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Economic slowdowns, hazard rates and foreign ownership

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ABSTRACT

This paper evaluates the link between foreign ownership and firm exit during crises, using a longitudinal micro dataset over an 18-year period. We address two main questions: first, if foreign affiliates have different failure rates than domestic firms during economic downturns, and second if the foreignness effect differs between two different economic downturns. The results partially confirm the liability of foreignness argument, suggesting that when the crisis was more pronounced at home than abroad, the differences in hazard rates between foreign and domestic firms reduce. The footloose argument is also only partially confirmed. For policy makers, our results on survival dynamics during crises are not against policies stimulating inward investment. There is no need to fear that foreign firms destabilize more than usual the host economy during economic slowdowns by immediately closing down operations.

1. Introduction

The recent global financial and economic crisis and the consequent scaling up of bankruptcy indicators call for further reflection on the survival patterns of firms during a crisis period. The literature on firm survival has shown the detrimental impact of macroeconomic instability upon firms' survival and their dynamics (e.g., Audretsch & Acs, 1994; Bhattacharjee, Higson, Holly, & Kattuman, 2009; Geroski, Mata, & Portugal, 2010; Varum & Rocha, 2011, 2012). However, particular groups of firms may be better able to surpass the difficulties of a crisis. In this regard, one may ask if foreign firms exit with less or greater likelihood than their domestic counterparts, and how does this likelihood of exiting vary in economic downturns. This issue has been relatively neglected in the literature, albeit the weight of foreign firms on many host economies.

There is a rich stream of literature investigating the survival of firms in foreign markets in comparison with domestic firms (Bernard & Sjöholm, 2003; Görg & Strobl, 2003a, 2003b; Kronborg & Thomsen, 2009; Li & Guisinger, 1991; Mata & Portugal, 2002). The overwhelming conclusion is that after controlling for characteristics that make foreign firms different than domestic ones, foreign firms tend to exit with greater likelihood. The most common explanations to why foreign firms exit more often than domestic ones rest upon the idea that in host economies foreign firms face certain disadvantages *vis-à-vis* their domestic counterparts, thus suffering from a 'liability of foreignness' (Zaheer, 1995). Along this line of thought, the theory of multinational enterprises has developed upon the argument that firms operating in foreign markets need to have some type of ownership advantages to compensate for these increased costs of doing business abroad (Dunning & Lundan, 2008). From another line of argumentation, multinationals are by nature more footloose than domestic firms, and therefore are more likely to exit (Mata & Freitas, 2012).

Both lines of argument support the view that foreign firms may be more likely to exit markets. However, they lead to different expectations with respect to the likelihood of exit during economic downturns. The footloose argument implies that foreign firms should be even more likely to exit during downturns. When changes in the host economy make that economy less attractive, relocation is seen more favorably by foreign firms than by domestic ones, which are more attached to a particular location. Alternatively, the liability of foreignness argument implies that the exit rates of foreign and domestic firms should converge during

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Table 1
Empirical evidence on the foreign ownership–firm survival link.[a]

(A) Positive relationship	(B) Negative relationship
Behrman and Deolalikar (1989) – Indonesia [1975–1985]	Zaheer and Mosakowski (1997) – 47 countries [1974–1993]
Li and Guisinger (1991) – USA [1978–1988]	Görg and Strobl (2003a, 2003b) – Ireland [1973–1996]
Audretsch and Mahmood (1994) – USA [1976–1986]	Bernard and Sjöholm (2003) – Indonesia [1975–1989]
Mata and Portugal (2004) – Portugal [1983–1989]	Kimura and Kiyota (2006) – Japan [1994–2000]
Narjoko and Hill (2007) – Indonesia [1993–2000]	Bernard and Jensen (2007) – USA [1987–1997]
Bridges and Guariglia (2008) – UK [1997–2002]	Van Beveren (2007) – Belgium [1996–2001]
Girma and Gong (2008) – China [1999–2005]	Fertala (2008) – Germany [1997–2004]
Kronborg and Thomsen (2009) – Denmark [1895–2005]	Álvarez and Görg (2009) – Chile [1990–2000]
Holmes, Hunt, and Stone (2010) – UK [1973–2001]	Bandick and Görg (2010) – Sweden [1993–2002]
(C) Neutral relationship	
Mata and Portugal (2002) – Portugal [1983–1989]	Kimura and Kiyota (2007) – Japan [1994–1998]
Özler and Taymaz (2004) – Turkey [1983–1996]	Taymaz and Özler (2007) – Turkey [1983–2001]

[a] Studies are presented in a chronological order (*Reference* – *Country* [*Time Period*]).

downturns because foreign firms hold some sort of ownership advantages over domestic ones. Foreign multinationals may have better conditions to face the crises owing to their multinationality advantages or they may resist more due to the sunk costs associated with their investment (Chung, Lu, & Beamish, 2008; Desai, Foley, & Forbes, 2004; Ghosal, 2010).

