THE DYNAMICS OF FRENCH FOOD INDUSTRIES: PRODUCTIVITY, SUNK COSTS AND FIRM EXIT

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Abstract:
This paper provides an empirical model which assumes that the firm probability of exit depends on the firm individual efficiency, its age, the level of sunk costs and the intensity of competition. We use a semi-parametric approach in order to estimate the unobserved individual productivity of firms, and then to use it in the exit equation. Sunk costs are measured at the firm level, taking into account several dimensions, as leasing, depreciation and the existence of a second-hand market for equipments. We use an unbalanced panel of 4818 firms from French food industries, observed between 1999 and 2002. We first provide an estimation of the inputs coefficients in the production function, which corrects both simultaneity and selection biases. When estimating the exit equation, we find a significantly negative relationship between the probability of exit on one hand, the firm individual efficiency, the age and the level of sunk costs on the other hand. At the opposite, the intensity of competition in the industry increases the propensity to exit.

Key-Words: firm productivity, sunk costs, exit, food industries.

JEL Classification: C23, D24, L25

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1. INTRODUCTION

During the present crisis period, the Banque de France (2009) notes that the number of firm failures has globally increased of 15% over one year (March 2008 to March 2009) to reach about 60 000 in March 2009. But, whatever the period which is considered, firm demography is a major topic. Bartelsman et al. (2005) shows that the firm turnover rate (calculated as the entry plus exit, annual average 1989-1994) varies from 16% in the Netherlands to 23% in the United States. Behind the apparent stability of the stock of existing units, those important flows deeply modify the industry, in terms of size or activity distribution, as well as in terms of performance.

There is a large empirical literature devoted to firm exit, as shown by Caves (1998). Until a recent period, most of studies highlight the influence of a particular set of determinants (as firm size, industry, owner's characteristics…), but without replacing exit as a possible issue within the framework of a theoretical model of industry dynamics. But, following the theoretical contributions of Jovanovic (1982), Hoppenhayn (1992) and Ericson and Pakes (1995), among others, some empirical methods have been proposed to assess the contribution of exit to the industry dynamics, the Olley and Pakes study (1996) (OP96 thereafter) being one of the most widely used. The study of productivity growth is often the first and main goal of such studies. But, it also leads to some richer empirical tests of exit models (Frazer, 2005, Shiferaw, 2009). The unobserved individual efficiency of the firm may be estimated and then introduced as a major determinant of the firm probability of exit. Clearly, if exit is the expression of a market selection process, the less efficient the firm, the higher its probability of exit. This is consistent with the results of Farinas and Ruano (2005), in the case of Spain, who find that exiting firms exhibit significantly lower productivity levels than the others. Bellone, Musso, Nesta and Quéré (2006) analyzing post-entry and pre-exit performances of French manufacturing firms also show that exiters are less efficient than firms still performing activity. Griliches and Regev (1995) or Almus (2004) suggest a similar relation between efficiency and exit, but based upon what is called the '*Shadow of Death*' effect: a lower (and lowering) efficiency would be a symptom of the soon coming exit of the firm.

Surprisingly, sunk costs (Sutton, 1991) are not introduced in empirical models of exit as OP96, while it plays a major role in the corresponding theoretical literature. Being non recoverable in case of exit, sunk costs have an engagement value for incumbents and consequently create barriers to entry for new firms but also barriers to exit for incumbents (see for example Dixit, 1989; Lambson, 1992; Sutton, 1991; Hopenhayn, 1992; Cabral, 1995). The corresponding empirical tests are less conclusive. Some authors (Dunne and Roberts, 1991; Fotopoulos and Spence, 1998), find that capital requirements are barriers to exit, while others (Rosenbaum, 1993; Roberts and Thompson, 2003) find no evidence of this. Two complementary reasons may explain such mixed findings: definition and measurement. Following the Sutton's distinction, a distinction has to be made between exogenous (*passive*) and endogenous (*active*) sunk costs. The first ones mainly (as the cost of '*acquiring a single plant of minimum efficient scale*', following the

Sutton's expression) depend on the industry and affect the capital variable. Such costs represent both entry and exit barriers. Endogenous sunk costs (as R&D or advertising expenses, for instance) are linked to the firm own strategy. It certainly represents entry and exit barriers, but in a more complex way, while, it may increase the individual efficiency of the firm. By this, it reduces the probability of exit even without being directly observed. Measurement of sunk costs is a severe problem, which supposes to take into account several dimensions. The first one is the specificity of assets, which has a direct effect on the existence and size of a potential second hand market (Kessides, 1986; Farinas & Ruano, 2005). It has also a significant effect on the possibility to rent the equipment, instead of buying it. Firms have little opportunities to lease all or part of their assets when such assets are very specific. A second reason is durability. Paradoxically, little attention has been devoted to explore the effects of asset depreciation on the evaluation of sunk costs (for exception see Kessides, 1990). The part of asset that is depreciated cannot be associated to sunk costs and then not be a source of barriers to exit. To sum up, sunk costs will be low for firms using assets that can be easily leased, for which a large second-hand market exists or which depreciate very quickly.

Following this, the aim of the paper is to analyse the exit process of the firms from the French food industries, by using a large unbalanced panel data of 4818 French firms over the period 1999-2002. We follow the semi-parametric method initially developed by OP96, which introduces the individual firm efficiency as a determinant of the probability of exit, besides the usual state variables, as age. But, we also introduce two variables, namely the level of sunk costs and the intensity of competition in the industry. From the econometric point of view, we follow the Levinsohn and Petrin (2003) argument, which leads to use intermediary consumption instead of investment, as a proxy for the unobserved efficiency.

Our main findings are the following. First, our statistics are consistent both with literature results and expected patterns. Average entry and exit annual rates vary between 5.6% and 8.0% according to the years, providing a turnover rate between 11.5 and 15.5%. Such a value is close, even slightly lower to those obtained in the literature (Bartelsman *et alii*, 2005), which are around 20%. The difference may be explained by several reasons linked to our population which is composed of manufacturing firms, and exclude the very small units (less than 20 employees). First, firm turnover is lower in manufacturing (including food industry) than in services. Second, very small firms (not included in our sample) exhibit generally high turnover rate. Third, turnover is lower when measured at the firm than at the plant level (because of the multiplant firms). When comparing the different component of food industry, we find that entry as well as exit rates greatly vary across the industries. As an example, exit rate is very low in the *Oils and fats* industry (around 2%) and very high in *Bakeries and pastries shops* sector (up than 16%). More generally, such variability, both within and between the different industries, affects all the variables which are used in the study. This is particularly true in the case of the sunk costs variable, but also when considering the intensity of competition. Some correlations may be found between variables when observed both at 3 and 4-digit mean levels. A well known positive correlation in Firm Demography is between entry and exit rates (as shown among others by Fotopoulos and Spence, 1998). But some other are more directly related to our model, as the apparent negative correlation between on one hand, sunk costs level and the competition intensity, and on the other hand, the intensity of flows (both entry and exit ones).

