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ESTUDOS DO GEMF
N.º 20 2010

PUBLICAÇÃO CO-FINANCIADA PELA
FUNDAÇÃO PARA A CIÊNCIA E TECNOLOGIA

Impresso na Secção de Textos da FEUC
COIMBRA 2010

Does Schumpeterian Creative Destruction Lead to Higher Productivity?
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September 2010

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Abstract:

This paper discusses the impact of newly created firms on industry productivity growth. Our central hypothesis is that there are two potential effects of new firms on productivity growth: a direct effect, as entrants may be relatively more productive than established firms; and an indirect effect, through increased competitive pressure that stimulates incumbents to elevate their productivity in order to survive. The results of the decomposition exercise of aggregate productivity growth suggest that the direct contribution of entry is small. In turn, the regression analysis on the effect of entry on productivity growth of incumbents indicates that the higher is the former, the higher is the latter, which is equivalent to say that the greater is the competitive pressure generated by new entrants, the higher is the expected aggregate productivity level.

Keywords: Entry, Firm dynamics, Productivity growth, Competition effect
JEL classification: L11, L16, L25, O12, O47, L60

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1. Introduction

Inspired by the pioneering work of Baily et al. (1992) and Griliches and Regev (1995), a number of authors has carried out decomposition exercises of aggregate productivity growth to examine the contribution of new firms—e.g. Baldwin and Gu (2006), Cantner and Krüger (2008), Carreira and Teixeira (2008), Disney et al. (2003), and Foster et al. (2001), for the analysis of the manufacturing sector in Canada, Germany, Portugal, the UK, and the US, respectively. The common premise across these studies is that productivity growth is both due to internal restructuring within established firms and to reallocation from low-productivity firms to more productive incumbents and new entrants.

In these studies, however, there is a risk of underestimation of the entry effect on industry productivity growth as standard decompositions fail to account for the entry effect on the overall competitive pressure. As shown by Aghion et al. (2009) and Falck et al. (forthcoming), industries with a high entry rate seem to be the ones in which incumbents have an increasing pressure to improve their performance. In the same vein, investigating the relationship between new firms and *employment change*, Fritsch and Mueller (2004) and Fritsch (2008) identified two effects: a direct effect and an indirect one. The former connected to the new productive capacities created by new units and the latter to the twofold effect of new business on incumbents via (a) the crowding-out of less competitive units and (b) the stimulus to innovate.

In this paper we too assume that firm entry generates *direct* and *indirect* productivity effects, with, to repeat, the former being related to the introduction of innovative products and processes, while the latter is connected to the crowding-out of low-productivity firms by new competitors, on the one hand, and to the increased incentive of established firms to innovate in order to survive. [1] By offering a detailed empirical analysis of the relationship between firm entry and industry-wide productivity growth—to our knowledge this is the first attempt to assess all these effects—we aim to shed further light on this crucial issue. To conduct our test, we use an unbalanced panel of Portuguese manufacturing firms covering the period 1996-2000.

To anticipate our results, we find that the direct effect of entry is small, while there is confirmation of a strong crowding-out effect. We also find that a higher entry rate of new firms is positively associated with a higher productivity level of incumbent firms. While the (small) direct effect can be easily attributed to the fact that, in the year of entry, the productivity level of new entrants tend to be, on average, smaller than that of continuing firms, it is reassuring to find that entry improves business efficiency both via exclusion of low-productivity firms and increased competitive pressure on all market players.

The paper proceeds as follows. Following a brief review of the background literature in the next section, Section 3 and 4 present the modelling and the data, respectively. Section 5 evaluates the entry and exit pattern in the Portuguese manufacturing sector *and* the direct and indirect effects of entry on productivity growth. Section 6 offers some concluding remarks.

2. New firms and industry productivity growth

The Schumpeterian approach provides an interesting theoretical framework in which the effects of entry on industry productivity can be analysed. According to Schumpeter (1934, 1942), each innovation introduced by an entrepreneur/firm can be taken as a business experiment subject to a market test. Thus, industry productivity growth is expected to be enhanced by entry of new firms so that we will have a close relationship between the number of business experiments (or entrants) and the number of successful cases. In this framework, firm exit works then as a

[1] There is a large body of literature showing the impact of innovation on productivity at firm-level (see Griliches, 2000, for an extensive survey).

necessary mechanism to eliminate non-competitive technologies (or products)—the classical Schumpeterian 'creative destruction'.[2]

An ingenious Schumpeterian growth model with entry is provided by Aghion et al. (2009). In this model, a final good is produced under perfect competition using a continuum of intermediate inputs. Each intermediate sector is a duopoly, with two permanent rivals, the incumbent and a potential entrant, engaged in price (Bertrand) competition.

Assuming that each potential entrant enters with a leading-edge technology, the entry effect on incumbent firms will then depend on the distance from the technology frontier so that *a*) if the incumbent has a leading-edge technology too, it will use its reputation advantage to maintain its market position while blocking entry; and *b*) if the incumbent is less technologically advanced than the entrant, the entrant excludes the incumbent. The model predicts that under increased entry threat incumbents in the neighbourhood of the technology frontier will tend to be increasingly innovative to preclude entry of new competitors, while those further behind the technological boundary—with a weaker incentive to innovate—will be replaced by entrants.