Studies about the importance of foreign ownership during crises are relatively scarce, the notable exceptions being the studies by Álvarez and Görg (2009), Lee and Makhija (2009) and Varum and Rocha (2011). Hence, in this paper we use longitudinal firm-level data for a large time span to assess, first, whether foreign ownership contributes to differentiating the incidence of firm exit during crises, controlling for other determinants that may affect the exit risk of firms. We use discrete time hazard models that account for firm-level unobserved heterogeneity to answer our research questions. In addition, we analyze whether the foreign ownership effect differs between two crises, which occurred in the same economy, in different periods of time and with different characteristics. To our knowledge the paper is unique in these respects. We analyze manufacturing firms created in Portugal in the period 1988–2005 by following their paths during the whole period and the economic slowdowns of early 1990s and 2000s. Portugal in particular is an interesting case as the economy experienced these significant slowdowns which provide us with 'a natural experiment to identify directly the "footloose nature" of multinationals' (Álvarez & Görg, 2009).

Results from past lessons may be of value in understanding more modern recessions, such as the one from which the world economy is currently recovering. For the Portuguese case we add to the previous important contributions of Mata and Portugal (2002, 2004), by enlarging the time span of their study and focusing on the potential effect of foreign ownership during (different) downturn periods. Compared to Varum and Rocha (2011), who examined the link between foreign ownership, firm employment and turnover growth and crises, the present study investigates firms' dynamics in terms of firm survival, using discrete time duration models. The analysis also adds to Varum and Rocha (2012) by exploring the foreignness effect upon firm survival under crises, differentiating between two distinct crisis contexts.

The paper is organized as follows. Section 2 reviews the literature on foreign ownership–firm survival relationship. Most of this literature does not focus on the effects during downturns, but allows for understanding why we may expect differences between foreign and domestic firms' exits patterns. Section 3 relates to methodological issues, where the data and econometric procedures are outlined. Section 4 presents some descriptive statistics and discusses the results. Section 5 concludes.

2. Macroeconomic conditions, foreign ownership, firm survival and exit

The overall state of the economy has long been indicated as an important force driving firms out of business (Geroski et al., 2010). Current macroeconomic environment affects not only market conditions but also market expectations about the future, leading firms to exit if an unfavorable environment is predictable. Despite the fact that some studies prove that exit is not responsive to the cycle (e.g. Boeri & Bellman, 1995; Ilmakunnas & Topi, 1999), many others found that firm exit is countercyclical and that there is a detrimental impact of macroeconomic instability upon firms' survival and their dynamics (Audretsch & Acs, 1994; Bhattacharjee et al., 2009; Box, 2008; Varum & Rocha, 2012). Downturn periods are expected to increase firms' hazards, though eventually this effect may be different between firms. Hence, it is important to investigate which firm-level conditions contribute to explain why firms resist differently during economic slowdowns.

Many studies have investigated the survival of firms in foreign markets. The empirical results on this matter are not unanimous (see Table 1). The overwhelming conclusion is that when controlling for a number of variables along which foreign firms differentiate from domestic ones, the former often exhibit higher exit rates. This fact may be due to the *liability of foreignness* (Zaheer & Mosakowski, 1997) or to the footloose nature of multinationals.

However, it remains overlooked whether under a crisis' environment foreign firms are affected or react differently from domestic firms and, if that is the case, whether or not their advantages compensate for the disadvantages of doing business abroad, possibly making them weather the crisis in a better way (or not). From the literature, we may explore arguments for a stabilizer or otherwise role of multinational enterprises (MNEs) during economic downturns.