The estimation results first provide some presumably unbiased estimates of the production function. Compared to the OLS results, the estimates obtained by using the OP96 method are significantly different: the estimated capital elasticity is higher (0.317 against 0.251), while the labor elasticity is lower (0.579 against 0.704). The OP96 estimates values are between the OLS and the Within one, clearly suggesting that endogeneity (corrected by OP96 and Within estimators) and selection biases (corrected only by OP96 estimator) exhibit opposite signs[4]. But our more important findings concern the exit function: the exit probability of firms is negatively and significantly correlated to (1) the individual firm productivity, (2) the firm age and (3) positively correlated to the intensity of competition in the industry. Such results are consistent with the predictions of the theoretical model and, more generally with previous studies using similar methods. The specific result provided by this study is that sunk costs also play a significant and negative role: the higher the sunk costs level, the lower the exit rate. The low magnitude of this effect, associated to the large dispersion of the variable value between firms, suggest that this effect is generally light but may become very strong in some particular industry cases. As a summary, competition intensity and sunk costs may explain exit rates differences between industries (opposing *inert* versus *turbulent* industries, while the age and individual efficiency would explain the variability observed between firms, within an industry.

The rest of this paper is organized as follows: Section 2 introduces the economic model; Section 3 presents the econometric methods. Data and some summary statistics are introduced in section 4, while in Section 5, estimation results are provided and analyzed. Section 6 concludes.

2. THE ECONOMIC MODEL

Ericson and Pakes (1995) provide the theoretical model underlying the OP96 approach. The aim is to explain the great variability observed between firms in terms of performance level, including entry or exit processes. In order to do that, the authors first incorporate '*idiosyncratic or firm-specific sources of uncertainty (which) can generate the variability in the fortunes of firms observed in (...) data*' (*53*), namely the introduction beyond the usual state variables (capital, labour, age) of a new argument: ω_t. This variable is defined as following: a firm (or an entrepreneur) exploits "*an opportunity (technology) provided by the industry, which is open to all, so that*

[4] Such differences are consistent, in value and sign, to those found in Olley and Pakes (1996) in the case of the *Telecommunications Equipment Industry.*

the only distinction among firms is their achieved state of "success" (index of efficiency), $\omega_t \in Z$, in exploiting it."(55). As defined, ω_t (in fact ω_{it}) (individual efficiency thereafter) captures all the unobserved heterogeneity between firms.

In such a model, entry and exit processes are natural component of industry dynamics. Entrants have to invest, in order to explore and then exploit the opportunity offered by the industry. By the same time, at the beginning of any period *t*, the incumbent firm makes two decisions. First, it must decide to continue or to exit the industry. Second, if it decides to stay, it must decide how much to invest.

To take the first decision, the firm compares ϕ the cost to remain in activity (the sell-off value) and *(EDP)* the expected present discount value of activity profit, according optimal future decisions concerning investment. The Bellman equation is:

$$V_{it}(\omega_{it}, K_{it}, a_{it}) = \max\left\{\phi_{it}, EDP_{it}\right\} \tag{1}$$

With:

$$EDP_{it} = \max_{I_{it}} \pi(\omega_{it}, K_{it}, a_{it}) - c(I_{it}) + rE\left[V_{it+1}(\omega_{it+1,} K_{it+1}, a_{it+1}) \middle| J_{it}\right] \tag{2}$$

Where $\pi(.)$ is the profit of the current period, gross of the investment cost $c(I_{it})$, K_{it} the capital, a_{it} the age of the firm and ω_{it} its individual unobserved efficiency. $E(.)$ is the expectation operator, r a discount factor, and J_{it} the information set available at time t. $V_{it+1}(\omega_{it+1}, K_{it+1})$ is the discounted value in $t+1$ of the future cash flows of the firm[5]. K_{it} the current capital stock, follows the accumulation equation, including δ the rate of capital depreciation:

$$K_{it+1} = (1-\delta)K_{it} + I_{it} \tag{3}$$

The exit rule is based on the comparison between the sell-off value ϕ and the optimal expected discounted profits EDP_{it}, depending on the value of $V_{it}(\omega_{it}, K_{it}, a_{it})$. If the first term is greater than the second, the firm goes out on the market otherwise it stays on. Let z be a decision variable such that $z = 1$ $(z = 0)$ if the firm decides to exit (stay on) the market. Then, the exit rule can be written as,

$$z = \begin{cases} 1 & if \quad \phi_{it} > EDP_{it} \\ 0 & \quad \text{otherwise} \end{cases} \tag{4}$$

[5] Note that this last function can be expressed as the following bellman equation:
$V_{it+1}(\omega_{it+1,} K_{it+1}) = \sup\left\{\phi_{it+1}, EDP_{it+1}\right\}$

Secondly, if the firm decides to stay in the industry, it has to choose the level of its investment I_{it} which maximizes EDP_{it}, in relation to the usual state variables capital and age, but also to the unobserved individual efficiency:

$$I_{it} = I(K_{it}, \omega_{it}, a_{it}) \quad (5)$$

Our specific contribution consists in introducing two new variables to this well-know model, namely sunk costs and competition intensity.

Concerning the first one, Ericson and Pakes (1995, 55) assume: *"Investment to enter is a sunk cost, perhaps partially recoverable if there is some scrap value realizable on exit"*. Such an assumption first suggests that the sell-off value ϕ may take an infinite set of values, from 0 to ∞. This value fundamentally results of the confrontation between a supply and a demand. At a period *t*, ϕ does not only depend on the intrinsic characteristics of the firm but also on the number and strategies of some potential buyers. Such a point is important when considering the empirics of firm exit. Exit does not take the single form of failure (which would correspond to $\phi = 0$), but also may be the consequence of mergers and/or acquisition[6] (where $\phi > 0$). By this, the theoretical model allows to take into account the heterogeneity which empirically exists between the different kinds of firm exits. But the main interest of the Ericson and Pakes' citation is that sunk costs are clearly invoked[7]. Such costs are present, first when the firm enters to explore the opportunities which are offered in the industry, second as a part of the investment cost for each period *t*:

$$\begin{aligned} Sunk_{it} &= \left[\alpha_I I_{it} + \alpha_K K_{t-1}\right] \\ \alpha_I, \alpha_K &\in [0,1] \end{aligned} \quad (6)$$

Such a view will be developed when presenting our empirical measurement of this variable. But, it is still consistent with the definition of sunk costs, or, precisely of what J. Sutton calls *exogenous* sunk costs (1991, p. 28): "*We identify the set-up cost incurred by firms on entering (…) with the cost of acquiring a single plant of minimum efficient scale, net of any resale value*". We introduce it in the exit equation which then becomes:

$$V_t(\omega_t, K_t, a_t) = \max\left\{\phi - SC_{it}, EDP_t\right\} \quad (7)$$

This exit rule suggests that the higher the sunk costs, the lower the propensity to exit. Sunk costs appear then to be barriers to exit as well as barriers to entry[8].

