factor productivity, as well as investigate whether any their effects occur in non-linear fashion. We follow Geroski, Roberts and Tybout in hypothesizing that concentration ratios are inversely related to entry.

The intuition behind industry capital output ratio (K/Y) as a potential entry determinant is that it captures the magnitude of the necessary sunk costs that new entrants incur to start operating in a given industry. This is usually though of as a powerful deterrent to net firm creation and we thus expect that higher capital/output rations would be inversely related to entry. The variable minimum efficient scale (MES) allows one other way of capturing these ideas. Entry is expected to be more difficult in sectors with larger average workforce.

Lastly, the growth rate of real output of a sector (Gr) is used to capture the economic conditions faced by the firms operating in the sector in a particular year. Roberts shows that entry and exit rates in developing countries tend to be higher (lower) in periods of expansion (contraction),10 yet this relationship is not unconditional: "if adjustment costs are small and sunk costs of entry are large, as is likely when the technology in use is very capital intensive, most variation in demand should be met by changes in the sizes of continuing plants. Large or permanent increases in demand would be required to boost profits sufficiently to cover the sunk costs of entry and thus to induce entry. Conversely, if marginal adjustment costs increase rapidly with changes in plant size, then entry and exit should play a larger role as a source of changes in supply" (1996, p. 26-27).

A last issue we look at is the role of exports as an entry determinant. There are a number of studies examining the impact of export orientation, export intensity and effective rates of protection on productivity across industrial plants (Tybout, 1996a). Our data set includes information not only on export intensity but also on the composition of the share of output that is exported every year. This information is broken-down in terms of the share of output exported to Mercosul countries ($Mercosul$) and to all other destinations ($N - Mercosul$). Notice that this information is a sectoral average per year, thus in sectors in which export opportunities abound (and conditional on capital intensity as a main sunk cost) we expect entry to be higher.[11]

Our main results are as follows. Table 3.1 reports fixed-effects estimates of our model of the determinants of gross firm entry rates. Notice that the Hausman test support the choice of fixed- against random-effects throughout. We find that concentration ratios (CR4 and CR8) are not important explanatory variables, and nor is the capital-output ratio (or the average firm size for that matter). The latter is not surprising in light of the fact that this result on the capital-output ratio concur with the many other findings for instance for Chile, Colombia and Morocco. The evidence from these countries with respect to concentration is more mixed though. Tybout and Haddad et al. reports inconclusive evidence on a negative effect for Chile and Morocco, respectively, while Roberts presents evidence that concentration has a positive effect on entry in Colombia in the first years of the sample. Although we would expect that entry would be less costly in less concentrated sectors, our coefficients are never statistically significant and thus our results are not as helpful as we hoped in throwing light on this issue.

Interestingly, and somewhat unexpectedly, sectors that export a higher share of their output tend to have higher entry rates, and this is particularly strong for the case of export

[10] Note that GDP growth rates in Brazil were 4.2% in 1995, 2.7% in 1996, 3.3% in 1997, 0.2% in 1998, 0.5% in 1999, 4.4% in 2000, 1.3% in 2001 and 1.9% in 2002.

[11] Haddad, de Melo and Horton (1996) use data from Morocco and report that the share of exports in output is a significant predictor of entry, but not of exit rates. Tybout (1996b) and Roberts (1996b) assess the effect of import penetration instead, in Colombia and Chile respectively, but find no evidence of a robust significant effect.

shares to Mercosul countries.[12] Our interpretation of this result is that the Mercosul free trade agreement between Argentina, Brazil, Paraguay and Uruguay markets have experienced greater rates of entry because these provide a secure and protected market in capital-intensive goods in which Brazil has to various degrees lost international competitiveness. The 3-digit sectors for which we observe higher export shares to Mercosul are: automotive and automotive-related, steel, chemicals and pulp and paper sectors (three-digit CNAE).

It is important to notice that although the R-square values we report are admittedly low, especially in light of the fact that fixed-effects are being taken into account, they are in line with those reported elsewhere in the literature (e.g., Perotti and Volpin, 2004).

