Productivity and market selection of french manufacturing firms in the nineties

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PRODUCTIVITY AND MARKET SELECTION OF FRENCH MANUFACTURING FIRMS IN THE NINETIES

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In this paper, we analyse post-entry and pre-exit performance of French manufacturing firms using a dataset covering 14 industries over the period 1990-2002. Our purpose is to shed light on the working of market selection mechanisms within French manufacturing industries. We found that market selection in France rightly operates in favour of more productive firms, but displays some potential inefficiency in selecting more severely new firms compared to mature firms. This claim is based on three results. First, on average, young firms fail to survive when they are faced with a small productivity disadvantage with respect to incumbents. By contrast, mature firms exit the market only when they are confronted by a large, persistent, and increasing productivity gap with their surviving counterparts. Second, we show that successful entrants do not easily catch up to the average size of the industry despite the fact that they exhibit significant TFP and profitability advantages over incumbents. This reveals the existence of barriers to growth for young firms. Thirdly, we show that, on the whole, productivity improvements due to market selection mechanisms within French manufacturing industries are primarily due to market share reallocation across incumbents and that the net entry effect is weak relative to the findings for other industrialised countries.

JEL Classification: D24, L11, L60.

Keywords: Entry Exit Patterns, Total Factor Productivity, France, Firm-level data, Market selection

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1. Introduction

This paper studies market selection mechanisms in firm's productivity and entry and exit patterns in French manufacturing industries for 1990-2002. We compute different performance indicators (Size, Total Factor Productivity (TFP), Labour Productivity (LP) and Profitability) for all French firms with more than 20 employees, operating in the manufacturing sector. We follow the productive performance of entering, continuing, and exiting firms over time in order to examine the efficiency of market selection mechanisms.

The crucial role of markets in selecting among heterogeneous firms has been emphasised in standard industrial dynamic models which integrate micro-level productivity heterogeneity within the dynamic general equilibrium framework of analysis (see Jovanovic, 1982, Lippman and Rumelt, 1982, Ericson and Pakes, 1989, 1995, and Hopenhayn, 1992). More fundamentally, it echoes the basic claim (especially within the evolutionary strand of economic literature, see, Nelson and Winter, 1982, Dosi, 1988), that economic Darwinism is a central feature of the market economy dynamics.

The idea that selection processes play an important role in market-based economies has been tested in large-scale empirical studies only recently. This may be explained by the fact that Longitudinal Micro-datasets (LMDs) were made available from the late 1970s. Prior to this, access to those datasets was restricted, both because of Statistical Office restrictions and also because of computational limitations. Both impediments have been virtually overcome during the two last decades and there has been a surge in empirical investigations using LMDs in a large variety of countries (see Bartelsman and Doms, 2000 and Tybout, 2000 for recent surveys).

In this paper, we continue this line of empirical research looking for evidence of a relationship between firm productivity and industrial dynamics within the French economy. Our principal objectives are to investigate the extent to which natural selection mechanisms affect French manufacturing industries, using conventional TFP indexes to measure firm-level productivity and to investigate the extent to which efficiency criteria play similar roles at different stages of the firm's life cycle. This latter objective is motivated by the fact that the institutions that help markets to operate selection processes in European countries have recently been pointed as inefficient, especially those in France, in promoting the growth of young firms and, consequently, in supporting the process of creative destruction that allows for aggregate productivity growth (see Bartelsman *et al.*, 2005). In this paper, we investigate this idea further by distinguishing between young and mature firms when we compare the relative performances of exiting and surviving firms.

Baldwin and Rafiquzzaman (1995) conducted a somewhat similar study. Their study sheds light on the relative importance of pure natural selection and learning mechanisms in shaping post-entry patterns. It shows that pure selection— i.e. selection based on intrinsic productivity differences— is more important during firms' infancy, while differences in learning abilities are more important in shaping post-entry growth. Our paper can be seen as extending their analysis to the pre-exit patterns of mature firms. Finally, in focusing on the distinction between young and mature firms, our paper overlaps with the literature that emphasises the distinction between small and large firms (Acs and Audretsch, 2005)[1].

The paper is organised as follows. Section 2 reviews the literature. Section 3 describes the dataset and the productivity measure used in this study. In Section 4, we focus on young firms and describe the relationship between productivity, firm heterogeneity and post-entry performance. In Section 5, we conduct a similar exercise for mature firms, describing the relationship between productivity, firm heterogeneity and pre-exit performances. Section 6 reports on aggregate productivity decomposition and examines which population contributes to which productivity growth. Section 7 concludes.

2. Literature background

In market-based economies, firms are continuously subject to market selection forces. The determinants of the relative abilities of firms to survive in competitive markets are diverse and complex. Various aspects that characterise this microeconomic heterogeneity and how it relates to industrial dynamics (through entry, exit and reallocation of market shares) can be identified in the literature. Basically, the link between firm heterogeneity and industrial dynamics can be tackled from two different streams of economic thinking: evolutionary economics and neo-classical industrial dynamics.

Evolutionary economics has for a long time dealt with empirical analyses aimed at characterising patterns of industry evolution. Starting with Nelson and Winter (1982), who emphasised the importance of variety and selection mechanisms at industry level for aggregate patterns of economic growth, a huge number of studies has tried to deal with industry and firm heterogeneity and to discuss its influence on economic performance. Gort and Klepper (1982) emphasised the importance of technical change (innovation) to determine critical industry characteristics such as entry rates or number of firms in an industry, within a five-stage cycle that they identified from a study based on a sample of product innovation. The focus of evolutionary economics in relation to micro-economic behaviour has largely been on the sources and processes of

1. Farinas and Ruano (2005) distinguish between large and small firms, but their underlying theoretical model (the Hopenayn 1992 model) rules out any independent impact of firm size on relative performance.

innovation (Dosi, 1988). As a consequence, the emphasis is mainly on the main characteristics of firm innovative activities. Firm heterogeneity is captured by various factors such as technological gaps, differences in search procedures and differences in behaviours. An illustration of this can be found in the self-organisation model suggested by Silverberg, Dosi and Orsenigo (1988) and the whole family of history-friendly models of industry evolution (Malerba and Orsenigo, 2002).

Authors dealing with empirical analyses were initially interested in explaining firm size-distributions. Important advances were made by Mansfield (1962), Hall (1987), Audretsch (1995), Klepper (1996), and Sutton (1997). In an evolutionary perspective, there have been some recent new insights in work by Bottazzi and Secchi (2003, 2005). As firm size is thought to be a critical factor to correlate with firm performance or innovation within the evolutionary stream, it also highlights the importance of technological development as an explanatory variable of firm heterogeneity (McKelvey, 1996; Saviotti, 1998). Alternatively, we can examine the patterns and determinants of entry (Geroski, Machin, and Van Reenen, 1993; Geroski, 1995, Audretsch, 1995), the reasons for successful market entry (Mata and Portugal, 1994; Audretsch and Mahmood, 1995), or the characteristics of exiting firms and their propensity to exit.