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[6] Bates (2005) use the term "*successful closures*" when considering such issues.

[7] One may note that sunk costs are present in the theoretical model but not in most of the derived empirical studies, including OP96 one. The measurement difficulties may be the reason to this.

[8] An interesting point may be that a potential buyer implicitly includes such costs in the value accorded to the firm. Unfortunately the structure of data does not allow us to test this assumption.

The intensity of competition in the industry should also be included in the model. If we consider the second part of Bellman equation, i.e. the expected profit, one conceives that ω_{it} the individual efficiency of the firm has to be compared with $\underline{\varpi_s}$ the cutoff efficiency level in the industry during the same period. Such an average efficiency is a function of competition intensity in the industry. It seems consistent to assume that the more intense the competition, the higher the value of $\overline{\omega_t}$, and, by the way, the higher the probability of exit, for a firm *i*. Then, we get:

$$V_{it}(\omega_{it}, K_{it}, a_{it}) = \max\left\{\phi_{it} - SC_{it}, EDP_{it}\right\} = f(\omega_{it}, K_{it}, a_{it}, Comp_{it}, SC_{it}) \tag{8}$$

The inclusion of those two variables, sunk costs and competition intensity, completes the theoretical model. By this, it allows a more precise identification of the resulting firm heterogeneity, through the non observable individual efficiency ω_{it} . One may consider that this efficiency still depends on many non measurable arguments: manager ability, skill level of labour force, agglomeration effect due to location... or the other kind of sunk costs, namely the *endogenous* ones (as advertising or R&D expenses).

3. THE ECONOMETRIC MODEL

The final goal is to estimate:

$$\Pr(Exit_{it}) = f(\varpi_{it}, a_{it}, Comp_{it}, SC_{it}, X_{it}) \tag{9}$$

The firm probability of exit depends on the individual firm efficiency, the age, the sunk costs levels, the intensity of competition and some control variables, as industry and time dummies. But ϖ_{it} the individual efficiency cannot be directly observed and then has to be estimated before. It can be made by using a production function of the following form (in the case of a Cobb-Douglas technology):

$$\log Y_{it} = \beta_0 + \beta_l \log L_{it} + \beta_k \log K_{it} + \beta_a a_{it} + \varpi_{it} + \varepsilon_{it} \tag{10}$$

where Y_{it} is the output of firm i observed at period t , L_{it} is the labor input, K_{it} the capital input, a_{it} the age of the firm and ϖ_{it} the individual efficiency. ϖ_{it} is a state variable in the firm's decision, known by the firm even if non observed by econometrician, while ε_{it} is the usual error-term, associated for instance to a non-predictable productivity shock.

As one knows, standard econometric methods provide biased and inconsistent estimates of the previous form for (at least) two reasons: simultaneity between output and inputs and selection bias resulting from the exit process[9]. Several methods exist in order to solve those problems, (or at least one of its), including current panel data estimators, as within estimator, IV or GMM estimators, or semi-parametric methods, as the OP96 method, or some extensions of it (Levinsohn and Petrin, 2003; Ackerberg, Caves and Fraser, 2006)[10]. In this study we use the OP96 approach. More precisely, we introduce two new variables, namely sunk costs and the competition intensity and, as a supplementary point, we follow the Levinsohn and Petrin argument. Such an argument is the following. In the standard OP96 method, investment is a proxy for the unobserved efficiency:

$$I_{it} = I(\omega_{it}, K_{it}, a_{it}) \tag{11}$$

Under the assumption that I_{it} is strictly positive, one can write the inverse function of the unobserved shock, and obtain:

$$\omega_{it} = I^{-1}(I_{it}, K_{it}, a_{it}) \tag{12}$$

However, especially in the perspective to exit, a firm may stop to invest while it always needs intermediate consumptions to produce. Consequently, we follow Levinsohn & Petrin (2003) and substitute intermediate consumption M_{it} to investment I_{it}. Under the assumption that M_{it} is strictly positive the inverse function of the unobserved shock is now,

$$\omega_{it} = M^{-1}(M_{it}, K_{it}, a_{it}) = h(M_{it}, K_{it}, a_{it}) \tag{13}$$

Following this, the method may be briefly recalled as following. At the first step, one estimates a reduced exit equation (which, of course, does not include the firm efficiency which cannot be yet estimated):

$$\Pr(Exit_{it}) = f(K_{it}, a_{it}, Comp_{it}, SC_{it}, X_{it}) \tag{14}$$

This provides $\widehat{p_{it}}$ the predicted exit probability of the firm *i* at the period *t*.

The second step consists in the estimation of β_l the labor coefficient, which is the only flexible input.

The third step consists in writing:

$$\log Y_{it} = \widehat{\beta_l} \log L_{it} + g(Comp_{it}, SC_{it}, \log M_{it}, a_{it}, \log K_{it}, \widehat{p_{it}}) + \eta_{it} \tag{15}$$

Being non parametric, *g* is estimated by using a second order polynomial series. At this step $\beta_k, \beta_a, \beta_{comp}, \beta_{SC}$ are estimated and, the difference between output and its fitted value from the second and third steps gives an estimate of the individual firm efficiency, $\widehat{\varpi_{it}}$.

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[9] Some other reasons may exist, which are not taken into account in this study. As one example, Katayama, Lu and Tybout (2009) suggest the existence of severe measurement errors of both output and inputs, when applying to differentiated products industries.

[10] It has been proposed many surveys about the way to estimate total factor productivity. The one by Van Beveren (2007) proposes an empirical application to the case of (Belgian) food industries.

The fourth and final step is the estimation of the exit model (equation 9) including the estimated value of individual firm efficiency:

$$\Pr(Exit_{it}) = f(\widehat{\varpi_{it}}, a_{it}, Comp_{it}, SC_{it}, X_{it})$$

4. DATA AND SUMMARY STATISTICS

Our database contains 15110 observations. This is an unbalanced panel of 4818 firms belonging to the French Food Industry, observed during the period 1999-2002. Data are obtained from the annual surveys about firms' activity ("*Enquête annuelle d'entreprises*", *EAE* thereafter) which is the official French business-level data collected by the French Office of National Statistics (INSEE), and in the case of Food industry, by the Statistical Department of the French Agriculture Ministry. This survey only concern firms which employ at least 20 employees. The affiliation of firms to industry depends on their activity in terms of turnover by products.