Table 3.2 reports fixed-effects estimates of our model of the determinants of gross exit rates. The values of the R-squares are still low and even less coefficients come close to show usual levels of statistical significance. One interesting finding is that of mortality rates being higher in sectors that are less likely to export to non-Mercosul markets, which is somewhat in line with our findings above about gross entry rates. Note also that sectors that were growing slower also experienced lower rates of mortality (the coefficient is significant at 10% throughout.)

Table 3.3 has our results for net entry rates. The only one factor that seems to play a relatively important role in terms of net entry is the share of sectoral output exported to Mercosul countries (the coefficient is significant at 10% throughout.) Notice that if we have the total number of firms in the sector instead of the concentration ratio, the coefficient on the former is also positive and statistically significant.

We further investigate the determinants of entry issue in three ways. First, we re-run all these specification using the Arellano-Bond estimator. The expectation here would be that this would help us understand the cross-sectoral process of convergence of entry rates pointed out by Geroski (1995) and, in doing so, help us assess the robustness of the results above. We find, first, that all the results reported above remain and, second, that the lagged dependent variable (capturing the speed of convergence) despite carrying the expected negative sign, is significant only for the case of gross and net entry rates with a coefficient value that we deem too small for yearly data (.23 and .27 to gross and net entry respectively).

Second, we used quantile regression to investigate whether the determinants would change across the entry rates range. We find some interesting differences. For the .25 and .50 quantiles, the coefficients on the concentration ratios are significant, while that is no the case for the .75 quantile (the very same result obtains for net entry rates). For mortality rates, the coefficient on concentration ratios is significant and negative for the .25 quantile, but significant and positive for the .5 and .75 quantile.

Thirdly, we split the years in our sample into those in which real per capita GDP was contracting and those in which it was expanding. Tables 3.4, 3.5 and 3.6 show these interesting results. We find that exports to Mercosul are mainly important to entry rates during recessionary years, while vis-à-vis gross exit we find that the effect of sectoral growth is observed basically in expansionary periods and that of exports to non-Mercosul countries is observed basically in contractionary years. With respect to net entry, only in good years we verify the positive effect of sectoral growth as well as only in bad years we can observe the positive effect of Mercosul-destined exports. We still find almost no support for the effects of concentration and capital-output ratios.

We have also investigated the consequences of splitting the sample in high and low-tech sectors, defined as those with a share of expenditures in Research and Development in revenue above and below the median (which is about 4%).[13] We find that share of exports to

[12] Notice that this set of results is robust to the addition of a variable reflecting the sectoral average share of inputs that were imported in a given year.

[13] These are not show for the sake of space, but are available from the authors' upon request.

Mercosul is an important determinant of gross entry rates (and of net entry rates) only in the low tech sectors (expenditures below median.) We also find some evidence that sectoral growth is an important determinant of gross exit rates only for the high-tech sectors (the relationship is negative.)

We now turn to the question of how entry and exit rates affect average sectoral total factor productivity (TFP). With respect to the determinants of TFP, we follow Haddad et al. (1996) and estimate:

TFP = f (entry rates; real output growth, industry CR4,industry capital/output ratio, year dummies, industry dummies)

Table 3.7 shows our first set of results in this regard. Although the values of our R-squares are still worrisomely low, we find that sectors that grow faster tend to be systematically associated with higher productivity. More interestingly are the findings that gross exit and net entry rates both show the expected yet highly significant effects on total factor productivity.[14] Our results suggest that higher net entry rates are observed in sectors with higher productivity, and that lower exit rates are observed in sectors with higher productivity. It is interesting to note that exports, both to Mercosul and non-Mercosul markets, seem to be a powerful boost to average sectoral productivity levels.

Table 3.8 reproduces these results, but splitting the sample years in those in which per capita GDP expanded from those in which it contracted. There are two interesting results worth mentioning. One is that the statistical significance of sectoral growth as a determinant of TFP only appears for those years in which per capita GDP contracted. Another noteworthy result is that export intensity (share to non-Mercosul markets) is highly correlated with TFP irrespective of GDP movements.

