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Dynamic Entry and Exit Linkages in the Brazilian Manufacturing Industry: An Econometric Investigation

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ABSTRACT *The paper investigates dynamic linkages between entry and exit rates in Brazilian manufacturing in the context of 231 (four-digit) industries during the 1996–2005 period. The empirical analysis focuses on the estimation of a dynamic panel data model for entry and exit rates, and controls for the business cycle and structural characteristics, such as industrial concentration and suboptimal scale. The empirical evidence is partially consistent with a multiplier effect where synergetic factors prevail by exit inducing exit. Evidence partially supports a competition effect that could be related to a selection process favoring efficiency, as exit induces entry. The business cycle control variable and the aforementioned structural variables appear to play no role in delineating entry and exit linkages. The results are similar, although not identical, to previous evidence for developed countries.*

Key Words: Entry and Exit Rates; Dynamic Panel Data.

JEL classifications: L1, C33.

1. Introduction

Perfect mobility of economic agents is an idealized assumption that enables a long-term competitive equilibrium in many economic models. Most notably, non-negligible firm entry rates are likely to play an important role in eroding abnormal profits in the absence of substantial barriers to entry. Nevertheless, it is important to stress that the presence of significant sunk costs in particular industries may thwart exit and therefore induce more cautious entry flows. This is one potential reason for the possibility of the emergence of different intertemporal linkages between entry and exit rates.

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In the 1990s, some empirical regularities regarding entry patterns emerged, as indicated by Dunne and Roberts (1991) and Geroski (1991, 1995). The former emphasized the substantial heterogeneity of entry patterns in the US manufacturing industry, while the latter showed the relevance of innovation in shaping those patterns. Caves (1998) provided a synthesis for developed countries. In the case of less developed economies, studies of industry dynamics explored cross sectional differences and patterns (e.g., Bartelsman, Haltiwanger, and Scarpetta (2009) for a range of countries; for Brazil, Campos and Iootty (2007)] on selected manufacturing industries, and Façanha and Resende (2004) in a multisector study).

A relatively neglected topic concerns the *dynamic* interdependencies between entry and exit rates (Johnson and Parker 1994; Kangasharju and Moisio 1998; Lu, Chen, and Huang 2008; Nyström 2007). Nyström highlights two kinds of effects that can establish linkages between entry and exit rates. First, a *competition effect* indicates that past entry induces exit and lowers entry, given pressures exerted by relatively more efficient firms. Second, a *multiplier effect* shows that entry might foster additional future entry (and lower exit rates), following the benefits from firm clustering. A multiplier effect of exit rates implies higher exit rates and lower entry rates, as higher exit rates indicate worse economic conditions. Previous evidence for Sweden and Taiwan appears to indicate the prevalence of both types of effects.

We follow this line of research, and explore unknown entry and exit rates dynamics for Brazil. Developing countries may have different results for entry and exit dynamics, as the institutional setting for doing business is often quite different from developed countries (Tybout 2001). The only limited study on entry and exit dynamics for developing countries we are aware of is Lu, Chen, and Huang (2008). Using a small eight-industry panel for Taiwan, they find evidence of a competition effect from entry to exit and multiplier effects on exit and entry rates.

Brazilian manufacturing can provide an interesting ground for additional studies on industry dynamics. In fact, this large emerging economy is characterized by the co-existence of both traditional and dynamic innovative sectors. Brazil has consistently appeared in the World Bank *Doing Business* survey as a country with significant barriers for companies of all sizes. At the same time, the estimated entry, exit, and firm turnover rates are very high compared to other countries (Façanha and Resende 2004; Bartelsman, Haltiwanger, and Scarpetta 2009). Even in the face of institutional barriers to entry, it is not possible to anticipate whether entry and exit rate *dynamics* differ from those in developed countries.

In addition, we take advantage of a unique data set for Brazil available for the 1996–2005 period, which covers firms of all sizes in a longitudinal dimension. In general, annual data sets based on National Statistical Office surveys impose a lower size threshold on the sampling frame. Based on these surveys, entry and exit may imply not only *de facto* business openings and closing, but also survey threshold crossings.