A. The construction of the variables

Before considering our definition of exit, it might be suggested that the ideal dataset would provide a direct measurement of ϕ the sell-off value of the firm. The availability of such data would imply the existence of a kind of *'second-hand firms'* market, where the average value of a firm, in relation to its characteristics, could be evaluated. Unfortunately such a market does not exist. Exit is then supposed to reflect the result of the comparison between the anticipated profit and this (unknown) sell-off value. Using the standard definitions of exit, an incumbent (at period *t*) is a firm present both during the current year t and the next year $t+1$ while the exit firm (at period *t*) is although on the market in year t but not in $t+1$ [11]. The EAE survey presents several limits to such a measurement, because of its own selection rules. A firm may disappear from the file for three reasons, two 'bad', according to this paper's topic, and a 'good' one. A firm may fall under the 20 employees threshold and then be disclosed from the survey file. Same thing may happen just because the main activity has changed. In the case of food industry, one may think to the case of retail stores which produce some food products. By the end, within the 'good' population of firms which have really stopped their activity, there is no distinction between attrition due to liquidation and attrition explained by the merging or acquisitions. On the other hand, the EAE survey provides the necessary information at the consistent level, which is the firm one. This is not the case of some other French sources, as those derived from the SIRENE registry, which would elsewhere provide some more complete information about plant closures.

[11] Our database ends at year 2002 but information about the presence of the firm in the industry is available for 2003.

Starting from the variables available in the EAE, we deflate the value-added of firm *i* operating in sector *j* at time *t* by the Annual Price Index of value-added. As a measure of capital used by firm *i*, we compute the sum of the value of fixed asset at the end of the year and of the leased capital. This sum is deflated by the Annual Price Index of capital. Intermediate consumption, proxy needed for estimates, is deflated by the Annual Price Index of intermediate consumption. Labour input in firm *i* at time *t* is the number of its employees at the end of year. The investment (deflated by the Annual Price Index of gross fixed capital formation) is used to build the capital series when value of fixed asset is only available either at the beginning or at the end of the period.

In order to measure the intensity of competition, we first compute the Herfindhal index ($Herfindhal$) calculated from the initial database for each industry *s* observed at period *t*:

$$Herf_{st} = \sum_{i=1}^{i=N_{st}} \left(\frac{VA_{it}}{\sum_{i=1}^{i=N_{st}} VA_{it}}\right)^2 \tag{16}$$

Then we use the following indicator:

$$LCOMP_{st} = \ln\left(\frac{1}{Herf_{st}}\right) \tag{17}$$

Given all this, the higher is the indicator value and the more intense is the competition within the industry. The level of measurement is an important point. In this study, we successively use two levels of the NACE 2: the 4-digit level and an intermediary 3-digit level. Our results will emphasize the importance of such a distinction.

We pay a particular attention to the sunk costs variable. We come back to equation (6) and propose the following indicator:

$$Sunk_{it} = \left(1-\rho_{st}\right)\left[cI_{it} + c\left(1-\delta_{st}\right)\left(1-\alpha_{st}\frac{s_{st}}{c}\right)K_{t-1}\right] \tag{18}$$

At the current period, the sunk cost of a firm is a linear function of its current investment I_{it} and the lagged value of physical capital K_{it-1}, with several underlying assumptions. First, the firm may lease ρ_{st} percent of its current physical capital K_{it}, and then only the fraction $1-\rho_{st}$ is concerned by sunk costs. Secondly, the physical capital is affected by a depreciation rate of δ_{st} percent a period. Thirdly, a firm may sell α_{st} percent of its physical capital on the second-hand market at the end of each period at a price s_{st}. From the information available in our database, we can build some proxies of δ_{st}, ρ_{st} and $\alpha_{st}\frac{s_{st}}{c}$. Thus, δ_{st} is built as the ratio between the destructed capital during the current period over the capital stock available at the beginning of the period, K_{t-1}. ρ_{st} is approximated by the rental payments divided by the capital in value while $\alpha_{st}\frac{s_{st}}{c}$ is the ratio of the used capital sold on the second market over the capital in value. These three variables are assumed to vary over time but to be the same within a given industry.

B. Summary statistics

As shown in Table 1, the exit rate of French food industry varies between 5.66 and 7.56 %, according to the year, between 1999 and 2002. These values are in accordance with the findings of the Firm Demography literature, being however in the lowest part of the range. Bartelsman *et alii* (2005), report an exit rate of 11 % per year over the period 1989-1994 and which ranks France amongst the OECD countries where firm turnover is the most important. Such a difference may be explained by the absence of very small firms (less than 20 employees) in our sample, while there is a well known negative relationship between the size of firms and both entry and exit rates. The industry is another reason: firm's mobility is traditionally higher in services than in manufacturing (including food industries). In a previous study (Huiban, 2009), we find a higher exit rate when using data concerning plants instead of firms. This is consistent with the high number of multiplant firms where a plant may be closed while the firm is still active. The same analysis may be also applied to the entry rate (between 5.67 and 7.97 %) and the resulting turnover rate (between 11.44 and 15.53 %). These results are consistent with those found in the literature, with a downward bias due to the same two effects: turnover is higher in manufacturing than in services, plant turnover is higher than firm turnover because of multiplant firms.

[*Table 1*]

An additional point may be first suggested in this time-varying dimension, which is the positive correlation between entry and exit rate. Such a result is strongly confirmed when considering now the comparisons between industry rates, at a narrower level. Food industry corresponds to the class 15 of the NACE 2-digit level, but also to 45 different industries at the NACE 4-digit level, and to 9 positions at an intermediate 'level 3' that we have built for this study. Table 2 provides a list of the corresponding industries and of the number of firms which are present in our population. One may note that the class 15-8 of the NACE 3-digit level is, by construction, a very heterogeneous one, including very different 4-digit level industries, as *Manufacture of Sugar*, compared to *Bakeries or Pastries shops*.

[*Table 2*]

As shown in table 2, there is a great variability in terms of entry and exit rates exist between the sectors which compose food industry. This is even true, when first considering the NACE 3-digit level. While the average exit rate between 1999 and 2002 equals 6.62 % for the all population, this rate varies between 2.02 and 8.56 %, the second value being more than four times the first. Then, a first distinction may be proposed between:

- A set of industries with low exit rate (smaller than 5 %): *Oils and fats*, *Fish*, *Dairies* and *Beverages*;
- A set of industries with medium exit rate (between 5 and 7 %): G*rain products*, *Meat*, *Fruits and vegetables products* and *Animal feeds*;
- A particular sector with a very high exit rate: *Other food products*.

