(Not so) easy come, (still) easy go? Footloose multinationals revisited

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by Pierre Blanchard, Emmanuel Dhyne, Catherine Fuss
and Claude Mathieu

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Abstract

This paper revisits the "footloose" nature of multinational firms (MNFs) hypothesis. Using firm-level data for Belgium over the period 1997-2008, we rely on a Probit model and take into account the endogeneity of the determinants of firm exit. Our results may be summarised as follows. First, the unconditional exit probability of MNFs is lower than that of domestic firms. Second, controlling for firm and sector characteristics - firm age, Total Factor Productivity, sunk costs, size, competition on the product market, sector-level value added growth, and sector dummies - the difference between the exit probability of MNFs and domestic firms becomes positive. Third, our results show that MNFs have a lower sensitivity to sunk costs and size than do domestic firms, which may be interpreted as lower exit barriers due to greater possibilities of relocating tangible and intangible assets to foreign affiliates.

Key words: firm exit, multinationals, Total Factor Productivity, sunk costs, panel data, Probit model

JEL Classification : D22, F23.

Authors:

Pierre Blanchard, University of Paris Est Créteil, ERUDITE.
Emmanuel Dhyne, NBB, Research Department and Université de Mons,
e-mail: emmanuel.dhyne@nbb.be.
Catherine Fuss, Corresponding author, NBB, Research Department
and Université Libre de Bruxelles
e-mail: catherine.fuss@nbb.be.
Claude Mathieu, University of Paris Est Créteil, ERUDITE.

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1. Introduction

In their policies for attracting foreign direct investment, public authorities take into account the fact that multinational firms (MNFs) are particularly dynamic and can grasp the opportunities offered by foreign markets. The reverse of the coin is that, in the case of negative shocks, MNFs may react (more) quickly, deciding to pull out of the market. This footloose characteristic of MNFs is an important issue for public authorities in terms of social costs. One major concern is that of employment destruction. Because these firms are typically larger, closing down a multinational can lead to sizeable job losses. For example, the figures reported in Dhyne *et al.* (2010) show that, in Belgium over the period 1998-2005, among the 87 000 jobs lost due to firms leaving the market, 25 000 were attributable to multinationals; 13 000 of which due to Belgian MNFs and 12 000 to foreign MNFs.[1] The potential footloose nature of MNFs constitutes a further challenge for the countries that implement attractiveness policies (see also Haskel *et al.*, 2007, for relevant examples in Europe).

Even though increasing globalisation has made companies more reactive to changes occurring in their economic environment, MNFs are thought to be more footloose than firms that operate solely on their domestic market because the scale of their international operations makes it easier to reallocate production from one country to another. This negative effect may be amplified by a home bias. Under adverse economic conditions, multinationals tend to safeguard employment in home-country headquarters compared to more distant plants located abroad (see Abraham *et al.*, 2010, for evidence for Belgium, Cappariello *et al.*, 2010, Landier *et al.*, 2009). This implies that foreign-owned firms, which are less deeply rooted into the local economy, are less reluctant to close down their activities than domestic MNFs. This issue is especially relevant for a small country such as Belgium where the number of foreign MNFs is around 2.5 times larger than the number of Belgian MNFs.[2]

The importance of MNF plant mobility for an economy calls for a better understanding of the determinants of firm exit, and more specifically the differences in exit behaviour between MNFs and domestic firms. This is the aim of our paper.

Two main conclusions can already be drawn from the literature devoted to this subject. First, MNFs have an unconditional probability of exit that is smaller than that of domestic firms. However, controlling for intrinsic firm and sector-level characteristics that influence firm exit, it is found that MNFs generally have a higher exit probability than domestic firms (see, for example, Alvarez and Görg, 2009, Bernard and Jensen, 2007, Bernard and Sjoholm, 2003, Görg and Strobl, 2003, Mata and Portugal, 2002). For Belgium, the conclusions are in line with the previous results since it has been shown that MNFs have a lower survival probability (Van Beveren, 2007) and a higher propensity to relocate their activities (Pennings and Sleuwaegen, 2000, 2002).

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[1] On average, a foreign MNF closure induces the direct destruction of 100 jobs (without taking into account the indirect job losses among their co-contractors), while the closure of a Belgian-owned firm only destroys 7.7 jobs.

[2] Throughout the paper, we distinguish between domestic firms (which are neither more than 50% foreign-controlled nor have foreign stakeholders), foreign MNFs (which are Belgian affiliates at least at 50% controlled by foreign companies) and Belgian MNFs (which are Belgian firms that undertake outward FDI and are not more than 50% controlled by foreign ownership).

To deal with the difference of exit behaviour between MNFs and domestic firms, it is important to take the specificities of the former into account. The main argument put forward in the literature is that MNFs which have specific advantages (associated with economies of scale across their international network) have the most productive performance (Markusen, 2002, Van Beveren, 2007). Consequently, in the event of adverse shocks in the host country, they may be incited to be footloose in order to maintain (or even to improve) their productive performance. Paradoxically, this literature seems to forget a counter-argument against the footloose nature of MNFs. Entry into a foreign market via a foreign affiliate involves sunk costs (Helpman *et al.*, 2004). As they cannot be recovered, these costs act as barriers to exit that may alter the ability of MNFs to be footloose.

This paper contributes to this literature in two main ways. First, it considers the role of sunk costs as barriers to firm exit. Thanks to information provided in the individual annual accounts on investment, the capital stock, leasing, depreciation and sales and disposals for both tangible and intangible fixed assets, a good proxy is provided for tangible and intangible sunk costs. This is in line with the distinction between endogenous sunk costs and exogenous sunk costs, initially proposed by Sutton (1991), and with the fact that MNFs possess some specific intangible assets based on R&D and marketing efforts (Helpman *et al.*, 2004). The paper considers the role of firm size in addition to sunk costs. Size may conveniently control for other sources of barriers to exit, such as economies of scale, the possible multi-plant nature of the firm, or better management for example.

Second, the paper examines whether MNFs have a different sensitivity to sunk costs than domestic firms in their decision to exit. Furthermore, it tests whether MNFs are more sensitive than domestic firms to a decline in their performance. The productive performances are proxied by Total Factor Productivity (TFP) which is estimated following a recent method put forward by Ackeberg *et al.* (2006) and extended to account for firm selection.

Besides the three central explanatory variables (sunk costs, TFP and size), it adds a large set of additional control variables usually present in an exit model. This set includes age, along with sector-level characteristics, such as market competition, minimum efficient scale, sector growth and demand uncertainty. We take advantage of the qualitative information on firms' expected demand reported in the business survey to construct a sector-level measure of demand uncertainty, using Theil's (1952) disconformity index. Alternatively, we consider the standard deviation of a forecast equation for sales as another measure of sector uncertainty.

The empirical analysis relies on a very rich and large panel of Belgian firms, for manufacturing industries, construction and market services, over the period 1998-2008. A random effects Probit model is estimated for firm exit, thus allowing for unobserved firm heterogeneity and taking into account the potential endogeneity of the explanatory variables with respect to firm effects as well as with the residual.

Our findings may be summarised as follows. Firstly, the unconditional exit probability of MNFs is lower than that of domestic firms. Secondly, the probability of exit depends on the three key explanatory variables (productivity, sunk costs, size) and on a set of control variables (firm's age, market structure, etc.) After controlling for these variables, we find evidence that MNFs have a higher propensity to exit than domestic firms. It should be noted that our findings do not suggest that Belgian MNFs would be less (or more) likely to close a local production site than foreign MNFs.

Thirdly, our results indicate that higher exit barriers, such as sunk costs and size seem to generate larger exit probabilities for domestic firms than for MNFs, which may rationalise part of the multinationals' footloose nature. Conversely, a deterioration in productive performance does not lead to different exit probabilities for domestic firms and MNFs. However, for foreign MNFs, what may matter most is the productivity trend of their Belgian affiliates relative to that of the other entities of the MNF.

The paper is organised as follows. Section 2 reviews the most important lessons from the literature on firm exit, as well as the empirical findings from the "footloose multinationals" literature. Section 3 describes the construction of the dataset and variables. Section 4 provides our estimation results. Section 5 concludes.

2. Review of empirical findings

Numerous studies have shown that productivity performance is an important determinant of firm survival (see Caves, 1998, for a survey). Further, a large body of the theoretical literature on MNFs has focused on the role played by specific assets owned by MNFs for their development abroad. These assets make firms more productive and enable them to offset the disadvantage compared to native firms when they enter foreign industries (Antràs, 2003, Markusen, 2002). By means of their international networks, MNFs may exploit their specific assets on a wider scale and benefit from all opportunities offered abroad (selection effect). Consequently, MNFs, as international multi-plant firms, improve their efficiency (learning effect), reducing their probability of exit (Bernard and Jensen, 2007). However, their international network also allows them to easily relocate production between countries in response to adverse shocks. Thus, in a selection process by which failing plants exit and successful plants prosper, MNFs may be prompted to quickly close their foreign plants and be viewed as more footloose than domestic firms. This "productivity premium" in favour of MNFs is verified empirically.[3]

The role played by sunk costs in the survival of foreign affiliates (plants) of MNFs is more ambiguous. First, it is generally assumed, as for export activities, that MNFs investing abroad have to bear costs that are sunk (Helpman *et al.*, 2004). These costs are formed by the three following elements: i) the cost of forming a distribution network and servicing a foreign market; ii) the cost of setting up a foreign subsidiary; iii) the adaptation costs of the specific assets provided by the headquarters. On the basis of these three elements, MNFs seem to incur high sunk costs when setting up production abroad that can alter their ability to be footloose. In actual fact, this is not so obvious. Indeed, a large part of foreign subsidiaries were previously locally-owned firms.[4] The takeover of existing local firms may induce lower sunk costs for MNFs compared to an *ex-nihilo* establishment abroad, because the MNF may benefit from previously existing networks, for instance. Furthermore, the specific assets generate sunk costs at the MNF network level, not at the affiliate level (see Markusen, 2002).