The Brazilian case has a number of interesting aspects. The data period is chosen to exclude the wake of the structural reforms from the early 1990s. Like many Latin American countries, until 1994, the country was plagued by near hyperinflation and related economic uncertainty. First, macroeconomic stabilization allowed an increasing emphasis on microeconomic issues and consolidated a relatively more business-friendly economic environment. Second, the more recent emergence of regulatory and competition agencies led to more stable rules that can be more conductive to firm survival. Third, Brazil is a large and heterogeneous developing economy characterized by the co-existence of traditional and modern industrial sectors. Fourth, the obstacles for smaller firms were reduced to some extent by some simplification of tax mechanisms and the procedures for opening new businesses (that are nevertheless still significant). It should be noted that even after all these changes, the Brazilian business environment is still an unfriendly one. Brazil ranks 120th out of 189 countries in the *Doing Business* ranking by the World Bank, with a score of 58.01, below the Latin American average of 60.66 (World Bank 2014). Altogether, those aspects may, in principle, imply weaker propagation mechanisms in terms of the multiplier and competition effects, as firm creation and survival could face significant difficulties.

Competition and multiplier effects can be tested by assessing the influence of coefficients related to lagged variables in a panel-VAR setting. Since Holtz-Eakin et al. (1998), it is unusual to impose strict exogeneity of both entry and exit rates. We highlight that this predeterminedness assumption is actually required to avoid an inconsistent empirical methodology. For example, in an entry regression with exit rates as an explanatory variable, exit rates must be considered predetermined. Otherwise, one imposes the absence of both multiplier and competition effects from entry to exit rates.

In short, the present paper aims to contribute to the literature in at least four ways:

(a) There is a clear gap in terms of related studies for developing countries, and the Brazilian economy is particularly suitable for a thorough analysis of the dynamics of entry and exit rates;
(b) The detailed plant-level data used for obtaining the entry and exit rates in the present study are not subject to the shortcomings of previous studies, in which indicators relied on concatenated plant- and firm-level data;
(c) We control for the business cycle and other structural variables (industrial concentration and suboptimal scale) that can potentially affect the dynamic linkages between entry and exit; and
(d) We explore the implications of exogeneity assumptions.

Using efficient generalized method of moments estimates for nonpersistent dynamic panel data models (GMM-DIF), and assuming that all right-hand side variables are weakly exogenous (predetermined), our results show that the competition effect appears relevant for the entry rates, while the exit rates reveal a multiplier effect but a nonsignificant competition effect.

The paper is organized as follows. The next section discusses motivations for the different dynamic linkages between entry and exit rates, and gives an overview of the econometric framework. The third section presents the data, and shows the descriptive and econometric results. The fourth and concluding section adds some final comments.

2. Entry and Exit Linkages

2.1. Conceptual Aspects

Determinants of firms' survival and the patterns of entry and exit are particularly relevant in the literature on entrepreneurship and the economics of business literature. Theoretical models find a wide range of explanations for the relationship between entry and exit in different industries. Hopenhayn (1992) presents a stochastic model in which entry and exit are part of the limiting behavior of the industry and not just part of the adjustment to a steady state, while the model by Jovanovic and Lach (1989) results in staggered entry and exit related to the learning curve of entrants. Agarwal and Gort (1996) explore the role of the product cycle and show that entry rates are affected by stage-related changes in both the rate of technical advance and the form that innovations take, while exit is determined largely by stage-related changes in the intensity of competition, which is the same result as in Klepper (1996). Beyond those theoretical works, there is a large empirical literature on entry and exit, with results for many countries, such as the United States (Dune et al. 1988; Dunne and Roberts 1991), the United Kingdom (Disney, Haskel, and Heden 2003), and Canada (Baldwin and Gorecki 1991).

The present paper follows an alternative strand of the literature that explains the dynamic interrelations between firm births and deaths through two main effects: the competition and multiplier effects. Johnson and Parker (1994) are the first to recognize these two distinct forces, and, more recently, the empirical literature has been taken up by Nystrom (2007) and Manjon-Antolin (2010). The latter considers many models, looking at structural, contemporaneous sector characteristics, as well as pure time series models of entry and exit in the case of Spain. The consideration of additional control variables pertaining to industrial structure is a relevant extension to previous empirical results.

The multiplier effect is related to the concept of network externalities, in which the entrance of a firm increases the probability of other firms entering the market. The argument for the multiplier effect is simple: market entrance signals market opportunities to other firms, and creates external economies of scale based on the size of the market, one of the main reasons for clustering.