On the whole, these attempts help to explain the diversity of firm behaviours in relation to the importance of the entry process, and the role of size in firm growth in relation either to competitive pressure (the stage of industry dynamics) or innovation pressure (the importance of R&D investment especially) (see Dosi, 2005).

With reference to neo-classical analysis, the link between firm heterogeneity (idiosyncratic uncertainty) and industrial dynamics (entry, exit and reallocation of market shares) was first integrated into the standard general equilibrium framework by Jovanovic (1982) and Lippman and Rumelt (1982). For a long time, competitive equilibrium models of industry evolution were based on stochastic processes of prices, investment and outputs but did not include firm-level heterogeneity. In Jovanovic's (1982) paper, firms are endowed at birth with a time invariant profitability parameter, which determines the distribution of its future profit stream. A new firm does not know what is its relative efficiency (its cost function), but discovers it through the process of Bayesian learning from actual post-entry profit realisations. Consequently, young firms have higher failure probabilities and more volatile growth rates. The model then allows for interesting patterns of industry dynamics to be reproduced in which firm size distribution can be stable over time despite the introduction of turbulence at firm level (through entry rates, failure of entrants, or displacement of incumbents through the growth of successful entrants). Ericson and Pakes (1989, 1995) enhance the model by assuming that firms know about the current value of the parameter that determines the distribution of their profits which is a function of the vector of firm-specific state variables representing 'market structure'. However, in these models, the value changes over time in response to the stochastic outcomes of firms' own investments, and those of other firms in the same oligopolistic market. A Markov perfect Nash equilibrium then results from both an investment and liquidation rule applied to reconcile firm's perceptions of the distribution of future market structures with the objective distribution of market structures generated from firms' actual choices.

In relation to empirical analysis, the neo-classical stream tends to concentrate on assessing whether or not market selection mechanisms are efficient. Following Baily, Campbell and Hulten's (1992) pioneering paper, a vast literature of studies on the extent to which entry and exit patterns are related to productivity differentials among firms has accumulated. A non-exhaustive list includes contributions by Haltiwanger (1997), Foster *et al.* (1998) for the United States, Griliches and Regev (1995) for Israel, Liu and Tybout (1996) and Eslava *et al.* (2003) for Chile and Colombia, Hahn (2000) and Awe, Chen and Roberts (2001) for South Korea and Taiwan, Disney, Haskel and Heden (2003) for United Kingdom, Nishimura, Nakajima and Kiyota (2005) for Japan, and Farinas and Ruano (2005) for Spain. Scarpetta *et al.* (2002) and Bartelsman, Scarpetta and Schivardi (2003) contribute by providing comparisons of the contribution of turnover to productivity growth among 10 countries, including France[2].

It is now widely accepted that exiting firms are usually concentrated in the lowest part of the productivity distribution, suggesting that markets contribute to aggregate productivity in rightly selecting against inefficient firms. Evidence of this natural selection mechanism (NSM) has been found in a large variety of countries.[3] Nonetheless, depending on a potentially large variety of factors, market selection processes work more or less efficiently across countries, industries and over time. For instance, Scarpetta *et al.* (2002) found instances of exit by firms with good relative productivity levels in downturn times and firms in mature and/or restructuring industries. Nishimura, Nakajima and Kiyota (2005) maintain that NMS mechanisms do not operate in periods of severe recession, as indicated by the fact that, over the last decade in the recessive Japanese economy, mature unproductive Japanese firms have remained in the market while younger efficient ones have exited. Aw, Chung and Roberts (2002) compare data for Taiwan and South Korea from 1983 to 1993, a period of rapid economic expansion for both those economies. They show that institutions in Taiwan were more effective in supporting the market selection process against unproductive firms and that plant and firm turnover contributed much more to the productivity growth of manufacturing industries in Taiwan than in Korea.

2. The others countries are the United States, Germany, Italy, United Kingdom, Canada, Denmark, Finland, Netherlands and Portugal.

3. More surprisingly, similar evidence has even been found in the case of developing countries, even though sources of markets distortion can be thought of as particularly prevalent in those countries (see Tybout, 2000 for a survey of empirical evidence on the developing World).

Our paper extends this line of empirical research by reporting new evidence in the case of France. In this work we intend to capitalise on theoretical insights from both the evolutionary and the neo-classical strands of literature, especially those related to the role of market pressure in selection mechanisms. We discuss those insights from an empirical viewpoint by documenting the evolution of different populations of firms (entrants, incumbents and exiting firms) and by emphasising the importance of firm age in the ability to resist market selection forces. More specifically, we emphasise the fact that market selection mechanisms impact differently on young and mature firms within the same industry. We then investigate how market selection mechanisms have impacted on aggregate productivity growth of the French manufacturing sector during the 1990s.

3. A comprehensive dataset on French manufacturing firms

3.1. Data sources

The firm-level data used in this paper were collected by the French Ministry of Industry (SESSI). The French manufacturing census (EAE[4]) is a unique survey collecting information about inputs and outputs of all firms with more than 20 employees. These data allow us to trace in some detail the performance of firms over time. Unlike almost all the existing literature,[5] our data were directly collected at firm rather than plant level, which means that we are dealing with firm, not plant, turnover. The advantage is that it avoids potential spurious effects when assessing the specific role of market selection in productivity growth. A plant closure is never the direct consequence of a market selection process; it is the result of the firm's decision. A firm may decide to close a plant because it is not sufficiently productive. This is not a pure market selection process; it is internally decided by the firm and depends on the ability of the firm to restructure, and on the capacity of the market to dissuade firms from getting rid of unproductive units. To assess the contribution of market selection to productivity growth (and not the firm's capabilities to restructure), firm turnover rather than plant turnover is more useful.

Additional industry-level data, mainly used in productivity computations, come from the INSEE database (French System of National Accounts). These data are described in the Annex to this paper.

3.2. Entry and exit patterns

We rely on the following standard definition for entrant, continuing and exiting firms: an entrant is a firm that exists in the reference year t, but not

4. *Enquête annuelle d'entreprises.*

5. Notable exceptions are Aw, Chen and Roberts (2001), Carreira and Teixeira, 2003, Nishimura, Nakajima and Kiyota (2005), and Farinas and Ruano (2005).

in $t - 1$. An exiting firm is a firm that exists in year t but not in $t + 1$. A continuing firm is a firm that exists in years t, $t + 1$ and $t - 1$[6]. When applied to our dataset, these definitions induce some re-entry phenomena, essentially due to the +20 employee threshold effect,[7] which induces an overestimation of firm turnover rates. However, this problem concerns only the smallest firms in the sample should not greatly bias the inputs or output-weighted entry and exit rates.

Based on these definitions, firms' entry and exit rates average about 9% and 10%, respectively. Firm turnover rates[8] average 18% per annum, displaying a slightly decreasing trend over the period (see Table 1 and Table 2). These numbers are slightly lower than those reported by Bartelsman, Scarpetta and Schivardi (2003) for France. Their firm turnover rate for manufacturing was around 24% per year in the period 1989-1994, which makes France as a relatively high turnover country in comparison with other OECD countries. This turnover figure is significantly reduced when related employment is included (Table 2). Whether entrants or exiting firms, both populations are much smaller than that of continuing firms.