Finally, and more importantly, the results in Table 3.8 confirm gross exit as a major determinant of inter-sectoral total factor productivity: lower exit rates translate into higher TFP levels in contracting and slightly more strongly in years in which per capita GDP actually grew. If we substitute lagged gross exit for gross exit, to at least acknowledge the endogeneity issue, the results are not affect qualitatively and the coefficient on exit remains negative and statistically significant. Table 3.8 also shows that the mixed effect of entry on productivity: in boom years, entry is positively related to TFP, while it is inversely related to TFP in burst years. Net entry rates seem to be positively related to TFP only in burst years.[15]

4. Conclusions

This paper tried to further our understanding of the determinants of firm entry and exit in developing countries and their effects on aggregate sectoral productivity, using panel data for 104 Brazilian manufacturing sectors (3-digit level) for the period 1996 to 2002. The first part of the paper describes in detail the entry process, broadly defined as encompassing gross entry, gross exit and net entry. We find large cross-sector variation: for instance, net entry rate averages 4% and ranges from -22% to 36%. Among those sectors with above average rates, the most important were sectors such as pulp and paper and clothing and textiles. Among those sectors with large positive changes in entry rates, the most important were sectors such as chemicals, optical and precision instruments, and machinery. The second part of the paper presents panel estimates of the determinants of entry, exit and productivity. Our

[14] Notice that these results do not change qualitatively if we use labour productivity instead of TFP, specify CR8 instead of CR4 as the measure of concentration in the sector, size of the average firm instead of capital-output ration, or only the share of output exported to Mercosul countries.

[15] We also split the sample in terms of the ratio of R&D expenditures to revenue (median value is approximately 4%). This information is only available for one year (2000) and is from IBGE's PINTEC at the two-digit level. The results above do not change qualitatively if we split the sample along R&D expenditures (results available from the authors upon request.)

results show that the share of exports in sectoral output is one main determinant of entry and exit rates. The results also suggest that in years of real per capita GDP decline, export propensity is associated with entry rates, while in years of GDP expansion, sectoral growth is positively associated with net entry. Finally, our results show that exit (and to a lesser extent, entry and net entry) is a very robust determinant of total factor productivity across industrial sectors in Brazil.

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Table 2.1 Basic statistics (pooled data)					
	N. Obs	Mean	Std Dev	Min	Max
Gross entry	594	13.86	5.81	0.00	44.48
Gross exit	594	9.80	3.69	0.00	33.33
Net entry	594	4.06	5.74	-22.22	36.17
CR4	687	0.41	0.24	0.03	1.00
CR8	687	0.52	0.25	0.07	1.00
Capital output ratio	685	0.29	0.82	0.00	12.69
MES (average size of firm)	685	205.14	642.235	12.77	6994.87
Growth sectoral output	587	15.40	30.95	-77.47	285.36
PTF	677	10.78	0.78	9.14	14.02