[3] See, for example, Criscuolo and Martin (2009) for the United Kingdom, and Doms and Jensen (1998) for the United States,

[4] The OECD (2000) estimates that mergers and acquisitions account for more than 60% of foreign direct investment by MNFs in developed countries.

Many recent papers, for a wide range of countries, provide evidence that MNFs are more footloose than domestic firms after controlling plant or firms characteristics such as age, size and productive performance.[5] As in the theoretical works of Jovanovic (1982) and Ericson and Pakes (1995), these characteristics are often highlighted as explanatory variables in the empirical literature on firm exit (Audretsch and Mahmood, 1995, Doms and Jensen, 1998, Dunne and Hughes, 1994, Mata and Portugal, 1994). Furthermore, the economic environment may also have some influence. For example, firms' exits may be more frequent in declining and/or less concentrated industries than in expanding and/or less competitive sectors. Again, these factors are taken into consideration in analysing the footloose nature of MNFs (Alvarez and Görg, 2009, Görg and Strobl, 2003). In addition, as pointed out by O'Brien and Folta (2009), firms may delay their exit decision when the profitability in the sector is more uncertain. Furthermore, the option value of waiting to take such decision increases with the level of sunk costs.

While the literature on firm exit has devoted a great deal of attention to the role played by sunk costs as barriers to exit, very few studies on MNF exits are concerned by this type of cost. Amongst the exceptions, Van Beveren (2007) concludes that higher sunk costs reduce the probability of exit. However, in her paper, sunk costs are proxied by the firm-level average wage. By contrast, in this paper, we introduce an observable measure of the part of (tangible and intangible) capital stock that is sunk. Furthermore, contrary to Van Beveren (2007) we test for different sensibility of firm exit with respect to exit determinants, in particular sunk costs. Van Beveren (2007) also introduces a foreign-owned dummy into the exit model, but no distinction is made between Belgian firms and foreign MNFs. By comparison, we test for a difference between Belgian and foreign MNFs. This approach enables us to check whether foreign MNFs may be less rooted in the local economy, after controlling for intrinsic firm- and sector-level characteristics.

When comparing MNFs to domestic firms, some authors have examined the role of workforce characteristics on the grounds that MNFs tend to employ a large proportion of high-skilled workers and pay higher wages. The impact of wages on the probability of exit is ambiguousn, however. On the one hand, firms that pay higher wages experience higher costs than their competitors; this may reduce their survival probability. On the other hand, higher wages may reflect higher productive performance, due for example to higher skills. The presence of a larger proportion of white-collar workers in a multinational firm's workforce may induce barriers to exit as well, owing to, among other things, higher firing costs than in the case of blue-collar workers. In this case, higher wages may be associated with lower probability of firm exit. For example, Bernard and Jensen (2007), find a negative effect of wages on the probability of firm exit. But Bernard and Sjoholm (2003) find that firms with higher wages have a lower survival probability, after controlling for the fraction of white-collar wages. Van Beveren (2007) reports mixed results for the effect of average firm wage. As we use direct proxies for productive performance and for barriers to exit, the wage variable is only used in our tests of robustness.

Owing to a lack of precise information, we disregard a number of potential explanatory variables. As we have no distinct information on the R&D and marketing expenditure, these are put together in our measure of intangible sunk costs. In the same vein, we disregard capital intensity

[5] See Ferragina *et al.* (2011) for Italy, Alvarez and Görg (2009) for Chile, Van Beveren (2007) for Belgium and Kimura and Kiyota (2006) for Japan.

because of its obvious relation to tangible sunk costs. Although group membership may provide management expertise, services support from the group, reputation advantages, better access to finance, collateral provision and intra-group lending, we do not consider the effect of being a member of a group, beyond MNF membership, due to a lack of information. Group membership is only partly controlled for by the MNF dummy since this variable only captures membership of an international group. Therefore, domestic firms may include single-plant firms, multi-plant firms as well as members from a Belgian group with activities only on the local market. We suspect that the latter form a minority of them. Lastly, we disregard financial factors such as financial constraints and access to financial markets. The reason for this is that such variables may be difficult to construct for firms that are members of a group and especially for those belonging to MNFs. Indeed, intra-group lending and the provision of collateral may be decisive advantages but cannot be measured owing to a lack of available data.[6]

Following our discussion above, after controlling for these variables, differences between MNFs and domestic firms may be attributed to differences in management practices, economies of scale in support services, better access to financing, through intra-group lending, collateral provision on financial markets, etc.

3. Data description, variable definitions and preliminary statistics

The dataset is obtained after merging figures from two sources of information: the Central Balance Sheet Office and the Survey on Foreign Direct Investment. The former provides us with firms' annual accounts while the latter is used to identify MNFs.

Appendix A describes in more detail the construction of the dataset, including annualisation of annual accounts when the accounting year differs from the calendar year, extrapolation of missing value, trimming for outliers and definition of the variables used. We consider firms that report positive employment, nominal physical capital stock above €100 and positive total assets at least once over the period surveyed. We restrict our attention to the manufacturing industry, construction and market services (i.e. two-digit NACE Rev 1.1 codes between 15 and 74) and leave out firms that may not be considered as "profit-maximising" firms, according to their legal status, e.g. we exclude non-profit associations and public administrations. Real values are constructed based on 2-digits NACE-level deflators.

MNFs are defined as firms with either outward FDI or foreign (direct and indirect) participation above 50%. Among MNFs, we distinguish between Belgian and foreign multinationals. Foreign MNFs are firms with at least 50% (direct and indirect) foreign ownership; Belgian MNFs are firms that undertake outwards FDI and are not more than 50% foreign-controlled (directly or indirectly). Other firms are classified as domestic. This includes Belgian firms with no outward FDI as well as affiliates of foreign MNFs.

Although the dataset contains information on the firm's legal situation, this is not exhaustive over the sample period, and could not reliably be used to identify firms' closure and takeovers.

6 While the Survey on Foreign Direct Investment conducted at the NBB provides information on intra-group lending between Belgian firms and their foreign partners within multinationals, we have no information about intra-group lending between Belgian firms belonging to a Belgian group.

Therefore, we identify firm exit based on the following criteria. The firm is considered as an exiter when, the last time it is observed in the sample, it has employment missing or zero, or nominal tangible fixed assets missing or below €100, or total assets missing or null in the next two years.[7] On average over the 1998-2008 period, the exit rate is 7.3%. This lies in between typical exit rates reported by Bartelsman *et al.* (2005) for large firms (around 5%) and small firms (around 10%) for a wide range of countries. The exit rate of large firms is generally smaller than that of small firms. Among others, one possible reason for this is that large firms are more likely to have multiple plants / multiple production lines, while small firms tend to be single-plant / single production line. Closing a plant / production line may therefore translate into downsizing for a large firm and to exit for a small one.

In this paper, we consider a broad set of potential determinants of firm exit, such as TFP, sunk costs, uncertainty, as well as firm size (measured by total employment) and age. Firm age is constructed from the date of the company's establishment.

To estimate TFP, we extend the method of Ackeberg *et al.* (2006) to account for firm exit, consistently with the focus of the paper. TFP is estimated on the basis of value added, initial capital stock at the beginning of the period, labour input (measured as average employment in full-time equivalent terms over the year) and, as in Olley and Pakes (1996), age. Intermediate consumption is used as a proxy to control for productivity shocks. In order to identify the labour and capital coefficients, we assume, as in Dhyne *et al.* (2010), that capital at the beginning of the period is orthogonal to the current productivity shock, and that employment adjusts with a time lag to productivity shocks. Appendix A reports the production function coefficients and bootstrapped standard errors, estimated at the 1-digit NACE level. We estimate production function coefficients on a reduced sample but construct TFP measures for the entire sample of firms. The reason is twofold. First, small firms do not have to report intermediate input consumption. We can still use the capital, labour and age coefficients to construct a TFP measure for them. This aims to avoid selection bias. Second, in order to avoid bias in the production function coefficients, we trim the data used to clean estimate production function coefficients for outliers, as explained in the Appendix. Again, coefficients estimated on the basis of this reduced sample are used to construct TFP for all firms of the entire sample.

Sunk costs are defined as retrospective costs that have already been incurred and cannot be recovered. They concern the part of capital investment that is not leased and cannot be resold on the second-hand market, following Blanchard *et al.* (2010). We construct sunk costs for tangible and intangible assets following equation (1)

$$sunk_{it} = NI_{it} + (1 - \delta_{st})(1 - \gamma_{st})NK_{it} \quad (1)$$

where NI_{it} represents nominal investment net of leased amount of firm *i* during period *t*, and $NK_{i,t-1}$ is the nominal capital stock, net of leased capital goods, available at the beginning of period

7 Owing to the lack of complete data for 2010, we define exits in 2008 solely on the basis of information for 2009.

t. δ_{st} and γ_{st} are respectively sector- and time-specific depreciation and resale rates[8]. We estimate δ_{st} by the average yearly sector-level depreciation rate, while γ_{st} is approximated by the sales and disposals rate of the capital stock, due to data limitations. The resale rate is intended to capture the possibility for firms to resell capital stock on the second-hand market rather than the effective resale. Therefore, we opt for a resale rate that is the same for all firms within a sector so that it also applies to firms that never resell their capital stock. The other advantage of this measure is that it evolves over time and may thereby better capture changes in resale price of capital. More details on the computation of the depreciation and resale rates are available in Appendix A.

We define total sunk costs as the sum of tangible and intangible sunk costs. The advantage over introducing separate tangible and intangible sunk costs is that total sunk costs provide a continuous measure. In fact, nearly all firms report tangible sunk costs, but only one half of them reports intangible sunk costs (48% of domestic firms and 68% for MNFs do so). However, for robustness, we provide in the Appendix estimates with tangible sunk costs only.