Another feature of our dataset, which is in line with the existing literature, is that industries differ significantly according to their turnover

1. Entry and exit by year

Year	Entrant	Continuing	Exiting	Turnover rate
1990	1 887	19 351	1 738	18.7
1991	2 130	19 181	2 057	21.8
1992	1 683	18 896	2 415	21.7
1993	1 157	18 295	2 284	18.8
1994	1 961	17 785	1 667	20.4
1995	1 511	17 816	1 930	19.3
1996	1 644	17 679	1 648	18.6
1997	1 626	17 828	1 495	17.5
1998	1 374	18 007	1 447	15.7
1999	1 304	17 911	1 470	15.5
2000	1 345	17 758	1 457	15.8
2001	1 464	17 617	1 486	16.7

6. In accordance with the OCDE definition (see Bartelsman Scarpetta and Schivardi 2003), firms existing for only one year are considered as "one year firms" and are counted neither as entrants nor exiting firms.

7. For instance, a firm reduces its number of workers and falls out of the range of the French census, but still exists in the market.

8. The turnover rate is defined as the sum of the entry rate and the exit rate.

2. Turnover rate by industry

Industry	Number of firms Entry	Number of firms Exit	Number of firms Σ	Labour Entry	Labour Exit	Labour Σ
Clothing & Footwear	9.2	15.2	24.4	5.1	9.3	14.4
Printing & Publishing	9.2	11.0	20.1	5.4	6.6	12.1
Pharmaceutical	8.1	8.4	16.6	4.3	6.2	10.5
House Equipment	8.3	10.4	18.8	4.8	5.9	10.7
Automobile	7.3	7.1	14.4	7.2	6.6	13.8
Transportation Machinery	8.9	9.4	18.2	5.5	3.5	9.1
Machinery & Mechanical Equip.	9.7	9.8	19.5	5.0	5.5	10.6
Electrical & Electronic Equip.	11.9	12.4	24.2	5.4	5.4	10.8
Mineral	7.6	8.6	16.2	3.9	4.7	8.6
Textile	7.6	10.0	17.6	4.7	6.5	11.3
Wood, Paper & Pulp	8.0	9.0	17.1	4.8	5.8	10.6
Chemical	8.1	7.1	15.2	3.9	3.8	7.8
Metallurgy, Iron & Steel	8.0	7.9	15.9	6.1	5.2	11.3
Electrical & Electronic components	9.5	8.9	18.4	5.2	5.7	10.9

rates. Table 2 shows the average annual turnover rates for each of our 14 two-digit level industries. There is quite a wide variability in numbers across industries with the highest turnovers in *clothing & footwear, printing & publishing*, and *electrical & electronic equipment*, and the lowest in *automobile, chemical industries, mineral industries*, and *metallurgy*.

3.3. Productivity measurement

Following Caves, Christensen and Diewert (1982) and Good, Nadiri and Sickles (1997), the TFP index for firm i at time t is measured as followed:

$$\ln \mathrm{TFP}_{it} = \ln \mathrm{Y}_{it} - \overline{\ln \mathrm{Y}_t} + \sum_{\tau=2}^{t} (\overline{\ln \mathrm{Y}_\tau} - \overline{\ln \mathrm{Y}_{\tau-1}}) - \sum_{n=1}^{N} \frac{1}{2}(S_{nit} + \overline{S_{nt}})(\ln \mathrm{X}_{nit} - \overline{\ln \mathrm{X}_{nt}}) - \sum_{\tau=2}^{t}\sum_{n=1}^{N} \frac{1}{2}(\overline{S_{n\tau}} + \overline{S_{n\tau-1}})(\overline{\ln \mathrm{X}_{n\tau}} - \overline{\ln \mathrm{X}_{n\tau-1}}) \quad (1)$$

where Y_{it} denotes firm i's real gross output at time t using the set of inputs X_{nit} (labour, capital and materials). S_{nit} is the cost share of input X_{nit} in the total cost. The symbols with an upper bar are the corresponding measures for the reference point (the hypothetical firm). They are computed as the arithmetic mean of the corresponding firm level variables over all firms in year *t*. Subscripts τ and n are indices for time and inputs, respectively. This methodology is particularly suited to comparisons within firm-level panel data sets as it guarantees the transitivity of any comparison between two firm-year observations by expressing each firm's input and output as deviations from a single reference point for each year.

The first characteristic in our dataset common to the firm-level productivity literature is the degree of heterogeneity among firm productivity levels. Table 3 presents several measures of this heterogeneity. The first column reports the annual standard deviation of productivity levels computed for the whole database. The second column shows the difference between the log of productivity for the firm at the 90th percentile and the log of productivity for the firm at the 10th percentile (the 90-10 differential). The spread in productivity between the firms in the top deciles and the firms in the lowest deciles is about 40% for TFP and 150% for labour productivity. The higher spread in labour productivity can, at least in part, be explained by differences in input proportions. The 90-50, 50-10 and 95-5 differentials are shown in the next three columns. Note that all of these productivity dispersions are fairly stable over time, suggesting persistent TFP heterogeneity at firm level.

In part, this heterogeneity reflects the variations in performances of French manufacturing industries during the 1990-2002 period. Figure 1 below depicts the average annual growth rates of TFP for each of the 14 manufacturing industries. These industry productivity indexes are computed by aggregating individual TFP indexes as follows:

$$\ln \text{TFP}_{I,t} = \sum_i \theta_{i,t} \ln \text{TFP}_{i,t} \tag{2}$$

where $\theta_{i,t}$ is the share of the i^{th} firm in the overall gross output of the 2-digit level industry to which it belongs and $\ln \text{TFP}_{i,t}$ is the productivity index for firm *i*.

Clearly, inter-industry differences contribute to heterogeneity in the productivity distribution of firms. Note in particular, the difference between the two main sectors, Electric and Electronic Equipments and Electric and Electronic Components, which are obviously boosted by the development of information technologies, and the rest. However, industry differentials account for only a small part of firm heterogeneity. The analysis of variance shows that less than 20% of TFP heterogeneity can be explained by industry effects. This suggests that, independent of the industry under consideration, some firms are intrinsically more productive than others. How those differences in firms' productivity relate to entry and exit patterns both at the aggregate (whole manufacturing) and at the industry levels requires investigation.