Figure 2.1

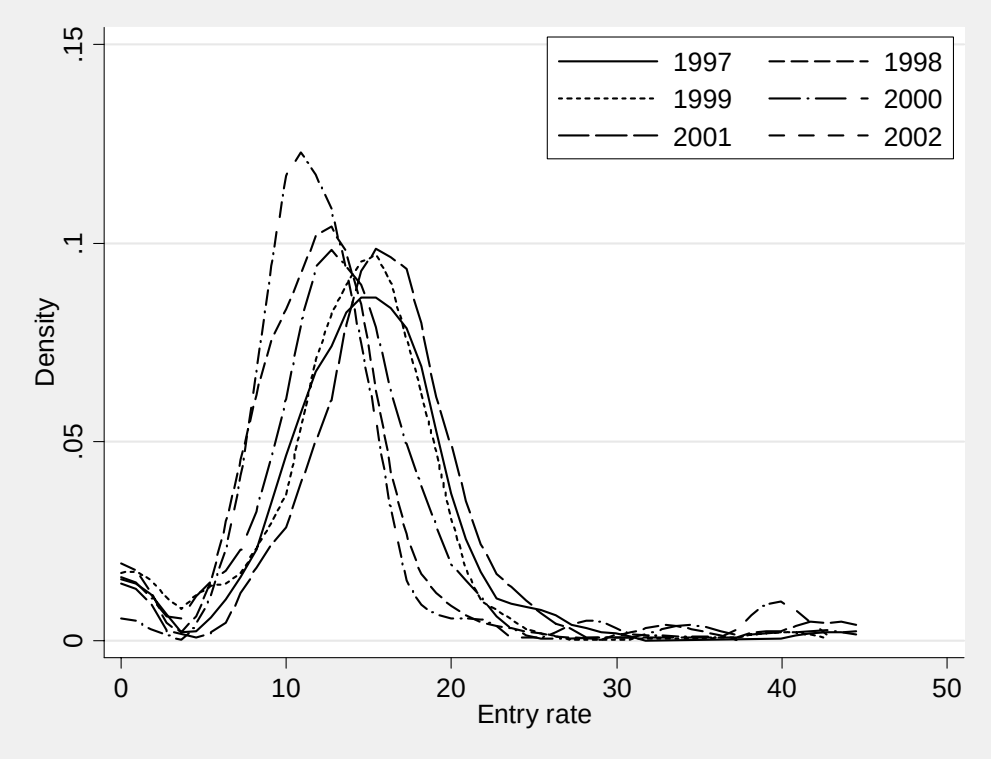

Figure 2.2

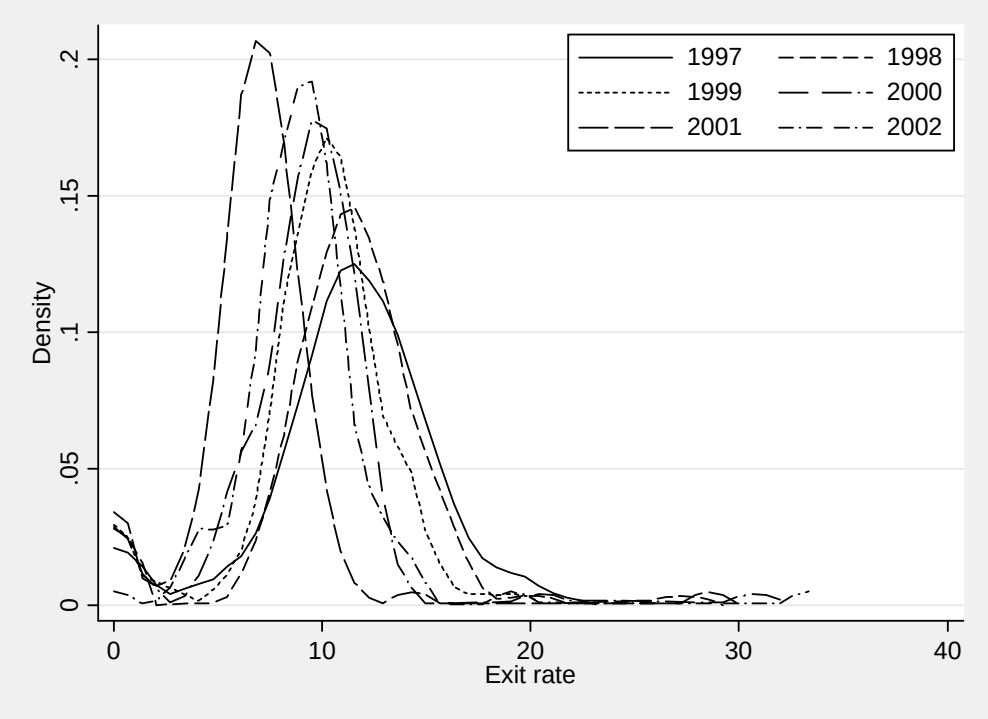

Figure 2.3

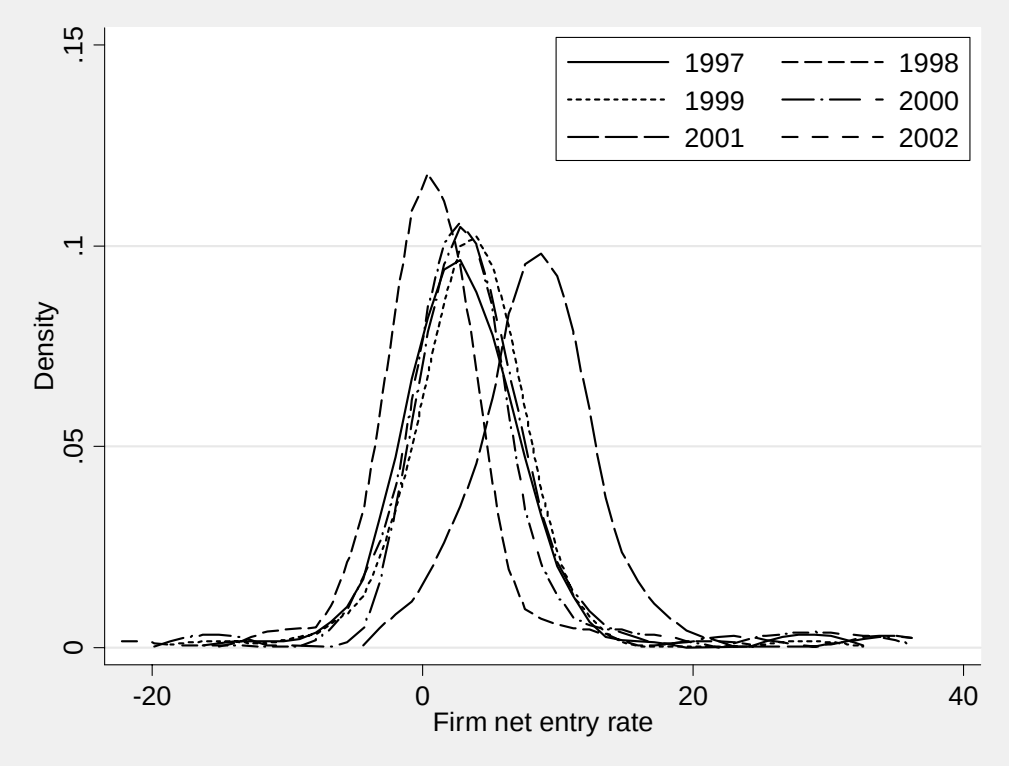

Table 3.1 What determines gross firm entry rates in Brazil from 1996 to 2002? Fixed-effects panel estimates				
	Entry rate	Entry rate	Entry rate	Entry rate
CR4	1.13		0.954	0.8
	[3.611]		[3.633]	[3.617]
Sectoral growth	-0.002	-0.002	-0.002	-0.001
	[0.006]	[0.006]	[0.006]	[0.006]
Capital output ratio	-0.327	-0.325		-0.212
	[0.428]	[0.428]		[0.437]
Share of sales to Mercosul	0.246	0.247	0.241	0.204
	[0.080]**	[0.080]**	[0.080]**	[0.086]*
CR8		0.854		
		[3.686]		
Size of average firm (#workers)			0	
			[0.001]	
Share of sales to non-Mercosul				-0.063
				[0.047]
Constant	12.937	12.951	12.84	13.94
	[1.498]**	[1.934]**	[1.496]**	[1.672]**
Observations	587	587	587	587
Number of Sector 3 digit CNAE	98	98	98	98
R-squared	0.02	0.02	0.02	0.02
Standard errors in brackets * significant at 5% level; ** significant at 1% level				