Applying their model to UK (1987–1993, micro panel data), Aghion et al. (2009) found that a higher entry threat (proxied by the foreign firm entry rate) encourages a greater innovation effort from incumbents and, as a consequence, a higher aggregate productivity growth. Similar results were found by Falck et al. (forthcoming) for Germany, in the 1987-2000 period. In particular, these authors found that (domestic) entry has a positive effect on incumbent's *process* innovation, but not on incumbent's *product* innovation, which can be explained by the fact that entrants tend to have a comparative advantage in selling new ideas but are perhaps less able to implement non-disruptive production processes.

A different explanation for the effects of entry on aggregate productivity growth can also be given along the lines of the monopolistic competitive model. Melitz (2003), for

[2] Marshall was perhaps the first to emphasize the role of the evolutionary process with his analogy of the forest in which the once mighty trees give place, one after the other, to the vigour of youth (Marshall,1890, Vol. IV, Ch. XIII).

example, built a monopolistic competitive industry model where, prior to the sunk cost of entry, each firm faces initial uncertainty about the true (fixed) productivity level. The main claim then is that firm entry forces less productive firms to exit which of course induces inter-firm market share reallocation towards more productive firms.

For its part, evidence from standard decomposition exercises of aggregate productivity growth on the direct impact of entry is not entirely conclusive. Bailey et al. (1992) and Griliches and Regev (1995), for example, claim that the direct entry effect is relatively small. A cross-country study by the OECD (2001) also suggests that whenever the net entry (i.e. entry minus exit) contribution is positive and sizeable, exits explain most of the impact—typically, the productivity level of entrants is higher than that of exiting firms (e.g. Carreira and Teixeira, 2008). In contrast, there are a number of other studies showing that entry makes a substantial contribution to industry productivity growth, in some cases up to 15–25% of the observed growth over the medium-term (5-year period, typically) as in Baldwin and Gu (2006), Cantner and Krüger (2008), Disney et al. (2003), Foster et al. (2001) and Vial (2008). This contrasting evidence has mostly to do with time horizon selected for the productivity decomposition exercise. If the post-entry learning period is sufficiently long, then the wider the selected period the higher will be the direct entry effect (Audretsch and Mata, 1995; Cantner and Krüger, 2008; Foster et al., 2001).[3] New firms need time to improve their products and processes and hence the contribution of new firms, at the moment of entry, is not expected to be easily mirrored on the entry effect.

New firms are also expected to have an indirect impact on productivity growth beyond the generated exit (or crowding-out). Thus, the increased competitive pressure forces incumbents to improve their efficiency or then exit, which can only lead to higher aggregate productivity growth. All in all, while the direct entry effect is likely to be unclear, indirect effects are expected to be strongly positive.

[3] This conflicting evidence can also be due to methodological differences. See Baldwin and Gu (2006) for a discussion of the topic.

3. Methodological issues

3.1. Productivity

We consider two alternative measures of productivity, that is, total factor productivity (TFP) and labour productivity (LP).[4] The firm-level labour productivity, LP_{it}, is defined as the value-added per unit of labour and is measured in log form as follows:

$$LP_{it} = va_{it} - l_{it}, \tag{1}$$

where i indexes firms and t indexes years; va_{it} is the log of value-added and l_{it} is the log of the labour input.

The firm-level total factor productivity, TFP_{it}, is defined as the difference between firms' output and the weighted sum of inputs, that is (in logs):[5]

$$TFP_{it} = y_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it}, \tag{2}$$

where y_{it} is the output level, and k_{it}, l_{it} and m_{it} are the levels of capital, labour and materials, respectively; $\hat{\beta}_j$, $j = k, l, m$, denotes factor elasticity parameters, estimated from the (log) Cobb-Douglas production function:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \omega_{it} + \eta_{it}, \tag{3}$$

with ω_{it} denoting a firm-specific parameter and η_{it} a random shock.

OLS estimation of model (3) produces inconsistent estimates due to the likely presence of simultaneity and selection bias.[6] Assuming that the firm-specific parameter ω_{it} is fixed over time, model (3) can be estimated using the least square dummy variable approach or the within transformation. Consistency of the fixed effect model requires, however, strictly exogeneity of the included regressors, a non-realistic assumption in our context (Grilliches and Mairesse,

[4] LP tends to overestimate productivity levels if the capital-labour ratio increases, while the TFP is likely to be contaminated by measurement errors (Bartelsman and Doms, 2000).

[5] See Bartelsman and Doms (2000) for a discussion of alternative TFP measures.

[6] The simultaneity bias arises because input demands are also determined by firm's knowledge of its productivity level, which makes ω_{it} correlated with the observed inputs. The selection bias is generated by endogenous exit, as smaller firms, with lower capital intensity, are more likely to exit.