3. Variability in Productivity

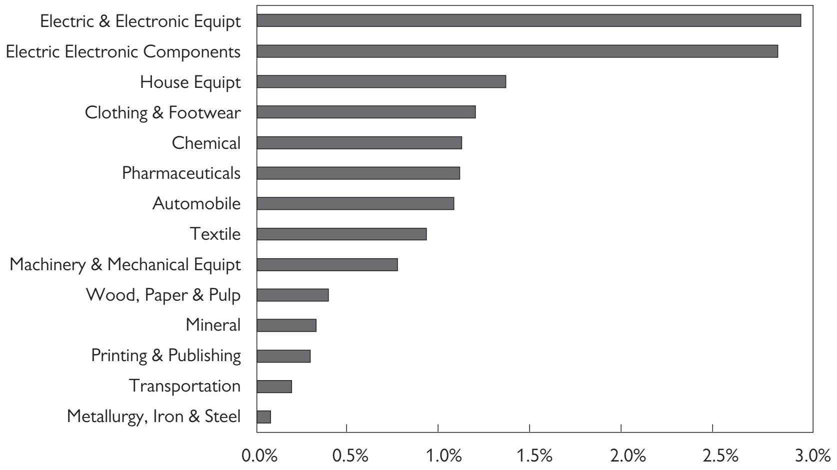
Year	St. Dev.	90 - 10	90 - 50	50 - 10	95 - 5
Total Factor Productivity (LnTFP)					
1990	0.177	0.394	0.191	0.203	0.538
1991	0.184	0.396	0.187	0.210	0.547
1992	0.177	0.393	0.184	0.209	0.545
1993	0.182	0.404	0.186	0.219	0.552
1994	0.197	0.393	0.183	0.210	0.553
1995	0.178	0.385	0.185	0.200	0.539
1996	0.174	0.383	0.183	0.200	0.541
1997	0.179	0.382	0.188	0.194	0.536
1998	0.175	0.382	0.193	0.190	0.533
1999	0.195	0.398	0.205	0.194	0.557
2000	0.185	0.403	0.211	0.192	0.549
2001	0.183	0.406	0.213	0.193	0.553
2002	0.186	0.414	0.222	0.192	0.575
Labour Productivity (Ln Y/L)					
1990	0.641	1.507	0.785	0.722	2.179
1991	0.635	1.493	0.779	0.714	2.143
1992	0.625	1.465	0.780	0.686	2.088
1993	0.629	1.473	0.780	0.693	2.097
1994	0.647	1.497	0.801	0.697	2.142
1995	0.639	1.488	0.802	0.686	2.100
1996	0.635	1.464	0.798	0.666	2.089
1997	0.645	1.482	0.813	0.668	2.101
1998	0.647	1.491	0.822	0.669	2.120
1999	0.652	1.488	0.816	0.672	2.111
2000	0.658	1.519	0.846	0.673	2.123
2001	0.645	1.491	0.827	0.664	2.074
2002	0.636	1.480	0.828	0.652	2.028

Note: Standard deviation and percentile differences for *LnTFP* and *LnY/L*.

4. Post-entry performance

Drawing on the current literature on entry process (whether conventional or evolutionary), and considering that imperfect competition is likely to prevail in manufacturing goods markets, at least two different and complementary types of selection mechanisms involved in the entry process can be identified. First, entry can reveal information on new firms about their relative abilities at birth. Either they perform well from the outset, because they embody an intrinsically better technological capacity

1. Industry TFP growth (average annual growth rates)



(a vintage effect argument)[9] or they lag behind from the start, due to insufficient ability to face competitive pressure. Post entry selection will result in only those firms that progressively exhibit sufficiently high efficiency levels surviving. Second, firms learn from market functioning, and post-entry learning can provide knowledge about how to produce more efficiently. If this type of learning is dominant, surviving entrants will be those most able to progress and improve productivity in the years after entry.[10] These arguments are not mutually exclusive as ex ante ability is not the only source of firm heterogeneity;[11] benefiting from market information and related learning will be more effective if initial technological capability is high and effective in the market.

In this Section, we demonstrate the relative importance of these two types of learning by examining the post-entry performance of new entrants. We proceed in three stages. First, we trace in time the average productivity (TFP) of each entry cohort relative to the incumbents. Second, we discriminate further between successful and unsuccessful entrants and compare productivity levels not only among themselves, but also between them and incumbents. Third, we examine how these productivity gaps are related to changes in relative size and profitability of the two types of entrants: successful and unsuccessful.

9. The underlying argument is that a best practice frontier, which evolves over time and is exogenous to the industry, is exclusively available to new firms (Greenwood and Jovanovic, 2001; Dwyer, 1998).

10. This type of learning is operating in the Ericson and Pakes (1989) model. It is also emphasised in evolutionary models in which new firms are assumed to be less experienced in terms of routines and best practice and have to acquire them after entry.

11. This extreme assumption prevails for instance in the Jovanovic (1982) model.

Table 4 summarises the first step. It traces the average productivity of entry cohorts relative to incumbent firms over time. For instance, the first line reports the average productivity of the 1990 entry cohort in 1990, 1991, 1992, etc., relative to the productivity of incumbent firms in the corresponding years. In this Table, incumbents are defined as the population of firms born before 1990 and surviving throughout the period of investigation.[12] Each entry cohort is composed of firms that enter the database that year and survive at least until 2002. This ensures that the results reflect the evolution only of the relative performance of entrants. They are not affected by market selection mechanisms, which could bias the average performance by eliminating low performing firms. The relative TFP of entrant i for period t and industry J is defined by:

$$\ln \mathrm{TFP}^{r}_{J,i,t} = \ln \mathrm{TFP}_{J,i,t} - \overline{\ln \mathrm{TFP}^{inc}_{J,t}} \qquad (3)$$

where $\overline{\ln \mathrm{TFP}^{inc}_{J,t}}$ denotes the average TFP of incumbent firms at time t in industry J. The relative productivity of the entry cohort is then defined as the unweighted average of relative individual TFP indexes. A negative number means that new entrants have a productivity disadvantage relative to incumbent firms while a positive number reveals a productivity advantage.

The first important result emerging from Table 4 is that generally entrants very quickly exhibit higher productivity as compared to incumbent firms. This result holds for each entry cohort from 1990 to 2002 and for almost all years of observation. Note that the few exceptions are never significant at the 0.05 level. The fact that new entrants rapidly outperform continuing firms suggests a very fast and effective learning process. This result is consistent with the vintage hypothesis according to which new firms embody better technology than older ones. Moreover, the differential for incumbents is highest in the three to four years after entry, which implies that an intrinsic advantage from entry is strengthened by market information. It is interesting that this relative advantage persists over time, for more than ten years for the oldest cohorts.