A variable that is naturally related to sunk costs is demand uncertainty. Indeed, demand uncertainty is especially relevant in the case of sunk costs, because investment cannot be easily reversed. We use two alternative measures of sector-level demand uncertainty. The first is based on qualitative data reported in the monthly business cycle survey. Following Fuss and Vermeulen (2008), we use the disconformity index proposed by Theil (1952), defined as

$$\sigma_t = (ups_t + downs_t) - (ups_t - downs_t)^2 \qquad (2)$$

where ups_t ($downs_t$) is the percentage of firms in year *t* that expect an increase (decrease) in demand for their main product. This measure, computed at the 2-digit NACE level, captures disagreement among respondents. For example, if all firms in a given sector report the same trend for future demand (either rise, or unchanged, or decrease), the Theil index takes value zero. If one-third of the firms expect a rise in demand and another third expect a drop in demand, the index takes the value of 0.67. Lastly, if half of the firms expect a rise in demand and the other half a decrease in demand, the index is equal to 1.

Alternatively, we consider a measure of sector-level demand uncertainty based on a forecast equation for firms' turnover. As in von Kalckreuth (2003), we estimate an autoregressive model of order one for the log of turnover ($turn_{it}$), at the 2-digit NACE sector level:

$$turn_{it} = \alpha + \rho turn_{i,t-1} + \nu_{it} \qquad (3)$$

Demand uncertainty is measured by the standard deviation of $\hat{\nu}_{it}$, the estimated residual of equation (3). It varies over time and across sectors.

Because firm exit is more likely in more competitive sectors, we also control for the degree of competition within the sector. We measure competition using the Herfindahl and C10 concentration indices based on firms' turnover at the 2-digit NACE level for each year in the sample.

8 Resale rates should represent the ratio of the capital stock sold in the second-hand market over the capital stock.

Alternatively, we also consider the firms' profits elasticity to marginal costs proposed by Boone *et al.* (2007). As explained in more details in Appendix A, this is obtained by regressing, for each sector, the log of profits on the log of marginal costs, where marginal variable costs are measured by variable costs over turnover.

Lastly, we also consider other sectoral characteristics such as sector growth, measured by the log difference of 2-digit NACE real value added, and the minimum efficient scale proposed by Sutton (1991).

Our final sample consists of firms with positive employment, sunk costs, TFP, and excluding those firms that can be assumed not to maximise profits such as non-profit associations. It is an unbalanced panel of 843,102 observations, related to 156,003 firms observed over the 1997-2008 period. Table 1 reports the mean and median of the potential determinants of firm exit and test differences between MNFs and domestic firms. Specifically, for each x_{it} variable, we estimate

$$x_{it} = \beta_1 + \beta_2 MNF_{it} + D_s + D_t + \epsilon_{it} \qquad (4)$$

where MNF_{it} is a dummy variable that takes value 1 if firm *i* is a MNF at time *t.* D_s *and* D_t *are* respectively 1-digit NACE sector and year dummies.

Table 1 - Descriptive statistics

	mean	median	Conditional difference wrt domestic firms Coef $\hat{\beta}_2$	t-stat
Size (number of workers)				
Domestic	12.27	4.00		
MNF	306.29	94.51	290.22	251.59
Age (in year)				
Domestic	16.03	14.00		
MNF	28.22	23.00	11.55	137.70
Apparent labour productivity				
Domestic	0.07	0.06		
MNF	0.20	0.09	0.13	68.00
Total factor productivity				
Domestic	450.50	0.49		
MNF	874.43	0.00	419.40	12.00
Average annual wage (in thousand euro)				
Domestic	26515.7	24426.2		
MNF	47319.8	41950.9	20724.22	229.80
Total sunk costs (in thousand euro)				
Domestic	0.58	0.16		
MNF	30.96	4.04	30.05	131.82
Intangible sunk costs (in million euro)				
Domestic	0.11	0.00		
MNF	12.04	0.21	11.75	65.73
Tangible sunk costs (in million euro)				
Domestic	0.47	0.12		
MNF	18.92	2.68	18.31	158.73
Herfindahl index				
Domestic	0.032	0.015		
MNF	0.038	0.020	0.003	12.75
Sector output growth				
Domestic	0.022	0.022		
MNF	0.024	0.023	0.001	2.76

Note: 843,102 observations, 156,003 firms over 1997-2008; 'conditional difference' reports the conditional difference and t-stat, controlling for 1-digit NACE sector and year dummies.

The figures reported in Table 1 confirm previous findings in the literature. Multinational companies tend to be larger and more productive. Possibly related to their productivity advantage, MNFs offer a substantial wage premium, consistent with previous evidence (see, for instance, Almeida, 2007, Malchow-Møller *et al.*, 2007). Table 1 also highlights substantial differences in sunk costs across types of firms. MNFs have, on average, tangible sunk costs that are more than 40 times larger than that of domestic firms. On average, intangible sunk costs are much lower than tangible sunk costs. Nevertheless, the ratio of average intangible sunk costs for MNFs and domestic firms is still higher, reaching a factor of 110. This highlights the importance of assets specific to MNFs. Given that MNFs have, by definition, more room for assets transfer across production units inside their international network, this calls for a better understanding of their role as barriers to exit. A huge difference is also reflected in size, as measured by total employment, which is on average 25 times larger for MNFs than for domestic firms.

Concerning the probability of observing a firm exit, Figure 1, which reports Kaplan-Meier estimates for domestic and multinational firms, suggests that the unconditional survival probability is much larger for multinational plants than for domestic firms. The next section examines whether this remains true after controlling for intrinsic firm and sector characteristics.

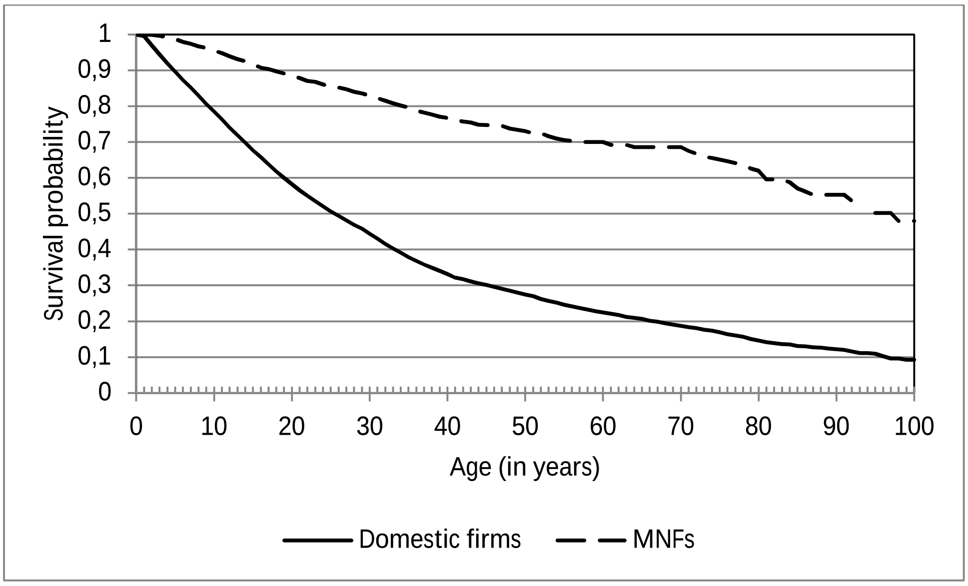

Figure 1 - Kaplan-Meier survival estimates

4. Estimation results

In order to analyse the firm's exit decision, we use firm-specific random effects Probit models. We estimate various specifications of an exit equation using the sample described in Section 3.

As mentioned above, we control for potential endogeneity problems for some of our explanatory variables (TFP, sunk costs, size and age). First, we control for potential correlation between the regressors and unobserved firm-specific random effect. We use the correction proposed by Mundlak (1978). This correction consists of introducing the intra-individual means of the explanatory variables as regressors in the model, which will capture the correlation with the unobserved individual effects. A second endogeneity issue may arise due to the correlation of explanatory variables with the error term. In a model for the probability of exit, this may be related to the so-called shadow of death phenomenon highlighted in Griliches and Regev (1995). They show that productivity declines prior to exit. This implies that current productivity is endogenous with respect to the exit decision. In order to correct for endogeneity bias, we use the instrumental variable correction proposed by Rivers and Vuong (1988). This two-step approach consists of a first-stage regression of the endogenous variables on a set of instruments. In the second stage, the fitted value is introduced into the Probit equation together with the residual of the first stage regression. A test of endogeneity is provided by the z-stat of the residuals of the first-stage regression. We apply this procedure to TFP, sunk costs and size. The instrument set includes an MNF dummy, age, the profit elasticity, sector growth, sector dummies, and one lag of the endogenous variable. The first-step regression is estimated year by year.

Our estimation results are presented in Tables 2 and 3, where the average partial effects on the exit probability associated with each explanatory variable are reported. All estimated equations include 2-digit NACE sector effects and time dummies. This makes it possible to control for the fact that MNFs may concentrate in some industries.

Consistently with the evidence presented in Figure 1, the results associated with the estimation of the unconditional exit probability presented in column (1) of Table 2 suggest that MNFs are less likely to close down their production units than purely domestic firms. On average, the exit rate of MNFs is 0.8 percentage point lower than the exit rate of domestic firms.

However, when we control for firm characteristics (TFP, sunk costs, size, age) and sectoral characteristics (Herfindahl index, sectoral growth and minimum efficient scale) as in columns (2) to (5) of Table 2, we mostly obtain a significantly higher exit probability for MNFs than for domestic firms. This indicates that MNFs are indeed more footloose than their domestic counterparts with similar characteristics.