2.1. Footloose multinationals and economic downturns

Compared to their domestic counterparts, it may be easier for foreign firms to transfer production facilities internationally (Flamm, 1984; Lee & Makhija, 2009), to cut operational costs (Gao & Eshaghoff, 2004) and, in the extreme, to exit the local economy. If multinationals are indeed more "footloose", they may be expected to be more likely to leave the country, especially during that period when it is hit by a negative shock. Actually, and relying on the way of thinking about foreign direct investment (FDI) enriched by real option theory (Campa, 1993; Li & Rugman, 2007), foreign firms may decide to switch operations quickly between locations in response to changing costs differentials, market opportunities and host country uncertainty, particularly

when the "growth-or-switch options" created when investing abroad overlap or duplicate each other (Belderbos & Zou, 2009). Unless sunk costs and the irreversibility of investment are considerable – which may, in opposition, create some "hysteresis" and inertia in foreign firms' strategic response to macroeconomic changes – multinational firms tend to be more footloose than their domestic counterparts when facing environmental uncertainty, especially when their real investment options are redundant, either at the host-country level or at the MNE portfolio level (Belderbos & Zou, 2007, 2009; Ghosal, 2010; Lehmann, 2002).

Though empirical analyses on MNEs' responses to macroeconomic changes are still scant, some results already emerged. Using plant-level data for manufacturing industries in Chile, Álvarez and Görg (2009) examined the determinants of exit probabilities of plants in the period 1995–2000 covering a major slowdown in the late 1990s, paying particular attention to the role of the nationality of the plant. They found robust evidence that foreign plants were more likely to exit only for the late 1990s, when the Chilean economy was in recession. They argue that this evidence is consistent with the argument that multinationals are more likely to readjust their investment decisions and exit if the economy is hit by a negative shock. Hence, following this line of argumentation, we derive the following hypothesis:

Hypothesis 1. The probability of exit of foreign-owned firms increases even further to those of domestic firms during economic downturns.

2.2. Liability of foreignness and ownership advantages over economic downturns

The liability of foreignness (Zaheer, 1995), or the extra costs foreign firms face *vis-à-vis* their domestic counterparts in host economies, has been at the center of the literature that found foreign firms to exit more than domestic ones with similar characteristics (Bernard & Sjöholm, 2003; Görg & Strobl, 2003a, 2003b; Zaheer & Mosakowski, 1997). Even though, foreign enterprises are said to possess firm-specific advantages – of the type described in the pioneering work of Hymer (1976) – that compensate for the liability of foreignness, which make them able to surpass and to outperform their domestic counterparts in the host economy (Dunning & Lundan, 2008). These advantages may become more valuable during economic downturns in the host economy.

Chung et al.'s (2008) study of a sample of Japanese subsidiaries from 1994 to 1999 indicates that the enhanced flexibility associated with intra- and inter-firm organizational linkages is more likely to increase the performance of subsidiaries operating in a crisis rather than in economically stable environments. Blalock, Gertler, and Levine (2005), in turn, investigated whether foreign ownership affected investment in Indonesia in 1997 following the Asian financial crisis. Despite they could not reject somewhat higher excess mortality rates among foreign-owned plants, they concluded that the post-crisis excess mortality of foreign firms was lower than the differences found in the pre-crisis. They argued that this convergence was due to the 'multinationality' advantage of foreign firms. Firms with foreign ownership, in particular those more oriented toward export markets, could access credit through their parent company and thus insure themselves against liquidity constraints. Accordingly, foreign subsidiaries in MNE networks may survive longer in a crisis owing to their better access to resources and greater ability to use internal capital markets when faced with financial constraints, being able to access overseas credit through their parent companies, which allows them to expand their economic activity even in turbulent periods (e.g., Desai et al., 2004). The argumentation above predicts that during economic downturns, the incidence of the exit of foreign firms, which in normal periods tends to be higher, may actually get closer to that of domestic firms. Hence, we derive the following alternative hypothesis:

Hypothesis 2. The probability of exit of foreign owned firms becomes closer to that of domestic firms during economic downturns.

In what follows we conduct the empirical analysis and derive our conclusions of the aforementioned hypotheses.

3. Data and methodological issues

3.1. Data

In this study, we use data from Quadros de Pessoal (henceforth QP), a matched employer–employee administrative dataset from the Portuguese Ministry of Employment. QP is an annual mandatory employment survey that all firms in the private sector employing at least one wage earner are legally obliged to fill in. Requested data cover the establishment (location, employment and economic activity), the firm (location, employment, sales, economic activity, ownership, number of establishments and legal setting) and each of its workers (gender, age, education, qualifications, occupational category, employment status, earnings, tenure and hours of work). All firms, establishments and workers entering QP dataset have a unique identification number, so we can track firms/establishments and workers over time and match workers with their respective employers. This makes QP a suitable dataset to study firm survival and exit.