However, another interesting structural pattern in relation to entry cohorts is their small relative size. Table 5 traces the relative size, in terms of number of employees, of entry cohorts within the years after entry. It appears that, at the year of entry, the size of entrants is around half of the size of incumbents. Moreover, this size disadvantage does not disappear in the post-entry period. If they progressively increased in size relative to incumbents, even one decade after entry, they would still be smaller (by a third) than incumbents. This observation underlines the small importance of internal improvements in entrants' post-entry behaviour. It implies that

12. While our investigation focuses on the 1990-2002 period, we can trace a firm back to 1984.

4. TFP level of entrants relative to incumbent firms by entry cohort (log difference)

Cohort	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1990	–0.005	*0.016*	*0.029*	*0.029*	*0.030*	*0.026*	*0.018*	*0.018*	*0.017*	*0.020*	*0.020*	*0.022*	*0.018*
1991		–0.014	*0.015*	*0.018*	*0.022*	*0.018*	*0.016*	*0.014*	0.010	0.011	0.007	0.008	0.000
1992			0.010	*0.034*	*0.042*	*0.040*	*0.032*	*0.031*	*0.027*	*0.025*	*0.024*	*0.023*	*0.025*
1993				0.011	*0.041*	*0.041*	*0.026*	*0.026*	*0.027*	*0.024*	*0.024*	*0.024*	*0.027*
1994					–0.004	*0.020*	*0.013*	*0.011*	*0.008*	*0.016*	*0.014*	*0.014*	*0.011*
1995						*0.021*	*0.032*	*0.030*	*0.024*	*0.028*	*0.025*	*0.027*	*0.025*
1996							–0.003	*0.014*	*0.012*	*0.017*	*0.022*	*0.019*	*0.015*
1997								–0.006	–0.009	–0.002	0.005	0.008	0.004
1998									–0.006	*0.019*	*0.027*	*0.031*	*0.027*
1999										–0.015	0.008	0.013	0.013
2000											0.002	*0.013*	*0.012*
2001												0.007	*0.010*
2002													0.003

Numbers in *italics* indicate significance at 5% level.

5. Size of entrants relative to incumbent firms by entry cohort (ratio of firm size over average firm size of incumbents)

Cohort	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1990	*0.529*	*0.568*	*0.575*	*0.584*	*0.590*	*0.583*	*0.597*	*0.638*	*0.656*	*0.663*	*0.671*	*0.669*	*0.665*
1991		*0.512*	*0.532*	*0.547*	*0.560*	*0.575*	*0.586*	*0.580*	*0.593*	*0.611*	*0.613*	*0.613*	*0.627*
1992			*0.542*	*0.577*	*0.600*	*0.606*	*0.611*	*0.626*	*0.618*	*0.619*	*0.621*	*0.628*	*0.631*
1993				*0.629*	*0.655*	*0.680*	*0.694*	*0.711*	*0.705*	*0.717*	*0.757*	*0.762*	*0.766*
1994					*0.544*	*0.558*	*0.575*	*0.599*	*0.604*	*0.624*	*0.630*	*0.636*	*0.640*
1995						*0.540*	*0.565*	*0.576*	*0.577*	*0.588*	*0.593*	*0.601*	*0.613*
1996							*0.425*	*0.455*	*0.462*	*0.478*	*0.483*	*0.488*	*0.495*
1997								*0.491*	*0.498*	*0.568*	*0.601*	*0.600*	*0.580*
1998									*0.570*	*0.595*	*0.604*	*0.615*	*0.631*
1999										*0.630*	*0.641*	*0.643*	*0.652*
2000											*0.597*	*0.631*	*0.634*
2001												*0.412*	*0.429*
2002													*0.594*

Numbers in *italics* indicate significance at 5% level.

there is inertia within the industry structures, and shows that replacement of incumbents by entrants would be unlikely or very slow.

Tables 6 and 7 allow direct comparison between the performances of successful and failing entrants. Successful entrants are defined as firms that survive more than 6 years. Failing entrants are defined as firms that failed within the 6 years after entry. In these tables, entry cohorts are pooled in order to emphasise general trends in the improving process of new firms.

The first Column *(E/I)* reports TFP differences between all entrants and incumbents. The next two columns (*SE/I* and *FE/I*) compare the productivity gaps between successful and failing entrants respectively, and incumbent firms. The last column in the Table shows TFP differences between entrants.

Several features emerge from this. First, we note that from the third period onwards, entrants enjoy higher average productivity levels than incumbents. This suggests a very fast learning process for new entrants and is consistent with the vintage hypothesis. Second, this aggregate result must be refined by comparing successful and failing entrants, whose behaviours are different. While successful entrants quickly benefit from a marked productivity advantage over incumbents, failing entrants exhibit a substantial negative productivity gap from the time of entry and never recover. Those results are similar to those of Farinas and Ruano (2005) who also found a systematic gap between failing and surviving entrants. Thus, this more refined population analysis argues for the existence of a selection mechanism in which failing entrants seem to be condemned from

6. Relative TFP by the number of years after entry (log difference)

Years	E / I	SE / I	FE / I	FE / SE
1	*–0.015*	–0.003	*–0.019*	*–0.031*
2	–0.002	*0.018*	*–0.012*	*–0.044*
3	*0.003*	*0.018*	*–0.007*	*–0.043*
4	*0.006*	*0.016*	*–0.005*	*–0.046*
5	*0.006*	*0.014*	*–0.007*	*–0.057*
6	*0.007*	*0.011*	*–0.012*	*–0.049*
7	*0.008*	*0.008*		
8	*0.009*	*0.009*		
9	*0.010*	*0.010*		
10	*0.013*	*0.013*		

E = entrants, I = Incumbents, SE = surviving entrants,
FE = failing entrants
Numbers in *italics* indicate significance at 5% level.

7. Relative performances by the number of years after entry (ratios)

7a. Relative Profitability

Years	E/I	SE/I	FE/I	FE/SE
1	–15.813	–12.658	–16.855	–0.132
2	*0.536*	*0.962*	*0.325*	*0.143*
3	*0.608*	*0.895*	*0.396*	*0.413*
4	*0.805*	*0.889*	*0.709*	*0.385*
5	*0.908*	*0.950*	*0.829*	*0.283*
6	*0.898*	*0.923*	*0.798*	*0.264*
7	*0.930*	*0.930*		
8	0.997	0.997		
9	1.042	1.042		
10	1.033	1.033		

E = entrants, I = Incumbents, SE = surviving entrants, FE = failing entrants.
Numbers in *italics* indicate significance at 5% level.

7b. Relative Employment

Years	E/I	SE/I	FE/I	FE/SE
1	*0.438*	*0.529*	*0.408*	*0.676*
2	*0.485*	*0.552*	*0.452*	*0.718*
3	*0.539*	*0.566*	*0.519*	*0.759*
4	*0.552*	*0.578*	*0.524*	*0.786*
5	*0.562*	*0.584*	*0.522*	*0.746*
6	*0.574*	*0.589*	*0.516*	*0.740*
7	*0.586*	*0.586*		
8	*0.632*	*0.632*		
9	*0.660*	*0.660*		
10	*0.677*	*0.677*		

E = entrants, I = Incumbents, SE = surviving entrants, FE = failing entrants.
Numbers in *italics* indicate significance at 5% level.

the start. They show a relative disadvantage that they never manage to overcome, despite a relative improvement before their exit.

Table 7 considers the improvement process of new entrants based on relative size (measured by employment) and profitability. Tables 7a and 7b are similar to Table 5 except that relative profitability and size indexes in these tables are ratios and not differences. Consequently, unity indicates identical performance (compared to nullity in Table 6). Again, entry cohorts are pooled to emphasise general trends, and successful entrants

(*SE*) *versus* failing entrants (*FE*) are compared not only with incumbents (*I*) but also with themselves. Table 7a reports relative profitability indexes for these different populations of firms. At firm level, profitability is measured by the ratio of operating-cash flow on sales. At population level, relative indexes correspond to the unweighted average of relative individual indexes.