As is standard in the literature, the estimates in Table 2 indicate a significantly negative impact of TFP and size on exit rates. As MNFs tend to be bigger and more productive, these factors explain the negative unconditional lower exit probability of MNFs compared to domestic firms. These results are in line with the conclusions of Alvarez and Görg (2009) for the Chilean manufacturing sectors over the period 1990-2000, even though in our exit model the effect of TFP is much lower while size has a very similar effect on the exit probability as in their study. The robustness of our results is confirmed by the fact that they are qualitatively similar to those reported by Van Beveren (2007) from a sample of firms located in Belgium for the years 1996-2001. In addition to productivity and size, our results highlight the role of sunk costs as impediments to firm exit, in line with the findings of Blanchard *et al.* (2010) for France. The introduction of sunk costs and size is particularly important in that respect as including only one of those two variables in the exit equation is enough to either offset or reverse the sign of the MNF dummy variable.[9]

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[9] Results are not reported but are available on request.

Table 2 - Probit models for the probability of exit - average partial effects

	(1)	(2)	(3)	(4)	(5)
MNF_{it}	-0.008***	-0.001	0.042***	0.053***	0.054***
	(-19.18)	(-0.15)	(6.49)	(7.72)	(7.74)
Belgian MNF_{it}	-	-	-	-	-0.010
	-	-	-	-	(-0.87)
Age_{it}	-	0.035***	0.033***	0.032***	0.032***
	-	(39.32)	(38.04)	(38.02)	(38.02)
Age_{it}^2	-	-0.0001***	-0.0001***	-0.0001***	-0.0001***
	-	(-8.99)	(-9.06)	(-8.98)	(-8.99)
TFP_{it}	-	-0.025***	-0.027***	-0.025***	-0.025***
	-	(-29.91)	(-31.39)	(-29.59)	(-29.59)
$Sunk_{it}$	-	-.0.023***	-	-0.015***	-0.015***
	-	(-41.01)	-	(-25.47)	(-25.57)
$Size_{it}$	-	-	-0.048***	-0.039***	-0.039***
	-	-	(-46.12)	(-37.02)	(-37.02)
$Herfindhal_{st}$	-	-0.183***	-0.163***	-0.167***	-0.167***
	-	(-7.78)	(-6.80)	(-7.03)	(-7.03)
$\Delta\log(VA_{st})$	-	-0.001	0.0003	-0.0004	-0.0004
	-	(-0.11)	(0.05)	(-0.07)	(-0.07)
$MES\text{-}Sutton_{st}$	-	0.013	-0.0231	-0.013	-0.013
	-	(0.17)	(-0.34)	(-0.20)	(-0.20)
log L	-152014.2	-120165.6	-116983.3	-115675.0	-115674.6
σ_u	1.064	2.434	2.347	2.282	2.283
std(σ_u)	0.014	0.030	0.031	0.029	0.029
$X^2(\rho)$	5103.4***	9121.2***	9549.5***	9253.3***	9253.9***
Avg. pred. prob. | exit=1	0.041	0.233	0.267	0.275	0.275
Avg. pred. prob. | exit=0	0.036	0.032	0.034	0.034	0.034
ROC Area	0.551	0.805	0.815	0.822	0.822
std(ROC Area).	0.002	0.001	0.001	0.001	0.001
RV_TFP	-	-47.39	-56.05	-55.30	-55.30
RV_sunk	-	-54.89	-	-41.84	-41.84
RV_size	-	-	-74.38	-67.64	-67.64

Notes: 687099 observations and 119343 firms over 1998-2008

All equations include year and NACE 2-digit sector dummies; z-statistic in brackets. σ_u is the estimated standard deviation of random effects; $X^2(\rho)$ is the Chi-squared test for the significativity of random effects.

*** = significant at the 1% level

Mundlak's correction has been applied to firm-level variables TFP_{it}, age_{it}, $sunk_{it}$ and $size_{it}$

Rivers-Vuong instrumental variable approach has been applied to TFP_{it}, $sunk_{it}$ and $size_{it}$. The instrument set includes MNF_{it}, Age_{it}, *Profit elasticity*$_s$, *Sector growth*$_{it}$ sector dummies, and one lag of, respectively, TFP_{it}, $sunk_{it}$ $size_{it}$. The first step regression is estimated year by year.

The ROC area is a measure of the predictive quality of each model. A value above 0.7 indicates good predictive quality.

RV stands for the Rivers-Vuong endogeneity test; i.e. the t-stat of the residuals of the 1st-step regression in the Probit.

Several of the control variables have a significant effect on the exit rate. Firstly, our results suggest an inverted-U-shaped relationship between exit and the firm's age (used as a proxy of knowledge accumulation) with a turning point of 17 years for *Age*.[10] Hence for firms less (more) than 17 years old, the older they are, the higher (lower) the propensity to exit is. This finding seems at first sight inconsistent with previous literature that found a negative effect of the firm's age on the probability to exit. However, our estimates control for a potential correlation among the regressors and the firm-specific random effects. For age, the correlation is negative between the intra-

[10] The value of *Age* at this critical point equals Age_{CP} = (Average partial effect of *Age*)/2(Average partial effect of Age^2).

individual mean and the individual effects. As a consequence, the "net" effect of age on the probability of exit may not be monotonic decreasing. This result suggests that the knowledge accumulation of firms depends on their unobserved characteristics. Further, as Geroski (1995) pointed out, other observed characteristics of firms may well capture the impact of knowledge accumulation. In particular, in our case, this impact is likely to have partly been captured by the productivity and size variables.

Secondly, we find that the exit probability increases with the degree of competition, measured by the Herfindhal index, computed using firms' turnover at the 2-digit NACE level. This suggests that the tougher the competition, the higher the exit rate. Alternative measures of the degree of competition (market share of the 10 largest firms) have been considered in Appendix but their impact is less conclusive (see Table B.2. in Appendix). Other measures of competition such as profit elasticity (Boone *et al.*, 2007) and sectoral markups (Christopoulou and Vermeulen, 2011) have also been considered but these measures do not vary over time and could therefore only be included in an equation without sectoral dummies. Their impact is therefore less clear to interpret as they may also capture other sectoral aspects.

The other variables that characterise the sectoral environment (sectoral growth and minimum efficient scale) do not seem to have a significant impact on the exit probability.[11]

One additional factor that may explain differences between MNFs and purely domestic firms is nationality. The footloose nature of MNFs is typically associated with foreign firms. Conversely, Belgian MNFs may be more reluctant to abandon their activities in their own country, due to organisation reasons, reputation issues, etc. Therefore, the positive impact of the MNF dummy on the exit rate might be entirely driven by the foreign multinationals and should be biased downward by the Belgian MNFs sampled. However, the last column of Table 2 does not give strong support to this hypothesis. Controlling for firm and sectoral characteristics, Belgian MNFs do not have a significantly different exit probability from other MNFs. Belgian MNFs have a lower conditional probability of exit but the difference with foreign MNFs is not significant at conventional significance levels. The sign of the estimated coefficient is in line with the findings of Ferragina *et al.* (2011), who show that the Italian MNFs had a lower probability of exit than the foreign MNFs over the period 2004-2008. But our results do not provide strong support for this home-bias hypothesis either as the coefficient is insignificant.

Our results also confirm the importance of the so-called "shadow of death" as the Rivers-Vuong endogeneity tests state that our three main firm-specific characteristics can be considered as endogenous. This reflects the fact that, typically, a decline in TFP, size and sunk costs is observed prior to firm exit.

It has to be mentioned that the predictive quality of our Probit equations, measured by the ROC area, is relatively good for the equations that include our main regressors. Indeed, it is generally considered that a ROC area above 0.7 indicates relatively good predictions. Based on this indicator, our preferred model is the one presented in column (4). This model will be used as a benchmark for further analysis. In Table B.1. in the Appendix, we also look at the role of some other variables that have been considered in the firm exit literature, for instance sectoral demand uncertainty, labour composition, and wages.

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[11] Due to the inclusion of time-invariant sector dummies in the equation, variables capture the time evolution.

Our disconformity index that captures sectoral uncertainty is found to have a significant and positive impact on the exit probability, indicating that firms operating in a risky environment tend to exit more frequently. However, this result is not robust to alternative measures of uncertainty (see Table B.2.). Our results also indicate that firms which pay higher wages tend to have a lower exit rate. This result is at odds with the common view that firms with high wages may be less competitive and therefore may be pushed out of the market. However, if we consider this variable as an indicator of the quality of the labour input, the results obtained can be rationalised as indicating that firms using labour inputs of higher quality tend to exit less (in line withBernard and Jensen, 2007, Bernard and Sjoholm, 2003).

The results presented in Table 2 are relatively robust to alternative definitions of the explanatory variables as shown in Table B.2. and for alternative sets of instruments used to control for endogeneity (Table B.3). For instance, in column (2) of Table B.2., instead of considering sunk costs associated with both tangible and intangible assets, we consider only sunk costs for tangible assets. The results obtained suggest that the impact of sunk costs is mostly related to tangible assets.

To summarise this first set of results, our preferred specification is the one reported in column (4) of Table 2. In all the above-mentioned cases, our estimates reveal that, conditional on firm and sector characteristics, MNFs have a higher probability of exiting the local market than purely domestic firms.

To observe a significantly higher exit probability for MNFs compared to similar domestic firms is a first indicator of the footloose nature of MNFs. Additionally, this footloose feature might be related to different responses of MNFs to changes in the value of regressors. For instance, because foreign MNFS perform international benchmarking of their different production sites, we may consider them to be more sensitive to the deterioration of TFP in their foreign affiliates and therefore may more rapidly decide to close down one of their production sites.

Results presented in column (2) of Table 3 do not support this assumption. Indeed, including the crossing between the TFP variable and the MNF dummy does not improve our estimation and the coefficient associated to that cross-term is non significant. [12]

For other factors influencing firm exit, we find that MNFs' sensitivity to exit determinants differs from that of domestic firms. This contrasts with the results of Mata and Portugal (2002) who did not find any differences in sensitivity to determinants of firm exit between MNFs and domestic firms.