1998). To overcome this problem, we will implement a semi-parametric method proposed by Olley and Pakes (1996).[7]

The *gross output* is given by the sum of total revenues from sales, services rendered, self-consumption of own production and the change in inventory of final goods. It is deflated by the producer price index at the 3-digit level. The *labour* input is a 12-month employment average. *Materials* include raw materials, services purchased, and other operating costs and were deflated by the GDP deflator. *Capital stock* is measured as the book value of total net assets.

3.2. Aggregate productivity growth decomposition

To evaluate the direct contribution of entry to industry productivity growth, we implement the decomposition method suggested by Melitz and Polanec (2009), which, in turn, is based on Olley and Pakes (1996).

Let the industry productivity level in year t, P_t, be given by the weighted average of aggregate productivity of firm groups g, g = 1, 2, ..., that is $P_t = \sum_{g \in G} \theta_{gt} P_{gt}$, where θ_{gt} is the output (or employment) share of group g in year t. ($\sum_{g \in G} \theta_{gt} = 1$ by definition.) P_{gt} is the weighted average of firm-level total factor (or labour) productivity for group g in year t, which can be split into two components by using the static Olley-Pakes decomposition (Olley and Pakes, 1996):

$$
\begin{aligned}
P_{gt} &= \sum_{i \in g} \theta_{it} p_{it} = \bar{P}_{gt} + \sum_{i \in g} \left(\theta_{it} - \bar{\theta}_{gt}\right)\left(p_{it} - \bar{P}_{gt}\right) \\
&= \bar{P}_{gt} + \operatorname{cov}_{gt}\left(\theta_{it}, p_{it}\right), ^{8} \qquad (4)
\end{aligned}
$$

[7] We used *opreg* procedure developed by Yasar et al. (2008) in Stata 9.

[8] The covariance operator would be divided by the number of firms. However, since θ_{it} is a share parameter, it already incorporates this division.

where θ_{it} and p_{it} are the output (or employment) share and the total factor (or labour) productivity level of the i^{th} firm in year t, respectively, and $\overline{P}_{gt}$ is the (unweighted) productivity average in group g and $\overline{\theta}_{gt}$ is the corresponding output (or employment) share.

The industry productivity change between $t-\tau$ and t can then be given by:

$$\Delta P_t = \theta_{Ct} P_{Ct} + \theta_{Et} P_{Et} - \theta_{C(t-\tau)} P_{C(t-\tau)} - \theta_{X(t-\tau)} P_{X(t-\tau)}$$

$$= P_{Ct} - P_{C(t-\tau)} + \theta_{Et}\left(P_{Et} - P_{Ct}\right) + \theta_{X(t-\tau)}\left(P_{C(t-\tau)} - P_{X(t-\tau)}\right), \qquad (5)$$

where C, E, and X denote the group of continuing, entering, and exiting firms. Using (4), we rewrite (5) as:

$$\Delta P_t = \Delta \overline{P}_{Ct} + \Delta \operatorname{cov}_{Ct}\left(\theta_{it}, p_{it}\right) + \theta_{Et}\left(P_{Et} - P_{Ct}\right) + \theta_{X(t-\tau)}\left(P_{C(t-\tau)} - P_{X(t-\tau)}\right). \qquad (6)$$

The first term on the right-hand-side of equation (6) is the ‘within’ term. It captures the aggregate growth due to productivity changes in continuing firms (unweighted average). The ‘covariance’ term—the second term in (6)—gives the inter-firm resource reallocation towards more productive continuing firms. The last two terms capture the contribution of entering and exiting firms, respectively. The entry (exit) effect is positive if the productivity level of entering (exiting) firms is higher (smaller) than the productivity level of continuing firms in the corresponding year. The third term gives the direct effect of entry, while the fourth gives the crowding (or exit) effect.

3.3. Estimation of the competitive effect

According to our discussion in Section 2, the within term of the aggregate productivity growth decomposition is expected to be a function of the entry threat. In particular, it is expected a positive relationship between entry of new firms and productivity among continuing firms. Clearly, the decomposition in equation (6) cannot disentangle this effect. Our proposal is to run a regression model in which productivity of continuing firms depends on the entry rate, plus an extended set of covariates.

Thus, to evaluate the competitive effect—that is, the impact of entry on continuing firms' productivity level—we specify the model:

$$p_{it} = \beta_0 + \beta_1 ER_{jt} + \beta_2 IC_{jt} + \beta_3 Z_j + \beta_4 Z_t + \eta_{it}\ , \tag{7}$$

where the log of productivity index of the continuing firm *i* in period *t*, p_{it}, is a function of the entry rate in industry *j*, ER_{jt}. The entry threat is of course unobservable and, following Aghion et al. (2009) and Falck et al. (forthcoming), we use the entry rate as a proxy. IC_{jt} contains various indicators of market competition and Z_j is a vector of industry-level, time-invariant control variables, while Z_t proxies the macroeconomic environment. η_{it} is a standard error term. We estimate equation (7) using GLS random-effects.