Tables 7a demonstrates the ability of some entrants (the survivors) to compete successfully against some others (their failing counterparts) and to grow rapidly enough to survive. Whereas the profitability of entrants as a whole (E) apparently follows a regular catching-up process towards the profitability levels of incumbent firms (1 means equal performance), the picture changes radically if we discriminate between the two sub-populations of successful (SE) and failing (FE) entrants.

On the one hand, successful entrants catch up very quickly to the profitability levels of incumbent firms. On the other hand, failing entrants also begin to catch up, but at a much slower rate. Note that the mechanism underlying the catching up process of the FE population may be due to a selection process (i.e. the exit of the least profitable firms within 3 years after entry). Unsuccessful entrants that survive until age 5 and 6 do not exhibit similar weak relative performances. This suggests that those firms were catching up, not falling behind, but that the process was neither strong enough nor fast enough to allow them to survive in the face of competitive pressure from the rest (young surviving firms and incumbents).

Table 7b reports relative employment levels for different populations of firms. Once more, the E/I show a catching-up dynamic although we should bear in mind that we have established that new entrants remain relatively small compared to incumbent firms even 10 years after entry. This is consistent with the literature on post-entry performance especially in relation to European countries (see for instance Carreira and Teixeira, 2003: 10). By contrast, successful US entrants are characterised by much higher growth rates after entry (see Bartelsman, Scarpetta and Schivardi 2005), and their recent comparative analysis of European and US firm demographies).

If we now consider the sub-populations of SE and FE, two main results emerge. First, it appears that the initial size of failing entrants is significantly smaller than the initial size of successful entrants. This may indicate that failing entrants are from the outset penalised by their relative smaller size, and that this relative size disadvantage translates into a productivity disadvantage. Note that the size gap relative to successful entrants is quite high (20% to 30%). The second finding is that FE experience lower growth rates (compared to SE) in their efforts to achieve a similar size to incumbents, but they still follow a catching up process towards the average employment level of incumbent firms.

8. Growth rate of size and TFP (successful and failing firms, in percentage)

Years	Labour		lnTFP	
	SE	FE	SE	FE
1	5.58	2.53	2.38	1.63
2	4.25	1.90	0.47	0.82
3	3.57	0.00	0.39	0.72
4	3.14	–1.14	0.45	0.16
5	2.60	–2.36	0.37	0.33
6	0.81		0.40	
7	0.64		0.49	
8	0.20		0.60	
9	–0.10		0.67	
10	–1.47		0.88	

The above discussion is based on the estimation of relative levels within a population analysis (SE, FE, I); it does not provide information about the growth rates of those populations. Table 8 shows the growth rates for size (labour) and TFP (log) for the successful and failing entrant populations. It validates some of the previous interpretative comments, notably those related to the differences in performance behaviours and related selection mechanisms.

It should be noted that, for the whole sample, the unweighted average of firm-level labour and TFP growth on the decade is respectively about 0.10% and 0.40%. Successful entrants exhibit a persisting and significant advantage over both failing entrants and the rest of the firms. Interestingly, the growth rates of size for successful entrants is continuously decreasing over time, despite the fact that they maintain an intrinsic and continuous advantage in terms of TFP. Although increasing in size, successful entrants are not able to catch-up to the average size level of the industry (see Table 5). This observation is compatible with a continuous and persistent improvement in TFP in that population. Note also that the gap between successful and failing entrants is pronounced from the start, i.e. from date of entry. This, on the whole, suggests that, if post-entry behaviour matters, most selection mechanisms seem to derive from the conditions at entry.

At this stage, we should note that TFP relative to incumbents allows us to discriminate between the population of failing and successful entrants. Even if, on average, successful entrants have a relative disadvantage at date of entry, they quickly catch-up and soon perform better than incumbents. The magnitude of the catching-up process differs widely among successful and failing entrants. This would indicate the existence of an enhancement effect, whereby initial conditions at entry affect the ability to learn about the market and to ensure post-entry survival. Selection mechanisms are

9. Pre-exit Performance of mature Firms (relative TFP)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1990	*–0.045*											
1991	*–0.052*	*–0.061*										
1992	*–0.041*	*–0.051*	*–0.055*									
1993	*–0.032*	*–0.047*	*–0.044*	*–0.042*								
1994	*–0.021*	*–0.034*	*–0.031*	*–0.049*	*–0.053*							
1995	*–0.015*	*–0.015*	*–0.025*	*–0.034*	*–0.047*	*–0.051*						
1996	*–0.015*	*–0.013*	*–0.017*	*–0.024*	*–0.036*	*–0.043*	*–0.064*					
1997	–0.009	–0.012	–0.009	*–0.019*	*–0.036*	*–0.050*	*–0.055*	*–0.070*				
1998	*–0.016*	*–0.022*	*–0.017*	*–0.023*	*–0.024*	*–0.030*	*–0.041*	*–0.057*	*–0.071*			
1999	0.006	–0.004	–0.012	–0.013	*–0.020*	*–0.022*	*–0.030*	*–0.040*	*–0.052*	*–0.063*		
2000	–0.012	*–0.021*	*–0.023*	*–0.020*	*–0.026*	*–0.025*	*–0.035*	*–0.040*	*–0.048*	*–0.061*	*–0.078*	
2001	–0.002	–0.003	–0.007	0.000	–0.008	–0.010	*–0.021*	*–0.027*	*–0.036*	*–0.044*	*–0.047*	*–0.067*

Numbers in *italics* indicate significance at 5% level.

then a mix between an intrinsic initial capability to outperform incumbents (a vintage effect) and learning from the market as a result of post-entry behaviour.

5. Pre-exit performance of mature firms

In this Section, we use the time series dimension of our data set in order to investigate pre-exit performance of mature firms. Neoclassical models of industry dynamics predict that exit mechanisms are driven by a minimum productivity threshold below which the firm decides to exit the market. Empirical analysis largely validates this hypothesis; there is general consensus that exiting firms are concentrated in the lower productivity ranges (Baily, Hulten and Campbell 1992; Foster, Haltiwanger and Krizan 1998). Aw, Chen and Roberts (2001) and Aw, Chung and Roberts (2002) found a mean productivity difference among cohorts of continuing and exiting firms that is significantly lower for exiting firms from Korean and Taiwanese data. Farinas and Ruano (2005) estimated that the productivity distribution of surviving firms stochastically dominates the distribution of exiting firms, confirming that exiting firms come from the group of least productive firms.

If exiting cohorts systematically exhibit a productivity disadvantage compared with their surviving counterparts in the year of their exit, we need to investigate why this arises, i.e. how the performance of exiting cohorts evolves in the years prior to exit. Griliches and Regev (1995) pointed to the existence of what they call a "shadow of death" effect, which refers to the fact that a performance gap exists between exiting and surviving firms in the years before the exit year. Few studies have addressed this issue, and their results are contradictory (see for example Almus, 2000, on German data sets). Most existing empirical studies address the shadow of death effect taking the evolution of employment growth rate as the main indicator. We examine it using size/employment, TFP, and profitability as indicators. Labour productivity is also included in the tables, but mainly as a control variable.