We have access to the original data for the period 1985–2007. By working directly with raw data files at the firm-level, it was possible to compute entry and exit measures by ourselves. Firm's entry year corresponds to the first year the firm appears in the dataset. Therefore, we can only identify entries from 1986 onwards, as data for 1985 was only used to check the presence of firms in the dataset. The time of exit, in turn, was determined by the last year the firm was registered in QP. However, as temporary exits of one year may occur (for instance, due to a firm's delay in delivering the survey in a particular year), we have required an absence of the firm from QP for at least two consecutive years to confirm that the firm has definitely exited and closed operations. Accordingly, we can identify exits only until 2005, as data for 2006 and 2007 are only used to check the records of the firm in the two subsequent years.

Firm exit is defined as the event of closing a firm. Despite the comprehensiveness of the QP database, it has also some limitations, which prevented us from distinguishing between different exit modes – namely between voluntary exit and bankruptcy – or even from identifying cases in which a firm is absorbed or taken over by another firm. The same problems were already faced by previous empirical works for Portugal (e.g. Geroski et al., 2010; Mata & Portugal, 2002, 2004) using QP data. As a result, our analysis is based on the timing at which a firm ceases to do business, disappearing from QP records. Regarding possible cases of mergers, in which an independent legal unit might disappear without the corresponding disappearance of the firm, there is no published data on mergers for Portugal. However, Geroski et al. (2010) ensure that less than 1% of the total number of liquidations in Portugal is due to mergers or acquisitions, which suggests that our limitations in identifying exits due to mergers have no significant impact on our results.

The analysis is performed for firms operating in Manufacturing Industry during the period 1988–2005. We have to restrict the period to 1988–2005 because we only have data on the industry's

exports and imports (which are needed to compute industry's openness to trade, to be controlled in our estimations) from 1988 onwards (see Appendix A.I). We focus on the 1988 and later cohorts, following each firm since the year of entry until its last record in the database, which may correspond to the moment of exit or, alternatively, to the last year we have information about the firm. If the firm has not experienced the exit during the whole period, it is identified as a right-censored case, corresponding to firms whose entry year is known but which are still active when the period under study ends (Hosmer, Lemeshow, & May, 2008; Singer & Willett, 1993).

3.2. Empirical strategy and variables

We rely on duration models, which provide a dynamic framework that addresses the inability of static binary choice models to take into account right-censoring issues. As data on firms' duration comes from an annual survey, our measured durations are grouped into yearly time intervals, which are properly accommodated by discrete time duration models (Singer & Willett, 1993). We thus proceed by dividing the time axis (1988–2005) into 18 intervals, corresponding to our 18 measured durations.

Formally, we observe firm i's spell from period $j = 1$ (corresponding to the year of entry) through to the end of the jth period, at which point i's spell is either complete $c_i = 1$ or right-censored $c_i = 0$ (flow sample). To estimate the discrete interval hazard rate – that is, the probability of exiting at discrete time t_j, $j = 1, 2, \ldots$, conditional upon having survived until then – can be defined as:

$$h_{ij} = Pr(T_i = j | T_i \geq j) = F(\gamma(t) + X_i'(t)\beta + \varepsilon_i), \quad (1)$$

where h_{ij} is the probability of firm i remaining active for exactly j years; $\gamma(t)$ describes the pattern of duration dependence (the baseline hazard); $X_i'(t)$ is a vector of firm and industry-level variables which, from the literature, and similarly to Varum and Rocha (2012), are expected to impact on firm survival (see Appendix A.I for details on these variables); β is a vector of unknown parameters to be estimated; ε_i is a disturbance term that includes the time-invariant unobserved heterogeneity (the firm-specific effect) and that is assumed to be uncorrelated with the observable firm and industry characteristics $X_i'(t)$; and finally $F(\cdot)$ denotes the complementary log-logistic distribution function.