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[12] Using our own data, we can only compare the deterioration (or improvement) of TFP in Belgian firms. Of course, a more relevant approach to test the hypothesis of the footloose nature of MNFs would be to make a comparison of TFP inside the foreign multinationals between their Belgian affiliates and affiliates located in other countries.

Table 3. - Probit models with interactions with MNF dummy - average partial effects

	(1)	(2)	(3)	(4)	(5)
MNF_{it}	0.053***	0.058***	0.047***	0.137***	0.080***
	(7.72)	(7.40)	(6.81)	(8.00)	(3.91)
Age_{it}	0.032***	0.032***	0.032***	0.032***	0.032***
	(38.02)	(37.96)	(37.99)	(37.97)	(37.98)
Age_{it}^2	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***
	(-8.98)	(-8.94)	(-9.01)	(-8.99)	(-9.01)
TFP_{it}	-0.025***	-0.025***	-0.025***	-0.025***	-0.025***
	(-29.59)	(-29.53)	(-29.47)	(-29.48)	(-29.47)
MNF_{it} x TFP_{it}	-	0.0002	-	-	-
	-	(0.99)	-	-	-
$Sunk_{it}$	-0.015***	-0.015***	-0.015***	-0.015***	-0.015***
	(-25.47)	(-25.58)	(-25.83)	(25.62)	(-25.79)
MNF_{it} x $Sunk_{it}$	-	-	0.009***	-	0.007***
	-	-	(6.91)	-	(4.32)
$Size_{it}$	-0.039***	-0.038***	-0.039***	-0.039***	-0.039***
	(-37.02)	(-36.97)	(-36.97)	(-37.17)	(-37.01)
MNF_{it} x $Size_{it}$	-	-	-	0.011***	0.003
	-	-	-	(5.41)	(1.57)
$Herfindhal_{st}$	-0.167***	-0.166***	-0.166***	-0.166***	-0.166***
	(-7.03)	(-7.03)	(-7.01)	(-7.02)	(-7.00)
$\Delta log(VA_{st})$	-0.0004	-0.0004	-0.0004	-0.0004	-0.0004
	(-0.07)	(-0.07)	(-0.07)	(-0.08)	(0.08)
$MES\text{-}Sutton_{st}$	-0.013	-0.013	-0.012	-0.013	-0.013
	(-0.20)	(-0.20)	(0.19)	(-0.20)	(-0.19)
log L	-115675.0	-115674.0	-115652.3	-115657.8	-115647.8
σ_u	2.282	2.276	2.271	2.270	2.268
std(σ_u)	0.029	0.029	0.029	0.029	0.029
$X^2(\rho)$	9253.3***	9214.5***	9228.1***	9221.5***	9222.2***
% true exits	0.275	0.275	0.275	0.275	0.275
% true surv.	0.034	0.034	0.034	0.034	0.034
ROC Area	0.822	0.822	0.822	0.822	0.822
std(ROC Area).	0.001	0.001	0.001	0.001	0.001
RV_TFP	-55.30	-55.22	-55.19	-55.20	-55.18
RV_MNF.TFP	-	2.54	-	-	-
RV_sunk	-41.84	-41.81	-41.93	-41.87	-41.87
RV_MNF.sunk	-	-	3.32	-	2.35
RV_size	-67.64	-67.49	-67.46	-67.45	-67.34
RV_MNF.size	-	-	-	4.05	3.06

Notes: 687,099 observations and 119,343 firms over 1998-2008

All equations include year and NACE 2-digit sector dummies; z-statistic in brackets. σ_u is the estimated standard deviation of random effects; $X^2(\rho)$ is the Chi-squared test for the significance of random effects.
*** = significant at the 1% level
Mundlak's correction has been applied to firm-level variables TFP_{it}, age_{it}, $sunk_{it}$ and $size_{it}$.
Rivers-Vuong instrumental variable approach has been applied to TFP_{it}, $sunk_{it}$ and $size_{it}$. The instrument set includes MNF_{it}, Age_{it}, *Profit elasticity*$_s$, *Sector growth*$_{it}$ sector dummies, and one lag of, respectively, TFP_{it}, $sunk_{it}$ $size_{it}$,. The first step regression is estimated year by year.
% of true exits is the fraction of exits correctly predicted by the model, for a threshold value of 0.075 for exits.
% of true survival is the fraction of survivals correctly predicted by the model, for a threshold value of 0.075 for exits.
RV stands for the Rivers-Vuong endogeneity test; i.e. the t-stat of the residuals of the 1^{st}-step regression in the Probit.

To sum up, our results indicate that more productive firms and firms facing higher sunk costs have a lower probability of exit than less productive firms, and firms with lower sunk costs. These factors also explain a large fraction of the difference between the exit probability of MNFs and domestic firms. MNFs may be considered as footloose, in the sense that, compared to similar domestic firms, they are characterised by higher exit probability and, because they are less sensitive to exit barriers such as sunk costs, most likely because they are able to relocate tangible and intangible assets within their international network.

5. Concluding remarks

The current economic and financial crisis has provided recent examples of MNFs plants closing or relocating even though it must be acknowledged that an even larger number of domestic firms exited the market during that period. Plant closures by MNFs are especially visible due to their large size, and the high job losses that follow. This is in line with the common wisdom that multinational firms may be more “footloose” than domestic firms, as they are considered to be less deeply rooted in the local economy and may be able to easily relocate production across their various plants at the international level. However, their large size relative to domestic firms may in fact be a hindrance to their ability to close down a production plant as their large size may be associated with higher sunk costs that should operate as barriers to exit.

This paper tests the hypothesis that MNFs are more footloose than domestic firms, distinguishing between the above-mentioned elements. We rely on a random effect Probit model of firm exit and control for endogeneity of the determinants of firm exit with respect to two types of endogeneity. The first is due to the correlation between explanatory variables and unobserved firm heterogeneity. The second is related to the correlation of covariates with the idiosyncratic error term.

We specifically examine the role of sunk costs and find that they indeed act as barriers to exit, beyond the role of firm size. We confirm previous findings that the unconditional exit probability of MNFs is *lower* than that of domestic firms, but that MNFs have a *higher* probability of exit conditional on a set of firm and sector characteristics, namely size, productivity, age, sunk costs, sector of activity, competition on the product market and sector growth.

In addition, we test for another aspect of the footloose nature of MNFs, i.e. to see whether they are less sensitive to (local) determinants of exits than domestic firms. The reason is, at least, twofold. Multinational enterprises' exit decisions are taken at international group level, and they may depend on other factors than simply the characteristics of the local plant. Further, contrary to domestic firms, for MNFs, closing a local production plant is not synonymous with exit for the multinational group as a whole.

We verify this conjecture empirically. Our results show that MNFs do not experience sunk costs as barriers to exit as much as domestic firms. This may be due to the fact that, thanks to its international nature, a multinational firm may reallocate (part of) its tangible and intangible assets to other affiliates of the group. These assets are therefore not totally sunk if the local plant is closed.

In sum, this paper highlights the twofold nature of MNFs' footlooseness. Not only do MNFs tend to exit the local market more frequently than domestic firms that are comparable in terms of size, productive performance, age, and sector of activity, but they are also less sensitive to the effects of sunk costs as barriers to exit.

Even if they are major employment providers and if their presence may stimulate competition within the sectors were they are active, the footloose nature of MNFs may be socially costly.

Moreover, with MNFs being amongst the most productive firms, the exit selection process that they induce does not lead to improved performance of the local markets. Both arguments may counter-balance the FDI attractiveness policies. At least, these arguments support the need to investigate all the positive and negative effects of this attractiveness policy for foreign firms that are not so easy to come but still easy to go.

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Appendix A: Data construction

The annual accounts dataset is nearly exhaustive.[13] We consider firms that report at least once over the period positive employment (as defined by the average number of employees in terms of full-time equivalents or FTE), nominal physical capital stock (as given by tangible fixed assets) above €100, and positive total assets. We restrict our attention to manufacturing industries, construction and market services (i.e. two-digit NACE Rev 1.1 codes between 15 and 74) and exclude firms that may not be considered as "profit-maximising" firms, according to their judicial form, e.g. we exclude non-profit associations and public administrations. Real values are constructed based on 2-digit NACE level deflators.

A few small corrections are made to the date and year or apparently inaccurate number of months of annual accounts. For example, when the closing date was 2 January 2005, we change the date into 31 December 2004. By doing so, we attribute the values reported in the annual accounts to the year 2004 instead of 2005.

Because the accounting year may differ from the calendar year, annual account information has been annualised, to guarantee consistency with other firm-level datasets such as the FDI Survey, ensure relevant cross-section comparisons, and use appropriate yearly deflators. Flows are adjusted by taking a weighted average of t and t+1 flows. Stocks are adjusted by adding to the current year stock the weighted stock variation between current and next year. The procedure attributes a missing value when there is not enough information to recover the entire year, for example when information about the first months or the last months of a given year is missing. This does not apply for the last year the firm is observed or for flows during the first year the firm is covered.

Lastly, we extrapolate missing values by taking the average difference between the previous and the next year. We allow up to two consecutive missing values.

We use the 2-digit NACE-Rev 1.1 deflators published in the national accounts to obtain real values of the nominal variables. Firm-level NACE codes are provided in the annual accounts dataset based on the main activity of the firm. We correct temporary NACE codes to avoid discontinuity, and possible exclusion of firms for some estimation procedures. We use the following rule: firms that have two, three or four different NACE codes over the period 1996-2007 take a single NACE code over the entire period if the most frequently observed code is reported for at least 8 periods and the least observed ones for at most 2 periods. In this case, firms are given the most frequently observed NACE code for the entire period.

We also extrapolate missing participation rates of inwards and outwards FDI, which, given the stability of participation rates, appear to be due to missing reporting. The sectoral distribution of the MNFs and the domestic firms are summarised in Table A.1.