But this last 3-digit level class *Other food products* is a very heterogeneous one, composed by very different 4-digit level industries, as *Manufacture of Sugar*, compared to *Bakeries or Pastries shops*. For this reason, table 2 proposes some results which are computed at the infra-level, i.e. the Nace 4-digit level. When observing the results of the industries which compose the *15.8* (*Manufacture of other food products*) class at the 3-digit, we find that only three 4-digit sectors exhibit some high entry rates: two, *Bakeries shops* and *Bakeries-Pastries shops*. Those sectors are closer to service activities than to manufacturing (in terms of products as well as in terms of firm's size). In such industries, the exit rate is very high (respectively 16.11 and 14.80 %). To a lesser extent, this is also the case of the exit rate observed in *Sugar manufacturing*, which equals 10.14 %. When considering the other 3-digit level classes, one may observe that within heterogeneity, as revealed by 4-digit level, is more limited. Thus, most part of heterogeneity is captured at the 3-digit level of the NACE, except for the class *Manufacture of other food products* which has to be desegregated.

[*Table 3*]

[*Table 4*]

[*Table 5*]

Table 3 reports the average value of the different variables by 3-digit level industry. Table 4 exhibits the correlation between the average levels of the variables of interest, observed at the 3-digit NACE level, i.e. 9 positions. Table 5 presents the same results, but at the 4-digit NACE level (45 positions). The main result is the positive correlation between exit and entry rates, which equals 0.707 at the level 3 of the NACE, and 0.582 at the level 4, both coefficients being significant at the 5 % level. This is the confirmation of a well established result (Caves, 1998). The distinction is not (or not only) between *creative* and *destructive* industries but between *turbulent* and *inert* ones. Another expected result is the mechanical positive correlation which exists between size, the level of sunk costs and competition. A particular attention may be paid to the apparent negative correlation between both exit and entry rate and *sunk costs* and *competition*. Such results are consistent with the expected results of estimations. It is even still satisfying to note that the two variables that we introduce competition and sunk costs are strongly correlated to exit rate than the ones usually used in the literature, *size* and *age*.

5. THE ESTIMATION RESULTS

A. Estimation of the production function

A first interest of the OP96 approach is to provide unbiased estimates for input coefficients in the production function, contrarily to OLS estimates which suffers of both endogeneity and selection biases, but also to Within estimator which corrects only the endogeneity bias (with a restricting assumption concerning the time invariance of unobserved heterogeneity), but not the selection one. Accordingly, Table 6 proposes estimation results using OLS and Within estimator (applied both to the balanced and unbalanced population), and OP96 one.

[*Table 6 about here*]

The first point is that significant differences appear between the results obtained with the different estimators. Several discussions about the expected biases may be found in the literature[12]. First conclusions about the endogeneity bias are that the biased estimates (as the OLS one) capture both the real effect of the variable and the effect of the correlation between the variable and the error term. In the production function case, one may consider that the error term (which in the OP96 or Within estimators, includes the unobserved individual productivity), is positively correlated to inputs and age. By this, when comparing the OLS to the Within estimates, one should find upbiased values. This is the case of our results, while the estimate of labor equals 0.704 with the OLS and 0.376 in the within case and the estimate for age is non significant in the OLS case and equals -0.033 when using the within. In the case of capital, Levinsohn and Petrin (2003, 319) suggest that, if there is a positive correlation between the two inputs, then the simultaneity bias will lead to underestimate the coefficient β_k. This seems to be the case, since the value when such bias is corrected is 0.278 (Within) against 0.213 (OLS).

Secondly, the selection bias comes from the fact that the exit decision is not taken into account in both OLS and Within estimators, while OP96 estimator includes the estimated probability of exit as an argument. Again the biased estimates add to the 'true' unbiased value the correlation between the variable and the exit probability. Such a probability is negatively related to age, capital and labour, and the selection biases are this time negative ones. When comparing Within to OP96 results, one should obtain higher values in the second case. We obtain 0.579 against 0.376 for labour, 0.317 against 0.278 for capital and, by the end, for age a non significantly different of 0 estimate against -0.033 for the Within. Direct comparison of OLS to OP96 results is more difficult, because of the opposite signs of the biases. For the same reason, the difference between Within and OP96 corrections of endogeneity (time-invariant versus time-variant one) is not taken into account in this analysis.

[12] This point is discussed in OP96, but also in Levinsohn and Petrin (2003).

B. Estimation of the exit equation

The individual firm productivity ($\hat{\omega}_{it}$), as estimated in the previous step, is now included as a regressor in the exit equation. The results of this estimation are presented in Table 7, which provides both coefficient estimates and marginal effects, allowing to compare directly (but carefully) the impact of the different variables on the probability of exit.

[*Table 7 about here*]

First, the coefficient of $\hat{\omega}_{it}$ is significantly negative, being equal to about -0.12: the more efficient the firm, the more protected against the risk of exit. Such a result is first consistent with the theoretical model prediction. Exit processes being the result of market selection, the less efficient producers are the first to be eliminated. Similar results may be found in empirical previous studies. Olley and Pakes (1996, *op. cit.)* obtain a significant value of -0.16 in the case of the American telecommunications equipment industry, observed during the 1980s. Exploring a very different context, namely the Ghana, Kenya and Tanzania manufacturing firms, Söderbom, Teal and Harding (2006) obtain a negative estimate equal to -0.239. When using a different specification (hazard survival rate), Shiferaw (2009) finds a positive estimate for the productivity variable in the case of private manufacturing sector in Ethiopia, during the 1996-2002 periods. Our results also show that the probability of exit is negatively and significantly correlated to the age of the firm. Such a result is consistent both with numerous empirical results and theoretical models based upon the effect of *learning by doing* (Jovanovic, 1982). But it is interesting to compare the marginal effects of the two variables, individual efficiency and age. The first one is clearly stronger: a 1% increase of the efficiency leads to a decrease of the exit probability of 1.47 %, which is about ten times more than the effect of one additional year of existence of the firm. One may conclude that most part of experience effect is captured by the unobserved individual efficiency, the age being a poor proxy. As in R&D models, the absorption capacity of the firm, largely based upon unobserved characteristics, would greatly improve the effect of experience and then represent a component of unobserved firm efficiency.