Following prior studies on firm survival using QP (Mata & Portugal, 2002; Varum & Rocha, 2012), we do not impose any functional form for $\gamma(t)$; we instead estimate a piecewise constant hazard model, where exit rates are assumed to be constant within each interval (year) but different between intervals (years). Thus, in order to estimate the full set of γ's, we have added an indicator variable per duration time t to the model. This flexible modeling has been recognized to be preferred in order to avoid serious misspecifications. Moreover, such hazard formulation with a flexible baseline hazard function makes an attractive model with which to combine a specific heterogeneity assumption (Cameron & Trivedi, 2005: 620). Accordingly, following usual conventions (e.g., Hougaard, 1995; Jenkins, 2005), we assume an Inverse Gaussian distribution for the unobserved heterogeneity term, so that ε_i is normally distributed with zero mean and unitary variance.

Summing up, the discrete time hazard function in (1), to be estimated under a complementary log-logistic model with Inverse Gaussian unobserved heterogeneity, may be rewritten as follows:

$$h_{ij} = 1 - \exp\{-\exp[\gamma(t) + X_i'(t)\beta + \log(\varepsilon_i)]\}. \quad (2)$$

The variable *Foreign Ownership* – one of the core variables included in the vector $X_i'(t)$ – will allow us to assess the effect of foreign capital participation in firms' exit patterns. As our main goal is to assess whether foreign-owned firms have different failure rates than domestic firms during downturns, and if that effect differs depending on the type of crises, we focus our attention on an interaction term between *Foreign Ownership* and two indicator variables for the periods of economic downturn (*For. Own*-Downturn*$_i$, with i = 1991–1994, 2001–2003).

Regarding other firm and industry-level variables that are believed to affect firm survival, we follow the existent empirical literature on firm survival determinants (see, for instance, Manjón-Antolín and Arauzo-Carod (2008) for a survey). At the firm-level, we control for firm age (see Jovanovic, 1982; Stinchcombe, 1965, among others), firm size (measured by the log number of employees) (e.g., Varum & Rocha, 2012), human capital (proxied by the share of college workers) (e.g., Acs & Armington, 2009; Bates, 1990), firm performance (sales per worker, in logs) (e.g., Bandick, 2010; Carreira & Teixeira, 2011) and location in urban centers (e.g., Fotopoulos & Louri, 2000). The effects of firm age and size are allowed to be non-linear in line with most of the literature, as these variables may exert an increasing (decreasing) effect on firm exit risks up to some point of firm age or size, while exerting a decreasing (increasing) effect thereafter.

Concerning the industry environment, we will control for potential differences in the industry context. We will consider the minimum efficient scale – calculated as the median of 2-digit industry's employment – as one of the reasons why so many firms fail is that their entry size is smaller than the minimum scale required to be efficient (Audretsch, 1995). By including industry openness (measured by the ratio of 2-digit industry's (exports + imports) to industry's gross value added), we try to take the industry's exposure to international conditions into account. We will control for market concentration through the Herfindahl–Hirschman (HH) Index, which may either raise the risk of failure through greater competition intensity or decrease the exit rates by offering the incumbents enough power to retaliate against entrants. Industry growth (in terms of employment) will also be controlled for, as average profits are affected by growth rates of industries, so industries growing quickly may exert positive impacts upon survival. Entry rates may also be associated with firm survival, as firms tend to enter the industries where higher profits are expected. Agglomeration economies at the industry and regional-levels, as well as foreign presence in the industry, will also be taken into account, as they are commonly controlled for in comparative studies of domestic and foreign firms (see Table A.I for additional details on the computation of these variables). Regarding foreign presence, this variable is commonly introduced in firm survival studies, not only to try to capture horizontal spillovers from multinationals to other firms in the industry (Álvarez & Görg, 2009), but also in order to account for some unobserved characteristics of the industries, such as advertising and technological intensity (Mata & Portugal, 2002), which may be related to the previous presence of foreign firms in the market.