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[13] Most Belgian enterprises in which the liability of the shareholders or members is limited to their contribution, plus some other enterprises, have to file their annual accounts and/or consolidated accounts with the Central Balance Sheet Office of the National Bank every year. Also, large and very large non-profit organisations and foundations have to file their annual accounts with the National Bank. Lastly, foreign enterprises with a branch in Belgium and enterprises not having a branch in Belgium but whose shares are officially listed on a Belgian stock exchange, as well as NPIs with a centre of activities in Belgium have to file their annual accounts with the National Bank

Table A.1. - 2-digit NACE sectoral distribution of MNFs and domestic firms (in percentage)

NACE 2	MNFs	Domestic firms
15	**4.16**	2.51
16	**0.21**	0.02
17	**1.60**	0.75
18	**0.45**	0.40
19	0.03	0.06
20	0.45	0.65
21	**1.45**	0.19
22	1.51	1.77
23	**0.36**	0.01
24	**5.88**	0.39
25	**2.41**	0.44
26	**2.96**	0.76
27	**1.39**	0.14
28	**2.65**	2.53
29	**2.38**	0.85
30	**0.18**	0.03
31	**1.42**	0.30
32	**0.81**	0.10
33	**0.66**	0.37
34	**1.45**	0.22
35	**0.39**	0.12
36	0.66	1.06
37	**0.42**	0.24
40	**0.33**	0.03
41	0.00	0.01
45	3.20	17.88
50	2.20	5.94
51	**22.80**	15.47
52	3.17	15.92
55	0.03	2.86
60	1.51	4.26
61	**0.39**	0.13
62	**0.18**	0.03
63	**3.68**	1.81
64	**1.03**	0.48
65	**4.40**	1.31
66	0.00	0.02
67	0.97	2.58
70	0.12	0.36
71	**1.54**	0.91
72	2.59	2.83
73	**0.45**	0.09
74	**17.52**	13.16

Note: in bold, sectors where MNFs are over-represented compared to domestic firms.

TFP estimates are based on the Ackeberg *et al.* (2006) procedure extended to account for firm selection. To clarify our correction for firm selection, it should be recalled that the objective is to estimate the following production function (in log):[14]

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \varepsilon_{it} \qquad \text{(a.1)}$$

where

y_{it} = log of value added of firm *i* at time *t*

k_{it} = log of real capital stock of firm *i* at the start of period *t*;

l_{it} = log of employment of firm *i* at time *t*, in full-time equivalent;

ω_{it} = productivity observable to the firm when making its input decision;

ε_{it} = unobserved shock or measurement error.

Following Olley and Pakes (1996) and Levinsohn and Petrin (2003), the productivity shock may, under certain conditions, be inverted from a non-linear function of the fixed or quasi-fixed factors, the capital stock and labour in our application, and a proxy, the log of material inputs, m_{it}, in our application:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + f_t^{-1}(k_{it}, l_{it}, m_{it}) + \varepsilon_{it} \qquad \text{(a.2)}$$

We first estimate the non linear equation (a.2), separately for each year.

Second, we estimate the probability of firm survival, ϕ_{it}, based on a non-linear model with time-varying coefficients, that depends on firm age, sunk costs, market concentration, capital and the proxy used to invert productivity, consistent with the model developed in the paper.

We extend the Ackeberg *et al.* (2006) framework by assuming that ω_{it} follows a first-order Markov process *conditional* on firm survival. In this case, productivity can be expressed as the sum of expected productivity and productivity shock, ξ_{it}, where expected productivity depends on firm survival probability:

$$\omega_{it} = E[\omega_{it} | \omega_{it-1}, \phi_{it-1}] + \xi_{it} \qquad \text{(a.3)}$$

Lastly, capital and labour production function coefficients are identified assuming that the capital stock available at the beginning of the period is independent of the current productivity shock, ξ_{it}. Identification of the labour coefficients rests on the assumption that the demand for labour inputs adjusts with some delay. This assumption is consistent with the existence of labour adjustment costs, as shown in Dhyne *et al.* (2010).

In practice, for given values of β_k and β_l, we estimate equation (a.2) and compute $\widehat{\omega}_{it}$. Then we regress $\widehat{\omega}_{it}$.on a fourth order polynomial function of $\widehat{\omega}_{it-1}$ and $\widehat{\phi}_{it-1}$and compute $\hat{\xi}_{it}$. Lastly, we

[14] Olley and Pakes (1996) include the firm's age in the production function, based on the assumption that profits depend on age. We omit age for expositionn but include it in our estimates.

evaluate the sample analogue to the moment conditions used to identify the production function parameters, i.e.

$$\frac{1}{N}\frac{1}{T}\sum_t \sum_i \hat{\xi}_{it} \begin{pmatrix} k_{it} \\ l_{it} \end{pmatrix} \qquad \text{(a.4)}$$

The procedure is repeated for different values of the parameters. We use genetic algorithm to minimize the moment conditions defined in a(4)[15]. This random search procedure is substantially faster than the traditional grid search procedure used to implement the Ackeberg *et al.* (2006) method. Note that, using a very fine grid search, we verify that the grid search and genetic algorithm yield the same coefficients estimates.

In order to estimate production function coefficients, we retain only firm-year observations where firms report positive employment, a value of capital above €100 and positive intermediate consumption. We remove outliers by keeping observations where the log of apparent labour productivity, the log of the ratio of real average wage bill over apparent labour productivity and the log of the capital-labour ratio, lie within the range defined by the median minus or plus three times the inter-quartile range. This criterion is applied by year and 2-digit NACE sectors. Lastly, we focus on firms with at least two consecutive observations and continuous spells. In the event of discontinuity, we consider only the last spell (provided it covers at least two years).

Production function coefficients are estimated at the sector level, following for age to enter the production function, as in Olley and Pakes (1996). In order to run the estimation on samples of sufficient size, we estimate TFP at the 1-digit NACE level. Table A.2. reports estimated production function coefficients and bootstrapped standard errors.

Table A.2. Estimates of production coefficients - Ackerberg *et al.* (2006) methodology extended for firm selection

Sector	α^K	α^L	age
(1) Food and textiles	0.179***	0.828***	0.818***
	(0.009)	(0.021)	(0.026)
(2) Wood, paper, chemicals, metal and non-metal products, machinery	0.126***	0.840***	0.728***
	(0.005)	(0.015)	(0.052)
(3) Equipment and recycling	0.156***	0.888***	0.777***
	(0.010)	(0.023)	(0.022)
(4) Energy and construction	0.156***	0.823***	0.749***
	(0.003)	(0.008)	(0.041)
(5) Trade and hotels and restaurants	0.087***	0.819***	0.840***
	(0.003)	(0.014)	(0.022)
(6) Communication and financial intermediation	0.137***	0.783***	0.829***
	(0.005)	(0.015)	(0.051)
(7) Real estate and business activities	0.088***	0.856***	0.670***
	(0.004)	(0.008)	(0.030)

Note: Final sample on 1997-2008; 329,389 observations and 83,923 firms, bootstrapped standard errors in bracket.
K stands for the capital stock, L for the number of workers
*** = significant at the 1% level.

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[15] Genetic algorithms are a family of search algorithms that seek optimal solutions to problems using the principles of natural selection and evolution. For details, see Goldberg (1989), among others.

Measurement of sunk costs

As explained in Section 3 of the paper, our measure of sunk costs, for tangible and intangible assets, is based on the following equation:

$$sunk_{it} = NI_{it} + (1 - \delta_{st})(1 - \gamma_{st})NK_{it} \quad \text{(a.5)}$$

where NI_{it} represents nominal investment net of investment in the form of leasing of firm *i* during period t, and $NK_{i,t-1}$ is the nominal capital stock, net of leased capital goods, available at the beginning of period *t.* δ_{st} and γ_{st} are respectively sector and time specific depreciation and resale rates. In order to obtain unbiased estimates of depreciation rate and resale rates, we exclude rates that exceed unity or are negative.[16] We then trim depreciation rates of firms with non-zero, respectively tangible or intangible, capital stock and on resale rates of firms with non-zero tangible fixed assets.[17] The trimming was based on the range defined by the median minus three times the interquartile range and the median plus three times the interquartile range. For observations where depreciation rates are not missing, we construct sunk costs using the average depreciation and re-sale rates by 2-digit NACE sector and year.

To evaluate our resale rates, we compare the resale rates by sector and year with the figures computed from the National Accounts statistics. Because the former include both sales and disposals, while the latter focus on sales on second-hand market, the former should be larger than the latter. This happens in 93.63% of the cases. Table A.3. below reports descriptive statistics on estimated sector-level depreciation rates and resale rates in our sample for firms with respectively tangible fixed assets and intangible fixed assets.

Table A.3. Descriptive statistics on estimated depreciation and resale rates of tangible and intangible fixed assets

	mean	std	Q1	median	Q3
$\delta^{tang}{}_{st}$	0.301	0.081	0.287	0.319	0.343
$\delta^{intang}{}_{st}$	0.031	0.049	0.000	0.000	0.077
$\gamma^{tang}{}_{st}$	0.019	0.022	0.004	0.014	0.026
$\gamma^{intang}{}_{st}$	0.016	0.027	0.000	0.000	0.032

16 This may be due to the fact that, for tangible capital, we subtract leasing from total capital stock.

17 We do not trim resale rates of intangible fixed assets because there is no resale in more than 75% of the observations. This makes the criterion unenforceable.

Measurement of demand uncertainty

We measure demand uncertainty at the 2-digit NACE sector level, by applying Theil's (1952) disconformity index to the firms' qualitative answers to the question.