Table 3.2 What determines gross firm exit rates in Brazil from 1996 to 2002? Fixed-effects panel estimates				
	Exit rate	Exit rate	Exit rate	Exit rate
CR4	2.418		2.724	1.917
	[2.315]		[2.325]	[2.299]
Sectoral growth	-0.009	-0.008	-0.009	-0.007
	[0.004]*	[0.004]*	[0.004]*	[0.004]
Capital output ratio	-0.043	-0.039		0.131
	[0.275]	[0.275]		[0.277]
Share of sales to Mercosul	0.064	0.07	0.065	0.001
	[0.051]	[0.051]	[0.051]	[0.055]
CR8		-0.172		
		[2.366]		
Size of average firm (#workers)			-0.001	
			[0.001]	
Share of sales to non-Mercosul				-0.095
				[0.030]**
Constant	8.877	9.94	8.904	10.398
	[0.960]**	[1.242]**	[0.957]**	[1.063]**
Observations	587	587	587	587
Number of Sector 3 digit CNAE	98	98	98	98
R-squared	0.02	0.01	0.02	0.04
Standard errors in brackets				
* significant at 5% level; ** significant at 1% level				

Table 3.3 What determines net firm entry rates in Brazil from 1996 to 2002? Fixed-effects panel estimates				
	Firm net entry rate	Firm net entry rate	Firm net entry rate	Firm net entry rate
CR4	-1.287		-1.77	-1.117
	[4.467]		[4.489]	[4.481]
Sectoral growth	0.006	0.006	0.007	0.006
	[0.008]	[0.008]	[0.008]	[0.008]
Capital output ratio	-0.284	-0.286		-0.343
	[0.530]	[0.530]		[0.541]
Share of sales to Mercosul	0.182	0.177	0.176	0.203
	[0.099]	[0.099]	[0.099]	[0.107]
CR8		1.027		
		[4.559]		
Size of average firm (#workers)			0.001	
			[0.001]	
Share of sales to non-Mercosul				0.032
				[0.058]
Constant	4.059	3.011	3.935	3.542
	[1.853]*	[2.393]	[1.848]*	[2.072]
Observations	587	587	587	587
Number of Sector 3 digit CNAE	98	98	98	98
R-squared	0.01	0.01	0.01	0.01
Standard errors in brackets * significant at 5% level; ** significant at 1% level				

Table 3.4
What determines gross firm entry rates in Brazil from 1996 to 2002 in output-contracting and –expanding years?
Fixed-effects panel estimates

	Entry rate	Entry rate	Entry rate	Entry rate	Entry rate	Entry rate	Entry rate	Entry rate
	Contract	Expand	Contract	Expand	Contract	Expand	Contract	Expand
CR4	1.086	1.681			0.761	1.253	1.781	0.934
	[6.303]	[5.260]			[6.321]	[5.306]	[6.215]	[5.175]
Sectoral growth	-0.008	0.02	-0.008	0.02	-0.008	0.022	-0.013	0.021
	[0.008]	[0.015]	[0.008]	[0.015]	[0.008]	[0.014]	[0.008]	[0.014]
Capital output ratio	-0.327	-0.212	-0.336	-0.202			-0.787	0.117
	[0.496]	[1.040]	[0.496]	[1.048]			[0.519]	[1.029]
Share of sales to Mercosul	0.422	0.077	0.422	0.077	0.417	0.069	0.602	-0.001
	[0.114]**	[0.150]	[0.113]**	[0.151]	[0.114]**	[0.151]	[0.132]**	[0.150]
CR8			2.578	0.849				
			[6.121]	[5.625]				
Size of average firm (#workers)					0.001	0.001		
					[0.002]	[0.001]		
Share of sales to non-Mercosul							0.242	-0.169
							[0.093]**	[0.060]**
Constant	12.696	12.646	11.799	12.891	12.593	12.606	9.122	15.244
	[2.569]**	[2.264]**	[3.202]**	[3.031]**	[2.580]**	[2.222]**	[2.877]**	[2.410]**
Observations	294	293	294	293	294	293	294	293
Number of Sector 3 digit CNAE	98	98	98	98	98	98	98	98
R-squared	0.08	0.02	0.08	0.01	0.08	0.02	0.11	0.05
Standard errors in brackets								
* significant at 5% level; ** significant at 1% level								