The competition effect relates entrance to future exit by a simple mechanism: new firms may be more innovative and disrupt the market, causing fringe inefficient incumbents to exit, either because of new products (related to the product life-cycle theory) or because of differences in production costs.

Because both effects occur simultaneously, there is interdependence between entry and exit. The literature is well established in finding evidence of such phenomena, comparing dynamic patterns either in different regions or across industrial sectors.

However, there is one important feature of the interdependence between exit and entry that is missing in the recent empirical literature: the impact of the business cycle on the patterns of entry and exit, as in Campbell (1998). The model relates entry and exit patterns to shocks to the rate of embodied technological progress, thus presenting another rationale for observable patterns other than the multiplier and competition effects. Business cycle features would exert an impact on the patterns of entry and exit due to technological advances. The result is that the increase in the aggregate exit rate would be followed by additional entry, productivity, and output, as new plants embodying innovations are more productive. The model economy would reproduce the cyclical features of the entry and exit data: exit would be countercyclical and would lead to output and productivity growth. In turn, this would lead to more entry. Thus, if we do not control for the business cycle, there is no way to distinguish if the patterns of exit and entry are due to the interdependence caused by the multiplier and competition effects or the natural cycle of technological shocks as in Campbell (1998).

We then build on the literature by improving the estimation and the accuracy in the search for better evidence of entry and exit patterns, after accounting for the business cycle. In contrast with the previous literature, we undertake a less restrictive econometric specification by assuming that the explanatory variables are predetermined rather than exogenous.

Usually the search for the multiplier and competition effects is based on their expected signs. If one assumes that both entry and exit are a function of previous entry and exit, the expected signs for the multiplier and competition effects are straightforward and predictable. In the dynamic empirical model, we should observe that the multiplier effect would cause previous entry to increase entry, the converse being true for exit. As for the competition effect, we should observe that previous entry would cause a higher exit rate, with the converse also being true. Table 1 provides a summary of relevant expected signs associated to the different effects.

2.2. Econometric Framework

The present paper aims to study the dynamic linkages between business entry (ENT) and exit (EX). Following the literature, we specify an autoregressive panel data model with individual (sector)-specific fixed effects in a panel-VAR empirical framework. The general empirical model that is later implemented also considers control variables related to the business cycle (BC) and to industry structure (industrial concentration [CONC] and suboptimal scale [SUBOPT]).

It is noteworthy that the previous empirical literature on entry and exit linkages (summarized in Table 6) did not control for business cycle effects. However, it is not clear that business cycle variables would actually show up in our estimates. Given the recent stabilization program in the Brazilian economy, it is still very hard to derive predictable business fluctuations in Brazil. Business cycles effects depend on stable environments that affect

Table 1. Expected signs for the multiplier and competition effects

	Multiplier	Competition
Entry/previous entry	+	–
Exit/previous exit	+	–
Entry/previous exit	–	+
Exit/previous entry	–	+

Source: Nystrom (2007).

long-term investment decisions. Even so, including such variables make our empirical estimation more robust, even if only to check for its possibility in the still-infant Brazilian modern economy – we can easily divide Brazil's most recent economic developments into pre-Plano Real (1994) and post-Plano Real, which brought tamer inflation and a more stable macro and microeconomic environment. Even in its most stable form, the Brazilian economy is still plagued by high interest rates (in 2014, it was still more than 11%; at one point, in 1998, it reached more than 40% in real terms) and other barriers to doing business that shorten the investment horizons of most companies.

Additionally, it can be potentially relevant to conceive other control variables pertaining to structural dimensions that may influence entry and exit linkages. Specifically, we consider an industrial concentration index for each four-digit sector measured by the Herfindahl index based on net sales (CONC). The information was obtained upon specially requested tabulations from the Annual Manufacturing Survey – PIA – from the National Statistical Office – IBGE. We also introduce an inverse proxy for barriers to entry (SUBOP), defined as the proportion of employment in an industry that is in plants that operate below the minimum efficient scale (approximated as the median number of employees in a given industrial sector).[1]