4. The dataset

The raw data is drawn from *Inquérito às Empresas Harmonizado* (IEH), an annual business survey run by the Portuguese Statistical Office (INE). It contains, in particular, detailed input and output information required to estimate productivity at firm level.

Our dataset of manufacturing firms comprises some 1,738 units from central region of Portugal, observed over the period 1996-2000, unbalanced panel. In the IEH survey, firms with more than 100 employees are chosen with certainty, while those with 20 to 99 employees are randomly drawn. In the empirical analysis below, small and large firms in each industry are weighted to ensure that the results are nationally representative at 2-digit sector level. The aggregate results were also sector weighted to ensure they are representative of the whole Portuguese manufacturing sector. The same industry weights across years are used to aggregate the industry results, so that the results do not reflect changes in industry composition. (The Data Appendix offers additional information on the structure of the dataset.)

One possible weakness of our dataset is related to the fact that we only observe firms with at least 20 employees. This means that an important fraction of firm entry and exit flows is ignored. But although firms with less than 20 employees represent approximately 80% of the population of firms, they only represent a modest 20% of total employment in manufacturing and 12% of total production (Carreira, 2006).

The longitudinal dimension of the panel was constructed using firm's unique identification code. Additional information with respect to the year of birth/death was obtained from *Ficheiro de Unidades Estatísticas* (FUE), another statistical data source run by INE. By combining the two data sources, it was then possible to determine the status of any surveyed unit in any period: continuing, entering (newly created) or exiting.[9]

We will use two variables to proxy the macro environment in model (7): the *GDP growth* and the *unemployment* rate.[10] For its part, the set of market competition variables contains the following indicators: industry concentration, industry size, industry growth, and export intensity. The *industry concentration* is given by the sample Herfindahl-Hirschman index, computed at the 2-digit level. The *industry size* variable is computed, for each year, as a percentage of the largest (3-digit) industry output level observed in the sample. To isolate industry-specific shocks from macro shocks, the *industry growth* rate is given in deviation form from the GDP growth rate. (The industry size and growth rate are extracted from *Estatísticas da Produção Industrial*, INE). Finally, we included as a control variable the technological regime at 2-digit level. Following the OECD methodology (OECD, 2005), the *industry technological regime* variable is proxied by a dummy variable equal to 1 if a firm belongs to an industry with high/medium R&D-intensity.

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[9] If there is a new identification code in the panel and the corresponding firm is 1 to 3 years old, the firm is classified as newly created firm. An exit from the sample is classified as a true exit if and only if the corresponding firm was coded as 'dead' by the tax authority. Changes in sector of activity at 3-digit level are classified as entry and exit.

[10] See Carreira and Teixeira (forthcoming). Annual series were extracted from the OECD database at http://stats.oecd.org/wbos/Index.aspx.

5. Results

5.1. Entry and exit patterns

Table 1 reports the average annual entry and exit rates in the manufacturing sector from 1996 to 2000. As it is apparent, there is a quite substantial annual rate of firm turnover. Looking at columns 3 and 7 of the table, last row (employment weighted averages), 4.3% of the firms operating in, say, year *t* were not producing in the previous years, while 5.2% of firms operating in year *t*-1 do not produce at all in the following years, which implies a gross reallocation rate of 9.5%. These figures do not change much if we consider alternative weighting procedures: the number of firms (columns 2 and 6) or the output level (columns 4 and 8). Columns (1) and (5) give the unweighted cases. The reported rates are also much in line with those reported for other European countries. For example, they are slightly higher than in Germany (3.8 and 4.6%, for entry and exit rates, respectively), but lower than in Belgium (5.8 and 6.3%) and Norway (8.2 and 8.7%) (Caves, 1998).

Table 1. Entry and exit rates (in percentage)

	Entry rate				Exit rate			
	Unweighted	Weighted			Unweighted	Weighted		
Year		N	L	Y		N	L	Y
1996	3.7	5.4	4.9	3.6	8.6	12.3	11.2	8.9
1997	0.8	0.6	0.6	0.7	3.0	4.3	4.0	3.2
1998	3.9	4.8	4.5	4.0	3.6	4.1	3.8	3.5
1999	4.9	5.2	5.1	3.9	2.9	2.2	2.3	2.3
2000	4.6	7.0	6.2	4.8	4.4	5.0	4.8	4.6
Average	3.6	4.6	4.3	3.4	4.5	5.6	5.2	4.5

Notes: The reported entry and exit rates are calculated as the ratio of entering and exiting firms, respectively, to the total number of firms in year *t*-1. N, L and Y denote number of firms, employment and output, respectively. Small (20-99 employees) and large (at least 100 employees) firms weighted at sector-level; aggregation unweight/weighted over 11 two-digit industries.

Employment and output shares of entrants and exiting firms are given in Table 2. Averaging over the sample period (1996-2000), entrants account for 2.5% (2.0%) of total manufacturing employment (output) in the year of entry. Firm exit, in turn, implied a 2.3% (1.4%) employment (output) loss in the exit year. The corresponding gross reallocation of employment (output) is 4.8% (3.4%), which are comparable with the figures obtained from other countries (e.g. Dunne et al., 1988).