4. Empirical results

4.1. Descriptive statistics and unconditional survival analysis

4.1.1. Survival and hazard rates

Over the time period under scrutiny, it was possible to identify two downturn periods in the Portuguese economy: the early 1990s (1991–1994) and the early 2000s (2001–2003) (Bank of Portugal, 2009). Figs. 1 and 2 illustrate, respectively, the evolution of real GDP growth rates and unemployment rates over the period under study, both for Portugal and for the Euro area. In these periods, the common stylized facts for a downturn period were observed – both periods were characterized by declines in GDP growth rates, in private consumption and investment and by a rise in unemployment. However, the early 2000s recession was different from that

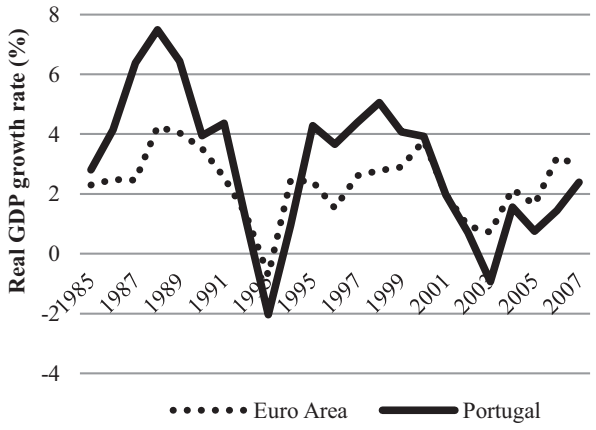


Fig. 1. Annual growth rate of real GDP.
Source: World Development Indicators.

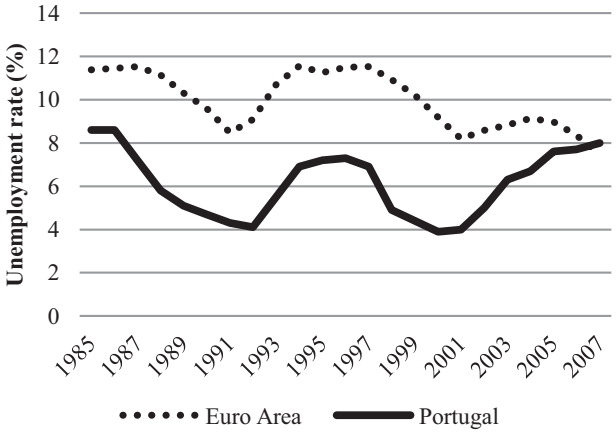


Fig. 2. Unemployment rate.

occurred in 1993/1994, when foreign demand for goods fell 3.2%, which culminated into a period of several years in which there was a gradual slowing of this variable. According to the Bank of Portugal (2004), the reduction of the product in 2003 was not associated with a fall in exports of goods and services. Hence, for the purpose of our analysis we consider the second crisis to be predominantly domestic driven.

After identifying entry and exits of firms in Manufacturing, we obtained a discrete time panel data set composed by 87,027 firms "born" during the period 1988–2005. From these, 55,622 exits were identified. As a first step of our survival analysis, we have estimated the survivor function of firms, without controlling for any observed and unobserved differences between them. Using Kaplan–Meier (KM) estimator (Kalbfleisch & Prentice, 1980), the unconditional probability of a firm surviving beyond time t is computed as follows:

$$\hat{S}(t_j) = \prod_{j=t_0}^{t} \left(1 - \frac{d_j}{n_j}\right), \tag{3}$$

where d_j is the number of exits in each time interval and n_j is the number of firms at risk of exit. Precise estimations for the survivor and hazard functions for all firms are presented in Table 2.

Only 15.57% of the firms remained active after 18 years. The results also confirm the high exit rate of young firms. Indeed, the risk of exit tends to be higher during the first five years of activity – which corresponds to the estimated median survival time – being slightly lower thereafter. In particular, data show that more than 50% of firms ceased their operations during the first five years and almost 70% of firms exited before completing a decade of activity.

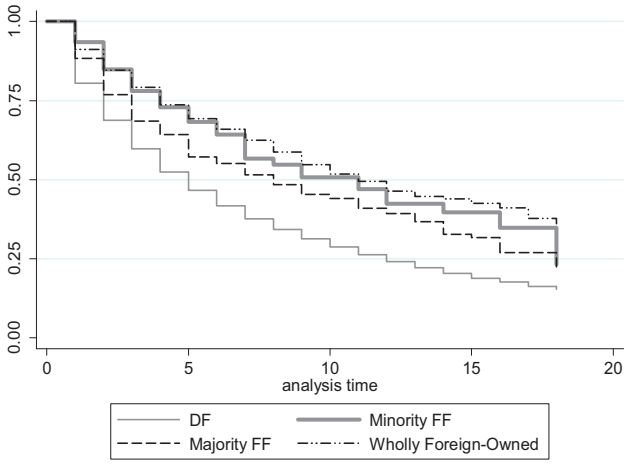
Fig. 3 depicts the KM survivor functions for different categories of firms, stratified according to their foreign ownership status (Domestic Firm if less than 10% of the capital is held by foreigners, Minority Foreign Firm (FF) if the share of foreign capital is between 10% and 49%, Majority FF if this share is between 50% and 99% and, finally, Wholly-Owned FF for the cases in which 100% of the capital is foreign). Table 3 compares the unconditional survival rates between small and large firms within the samples of foreign and domestic firms. Firms are stratified into small and medium-sized or large-sized firms through an indicator variable *Small* that assumes the value 1 if the firm is a SME (Small–Medium Enterprise). This classification is made according to the European definition of SMEs (European Commission, 2005).