One has now to consider the effect of industry variable, namely competition intensity. We successively use two different measurements for this variable: the first one states at the aggregated 3-digit level (9 different food industries), while the second one is built at the 4-digit one (45 food industries). Columns (1, 2) propose the results of the estimation using the first *Lcomp3* variable, while results when using *Lcomp4* are shown in columns (3, 4). The difference between both results is important. If we first focus on the single estimate of competition variable, a positive estimate is first obtained when using the aggregated measurement: the higher the intensity of competition, the higher the probability of exit. This result is consistent with the findings about industry life cycles, and more precisely with the '*Shakeout*' literature (Klepper and Miller, 1995; Klepper and Simons, 2005). When the competition is the more intense in an industry, a great number of exits occur. Once this '*Shakeout*' period ends and that the industry has become more concentrated, the exit rate decreases. Using a different approach based on spatial patterns, Huiban (2009) empirically obtains the same result: a negative relation between the firms' *survival* probability and the intensity of local competition. The result is different, when considering the 4-digit level: the estimate of the competition coefficient becomes negative, with a lower significance level, while, by the same time the estimates for other variables are affected. Several reasons may be found to explain such a result. A first statistical point is that when considering the 4-digit level, one is faced to narrow definition of industries, sometimes leading to small populations of firms as shown in table 1: 28 industries on 45 are composed of less than 100 firms, and 8 of less than 50 firms. By this, the measurement of competition intensity at such a narrow level may lead to biases. Moreover, it does not take into account the possibility of substitution between products issued from close but different 4-digit level industries (as between fruit juices and mineral waters, for instance). Because of this, the 3-digit level measurement appears to be more consistent to reflect the competition intensity to which firms are really faced. The choice of competition index also produces some effects on other variables and confirms, for instance, the existence of a strong correlation between industry competition and the sunk costs, even observed at the firm level. When a correct measurement is chosen for the intensity of industry competition, the presumably 'pure' effect of sunk costs on exit probability may be observed: it is a significant and negative one. Sunk costs are barriers to exit for French firms since they limit the mobility of the incumbents outside the market, other things being equal. The intensity of this effect seems lower than the competition one, as shown by the marginal effect. But, by the same time, one has to recall that there is a huge dispersion of the sunk cost levels, between industries, even if not speaking of the firm level. One may conclude from this that sunk costs play a poor role for most firms and in most industries, but, may be a very important obstacle to exit in particular cases.

By summary, competition increases the probability of exit, while sunk costs act as exit barriers. These variables may mostly explain the differences between industries, while the first indicator is measured at the industry level and the second vary much more between than within industries. This is consistent with the fact that the first one is an industry level variable and the second is observed at a firm level but defined in a way (the exogenous definition of sunk costs according to Sutton, 1991) which tend to favour inter-industry dispersion and reduce intra-industry one. It could be even suggested that the other kind of sunk costs, namely endogenous ones, are part of the individual efficiency of the firm. Such efficiency, besides to the age of the firms appears as a major barrier to exit, when considering this time, firm level and may explain the exit heterogeneity still observed within industries.

6. CONCLUSIONS

This study uses the OP96 method in order to estimate the effects of several determinants of the firm probability of exit. As in previous works using the same approach, some robust estimates are

obtained for the production function arguments. Both capital and labor estimates are different from those obtained when using methods which do not correct simultaneity and selection biases.
Once the unobserved individual efficiency has been estimated for each firm, it is introduced as a regressor in the exit model. As a result, the firm probability of exit is negatively and significantly correlated to the individual firm productivity (1), the firm age (2) and positively correlated to the intensity of competition which exists in the industry (3). But this study also provides an original measurement of sunk costs at the firm level which are then introduced in the empirical model. Thus sunk costs appear to play a significant and negative role: the higher the level, the lower the exit rate. The low value of marginal effect and the large dispersion of the variable value suggest that this determinant effect is generally light but may become very strong in some particular industry cases. As a summary, competition intensity and sunk costs may explain exit rates differences between industries, while the age and individual efficiency would explain the variability observed between firms, within an industry.

Several extensions and improvements may be envisaged to the present study. Some first concern the measurement of exit rate. It would be useful to introduce, (and above all to measure) a distinction between, on one hand, exits which correspond to a failure situation (as closure) and, on the other hand, those which signify a success (as selling, merging and acquisitions). Actually, one may conceive that both determinants and effects of exit differ between those two kinds of situations. A second point is clearly emphasized by our results concerning the effect of competition intensity in the industry. As results dramatically differ when considering 3-digit or 4-digit levels classification, one has to carefully choose the estimation level and moreover the industry classification which is used. As the existing 2-digit and 4-digit classification seem both imperfect, a specific classification should be implemented.

References

Ackerberg, D., Caves, K. and G. Frazer, (2006). *Structural identification of production functions*. Unpublished, University of Toronto.

Almus, M. (2004). The shadow of death: An empirical analysis of the pre-exit performance of new German firms. *Small Business Economics*, 23(3), pp. 189-201.

Banque de France (2009). Les défaillances d'entreprises en France: données définitives à fin mars 2009 et provisoires à fin avril 2009. *Banque de France-Observatoire des Entreprises*, Juin.

Bartelsman, E., S. Scarpetto and F. Schivardi (2005). Comparative analysis of firm demographics and survival: Evidence from micro-level sources in OECD countries. *Industrial & Corporate Change*, 14(3), pp. 365-391.

Bates, T. (2005). Analysis of young, small firms that have closed: delineating successful from unsuccessful closures. *Journal of Business Venturing* 20, pp. 343-358

Bellone, F., P. Musso, L. Nesta, and M. Quéré, (2006). Productivity and market selection of French manufacturing firms in the nineties. *Revue de l'OFCE*, 97(5), pp. 319-349.

Cabral, L. (1995). Sunk costs, firm size and firm growth, *Journal of Industrial Economics*, 43(2), pp. 161–172.

Caves, R. (1998). Industrial organization and new findings on the turnover and mobility of firms. *Journal of Economic Literature*, 36(4), pp. 1947-1982.

Dixit, A. (1989). Entry and exit decisions under uncertainty. *Journal of Political Economy*, 97(3), pp. 620–638.

Dunne, T. and M. Roberts, (1991). *Variation in producer turnover across US manufacturing, in entry and Market Contestability: An international comparison.* (Eds) P. Geroski and J. Schwalbach, Blackwell, London.

Ericson, R. and A. Pakes, 1995. Markov-Perfect Industry Dynamics: A Framework for Empirical Work. *Review of Economic Studies* 62, pp. 53-82.

Farinas, J. and S. Ruano, (2005). Firm productivity, heterogeneity, sunk costs and market selection. *International Journal of Industrial Organization*, 23(7/8), pp. 505-534.

Frazer, G. (2005). Which Firms Die? A look at manufacturing Firm Exit in Ghana. *Economic Development and cultural change* 53(3), pp. 585-617.

Fotopoulos, G. and N. Spence, (1998). Entry and exit from manufacturing industries: Symmetry, turbulence and simultaneity - some empirical evidence from Greek manufacturing industries. *Applied Economics*, 30(2), pp. 245–62.