Table 3.5
What determines gross firm exit rates in Brazil from 1996 to 2002 in output-contracting and –expanding years?
Fixed-effects panel estimates

	Exit rate	Exit rate	Exit rate	Exit rate	Exit rate	Exit rate	Exit rate	Exit rate
	Contract	Expand	Contract	Expand	Contract	Expand	Contract	Expand
CR4	4.442	1.38			4.749	1.696	3.944	0.873
	[4.597]	[2.964]			[4.593]	[2.988]	[4.535]	[2.889]
Sectoral growth	-0.006	-0.018	-0.006	-0.018	-0.006	-0.019	-0.002	-0.018
	[0.006]	[0.008]*	[0.006]	[0.008]*	[0.006]	[0.008]*	[0.006]	[0.008]*
Capital output ratio	-0.117	0.104	-0.107	0.076			0.213	0.327
	[0.361]	[0.586]	[0.363]	[0.591]			[0.379]	[0.574]
Share of sales to Mercosul	0.105	0.044	0.115	0.046	0.101	0.049	-0.024	-0.01
	[0.083]	[0.085]	[0.083]	[0.085]	[0.083]	[0.085]	[0.096]	[0.084]
CR8			0.801	-0.838				
			[4.476]	[3.170]				
Size of average firm (#workers)					-0.002	-0.001		
					[0.002]	[0.001]		
Share of sales to non-Mercosul							-0.174	-0.115
							[0.068]*	[0.034]**
Constant	7.699	9.632	9.059	10.639	7.865	9.641	10.264	11.395
	[1.873]**	[1.276]**	[2.341]**	[1.708]**	[1.875]**	[1.252]**	[2.099]**	[1.346]**
Observations	294	293	294	293	294	293	294	293
Number of Sector 3 digit classif CNAE	98	98	98	98	98	98	98	98
R-squared	0.02	0.03	0.02	0.03	0.03	0.03	0.05	0.09
Standard errors in brackets								
* significant at 5% level; ** significant at 1% level								

Table 3.6
What determines net firm entry rates in Brazil from 1996 to 2002 in output-contracting and –expanding years?
Fixed-effects panel estimates

	Firm net entry rate	Firm net entry rate	Firm net entry rate	Firm net entry rate	Firm net entry rate	Firm net entry rate	Firm net entry rate	Firm net entry rate
	Contract	Expand	Contract	Expand	Contract	Expand	Contract	Expand
CR4	-3.356	0.301			-3.988	-0.443	-2.163	0.061
	[8.298]	[6.293]			[8.301]	[6.342]	[8.080]	[6.309]
Sectoral growth	-0.002	0.038	-0.003	0.038	-0.002	0.04	-0.011	0.038
	[0.010]	[0.017]*	[0.010]	[0.017]*	[0.010]	[0.016]*	[0.010]	[0.017]*
Capital output ratio	-0.21	-0.315	-0.229	-0.278			-1	-0.21
	[0.653]	[1.245]	[0.653]	[1.254]			[0.675]	[1.254]
Share of sales to Mercosul	0.318	0.033	0.307	0.031	0.316	0.02	0.627	0.008
	[0.150]*	[0.180]	[0.149]*	[0.180]	[0.149]*	[0.180]	[0.171]**	[0.183]
CR8			1.777	1.687				
			[8.065]	[6.726]				
Size of average firm (#workers)					0.002	0.001		
					[0.003]	[0.002]		
Share of sales to non-Mercosul							0.416	-0.054
							[0.120]**	[0.073]
Constant	4.996	3.014	2.74	2.252	4.728	2.965	-1.142	3.849
	[3.382]	[2.709]	[4.218]	[3.625]	[3.388]	[2.656]	[3.739]	[2.938]
Observations	294	293	294	293	294	293	294	293
Number of Sector 3 digit CNAE	98	98	98	98	98	98	98	98
R-squared	0.02	0.03	0.02	0.03	0.03	0.03	0.08	0.03