Table 9 displays the relative TFP performance of exiting cohorts. The reference population in each column are firms of more than five years that are present in the data base for the whole period (1990 to 2002). Each row expresses the evolution of relative TFP difference between each exiting cohort (from 1990 to 2001) and the corresponding population of incumbents.

There are two major findings from this Table. First all exit cohorts are performing less well than the surviving firms long before the exit year. Second this observation is always significant for each cohort not only at date of exit, but also in the years prior to exit. Moreover, the gap tends to increase gradually as we approach the exit date. Thus, in terms of TFP, we found the existence of a shadow of death effect in all exit cohorts. On the whole, these results are quite similar to those in Kiyota (2005).

10. TFP, Profitability and Size differences by number of years prior to exit

Prior to exit (in Years)	TFP (log)	P (lev)	S (lev)	LP (log)
10	–0.007	0.990	1.101	*–0.072*
9	–0.007	*0.902*	1.030	*–0.062*
8	*–0.010*	*0.910*	0.950	*–0.052*
7	*–0.014*	*0.853*	0.901	*–0.049*
6	*–0.016*	*0.797*	0.911	*–0.055*
5	*–0.018*	*0.799*	0.834	*–0.056*
4	*–0.022*	*0.750*	*0.793*	*–0.067*
3	*–0.031*	*0.645*	*0.737*	*–0.089*
2	*–0.041*	*0.548*	*0.665*	*–0.109*
1	*–0.050*	*0.391*	*0.621*	*–0.121*
0	*–0.059*	*0.235*	*0.564*	*–0.129*

Numbers in *italics* indicate significance at 5% level.

We build on these results by adding size and profitability as performance indicators. Here, we pooled the exiting firms and developed a population analysis comparing their relative performance with surviving firms (those surviving more than five years).

A noticeable feature is the continuous decrease in the relative performance of exiting firms for each performance indicator. Relative TFP gradually decreases along the 10 years period before the exit date; it is always negative 10 years before exit date, even when it is no longer significant 9 years before exit date. Relative profitability and size continuously decrease and are significant 9 years and 4 years respectively, before exit date. Relative profitability is shown to be much higher, and the magnitude sharply increases during the 4 years period prior to exit. Therefore, the evolution of firm profitability is probably the most relevant indicator for firm exit mechanisms. Contrary to other contributions (see Van der Wiel, 1999), we found a remarkably similar trend for all three performance indicators indicating the existence of a shadow of death effect in our data set. Finally, relative labour productivity is always negative; this can be thought of as indicating systematically weaker capital intensity of exiting firms.

These results are fairly stable and robust. Table 11 provides similar information to Table 10, but for a different reference population. Instead of taking the mature firms in the sample, we adopted a parametric matching method, similar to Almus (2000), to compare exiting firms with the sub-set of their most similar surviving counterparts. The match was performed for the following initial characteristics: initial firm size, year of entry, 4 digit industry classification, legal form, and initial number of establishments.

11. TFP, Profitability and Size differences by number of years prior to exit (with matching)

Prior to exit (in Years)	TFP (log)	P (lev)	S (lev)	LP (log)
10	*–0.032*	*0.839*	1.219	*–0.177*
9	*–0.035*	*0.802*	1.146	*–0.164*
8	*–0.039*	*0.761*	1.015	*–0.152*
7	*–0.047*	*0.706*	0.946	*–0.163*
6	*–0.051*	*0.671*	0.946	*–0.175*
5	*–0.061*	*0.664*	*0.822*	*–0.191*
4	*–0.070*	*0.619*	*0.747*	*–0.221*
3	*–0.081*	*0.527*	*0.680*	*–0.254*
2	*–0.094*	*0.445*	*0.613*	*–0.288*
1	*–0.107*	*0.308*	*0.564*	*–0.313*
0	*–0.123*	*0.206*	*0.529*	*–0.333*

Numbers in *italics* indicate significance at 5% level.

The previous (non matching) results are essentially affected in two ways. First, the matching method improves the magnitude of exiting firms' decreased performance, especially relative TFP growth rates. As such, it adds weight to the existence of a shadow-of-death effect in that it extends the period, prior to exit, in which significant lower performance of exiting firms can be shown. Second, it improves the significance of the results, at least for relative TFP and profitability. Relative size is not affected.

From previous comments, it can be seen that relative TFP gaps are very significant to identify market selection as far as the pre-exit behaviour of exiting firms is concerned. Therefore, TFP can be thought of as the appropriate variable to identify the conditions required to survive in the market and to demonstrate the degree and persistency of firm heterogeneity characterising the market selection process. Moreover, the existence of a shadow of death effect can be interpreted in two ways: it could mean that market selection is not effective enough and allows firms to survive for longer, or it might mean that market selection is efficient, but allows firms to recognise that they need to leave the market allowing them to gradually adjust downward especially in terms of their employment level, before they actually exit the market (Almus, 2000).

In the next Section we focus on productivity decomposition patterns in order to discuss the relative contribution of the different populations of firms to aggregate productivity improvements.

6. Productivity Decomposition

The two previous Sections developed a mainly descriptive approach to firm heterogeneity based on population analysis, by highlighting post-entry and pre-exit behaviours of firms. It is useful to complement this population analysis by decomposing the contributions of each population's contribution to aggregate productivity growth. This can be achieved looking at changes in both inputs and outputs of individual firms over time. This reallocation occurs through internal and external reallocation. The former essentially refers to internal firm productivity improvements and the latter can be the result either of a redistribution of market shares to the benefit of the best performing firms, or of a positive net entry effect (where the gains due to new entrants, are larger than the losses due to exiting firms). Both effects result from the heterogeneity characteristics already discussed and it is interesting to look at their macro-economic incidence.

Remember that, according to equation (2), the manufacturing-wide productivity index in year t can be computed as

$$\ln \mathrm{P}_t = \sum_i \theta_{i,t} \ln \mathrm{p}_{i,t} \qquad (4)$$

where $\theta_{i,t}$ is the output share of firm i and $\mathrm{p}_{i,t}$ a productivity measure (labour productivity or TFP). Following the Foster, Haltiwanger and Krizan (1998) method, a change in aggregate productivity (ΔP) between t – 1 and t can be written as:

$$\Delta P = \underbrace{\sum_{i \in S} \theta_{i,t-1} \Delta p_{i,t}}_{\text{Internal effect}} + \underbrace{\sum_{i \in S} \Delta\theta_{i,t}(p_{i,t-1} - P_{t-1}) + \sum_{i \in S} \Delta\theta_{i,t} \Delta p_{i,t}}_{\text{External effect}} + \underbrace{\sum_{i \in N} \theta_{i,t}(p_{i,t} - P_{t-1}) - \sum_{i \in X} \theta_{i,t-1}(p_{i,t-1} - P_{t-1})}_{\text{Net entry effect}} \qquad (5)$$

where S, N and X denote respectively firms that survive, enter and exit between t and t – 1. The first term in (5) shows the contribution to productivity growth of growth within the surviving firms (within effect). The second term shows the between-survivors effect (external effect). The third term is an additional covariance term which is positive when firm market share changes in the same direction as productivity. As variation in market share is a consequence of market activity, this third term is also often considered as external to the firm. The last two terms show the contribution of entry and exit (net entry effect). Table 12 expresses overall productivity improvement (TFP and labour productivity) for the whole period.