Griliches, Z. and H. Regev, (1995). Firm productivity in Israeli industry 1979-1988. *Journal of Econometrics*, 65(1), pp. 175-203.

Hart, P. (2000). Theories of firms' growth and the generations of jobs. *Review of Industrial Organization*, vol. 17(3), pp. 229-248.

Hoppenhayn, H. (1992). Entry, exit, and firm dynamics in long run equilibrium. *Econometrica*, 60(5), pp. 1127-1150.

Huiban, J. P. (2009). The spatial demography of new plants: urban creation and rural survival. *Small Business Economics (Forthcoming), DOI 10.1007:s11187-009-9228-0.*

Jovanovic, B. (1982). Selection and the Evolution of Industry. *Econometrica*, 50(3), pp. 649-670.

Katayama, H. , Lu, S. and J. R. Tybout, (2009), Firm-level productivity studies: illusions and a solution, *International Journal of Industrial Organization*. 27 (3), pp. 403-413.

Kessides, I. (1986). Advertising, sunk costs and barriers to entry. *Review of Economics and Statistics*, 68(1), pp. 84-95.

Kessides, I. (1990). Market concentration, contestability, and sunk costs. *Review of Economics and Statistics*, 72(4), pp. 614-622.

Klepper, S. ,Miller, J. H. (1995). Entry, exit, and shakeouts in the United States Market in new manufactured Products, *International Journal of Industrial Organization*. 13 (4), pp. 567-591.

Klepper, S. ,Simons, K. L. (2005). Industry shakeouts and technological change manufactured Products, *Industrial Journal of Industrial Organization*. 23 (1-2), pp. 23-43.

Lambson, V. (1991). Industry evolution with sunk costs and uncertain market conditions, *International Journal of Industrial Organization.*, 9 (2), pp. 171–196.

Levinsohn, J. and A. Petrin, (2003). Estimating production functions using inputs to control for unobservables. *Review of Economic Studies* 70(2), pp. 317-342.

Olley, G. and Pakes, A. (1996). The Dynamics of Productivity in the Telecommunications Equipment Industry. *Econometrica* 64(6), pp. 1263-1297.

Roberts, B. and S. Thompson, (2003). Entry and exit in a transition economy: the case of Poland. *Review of Industrial Organization*, 22(3), pp. 225–43.

Rosenbaum, D. (1993). Profit, entry and changes in concentration. *International Journal of Industrial Organization*, 11(2), pp. 185–203.

Shiferaw, A. (2009). Survival of Private Sector Manufacturing Establishments in Africa: The Role of Productivity and Ownership. *World Development* 37(3), pp. 572-584.

Soderböm, M. , Teal, F. and A. Harding, (2006). The determinants of survival among African manufacturing firms. *Economic Development and Cultural Change* 54(3), pp. 533-555.

Sutton, J. (1991). *Sunk Costs and Market Structure*, MIT Press, Cambridge.

Van Beveren, I. (2007). Total factor Productivity Estimation: A Practical Review. *LICOS Discussion Paper Series*, Katholieke Universiteit Leuven.

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Table 1: Exit by year

Year	*Number of Observations*	*Entry Rate*	*Exit Rate*	*Turnover*
1999	3725	5.80	5.66	11.46
2000	3822	7.64	7.22	14.86
2001	3738	5.67	5.99	11.66
2002	3825	7.97	7.56	15.53
Average Rate	15110	6.78	6.62	13.40

Table 2: Exit by industry, average annual rate (1999-2002)
Nace, 2,3 and 4-digit levels

Industry code and name	*Number of Firms*	*Number of Observations*	*Entry Rate*	*Exit Rate*
15 Manufacture of food products and beverages	**4818**	**15110**	**6.78**	**6.62**
15.1 Production and preserving of meat and meat products	**1524**	**4822**	**6.43**	**6.64**
15.1A Production, processing and preserving of meat	509	1740	4.89	5.63
15.1C Production of poultry meat	207	707	5.23	4.67
15.1E Production of meat and poultry meat products	520	1702	6.46	6.23
15.1F Cooked pork meats	288	673	11.59	12.33
15.2 Processing and preserving of fish and fish products	**198**	**637**	**5.97**	**4.55**
15.2Z Processing and preserving of fish and fish products	198	637	5.97	4.55
15.3 Processing and preserving of fruits and vegetables	**186**	**608**	**6.58**	**5.26**
15.3A Processing and preserving of potatoes	12	41	2.44	4.88
15.3C Manufacture of fruit and vegetable juice	21	63	6.35	7.94
15.3E Processing and preserving of vegetables	92	302	7.62	4.64
15.3F Processing and preserving of fruit	61	202	5.94	5.45
15.4 Manufacture of vegetable and animal oils and fats	**27**	**99**	**4.04**	**2.02**
15.4A Manufacture of crude oils and fats	15	53	1.89	1.89
15.4C Manufacture of refined oils and fats	10	39	7.69	2.56
15.4E Manufacture of margarine and similar edible fats	2	7	0	0
15.5 Manufacture of dairy products	**318**	**1082**	**3.70**	**3.70**
15.5A Operation of dairies and cheese making	54	192	4.17	3.65
15.5B Production of butter	13	40	0	7.50
15.5C Production of cheeses	188	665	3.61	3.31
15.5D Production of other dairy products	39	108	2.78	2.78
15.5F Manufacture of ice	24	77	6.49	6.49

cream				
15.6 Manufacture of grain mill products, starches and starch products	**138**	**485**	**4.74**	**5.36**
15.6A Manufacture of grain mill products	100	355	4.79	4.51
15.6B Other Manufacture of grain products	27	91	4.40	8.79
15.6D Manufacture of starches and starch products	11	39	5.13	5.13
15.7 Manufacture of prepared animal feeds	**251**	**857**	**5.02**	**6.88**
15.7A Manufacture of prepared feeds for farm animals	225	768	5.08	6.77
15.7C Manufacture of prepared pet foods	26	89	4.49	7.87
15.8 Manufacture of other food products	**1700**	**4919**	**8.52**	**8.56**
15.8A Manufacture of bread; manufacture of fresh pastry goods and cakes	329	1116	6.72	6.72
15.8B Cooking of bakery products	130	277	21.30	14.80
15.8C Bread and pastry goods and cakes shops	295	776	14.56	16.11
15.8D pastry goods and cakes shops	393	928	5.82	8.19
15.8F Manufacture of rusks and biscuits; manufacture of preserved pastry goods	126	421	7.13	5.23
15.8H Manufacture of sugar	23	69	4.35	10.14
15.8K Manufacture of cocoa; chocolate and sugar confectionery	138	456	5.26	7.89
15.8M Manufacture of macaroni, noodles, couscous and similar farinaceous products	35	116	3.45	7.76
15.8P Processing of tea and coffee	51	176	5.11	5.11
15.8R Manufacture of condiments and seasonings	29	100	5.00	3.00
15.8T Manufacture of homogenized food preparations and dietetic food	38	114	14.04	4.39
15.8V Manufacture of other food products n.e.c.	113	370	7.30	3.51
15.9 Manufacture of beverages	**476**	**1601**	**6.75**	**4.43**
15.9A Manufacture of distilled potable alcoholic beverages	53	188	4.79	3.72
15.9B Production of ethyl alcohol from fermented materials	29	101	2.97	2.97
15.9D Production of ethyl	22	73	4.11	8.22