Standard errors in brackets * significant at 5% level; ** significant at 1% level

Table 3.7 What determines total factor productivity (log) in Brazil from 1996 to 2002? Fixed-effects panel estimates				
	Total factor productivity (log)	Total factor productivity (log)	Total factor productivity (log)	Total factor productivity (log)
CR4	0.39	0.39	0.427	0.402
	[0.219]	[0.219]	[0.210]*	[0.216]
Growth Rate of Sectoral Output	0.002	0.002	0.002	0.002
	[0.000]**	[0.000]**	[0.000]**	[0.000]**
Capital output ratio	-0.072	-0.071	-0.065	-0.068
	[0.026]**	[0.026]**	[0.025]*	[0.026]**
Share of sales to MERCOSUL	0.014	0.013	0.013	0.012
	[0.005]*	[0.005]*	[0.005]*	[0.005]*
Share of sales to non-MERCOSUL	0.03	0.031	0.027	0.03
	[0.003]**	[0.003]**	[0.003]**	[0.003]**
Entry rate		0.002		
		[0.003]		
Exit rate			-0.028	
			[0.004]**	
Firm net entry rate				0.008
				[0.002]**
Constant	10.25	10.219	10.572	10.219
	[0.103]**	[0.111]**	[0.110]**	[0.102]**
Observations	580	580	580	580
Number of Sector 3 digit classif CNAE	97	97	97	97
R-squared	0.2	0.2	0.27	0.23
Standard errors in brackets * significant at 5% level; ** significant at 1% level				

Table 3.8
What determines total factor productivity (log) in Brazil from 1996 to 2002 in output-expanding and contracting year?
Fixed-effects panel estimates

	Total factor productivity (log)	Total factor productivity (log)	Total factor productivity (log)	Total factor productivity (log)	Total factor productivity (log)	Total factor productivity (log)	Total factor productivity (log)	Total factor productivity (log)
	Contract	Expand	Contract	Expand	Contract	Expand	Contract	Expand
CR4	0.294	0.294	0.287	0.292	0.382	0.321	0.346	0.295
	[0.319]	[0.371]	[0.300]	[0.368]	[0.294]	[0.356]	[0.279]	[0.372]
Sectoral growth	0.002	0	0.003	0	0.002	-0.001	0.002	0
	[0.000]**	[0.001]	[0.000]**	[0.001]	[0.000]**	[0.001]	[0.000]**	[0.001]
Capital output ratio	-0.046	-0.117	-0.03	-0.113	-0.037	-0.107	-0.023	-0.117
	[0.027]	[0.074]	[0.025]	[0.073]	[0.024]	[0.071]	[0.023]	[0.074]
Share of sales to Mercosul	0.013	0.014	0.002	0.014	0.011	0.017	0	0.015
	[0.007]	[0.012]	[0.007]	[0.011]	[0.006]	[0.011]	[0.006]	[0.012]
Share of sales to non-Mercosul	0.027	0.033	0.022	0.03	0.02	0.028	0.017	0.033
	[0.005]**	[0.005]**	[0.005]**	[0.005]**	[0.005]**	[0.005]**	[0.005]**	[0.005]**
Entry rate			0.018	-0.01				
			[0.003]**	[0.005]*				
Exit rate					-0.028	-0.038		
					[0.005]**	[0.009]**		
Firm net entry rate							0.019	0.001
							[0.003]**	[0.004]
Constant	10.314	10.336	10.152	10.511	10.641	10.767	10.358	10.33
	[0.147]**	[0.175]**	[0.142]**	[0.195]**	[0.146]**	[0.197]**	[0.129]**	[0.177]**
Observations	290	290	290	290	290	290	290	290
Number of Sector 3 digit CNAE	97	97	97	97	97	97	97	97
R-squared	0.29	0.2	0.38	0.22	0.4	0.27	0.46	0.2
Standard errors in brackets * significant at 5% level; ** significant at 1% level								