> *Do you expect demand for your product in the next three months (A) to rise, (B) to remain unchanged, (C) to decrease, with respect to its average level at that time of the year?*

The index is applied to all firms in sector *s* and all months of year *t*. Note that the question slightly differs from one economic sector to the other. In services in particular, the business survey asks

> *Do you expect demand of your clients (or your turnover) in the next three months (A) to rise, (B) to remain unchanged, (C) to decrease, with respect to its average level at that time of the year?*

Alternatively, we test the robustness of our results with respect to another measure of sector uncertainty that has been widely used in the uncertainty literature. Following von Kalckreuth (2003), we estimate an first order autoregressive model of for (the log of) turnover, at the 2-digit NACE sector level. Sector uncertainty is measured by the standard deviation of the residual of this forecasting equation. It varies over time and across sectors. Ghosal (2010), like many others, applies the same methodology to profits.

Measures of competition

We rely on four measures of competition on the product market. First, we rely on classical concentration indices such as the Herfindahl index and C10 concentration index, at the 2-digit NACE and year level. The indices are constructed on the basis of market shares defined as the proportion of a firm's turnover in the total turnover of the sector. The computation of market shares is performed on the sample of firms and which report turnover (this information is not compulsory for small firms). This reduces the sample to 488,203 observations and 100,328 firms.

As alternatives, we also considered the elasticity of firms' profits with respect to marginal costs proposed by Boone *et al.* (2007). More specifically, we regress the log of profits on the log of marginal costs. Marginal variable costs are defined as variable costs over turnover. We exclude outliers such as observations with variable costs over turnover and profits over total assets outside the range defined by the median minus or plus three times the inter-quartile range. For each 2-digit NACE sector, we estimate the following firm-specific fixed effects regression of the log profits on the log of marginal costs, for the period 1997-2007:

$$profits_{it} = \alpha_i + D_t - \beta mc_{it} + v_{it} \qquad \text{(a.5)}$$

where β is the profit elasticity. As a robustness check, we also consider the sector-level estimates of price-cost margins constructed by Christopoulou and Vermeulen (2011) for 2-digit NACE sectors for the US and several EU countries, including Belgium.

While our first two indicators are time variant, the last two are only sector-specific and have therefore only been considered as robustness checks. Table A.4. reports the four measures of competition as well as correlations with median firm size in the sector, the number of firms within the industry, and sector average exit rates.

Table A.4. Measures of competition - Average over the period

nace 2-digit	Herfindahl	C10	profit elasticity	markup
15	0.01	0.27	0.63	1.07
16	0.26	0.97	5.64	1.04
17	0.02	0.31	0.89	1.07
18	0.23	0.73	0.77	1.10
19	0.62	0.98	0.42	1.09
20	0.05	0.49	0.84	1.11
21	0.05	0.57	1.02	1.10
22	0.01	0.30	0.99	1.13
23	0.76	1.00	1.23	1.08
24	0.03	0.44	0.68	1.13
25	0.02	0.38	0.74	1.12
26	0.02	0.37	1.03	1.08
27	0.10	0.77	1.63	1.19
28	0.01	0.22	0.92	1.11
29	0.04	0.51	1.57	1.20
30	0.20	0.94	0.40	1.38
31	0.06	0.61	0.79	1.11
32	0.16	0.87	0.92	1.04
33	0.08	0.68	1.23	1.17
34	0.12	0.79	0.78	1.06
35	0.12	0.87	1.33	1.07
36	0.02	0.37	0.93	1.03
45	0.05	0.54	1.21	1.13
50	0.33	0.94	0.97	1.44
51	0.14	0.96	1.34	1.42
52	0.00	0.14	0.93	1.15
60	0.10	0.56	0.64	1.21
63	0.01	0.23	0.72	1.14
64	0.04	0.44	0.78	1.20
65	0.02	0.31	0.61	1.22
67	0.07	0.45	0.65	1.25
70	0.35	0.96	0.60	1.07
71	0.28	0.98	0.20	1.00
72	0.01	0.28	0.65	1.33
73	0.15	0.88	0.98	1.46
correlations				
# firms	-0.293	-0.502	-0.111	-0.072
average size	0.419	0.384	0.045	-0.044
exit freq.	0.102	0.243	-0.274	0.382

Notes: *profit elasticity* is the competition measure used by Boone *et al.* (2007); *markup* is taken from Christopoulou and Vermeulen (2011); *Herfindahl*, the Herfindahl index and *C10,* the concentration index, are calculated based on turnover market shares.

Appendix B: Robustness tests

Table B.1 Additional variables - average partial effects of Probit estimates

	(1)	(2)	(3)	(4)
MNF_{it}	0.053***	0.049***	0.052***	0.069***
	(7.72)	(7.28)	(7.56)	(9.66)
Age_{it}	0.032***	0.033***	0.032***	0.034***
	(38.02)	(38.81)	(37.95)	(38.92)
Age_{it}^2	-0.0001***	-0.0001***	-0.0001***	-0.0001***
	(-8.98)	(-8.81)	(-9.00)	(-7.07)
TFP_{it}	-0.025***	-0.025***	-0.025***	-0.019***
	(-29.59)	(-29.63)	(-29.62)	(-22.68)
$Sunk_{it}$	-0.015***	-0.015***	-0.15***	-0.014***
	(-25.47)	(-25.68)	(-25.61)	(-24.46)
$Size_{it}$	-0.039***	-0.039***	-0.039***	-0.035***
	(-37.02)	(-37.08)	(-36.92)	(-34.23)
$Herfindhal_{st}$	-0.167***	-0.170***	-0.168***	-0.173***
	(-7.03)	(-6.97)	(-7.08)	(-7.49)
$\Delta log(VA_{st})$	-0.0004	-0.006	-0.0004	0.002
	(-0.07)	(-1.01)	(-0.07)	(0.44)
$MES\text{-}Sutton_{st}$	-0.013	0.260*	-0.014	-0.009
	(-0.20)	(1.69)	(-0.21)	(-0.14)
σ_{st}	-	0.056***	-	-
	-	(5.87)	-	-
Capital intensity	-	-	0.0003	-
	-	-	(0.87)	-
$Wage_{it}$	-	-	-	-0.015***
	-	-	-	(-8.25)
log L	-115675.0	-115013.7	-115651.9	-113211.2
σ_u	2.282	2.259	2.279	2.229
std(σ_u)	0.029	0.030	0.030	0.028
$X^2(\rho)$	9253.3***	9167.4***	9237.1***	9209.2***
Avg. pred. prob. | exit=1	0.275	0.274	0.275	0.281
Avg. pred. prob. | exit=0	0.034	0.034	0.034	0.033
ROC Area	0.822	0.823	0.822	0.827
std(ROC Area).	0.001	0.001	0.001	0.001
RV_TFP	-55.30	-55.34	-55.29	-38.89
RV_sunk	-41.84	-41.84	-41.83	-38.86
RV_size	-67.64	-67.31	-67.47	-69.65
RV_σ_{st}.sunk	-	-	-	-
RV_K/L	-	-	0.02	-
RV_wage	-	-	-	-44.68

Notes: The number of observations varies slightly according to data availability.

All equations include year and NACE 2-digit sector dummies; z-statistic in italic. σ_u is the estimated standard deviation of random effects; $X^2(\rho)$ is the Chi-squared test for the significativity of random effects.
*** = significant at the 1% level; * = significant at the 10% level.
Mundlak's correction has been applied to firm-level variables TFP_{it}, age_{it}, $sunk_{it}$ and $size_{it}$.*wages,* σ_{st}*sunk and capital intensity.
Rivers-Vuong instrumental variable approach has been applied to TFP_{it}, $sunk_{it}$ and $size_{it}$. The instrument set includes MNF_{it}, Age_{it}, *Profit elasticity*$_s$, *Sector growth*$_{it}$ sector dummies, and one lag of, respectively, TFP_{it}, $sunk_{it}$ $size_{it}$, *wages,* σ_{st}*sunk and *capital intensity.* The first step regression is estimated year by year.
% of true exits is the fraction of exits correctly predicted by the model, for a threshold value of 0.075 for exits.
% of true survival is the fraction of survivals correctly predicted by the model, for a threshold value of 0.075 for exits.
RV stands for the Rivers-Vuong endogeneity test; i.e. the t-stat of the residuals of the 1st-step regression in the Probit.

Table B.2 Alternative definition of variables - average partial effects of Probit estimates

	(1)	(2)	(3)	(4)
MNF_{it}	0.053***	0.052***	0.053***	0.054***
	(7.72)	(7.57)	(7.73)	(7.74)
Age_{it}	0.032***	0.031***	0.032***	0.032***
	(38.02)	(37.34)	(38.02)	(38.46)
Age_{it}^2	-0.0001***	-0.0001***	-0.0001***	-0.0001***
	(-8.98)	(-8.97)	(-8.98)	(-9.11)
TFP_{it}	-0.025***	-0.025***	-0.025***	-0.025***
	(-29.59)	(-30.04)	(-29.59)	(-29.10)
$Sunk_{it}$	-0.015***	-	-0.015***	-0.015***
	(-25.47)	-	(-25.57)	(-25.47)
Tangible $sunk_{it}$	-	-0.017***	-	-
	-	(-30.16)	-	-
$Size_{it}$	-0.039***	-0.037***	-0.039***	-0.039***
	(-37.02)	(-35.70)	(-37.02)	(-36.96)
$Herfindhal_{st}$	-0.167***	-0.166***	-0.166***	-
	(-7.03)	(-7.07)	(-7.00)	-
$\Delta\log(VA_{st})$	-0.0004	0.0005	-0.0004	-0.003
	(-0.07)	(0.10)	(-0.07)	(-0.49)
MES-$Sutton_{st}$	-0.013	-0.011	-0.011	-0.016
	(-0.20)	(-0.17)	(-0.20)	(-0.23)
$\sigma^{(turnover)}_{st}$	-	-	0.002	-
	-	-	(0.27)	-
$C10_{st}$	-	-	-	-0.0002
	-	-	-	(-0.02)
log L	-115675.0	-114903.7	-115674.9	-115700.9
σ_u	2.282	2.290	2.282	2.279
std(σ_u)	0.029	0.029	0.029	0.029
$X^2(\rho)$	9253.3***	9252.0***	9253.1***	9236.3***
Avg. pred. prob. | exit=1	0.275	0.274	0.275	0.274
Avg. pred. prob. | exit=0	0.034	0.033	0.034	0.034
ROC Area	0.822	0.822	0.822	0.822
std(ROC Area).	0.001	0.001	0.001	0.001
RV_TFP	-55.30	-55.97	-55.30	-55.08
RV_sunk	-41.84	-	-41.84	-41.82
RV_tangible_sunk	-	-45.36	-	-
RV_size	-67.64	-66.61	-67.64	-67.61
RV_σ_{st}.sunk	-	-	-	-

Notes: 687,099 observations and 119,343 firms over 1998-2008.