alcohol from fermented materials				
15.9F Manufacture of champagne	104	363	6.06	5.51
15.9G Manufacture of wine	154	483	11.59	3.73
15.9J Manufacture of cider and other fruit wines	6	22	9.09	4.55
15.9L Manufacture of other non-distilled fermented beverages	2	8	0	0
15.9N Manufacture of beer	31	91	4.40	7.69
15.9Q Manufacture of malt	7	21	0	4.76
15.9S Production of mineral waters	43	159	3.14	2.52
15.9T Production of soft drinks	25	92	4.35	4.35

Table 3: Average annual values by industry, (1999-2002)
Nace, 3-digit level

Industry code and name	*Size (Number of Employees)*	*Age (Years)*	*Sunk Cost (€ millions)*	*Herfindahl*
15.1 Production and preserving of meat	106.95	11.50	5.05	0.54
15.2 Processing and preserving of fish and fish products	94.38	10.21	5.77	3.80
15.3 Processing and preserving of fruits and vegetables	144.52	11.88	14.52	2.34
15.4 Manufacture of vegetable and animal oils and fats	126.59	13.77	20.49	24.43
15.5 Manufacture of dairy products	183.99	14.02	20.09	3.58
15.6 Manufacture of grain mill products, starches and starch products	95.91	13.24	26.03	13.46
15.7 Manufacture of prepared animal feeds	76.64	13.38	7.99	4.34
15.8 Manufacture of other food products	94.25	10.71	9.09	1.73
15.9 Manufacture of beverages	96.77	13.21	19.23	3.58

Table 4: A correlation table at the industry level (1999-2002)
Nace, 3-digit level (9 industries)

Variable *Variable*	*Size*	*Entry rate*	*Exit rate*	*Sunk costs*	*Herfindahl*	*Age*
Size	1	-0.43286	-0.50693	0.37953	0.04297	0.35715
		(0.2445)	(0.1637)	(0.3137)	(0.9126)	(0.3454)
Entry rate	-0.43286	1	0.70672	-0.51151	-0.57954	-0.74389
	(0.2445)		(0.0333)	(0.1593)	(0.1019)	(0.0216)
Exit rate	-0.50693	0.70672	1	-0.56788	-0.64167	-0.52457
	(0.1637)	(0.0333)		(0.1107)	(0.0107625)	(0.1471)
Sunk costs	0.37953	-0.51151	-0.56788	1	-0.52457	0.72457
	(0.3137)	(0.1593)	(0.1107)		(0.1471)	0.47070272
Herfindahl	0.04297	-0.57954	-0.64167	-0.52457	1	0.49744
	(0.9126)	(0.1019)	(0.0107625)	(0.1471)		(0.1730)
Age	0.35715	-0.74389	-0.52457	0.72457	0.49744	1
	(0.3454)	(0.0216)	(0.1471)	0.47070272	(0.1730)	

Table 5: A correlation table at the industry level (1999-2002)
Nace, 4-digit level (45 industries)

Variable *Variable*	*Size*	*Entry rate*	*Exit rate*	*Sunk costs*	*Herfindahl*	*Age*
Size	1	-0.2470	-0.13457	0.81210	0.35300	0.18154
		(0.106)	(0.3782)	(0.0001)	(0.0174)	(0.2327)
Entry rate	-0.2470	1	0.58179	-0.15282	-0.28003	-0.78027
	(0.106)		(0.0001)	(0.3162)	(0.0624)	(0.0001)
Exit rate	-0.13457	0.58179	1	-0.01643	-0.37704	-0.53618
	(0.3782)	(0.0001)		(0.9147)	(0.0107)	(0.0001)
Sunk costs	0.81210	-0.15282	-0.01643	1	0.37415	0.11031
	(0.0001)	(0.3162)	(0.9147)		(0.0113)	0.4707
Herfindahl	0.35300	-0.28003	-0.37704	0.37415	1	0.36730
	(0.0174)	(0.0624)	(0.0107)	(0.0113)		(0.0131)
Age	0.18154	-0.78027	-0.53618	0.11031	0.36730	1
	(0.2327)	(0.0001)	(0.0001)	0.4707	(0.0131)	

Table 6: Estimates of the production function
Food Industry, 1999-2002

Variables	OLS (Balanced)	OLS (Unbalanced)	Within (Balanced)	Within (Unbalanced)	Olley-Pakes 96
L	0.740 (0.0066)	0.704 (0.0063)	0.431 (0.0151)	0.376 (0.0014)	0.579 (0.0068)
K	0.224 (0.0046)	0.251 (0.0041)	0.213 (0.0093)	0.278 (0.0081)	0.317 (0.0367)
Age	Ns	Ns	-0.027 (0.0023)	-0.033 (0.0023)	Ns
N	11448	15110	2862	4818	15110
R^2	0.8278	0.8040	0.1877	0.2038	0.5801

Standard Errors are in parentheses, and computed using 50 bootstrap replications (OP96).
Times and industries (Nace3 level) dummies are included in each regression but are not reported.

Table 7: Estimates of the exit probit model (marginal effects)
Food Industry, 1999-2002
(Including *Lcomp3* and *Lcomp4*)

Variables	including *Lcomp3*		including *Lcomp4*	
	(1) Estimates	(2)Marginal Effects	(3) Estimates	(4)Marginal Effects
$\hat{\omega}_{it}$	-0.1233 (0.0238)	-0.0146 (0.0028)	-0.1215 (0.0238)	-0.0145 (0.0028)
Age	-0.0146 (0.0026)	-0.0017 (0.0003)	-0.0144 (0.0026)	-0.0017 (0.0003)
Competition	0.7387 (0.1734)	0.0877 (0.0205)	-0.0669 (0.0200)	-0.0083 (0.0024)
Sunk Costs	-0.0586 (0.0116)	-0.0070 (0.0014)	-0.0879 (0.0105)	0.0105 (0.0013)
Intercept	-5.5061 (0.9108)		-1.3267 (0.1032)	
N	15110	15110	15110	
Log Likelihood	-3539		-3543	

Standard Errors are in parentheses.
Times and industries (Nace3 level) dummies are included in each regression but are not reported.