Table 2. Employment and output shares of entering and exiting firms (in percentage)

	Entering firms share		Exiting firms share	
Year	L	Y	L	Y
1996	3.8	2.9		
1997	0.3	0.3	2.9	1.2
1998	2.3	1.7	2.0	1.5
1999	3.1	2.1	2.0	1.0
2000	3.3	3.3	2.3	1.9
Average	2.5	2.0	2.3	1.4

Notes: The reported employment and output shares of entrants and exits are calculated as the ratio of the total output/employment of entrants and exits to the total output/employment of all firms in the market in each year. L and Y denote employment and output, respectively. Small and large firms weighted at sector-level; aggregation weighted over 11 two-digit industries by firm's employment and output, respectively.

Table 3 presents entry and exit rates and the corresponding output and employment shares by sector, and as it is apparent the annual entry and exit rates vary considerably across sectors. In particular, *apparel and leather* present the highest average entry rate, at 9%, while the lowest entry rate is in *paper and printing*, at 1%. *Apparel and leather* also has the highest exit rate, at 9.6%.

Table 3. Entry and exit rates and corresponding shares by industry, 1996-2000 (in percentage)

Industry	Entry rate	Entering firms share		Exit rate	Exiting firms share	
		L	Y		L	Y
Food and beverages	1.9	0.9	0.4	3.4	1.3	0.8
Textiles	2.5	1.3	1.0	5.8	4.8	2.9
Apparel and leather	8.6	4.0	3.9	9.6	2.8	1.5
Wood and cork	4.7	3.6	5.3	5.1	2.5	1.7
Paper and printing	1.0	1.8	1.1	3.8	1.5	0.9
Chemical, rubber and plastic	3.3	2.0	1.5	4.5	2.3	1.6
Non-metallic minerals	3.4	1.5	1.3	3.9	1.3	1.6
Metals	3.0	3.0	3.3	3.6	2.6	2.8
Machinery and equipment	2.2	1.0	1.2	1.6	0.5	0.4
Transport equipment	2.6	4.0	3.8	3.8	2.0	0.5
Other	6.2	4.8	4.9	4.4	2.2	2.3

Note: The reported entry and exit rates are calculated as the ratio of entering and exiting firms to the total number of firms in year *t*-1. L and Y denote employment and output, respectively. Small and large firms weighted at sector-level. The reported values are annual averages over the period 1996-2000.

Employment and output creation and destruction flows and the corresponding shares from firm entry and firm exit are presented in Table 4. The average employment (output) creation rate is 7.9% (12.5%), while the destruction rate is 6.6% (6.0%). Firm entry contributes to approximately 28% of these job creation flows, while firm exit contributes to 30% of the job destruction rate. The corresponding figures for output are 18% and 30%, respectively. These job flows broadly confirm the pattern observed in other European countries, as reported by Broersma and Gautier (1997), Klette and Mathiassen (1996) and Vainiomaki and Laaksonen (1999), for example.

Table 4. Employment and output creation and destruction rates

	Creation rate (%)		Share due to entrants		Destruction rate (%)		Share due to exits	
Year	L	Y	L	Y	L	Y	L	Y
1997	6.2	13.9	0.097	0.047	7.1	6.3	0.332	0.468
1998	8.4	11.7	0.299	0.197	5.2	5.6	0.172	0.111
1999	9.0	13.5	0.388	0.204	7.1	5.3	0.291	0.209
2000	7.9	10.7	0.343	0.281	6.9	6.9	0.386	0.392
Average	7.9	12.5	0.282	0.182	6.6	6.0	0.295	0.295

Notes: The reported creation and destruction rates are calculated as a percentage of the average output (employment) in years *t* and *t*-1. L and Y denote employment and output, respectively. Small and large firms weighted at sector-level; aggregation weighted over 11 two-digit industries by firm's employment and output, respectively.

5.2. Productivity growth decomposition

Given the intensity of firm entry and exit, the issue is whether less productive firms have been replaced by more productive entrants. To this end, we looked at aggregate productivity growth and applied the decomposition described in model (6). The aggregate results are given in Table 5 and, clearly, the within effect is dominant, with a share of 89% (or 0.0096/0.0108) in the TFP case and 67% (or 0.0354/0.0527) in the LP case, on average. For its part, the entry effect is slightly negative in both decompositions, at -1.9% and -1.2% of the total, respectively, while the exit effect is consistently positive and large.

The contribution of entry to productivity growth varies greatly across industries as shown in Table 6. The highest annual TFP increase was observed in *food and beverages*, at 0.035. In this case, the entry effect accounts for just 3.1% (0.0011/0.0347) of the observed productivity growth. In the case of labour productivity, the industry with the highest productivity increase is *textiles*, at 0.106, with a negative entry contribution of 5.3% (-0.0056/0.1064).