Initially, we have two equations that are specified in levels and are estimated separately in terms of a single-equation estimator:

$$ENT_{it} = \alpha_{11} ENT_{i,t-1} + \beta_{11} EX_{i,t-1} + \beta_{12} BC_{i,t-1} + \beta_{13} CONC_{i,t-1} + \beta_{14}\, SUBOP_{i,t-1} + \mu_{y_i} + \lambda_{y_t} + v_{it} \tag{1}$$

$$EX_{it} = \alpha_{21} EX_{i,t-1} + \beta_{21} ENT_{i,t-1} + \beta_{22} BC_{i,t-1} + \beta_{23}\, CONC_{i,t-1} + \beta_{24}\, SUBOP_{i,t-1} + \mu_{xi} + \lambda_{xt} + w_{it} \tag{1$'$}$$

In equations (1) and (1´), μ_{xi} and μ_{yi} are fixed effects that capture sector time invariant heterogeneity, and v_{it} and w_{it} are unobserved terms, contemporaneously uncorrelated with the explanatory variables.[2] The model also includes time effects (λ_{y_t} and λ_{xt}) to capture nonobserved heterogeneities that depend on the time period only and are typically considered by period dummy variables.

Our empirical strategy uses a panel of sectors, instead of a pure time series analysis. Generally, there are no long time series of entry and exit rates, particularly in developing countries. A dynamic panel data model motivates the use of the well-known Arellano and Bond (1991) estimator that avoid biases from traditional estimators (Baltagi 2001; Cameron and Trivedi 2010).[3] The result is a GMM estimator that uses an orthogonality condition on the appropriate instruments and the error on the first difference of the above equations (GMM-DIF).

First differencing to eliminate fixed effects generates contemporaneous correlation between the differenced lagged dependent variable and the differenced error term, but instruments are available in a panel structure. Arellano and Bond (1991) highlighted that lagged dependent variables are appropriate instruments for the differenced lagged dependent variable dated *t*–2 and later periods. The remaining elements of the instrument matrix are related to the assumptions regarding additional regressors. In the simplest case, in which we assume strict exogeneity (uncorrelated with past, current, and future errors), the variables can be readily used as instruments, whereas in the case of weak exogeneity, these explanatory regressors are treated as lagged dependent variables. The validity of the instruments is important for the consistency of the GMM-DIF estimator. It can be evaluated using the Sargan test for overidentifying restrictions. It is important to restrict the number of instruments to assure good power properties for the Sargan test. Additionally, the validity of lags as instruments hinges on the absence of second order serial correlation. Due to the GMM estimation, we use the autocorrelation tests suggested by Arellano and Bond.

We assume that all right-hand-side variables are weakly exogenous (predetermined), as it is a weaker assumption than strict exogeneity. This is a point overlooked in the empirical literature. Ignoring this would result in a logically flawed empirical strategy. Imposing strict exogeneity of the lagged exit rate in the entry rate equation (1) means that there is neither a multiplier nor competition effect from (lagged) entry on exit, i.e., $\beta_{21}=0$ in equation (1′) (Cameron and Trivedi, 2010). Also, a strict exogeneity assumption of the exit rate in the entry rate equation implies that there is no feedback from entry to exit rates.

3. Empirical Analysis

3.1. Data Source

Our basic data source is the *Relação Anual de Informações Sociais* (RAIS; Ministry of Labor and Employment, Brazil). This data set is a census, and collects information on the number of employees and their educational characteristics at the plant level in formal establishments for all Brazilian regions. It is a unique data set that can be used for measuring entry and exit rates, as it covers firms of all employee sizes, contrary to most manufacturing surveys. It allows firms to be followed over time, from opening to closing. Other annual manufacturing surveys (such as the Brazilian PIA or the European Manufacturing Survey) have a minimum firm size for sampling. Data on such surveys therefore include firm openings and closings, as well as firms crossing the sampling size threshold. This is a limitation in all papers that use annual surveys, such as Nystrom (2007). To the best of our knowledge, only Dunne and Roberts (1991) use census data, but for five-year intervals.

We focus on four-digit industries for Brazilian manufacturing over the 1995–2005 period. We were granted special access to identified microdata that allowed us to compute sector-level entry and exit rates for the 1996–2005 period, totaling about 580,000 plants. Entry or exit can be identified by comparing the unique plant identifier between adjacent periods, namely the numerical identifier (CNPJ, in the Brazilian acronym).

The entry rate (ENTRY) is computed as the ratio of newly created plants in a given year relative to the total number of plants in the previous year, for each industrial sector.