With regard to TFP improvements, the internal effect is relatively low compared to Baily, Hulten and Campbell's (1992) and Foster, Haltiwanger and Krizan's (2002) findings. However, it is higher when compared to Aw, Chen and Roberts' (2001) and Carreira and Teixeira's (2003) findings using firm level data. The dominant effect in productivity improvement is gains from external reallocation (80%). The latter is mostly obtained

12. Productivity Growth Decomposition, 1990-2002

Total	Internal effect	External effect	Net entry
		lnTFP	
1.1	0.2	0.8	0.1
100.0	18.5	75.1	6.4
		Ln(Y/L)	
5.3	4.0	2.0	– 0.8
100.0	75.8	38.7	– 14.5

through displacement effects within industries whereas the net entry effect (gains from entrants minus losses from exiting firms) is relatively weak, again compared to the results in the literature. This observation is probably due to the specificity of entrants within our sample; we showed already how they were initially smaller and performed less well than incumbents at the time of entry. However, we probably underestimated at the aggregate level the actual effect of entry on productivity improvement as we also show how their relative disadvantage at entry (negative value) was disappearing and was substituted by a consistent durability of positive advantage along the post-entry period. Therefore, in our case, this post-entry effect shifted to an internal effect.

Labour productivity improvements were more significant for internal effects (75%), than external effects (25%). This is logical in that it reflects the increase in the capital/labour ratio resulting from firm investment and growth. On the whole, evidence from TFP decomposition allows us to map the existence of a process of 'creative destruction' that allows for productivity growth. Interestingly, this process of creative destruction derives more from restructuring and reallocation across producers than from novelty in itself, assuming this latter feature is embodied in the new firms (entrants). This emphasises the complicated character of market selection processes and the importance of considering the dynamic trends that characterise the competitive process within a market (an industry) among different categories of producers (either restructuring of incumbents, or the transformation of successful entrants into incumbents).

7. Conclusion

In this paper we analysed market selection mechanisms from French manufacturing goods markets over the 1990-2002 period. This empirical investigation produced the following results.

First, we found that successful entrants exhibit a productivity advantage at birth that is not fully exploited over time to achieve the average firm size within the sector. This suggests the existence of barriers to growth in the sense that, even if successful entrants have TFP and profitability advantages, they do not easily catch up with the average firm size in the industry.

Second, we found that exiting firms, as a whole, display below-average performance levels and are significantly smaller than their surviving counterparts. We nonetheless found distinguishing features among exit patterns by comparing young and mature firms. Young exiting firms display a relatively small productivity disadvantage relative to either successful entrants or incumbent firms, while mature exiting firms display a large productivity disadvantage relative to their surviving counterparts. This gap widens at the year of exit, but emerges several years prior to exit. More precisely, we found a shadow of death effect existed for each of the performance indicators (relative TFP, profitability and size). This could indicate that, as far as mature firms are concerned, French markets select against persistent bad performers but not against temporary losses of efficiency. This stylised fact can be interpreted in two ways. It might be that markets are efficient as they evaluate firms on a medium rather than a short term horizon. On the other hand, it might be indicative of a sort of inertia in industry structures as market selection processes favour established firms against new entrants, the latter being more heavily rejected than the former.

Third, we show that aggregate TFP growth is mainly driven by the reallocation of market shares in favour of more productive firms. The so-called internal effect resulting from TFP improvements in individual firms (due to learning by doing or technological change) accounts for less than 20% of manufacturing TFP growth.

Finally we conclude that micro data from French manufacturing industries on average behave in a way that is consistent with the generally accepted view that market selection mechanisms favour the most efficient firms. However, the institutions that contribute to markets' operating this selection process seem to be more severe on young firms than mature firms.

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APPENDIX

Main variables for TFP computation

All nominal output and input variables are available at firm level. Industry level data are used for price indexes, hours worked and depreciation rates.

1. Output

Gross output (sales) is deflated using sectoral price indexes published by INSEE (French System of National Accounts).

2. Labour input

Labour input is obtained by multiplying the number of effective workers[13] by the average hours worked each year at industry level. This choice was made because there are no data on hours worked in the EAE survey. Note that a decrease in hours worked occurs between 1999 and 2000 because of the specific "French 35 hours policy". (On average, hours worked fell from 38.39 in 1999 to 36.87 in 2000).

3. Capital input

Capital stocks are computed from investment and book values of tangible assets[14] following the traditional perpetual inventory method (PIM):

$$K_t = (1 - \delta_{t-1}) K_{t-1} + I_t$$

where δ_t is the depreciation rate and I_t is real investment (deflated nominal investment).[15]

4. Materials

Materials are deflated using sectoral price indexes published by INSEE (French System of National Accounts).

13. The number of effective workers is the number of employees plus the number of outsourced workers minus workers taken from other firms.

14. For each year, we rely on the book values reported at the *end* of the accounting exercise.

15. Both investment price indexes and depreciation rates are available at the 2-digit industry classification level.

5. Labour and capital cost shares

With w and c being respectively wage rate and user cost of capital, $CT_{kt} = w_{kt}L_{kt} + c_{kt}K_{kt} + m_{It}M_{kt}$ represents the total cost of production of firm k at time t. Labour and capital cost shares are then respectively given by:[16]

$$S_{Lk} = \frac{w_k L_k}{CT_k} \text{ and } S_{Kk} = \frac{c_k K_k}{CT_k}$$

To compute the labour cost share, we rely on the variable "labour compensation" in the EAE survey. This value includes total wages paid to salaries plus income tax withholding, and is used to approximate the theoretical variable $w_k L_k$.

We compute the user cost of capital using Hall's (1988) methodology where the user cost of capital (i.e. the rental of capital) in the presence of a proportional tax on business income and of a fiscal depreciation formula, is given by:[17]

$$c_{It} = (r_t + \delta_{It} - \pi_t^e)\left(\frac{1 - \tau_t Z_I}{1 - \tau_t}\right) p_{IKt}$$

where τ_t is the business income tax in period t and z_I denotes the present value of the depreciation deduction[18] on one nominal unit investment in industry I.

16. For simplicity, we make abstractions of temporal indices when this does not lead to confusion.

17. In this equation, we abstract from the tax credit allowance.

18. Complex depreciation formula can be employed for tax purposes in France. To simplify, we choose to rely on the usual following depreciation formula:

$z_I = \sum_{t=1}^{n} \frac{(1 - \bar{\delta}_I)^{t-1}\delta}{(1 + \bar{r})^{t-1}}$ where δ_I is the mean of industrial deprecation rates for the period 1984-2002 and $\bar{r}$ is the mean of nominal interest rates for the period 1990-2002.