Table 5. Productivity growth decomposition

Year	Productivity growth	Within	Covariance	Net entry	Entry	Exit
a) ΔlnTFP						
1997	0.0375	0.0100	0.0282	-0.0007	-0.0007	0.0000
1998	0.0272	0.0354	-0.0099	0.0017	0.0009	0.0008
1999	0.0235	0.0447	-0.0226	0.0013	-0.0010	0.0023
2000	-0.0449	-0.0518	0.0074	-0.0006	0.0000	-0.0005
Average	0.0108	0.0096	0.0008	0.0005	-0.0002	0.0007
b) ΔlnLP						
1997	0.0665	0.0151	0.0274	0.0240	-0.0010	0.0250
1998	0.0561	0.0599	-0.0129	0.0091	-0.0010	0.0101
1999	0.0750	0.0752	-0.0111	0.0110	-0.0016	0.0126
2000	0.0133	-0.0084	0.0050	0.0167	0.0012	0.0155
Average	0.0527	0.0354	0.0021	0.0152	-0.0006	0.0158

Notes: Dynamic Olley-Paques decomposition (Melitz and Polanec, 2009). Small and large firms weighted at sector-level; aggregation weighted over 11 two-digit industries by firm's employment and output, respectively.

5.3. The competitive effect

These relatively small entry and exit effects are not unique and have been observed in other studies (e.g. Bailey et al., 1992; Griliches and Regev, 1995; OECD, 2001). As mentioned earlier, the likely explanation for this commonality is that productivity is highly increasing in the post-entry period and highly decreasing in the pre-exit period (Carreira and Teixeira, 2008, forthcoming; Caves, 1998; Geroski, 1995). The dominance of the within effect is therefore natural and highly expected (Foster et al., 2001). What remains to be seen is the extent to which the within effect depends on firm entry intensity.

Table 6. Productivity growth decomposition by industry, 1996-2000

Year	Productivity growth	Within	Covariance	Net entry	Entry	Exit
a) ΔlnTFP						
Food and beverages	0.0347	0.0099	0.0277	-0.0029	0.0011	-0.0040
Textiles	0.0207	0.0226	-0.0079	0.0060	0.0005	0.0055
Apparel and leather	0.0155	0.0111	0.0029	0.0015	0.0028	-0.0013
Wood and cork	0.0185	-0.0179	0.0339	0.0025	-0.0012	0.0038
Paper and printing	0.0177	-0.0014	0.0183	0.0008	-0.0002	0.0010
Chemical, rubber and plastic	-0.0039	0.0268	-0.0362	0.0055	0.0002	0.0053
Non-metallic minerals	0.0156	0.0238	-0.0066	-0.0015	-0.0006	-0.0009
Metals	0.0076	0.0118	-0.0068	0.0026	-0.0032	0.0058
Machinery and equipment	0.0023	-0.0010	0.0032	0.0000	-0.0010	0.0010
Transport equipment	-0.0512	-0.0059	-0.0417	-0.0036	-0.0038	0.0002
Other	0.0225	0.0209	0.0036	-0.0020	-0.0020	0.0000
b) ΔlnLP						
Food and beverages	0.0666	0.0122	0.0277	0.0267	-0.0044	0.0310
Textiles	0.1064	0.0754	-0.0079	0.0389	-0.0056	0.0445
Apparel and leather	0.0440	0.0229	0.0029	0.0181	0.0007	0.0175
Wood and cork	0.0336	-0.0045	0.0339	0.0042	-0.0057	0.0100
Paper and printing	0.0724	0.0414	0.0183	0.0127	-0.0031	0.0158
Chemical, rubber and plastic	0.0026	0.0390	-0.0362	-0.0003	-0.0007	0.0004
Non-metallic minerals	0.0841	0.0893	-0.0066	0.0014	-0.0007	0.0022
Metals	0.0359	0.0382	-0.0068	0.0045	0.0094	-0.0048
Machinery and equipment	0.0194	0.0138	0.0032	0.0024	0.0030	-0.0007
Transport equipment	0.0708	0.0383	-0.0417	0.0743	0.0217	0.0526
Other	0.0263	0.0369	0.0036	-0.0142	-0.0150	0.0008

Notes: Dynamic Olley-Paques decomposition (Melitz and Polanec, 2009). Small and large firms weighted at sector-level. The reported values are annual averages over the period 1996-2000.

To this end, we use the regression model (7) to evaluate whether firm entry has an impact on the productivity growth of continuing firms, controlling for a wide set of industry and macro variables.[11] As can be seen in Table 7, the coefficient of the entry rate variable is positively signed and statistically significant at conventional levels in all model specifications.

[11] Model (7) is in logs (except the dummy variables) so that the estimated coefficients in Table 7 can be read as elasticity parameters. We also note that the (contemporaneous) correlation between the GDP growth rate and unemployment is low.

In other words, we found a positive relationship between firm entry and productivity. Ceteris paribus, if the entry rate increases by 1%, then the TFP of continuing firms increases by 0.02 and 0.01% (columns 1 and 3 of Table 7, respectively). In the case of labour productivity, the corresponding increment is 0.03 and 0.02%.