The exit rate (EXIT) is computed as the ratio of exit plants in a given year relative to the total number of plants in the previous year, for each industrial sector.

Relevant descriptive statistics are reported in Table 2. We observe significant heterogeneity across sectors and over time. Average entry rates range from 23% to 15.9%, while average exit rates are between 19.2% and 12.6%. The possibility of the business cycle (BC) affecting the dynamic relationship between entry and exit rates motivates the control for real sales. Sales for each sector are obtained from the Pesquisa Industrial Anual-PIA-IBGE (we define sales as net operational revenues deflated by the consumer price index [IPCA-IBGE]

3.2. *Empirical Results*

The econometric results for the entry and exit equations are reported in Tables 3 and 4, respectively. Table 5 reports related joint significance tests.

The diagnostic tests present satisfactory results, based on the nonrejection of the Sargan test for the validity of instruments, and the absence of residual second-order serial correlation. We limit the number of lags used as instruments, under predetermined explanatory variables, to strengthen the Sargan test. We experimented with the maximum number of instruments, using two or three lags. The use of additional lags weakens specification tests (Cameron and Trivedi 2010). The preferred model for the dynamic specifications of the entry and exit equations is selected on joint significance

Table 2. Summary statistics – entry and exit rates in Brazilian manufacturing 1996–2005 (231 [four-digit] sectors)

Year	Mean	Std. Dev.	Min.	Max.	Skewness	Kurtosis
Entry rates						
1996	0.196	0.073	0.043	0.537	1.192	6.057
1997	0.230	0.077	0.062	0.484	0.308	3.024
1998	0.182	0.062	0.040	0.426	0.500	3.771
1999	0.182	0.066	0.011	0.566	1.151	8.244
2000	0.205	0.071	0.040	0.545	1.566	7.938
2001	0.181	0.063	0.041	0.510	1.250	6.971
2002	0.169	0.054	0.043	0.351	0.500	3.536
2003	0.160	0.055	0.037	0.382	0.951	4.967
2004	0.166	0.071	0.024	0.590	2.451	13.819
2005	0.159	0.063	0.028	0.482	1.733	8.251
Exit rates						
1996	0.192	0.066	0	0.529	1.142	6.494
1997	0.186	0.060	0.030	0.402	0.998	4.536
1998	0.175	0.054	0.031	0.453	0.956	6.348
1999	0.167	0.057	0	0.435	1.118	6.826
2000	0.170	0.064	0	0.476	1.368	6.532
2001	0.149	0.054	0	0.469	1.756	10.217
2002	0.139	0.045	0	0.354	1.056	6.615
2003	0.147	0.052	0.043	0.421	1.416	6.787
2004	0.126	0.040	0.045	0.341	0.846	6.266
2005	0.131	0.048	0.029	0.450	1.890	11.444

Table 3. Results from GMM-DIF estimation (two-step estimation) – four-digit sectors $\Delta ENTRY_t = f(\Delta ENTRY_{t-1}, \ldots, \Delta ENTRY_{t-p}, \Delta EXIT_{t-1}, \ldots, \Delta EXIT_{t-p}, \Delta BC_{t-1}, \ldots, \Delta BC_{t-p}, \Delta CONC_{-1}, \ldots, \Delta CONC_{t-p}, \Delta SUBOP_{-1}, \ldots, \Delta SUBOP_{t-p})$