All equations include year and NACE 2-digit sector dummies; z-statistic in brackets. σ_u is the estimated standard deviation of random effects; $X^2(\rho)$ is the Chi-squared test for the significativity of random effects.
*** = significant at the 1% level.
Mundlak's correction has been applied to firm-level variables TFP_{it}, age_{it}, $sunk_{it}$ and $size_{it}$.
Rivers-Vuong instrumental variable approach has been applied to TFP_{it}, $sunk_{it}$ and $size_{it}$. The instrument set includes MNF_{it}, Age_{it}, *Profit* $elasticity_s$, *Sector* $growth_{it}$ sector dummies, and one lag of, respectively, TFP_{it}, $sunk_{it}$ $size_{it}$. The first step regression is estimated year by year.
% of true exits is the fraction of exits correctly predicted by the model, for a threshold value of 0.075 for exits.
% of true survival is the fraction of survivals correctly predicted by the model, for a threshold value of 0.075 for exits.
RV stands for the Rivers-Vuong endogeneity test; i.e. the t-stat of the residuals of the 1st-step regression in the Probit.

Table B.3 - Probit models for the probability of exit - average partial effects - alternative instrument sets

instruments set include:	(1) 1 lag of endogeneous variables	(2) No lag of endogeneous variables	(3) 2 lags of endogeneous variables
MNF_{it}	0.053***	-0.077	0.037***
	(7.72)	(-1.03)	(4.96)
Age_{it}	0.032***	0.049***	0.032***
	(38.02)	(14.48)	(35.75)
Age_{it}^2	-0.0001***	-0.00003***	0.000
	(-8.98)	(-5.29)	(0.06)
TFP_{it}	-0.025***	-0.015***	-0.018***
	(-29.59)	(-3.89)	(-22.10)
$Sunk_{it}$	-0.015***	-0.066***	-0.013***
	(-25.47)	(-12.77)	(-21.39)
$Size_{it}$	-0.039***	0.034***	-0.031***
	(-37.02)	(5.83)	(-29.36)
$Herfindhal_{st}$	-0.167***	-0.168***	-0.140***
	(-7.03)	(-6.82)	(-6.25)
$\Delta\log(VA_{st})$	-0.0004	-0.012**	0.005
	(-0.07)	(-2.07)	(1.06)
$MES\text{-}Sutton_{st}$	-0.013	-0.043	0.045
	(-0.20)	(-0.58)	(0.49)
log L	-115675.0	-114492.1	-87235.0
σ_u	2.282	2.312	2.499
std(σ_u)	0.029	0.031	0.036
$X^2(\rho)$	9253.3***	5944.4***	5927.3***
Avg. pred. prob. | exit=1	0.275	0.287	0.257
Avg. pred. prob. | exit=0	0.034	0.033	0.024
ROC Area	0.822	0.832	0.825
std(ROC Area).	0.001	0.001	0.001
RV_TFP	-55.30	-48.92	-49.99
RV_sunk	-41.84	-40.18	-37.93
RV_size	-67.64	-59.95	-56.36

Notes: All equations include year and NACE 2-digit sector dummies; z-statistic in brackets. σ_u is the estimated standard deviation of random effects; $X^2(\rho)$ is the Chi-squared test for the significativity of random effects.
*** = significant at the 1% level ; ** = significant at the 5% level.
Mundlak's correction has been applied to firm-level variables TFP_{it}, age_{it}, $sunk_{it}$ and $size_{it}$.
Rivers-Vuong instrumental variable approach has been applied to TFP_{it}, $sunk_{it}$ and $size_{it}$. The instrument set includes MNF_{it}, Age_{it}, *Profit elasticity*$_s$, *Sector growth*$_{it}$ sector dummies, and in column (1) one lag of, respectively, TFP_{it}, $sunk_{it}$ and *size*, in column (2) zero lag of. TFP_{it}, $sunk_{it}$ and *size*, and in column (3) lag 2 of TFP_{it}, $sunk_{it}$ and *size.* The first step regression is estimated year by year.
% of true exits is the fraction of exits correctly predicted by the model, for a threshold value of 0.075 for exits.
% of true survival is the fraction of survivals correctly predicted by the model, for a threshold value of 0.075 for exits.
RV stands for the Rivers-Vuong endogeneity test; i.e. the t-stat of the residuals of the 1st-step regression in the Probit.

R^2 of endogenous variable regressed on DMNF, age, profit elasticity, sectoral growth and year dummies and own lags

	TFP_{it}	$Sunk_{it}$	$Size_{it}$
lag 1	0.9984	0.8941	0.9568
no lag	0.9917	0.1411	0.2209
lag 2	0.9880	0.8249	0.9196

Table B.4. - Probit models with interactions with MNF and Belgian MNF dummies - average partial effects

	(1)	(2)	(3)	(4)	(5)
MNF_{it}	0.054***	0.059***	0.049***	0.139***	0.081***
	(7.74)	(7.46)	(6.85)	(7.96)	(3.91)
Belgian MNF_{it}	-0.010	-0.016	-0.017	-0.010	-0.020
	(-0.87)	(-1.26)	(-1.46)	(-0.42)	(-0.64)
Age_{it}	0.032***	0.032***	0.032***	0.032***	0.032***
	(38.02)	(37.96)	(37.98)	(37.96)	(37.97)
Age_{it}^2	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***
	(-8.99)	(-8.94)	(-9.01)	(-8.99)	(-9.01)
TFP_{it}	-0.025***	-0.025***	-0.025***	-0.025***	-0.025***
	(-29.59)	(-29.53)	(-29.49)	(-29.48)	(-29.47)
MNF_{it} x TFP_{it}	-	0.0002	-	-	-
	-	(1.09)	-	-	-
Belgian MNF_{it} x TFP_{it}	-	-0.0005	-	-	-
	-	(-0.75)	-	-	-
$Sunk_{it}$	-0.015***	-0.015***	-0.015***	-0.015***	-0.015***
	(-25.57)	(-25.58)	(-25.83)	(25.62)	(-25.79)
MNF_{it} x $Sunk_{it}$	-	-	0.009***	-	0.007***
	-	-	(6.85)	-	(4.28)
Belgian MNF_{it} x $Sunk_{it}$	-	-	0.004	-	0.004
	-	-	(0.47)	-	(0.34)
$Size_{it}$	-0.039***	-0.039***	-0.039***	-0.039***	-0.039***
	(-37.02)	(-36.96)	(-36.97)	(-37.15)	(-36.99)
MNF_{it} x $Size_{it}$	-	-	-	0.011***	0.004
	-	-	-	(5.39)	(1.58)
Belgian MNF_{it} x $Size_{it}$	-	-	-	-0.001	-0.003
	-	-	-	(-0.09)	(-0.23)
log L	-115674.6	-115673.2	-115650.9	-115656.7	-115646.3
σ_u	2.283	2.277	2.271	2.270	2.268
std(σ_u)	0.029	0.030	0.030	0.030	0.030
$X^2(\rho)$	9253.9***	9213.39***	9226.1***	9217.4***	9218.1***
% true exits	0.275	0.275	0.275	0.275	0.275
% true surv.	0.034	0.034	0.034	0.034	0.034
ROC Area	0.822	0.822	0.822	0.822	0.822
std(ROC Area).	0.001	0.001	0.001	0.001	0.001
RV_TFP	-55.30	-55.22	-55.19	-55.20	-55.18
RV_MNF.TFP	-	2.64	-	-	-
RV_Belgian MNF.TFP	-	-0.90	-	-	-
RV_sunk	-41.84	-41.81	-41.93	-41.86	-41.87
RV_MNF.sunk	-	-	3.17	-	2.31
RV_Belgian MNF.sunk	-	-	1.45	-	0.61
RV_size	-67.64	-67.49	-67.46	-67.43	-67.33
RV_MNF.size	-	-	-	3.58	2.62
RV_Belgian MNF.size	-	-	-	1.47	0.99

Notes: 687,099 observations and 119,343 firms over 1998-2008.
All equations include year and NACE 2-digit sector dummies, the NACE 2-digit turnover Herfindhal index, the NACE 2-digit sectoral growth and the MES; z-statistic in brackets. σ_u is the estimated standard deviation of random effects; $X^2(\rho)$ is the Chi-squared test for the significance of random effects.
*** = significant at the 1% level.
Mundlak's correction has been applied to firm-level variables TFP_{it}, age_{it}, $sunk_{it}$ and $size_{it}$.
Rivers-Vuong instrumental variable approach has been applied to TFP_{it}, $sunk_{it}$ and $size_{it}$. The instrument set includes MNF_{it}, Age_{it}, *Profit elasticity*$_s$, *Sector growth*$_{it}$ sector dummies, and one lag of, respectively, TFP_{it}, $sunk_{it}$ $size_{it}$,. The first-step regression is estimated year by year.
% of true exits is the fraction of exits correctly predicted by the model, for a threshold value of 0.075 for exits.
% of true survival is the fraction of survivals correctly predicted by the model, for a threshold value of 0.075 for exits.
RV stands for the Rivers-Vuong endogeneity test; i.e. the t-stat of the residuals of the 1st-step regression in the Probit.

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