Table 7. Productivity level regressions, continuing firms

Variables	(1) TFP	(2) TFP	(3) LP	(4) LP
Constant	0.434*** (0.033)	0.519*** (0. 760)	8.007*** (0.007)	8.248*** (0.144)
Entry rate	0.015*** (0.004)	0.007* (0.004)	0.031*** (0.008)	0.016** (0.007)
Herfindahl Index		0.032*** (0.011)		0.061** (0.025)
Industry size		-0.001 (0.062)		0.077 (0.107)
Export intensity		-0.044 (0.030)		-0.143*** (0.052)
Industry growth		-0.154*** (0.061)		0.055 (0.091)
Technological regime		1.337*** (0.090)		0.319* (0.167)
GDP growth		0.024 (0.023)		-0.027 (0.046)
Unemployment		-0.072*** (0.017)		-0.216*** (0.029)
Industry dummies	Yes	Yes	Yes	Yes
Num. of observations	4164	4154	4138	4128
R-squared	0.918	0.919	0.169	0.1820
Wald test	14188.13***	14785.33***	484.92***	610.28***

Notes: Random-effects GLS regression of model (7). Variables are in logarithmic form (except in the case of the dummy variables). Robust standard errors are given in parentheses. ***, **, and * denote statistical significance at the .01, .05, and .10 levels, respectively. In all specifications, the Wald test rejects the null of no overall significance.

As regards the Herfindahl index, the corresponding coefficient is positive and statistically significant, while export intensity is negative and statistical significant (at the 0.01 level). It seems therefore that highly concentrated markets tend to be populated with some large (and innovative) firms. Finally, since the technological regime dummy is positively signed, there is the indication that firms in high-tech industries do have a higher productivity growth than firms in medium- and low-tech industries.

6. Concluding remarks

This paper focuses on the impact of entry on industry productivity growth. Our empirical test is inspired by Aghion et al. (2009) and Melitz (2003) modelling, in the sense that the effect of firm entry on aggregate productivity growth is assumed to work directly, as entrants may be relatively more productive than the established firms, and indirectly, via increased market competition which can force incumbents to elevate their productivity in order to maintain their market shares or face exit.

We found that in spite of the strong flow of firm entry, the direct effect of entry on aggregate productivity growth is small (if not negative), a result that can be explained by the fact that in the year of entry the newly founded firms tend to exhibit lower productivity than incumbents. There is also evidence that entrants tend to replace less efficient firms as they do reveal a higher productivity level than exiting firms.

But do entrants actually encourage incumbents to improve their practices? Our econometric estimates confirm this conjecture, as there is a statistically significant and positive association between the selected entry rate variable and the productivity of continuing firms. Our results thus suggest that substantial gains are perhaps to be expected from firm entry and in a much higher degree than the revealed gains obtained from the strict comparison between entrants and incumbents productivity in the year of entry. Our research reinforces therefore the idea that a more favourable environment towards entry of firms is certainly a productivity-enhancing device.

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DATA APPENDIX

Table A1. Distribution of firm observations across years

Number of observations, 1996-2000	Frequency		Cumulated frequency (%)
	Number of firms	%	
5	484	27.8	27.8
4	202	11.6	39.5
3	237	13.6	53.1
2	371	21.3	74.5
1	444	25.5	100.0
Total	1738	100.0	

Table A2. Observations by year

Year	Number of firms
1996	1106
1997	1008
1998	998
1999	1041
2000	972

Table A3. Number of firm-year observations by industry

Industry	ISIC	Number of firms		
		Mean	Min.	Max.
Food and beverages	15	124	131	114
Textiles	17	111	125	100
Apparel and leather	18, 19	104	121	96
Wood and cork	20	65	81	54
Paper and printing	21, 22	39	42	37
Chemical, rubber and plastic	24, 25	72	80	65
Non-metallic minerals	26	165	182	143
Metals	27, 28	108	117	98
Machinery and equipment	29, 30, 31, 32, 33	125	131	121
Transport equipment	34, 35	54	60	49
Other and recycling	36[a)], 37	59	64	56

Note: a) Includes wooden furniture.

Table A4. Weights for small and large firms by industry(%)

Industry	Employment category 20-99	≥100
Food and beverages	82.16	17.84
Textiles	73.68	26.32
Apparel and leather	84.74	15.26
Wood and cork	89.51	10.49
Paper and printing	85.30	14.70
Chemical, rubber and plastic	79.56	20.44
Non-metallic minerals	82.77	17.23
Metals	86.91	13.09
Machinery and equipment	82.47	17.53
Transport equipment	70.32	29.68
Other and recycling	92.15	7.85

Note: Five-year averages, 1996-2000.
Source: INE and DETEFP/MTS - Quadros de Pessoal.

Table A5. Industry weights

Industry	No. of firms	Employment	Output
Food and beverages	10.90	11.39	20.04
Textiles	10.87	11.49	8.91
Apparel and leather	28.14	22.76	12.11
Wood and cork	5.33	6.19	4.36
Paper and printing	5.32	5.29	7.93
Chemical, rubber and plastic	5.37	4.59	9.32
Non-metallic minerals	7.52	8.53	7.51
Metals	9.63	9.34	5.50
Machinery and equipment	8.27	10.07	11.68
Transport equipment	2.27	3.76	8.69
Other and recycling	6.63	6.58	3.95

Note: Five-year averages, 1996-2000.
Source: INE and STAN Database.