	Dependent Variable: ΔENTRY		
Regressors	p=1	p=2	p=3
Constant	0.127 (0.002)	0.099 (0.112)	−0.031 (0.790)
$\Delta ENTRY_{-1}$	0.078 (0.074)	0.048 (0.406)	0.053 (0.570)
$\Delta ENTRY_{-2}$	–	−0.046 (0.213)	−0.055 (0.299)
$\Delta ENTRY_{-3}$	–	–	−0.011 (0.843)
$\Delta EXIT_{-1}$	0.140 (0.002)	0.174 (0.248)	0.328 (0.020)
$\Delta EXIT_{-2}$	–	0.048 (0.300)	0.093 (0.452)
$\Delta EXIT_{-3}$	–	–	0.010 (0.840)
ΔBC_{-1}	3.41E-04 (0.938)	0.031 (0.102)	0.039 (0.056)
ΔBC_{-2}	–	0.005 (0.299)	0.002 (0.930)
ΔBC_{-3}	–	–	−0.012 (0.092)
$\Delta CONC_{-1}$	−0.028 (0.619)	−0.049 (0.640)	−0.120 (0.256)
$\Delta CONC_{-2}$	–	−0.025 (0.640)	−0.020 (0.800)
$\Delta CONC_{-3}$	–	–	0.030 (0.558)
$\Delta SUBOP_{-1}$	0.009 (0.981)	1.082 (0.215)	1.659 (0.174)
$\Delta SUBOP_{-2}$	–	−0.622 (0.433)	−0.658 (0.511)
$\Delta SUBOP_{-3}$	–	–	1.179 (0.151)
D1999	0.015 (0.011)	–	–
D2000	0.019 (0.000)	0.022 (0.027)	–
D2001	0.038 (0.000)	0.036 (0.000)	0.034 (0.000)
D2002	0.013 (0.002)	0.013 (0.133)	0.009 (0.298)
D2003	0.007 (0.061)	0.007 (0.269)	0.007 (0.369)
D2004	0.007 (0.750)	2.68E-04 (0.948)	5.38E-04 (0.906)
D2005	0.006 (0.098)	0.006 (0.235)	0.005 (0.236)
Sargan test	$\chi^2(93)$=100.116 (0.289)	$\chi^2(74)$=73.716 (0.487)	$\chi^2(70)$=69.421 (0.497)
AR(1) test	−6.018 (0.000)	−5.610 (0.000)	−4.433 (0.000)
AR(2) test	−0.127 (0.899)	0.882 (0.378)	1.203 (0.229)

Note: *p*-values are indicated in parentheses.

tests for the maximum lag p to be considered, as reported in the first and sixth rows of Table 5 for entry and exit equations, respectively. The evidence for both equations favors the choice of p=1, compared to p=2 or p=3. With this result, one can proceed with a closer inspection of the entry and exit equations estimates, and interpret results in connection with the multiplier and competition effects.

Recall that we conclude for a competition effect when past exit (entry) rates positively influence future entry (exit) rates. Multiplier effects are present when entry and exit rates follow a positively autocorrelated structure (significant and positive lagged dependent variable coefficients).

The evidence indicates a competition effect where past exit rates positively influence future entry rates. Multiplier effects are present with exit rates following a positively autocorrelated structure (significant and positive lagged dependent variable coefficients).

The second and third rows in each block of Table 5 present the significance of the entry and exit variables, respectively, in each equation. The corresponding fourth and fifth rows in each block of Table 5 indicate the total

Table 4. Results from GMM-DIF estimation (two-step estimation) – four-digit sectors $\Delta EXIT_t = f(\Delta ENTRY_{t-1}, \ldots, \Delta ENTRY_{t-p}, \Delta EXIT_{t-1}, \ldots, \Delta EXIT_{t-p}, \Delta BC_{t-1}, \ldots, \Delta BC_{t-p}, \Delta CONC_{-1}, \ldots, \Delta CONC_{t-p}, \Delta SUBOP_{-1}, \ldots, \Delta SUBOP_{t-p})$

	Dependent Variable: ΔEXIT		
Regressors	p=1	p=2	p=3
Constant	0.085 (0.006)	0.121 (0.021)	0.101 (0.292)
$\Delta EXIT_{-1}$	0.107 (0.051)	0.096 (0.179)	0.115 (0.151)
$\Delta EXIT_{-2}$	–	−0.010 (0.874)	0.040 (0.591)
$\Delta EXIT_{-3}$	–	–	0.044 (0.329)
$\Delta ENTRY_{-1}$	0.048 (0.244)	0.154 (0.070)	0.156 (0.113)
$\Delta ENTRY_{-2}$	–	0.005 (0.880)	−0.014 (0.901)
$\Delta ENTRY_{-3}$	–	–	−0.033 (0.425)
ΔBC_{-1}	−0.004 (0.350)	−0.007 (0.659)	0.021 (0.201)
ΔBC_{-2}	–	0.004 (0.446)	0.040 (0.016)
ΔBC_{-3}	–	–	0.003 (0.464)
$\Delta CONC_{-1}$	0.012 (0.633)	0.183 (0.064)	0.183 (0.024)
$\Delta CONC_{-2}$	–	−0.050 (0.380)	−0.007 (0.939)
$\Delta CONC_{-3}$	–	–	−0.019 (0.703)
$\Delta SUBOP_{-1}$	0.280 (0.539)	1.013 (0.115)	1.026 (0.335)
$\Delta SUBOP_{-2}$	–	−1.792 (0.007)	−1.472 (0.092)
$\Delta SUBOP_{-3}$	–	–	−0.273 (0.678)
D1999	0.037 (0.000)	–	–
D2000	0.028 (0.000)	0.021 (0.012)	–
D2001	0.003 (0.000)	0.026 (0.000)	0.029 (0.003)
D2002	0.011 (0.001)	0.006 (0.318)	0.002 (0.832)
D2003	0.007 (0.010)	0.005 (0.241)	0.002 (0.827)
D2004	0.015 (0.000)	0.014 (0.000)	0.016 (0.000)
D2005	−0.004 (0.208)	−0.003 (0.358)	−0.002 (0.432)
Sargan test	$\chi^2(93)$=110.349 (0.106)	$\chi^2(74)$=85.395 (0.172)	$\chi^2(70)$=78.073 (0.238)
AR(1) test	−5.600 (0.000)	−5.042 (0.000)	−3.790 (0.000)
AR(2) test	−0.212 (0.832)	−0.098 (0.922)	−0.185 (0.854)

Note: *p*-values are indicated in parentheses.

Table 5. Joint significance tests – four-digit sectors

Test	p=1	p=2	p=3
Dependent Variable: ENTRY			
Highest lag signif.	12.73 (0.002)	3.120 (0.211)	0.080 (0.962)
Joint signif. past entry coefficients	3.20 (0.074)	4.180 (0.124)	4.580 (0.205)
Joint signif. past exit coefficients	9.32 (0.002)	2.780 (0.250)	6.610 (0.085)
Entry effect (coef. sum)	3.20 (0.074)	0.00 (0.973)	0.010 (0.943)
Exit effect (coef. sum)	9.32 (0.002)	2.14 (0.144)	5.570 (0.018)
Dependent Variable: EXIT			
Highest lag signif.	4.28 (0.118)	0.06 (0.971)	1.77 (0.414)
Joint signif past entry coef.	1.36 (0.244)	3.30 (0.192)	3.82 (0.282)
Joint signif past exit coef.	3.82 (0.051)	2.49 (0.288)	2.81 (0.423)
Entry effect (coef. sum)	1.36 (0.244)	2.99 (0.084)	0.39 (0.534)
Exit effect (coef. sum)	3.82 (0.051)	0.60 (0.440)	1.76 (0.184)

Note: *p*-values are indicated in parentheses.

entry and exit effects, by adding up the coefficients. These rows complement the significance tests and point to whether the effect of entry on entry is positive or negative.

In the selected lag structure (one lag), past exit influences entry, as the significance test is rejected. Past entry influences entry only at the 10% significance level. Looking at the signs of these effects, we see that, for all lag choices, there seems to be a positive, albeit not always significant, effect of past exit rates on current entry rates that points to a competition effect.

In the last five rows of Table 5, we have the results for the exit rates equation. Again, lag choice tests point to a one-lag regression specification, compared to two or three lags, as in the entry equation. The next two rows evaluate the significance of entry and exit lags coefficients. The entry variable does not seem to influence exit rates, while exit rates follow an autoregressive pattern. The last line indicates that the autoregressive coefficient for exit is positive. This is interpreted as a multiplier effect of exit on exit rates.

Table 6 summarizes the main results in comparison with previous studies, and indicates only partial conformity with earlier evidence. As mentioned, the multiplier effect seems to be present solely in the exit equation, whereas the competition effect emerges only in the case of the entry equation. The results for the Brazilian case contrasts with previous empirical studies, and the closest similarity appears to be with Johnson and Parker (1994).

It is worth mentioning that this particular interpretation of the dynamic structure of entry and exit rates hinges on the selected lag structure (p=1 is the optimal lag). For the sake of robustness, we considered multiplier and competition tests for other lag structures ($p = 2$ and $p = 3$). For these cases, the use of a suboptimal lag structure indicates a bias in the results, weakening coefficient estimates precision and changing conclusions.