Table A6. Average firm size by industry, 1996-2000

	Size category by number of employees					
	20-99		≥100		All simple	
Industry	L	Y	L	Y	L	Y
Food and beverages	41.8	4.0	171.8	17.8	68.7	6.8
	(20.9)	(3.9)	(81.9)	(15.8)	(67.1)	(9.7)
Textiles	53.0	1.6	239.3	7.4	121.9	3.7
	(24.5)	(1.5)	(160.5)	(7.7)	(134.1)	(5.6)
Apparel and leather	46.8	0.9	209.9	4.5	146.0	3.1
	(24.5)	(0.9)	(98.9)	(3.9)	111.9)	(3.6)
Wood and cork	38.0	1.6	208.8	23.8	64.5	5.0
	(20.9)	(1.6)	(91.0)	(25.6)	(73.9)	(13.0)
Paper and printing	40.0	1.9	299.3	76.0	88.5	15.8
	(19.1)	(1.6)	(251.4)	(121.5)	(148.8)	(59.5)
Chemical, rubber and plastic	47.4	5.9	174.7	17.2	79.2	8.7
	(25.2)	(14.4)	(77.5)	(20.1)	(70.8)	(16.7)
Non-metallic minerals	43.2	1.9	246.9	13.0	114.3	5.8
	(22.5)	(2.2)	(179.0)	(15.0)	(144.7)	(10.4)
Metals	47.0	2.0	206.0	11.9	78.2	4.0
	(22.4)	(1.9)	(74.3)	(8.9)	(74.0)	(5.8)
Machinery and equipment	42.7	2.3	725.7	34.1	115.7	5.7
	(21.4)	(2.0)	(1772.4)	(61.6)	(613.6)	(22.4)
Transport equipment	47.2	2.2	234.1	24.2	100.2	8.4
	(22.6)	(2.5)	(212.4)	(47.3)	(142.0)	(27.0)
Other	44.7	1.7	146.9	5.8	62.2	2.4
	(20.8)	(1.3)	(42.4)	(3.8)	(46.4)	(2.5)
Total Manufacturing	44.6	2.4	242.2	14.3	98.8	5.7
	(22.6)	(4.6)	(426.6)	(31.1)	(241.0)	(17.6)

Notes: L and Y denote employment and output (in million Euros), respectively. Industry aggregation unweighted. Standard deviations are in parentheses.

Table A7. Firm productivity distribution by industry, 1996-2000

Industry	Mean	Std. Dev.	Skewness	Kurtosis	Q0.25	Q0.50	Q0.75
a) TFP							
Total Manufacturing	2.272	0.975	-0.967	3.219	1.598	2.686	2.951
Food and beverages	0.339	0.427	-1.665	10.098	0.129	0.411	0.605
Textiles	1.252	0.306	-0.057	27.983	1.130	1.283	1.386
Apparel and leather	2.993	0.241	-0.998	12.362	2.871	2.985	3.114
Wood and cork	2.692	0.260	-1.143	10.260	2.602	2.699	2.804
Paper and printing	3.004	0.231	0.221	3.669	2.855	3.007	3.151
Chemical, rubber and plastic	2.885	0.344	-1.690	14.356	2.721	2.867	3.069
Non-metallic minerals	2.630	0.250	-2.333	39.35	2.512	2.647	2.756
Metals	1.676	0.178	-0.204	4.869	1.594	1.674	1.761
Machinery and equipment	2.998	0.245	2.928	39.868	2.893	2.999	3.113
Transport equipment	3.363	0.381	-0.196	6.686	3.149	3.350	3.578
Other and recycling	2.704	0.204	-0.065	5.084	2.599	2.704	2.818
b) Labour productivity							
Total Manufacturing	7.908	0.642	-0.538	11.455	7.521	7.893	8.287
Food and beverages	7.949	0.699	-1.437	11.107	7.588	7.996	8.402
Textiles	7.554	0.690	-3.430	31.020	7.342	7.590	7.911
Apparel and leather	7.368	0.427	0.202	12.196	7.178	7.364	7.546
Wood and cork	7.713	0.544	1.473	6.903	7.389	7.604	7.891
Paper and printing	8.171	0.665	1.505	6.167	7.741	8.062	8.379
Chemical, rubber and plastic	8.381	0.650	1.370	7.280	7.968	8.273	8.672
Non-metallic minerals	8.025	0.661	-0.567	7.589	7.628	7.975	8.411
Metals	7.991	0.441	-0.132	4.926	7.680	7.953	8.279
Machinery and equipment	8.183	0.436	-0.381	6.210	7.937	8.190	8.446
Transport equipment	7.882	0.520	0.593	5.733	7.618	7.885	8.113
Other and recycling	7.810	0.501	-0.189	5.124	7.506	7.773	8.096

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