As an additional robustness exercise, we re-estimated the models using three-digit-level entry and exit rates.[4] The coarser breakdown could minimize classification errors or firm movements between sectors, as well as allowing us to eliminate zero entry/exit rates entirely. The drawback is the reduction in degrees of freedom. The results are available upon request, and confirm the competition effect from exit to entry. However, the autoregressive multiplier effect of exit on exit does not appear statistically significant.

Table 6. Comparison of empirical results with previous studies

	ENTRY (EN)		EXIT (EX)	
Studies	$\partial EN_t/\partial EN_{t-1}$	$\partial EN_t/\partial EX_{t-1}$	$\partial EX_t/\partial EX_{t-1}$	$\partial EX_t/\partial EN_{t-1}$
Johnson and Parker (1994)	Competition effect	Competition effect	Multiplier effect	Multiplier effect
Kangasharju and Moisio (1998)	Not significant	Multiplier effect	Competition effect	Not significant
Nyström (2007)	Multiplier effect	Competition effect	Competition effect	Competition effect
Lu, Chen, and Huang (2008)	Multiplier effect	Not significant	Multiplier effect	Competition effect
This study	Not significant	Competition effect	Multiplier effect	Not significant

Our results are not as robust as in the rest of the literature, but show some interesting patterns. First, we cannot take for granted both effects in the case of a large developing economy in a transition period. The 1995–2005 period is fraught with stabilization policies and different crises, such as two currency crises (in 1999 and 2002), a banking crisis (in 1995–96), and an energy crisis (2001). The institutional environment of the Brazilian economy evolved rapidly by the adoption of privatization policies, a restructuring of the financial system (Torres Filho et al. 2014), and a balanced budget act. However, the macroeconomic scenario was bleak for the most part, with low growth, high unemployment, and high volatility in exchange and interest rates (the latter reached 45% in real terms in 1998). Against this changing background, we would expect an unclear pattern of exit and entry in different industrial sectors, and this is what appeared. We also did not expect significant effects for the business cycle and the market concentration variable. In the latter case, in a changing environment barriers to entry seem to be less relevant, and thus both entry (and exit) are much higher than in the case of developed countries. Concentration also does not seem statistically relevant, another result we attribute to the changing environment in the Brazilian economy in the 1995–2005. We argue that an exercise for a transition economy such as Brazil in the 1995–2005 is important, especially if further works show improved estimation of the multiplier and competition effects, and robust effects for concentration and the business cycles. Such results would justify an institutional view of microeconomics, in which companies evolve from chasing erratic opportunities to clearer patterns of entry and exit as markets coalesce into a stable environment.

4. Final Comments

The paper aims to investigate the dynamic linkages between entry and exit rates in the context of the Brazilian manufacturing industry at the four-digit level, using plant-level data.

Our methodology considers many different strands of the literature, as well as the use of a large set of controls to avoid correlations due to time varying control variables. We use a GMM dynamic panel data estimation method on a comprehensive manufacturing plant data set. The evidence partially supports the prevalence of both multiplier and competition effects even after controlling for the business cycle and structural variables (industrial concentration and suboptimal scale). Results display some similarities with previous evidence for developed countries. We argue that the lack of evidence for more compelling results on the main effects, and on the concentration and business cycle controls, is due to the changing nature of the Brazilian economy and the institutional setting in the period of our data, 1995–2005. The country had just dispelled hyperinflation and was in a transition period to a more stable economy, with currency, energy, and banking crises in between the more stable period that begins in the first years of the present century. At the same time, the high costs of doing business in Brazil may still affect firm dynamics and weaken competition and multiplier effects.

Avenues for future research include the assessment of specific underlying forces driving the multiplier and competition effects, and the investigation, for instance, of connections with productivity dynamics. Moreover, it would be relevant to conduct the analysis at the firm level as well as the plant level, but such initiatives are beyond the scope of the present paper.

Notes

1. Sutton (1998) proposed an empirical criterion for defining the minimum efficient scale based on the median approximation. Mata and Machado (1996) suggested a similar measure for suboptimal scale.
2. We use one lag for the explanatory variables for model description purposes. Further lags are considered in the empirical application.
3. The AB estimator is an efficient and consistent estimator for dynamic panel data models, and avoids biases that prevailed in earlier models, as highlighted by Nickell (1981).
4. We thank a referee for suggesting this investigation

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