Unconditionally, foreign-owned firms survive longer than their domestic counterparts and, moreover, wholly foreign-owned firms seem to have the highest survival rates. Median survival time is lower for domestic firms (about four to five years against 10–12 years for foreign firms). The Log-Rank and Wilcoxon tests confirm that differences are statistically significant at the 1% level. Taking in consideration firm size, the differences in survival chances seem not to be relevant among foreign firms. Conversely, large domestic

Table 2
Survival and hazard rates – all firms in Portuguese manufacturing industry, 1988–2005.

Time interval	Nr. firms at risk	Nr. failures	Net Lost[a]	Survival	Std. error	Hazard	Std. error	Cumulative failure
[1–2[	87,027	16,890	3350	0.8059	0.0013	0.1941	0.0015	0.1941
[2–3[	66,787	9631	2820	0.6897	0.0016	0.1442	0.0015	0.3103
[3–4[	54,336	7058	3145	0.6001	0.0017	0.1299	0.0015	0.3999
[4–5[	44,133	5328	3381	0.5277	0.0018	0.1207	0.0017	0.4723
[5–6[	35,424	3953	3466	0.4688	0.0018	0.1116	0.0018	0.5312
[6–7[	28,005	2872	1975	0.4207	0.0018	0.1026	0.0019	0.5793
[7–8[	23,158	2277	1544	0.3793	0.0018	0.0983	0.0021	0.6207
[8–9[	19,337	1704	1335	0.3459	0.0018	0.0881	0.0021	0.6541
[9–10[	16,298	1387	1290	0.3165	0.0019	0.0851	0.0023	0.6835
[10–11[	13,621	1125	1060	0.2903	0.0019	0.0826	0.0025	0.7097
[11–12[	11,436	929	1273	0.2668	0.0019	0.0812	0.0027	0.7332
[12–13[	9234	787	1491	0.2440	0.0019	0.0852	0.0030	0.7560
[13–14[	6956	547	896	0.2248	0.0019	0.0786	0.0034	0.7752
[14–15[	5513	447	854	0.2066	0.0019	0.0811	0.0038	0.7934
[15–16[	4212	303	950	0.1917	0.0020	0.0719	0.0041	0.8083
[16–17[	2959	181	855	0.1800	0.0020	0.0612	0.0045	0.8200
[17–18[	1923	150	914	0.1660	0.0022	0.0780	0.0064	0.8340
[18–19[	859	53	806	0.1557	0.0025	0.0617	0.0085	0.8443

[a] "Net Lost" gives the number of censored cases, and hence the cases no longer entering the risk set.



Log-Rank Test $\chi^2(3) = 228.53$*** Wilcoxon Test $\chi^2(3) = 207.41$***

Fig. 3. K–M survivor function, by foreign ownership.

firms seem to have substantially better chances of survival. In opposition, small domestic firms are more exposed to risk of exit during their infancy, with almost 40% of these firms closing down operations before the third year of activity, and less than 50% reaching the fifth year.

4.1.2. Describing foreign and domestic firms

Table 4 provides a brief comparison between domestic and foreign firms, presenting the mean values of the main independent variables included in our estimations. Overall, we observe that firms with foreign participation are larger, more intensive in human capital, with higher levels of operational performance, being also more concentrated in urban centers, when compared to domestic firms.

Regarding the industries entered, our results confirm expected differences between foreign and domestic entrants. Foreign entrants prefer industries where concentration is higher, where minimum efficient scale is larger, with stronger foreign presence and greater openness to external trade. Regarding the industry growth rate, the entry rates in the industry and the agglomeration in the region where firms are located, the differences were not so evident. However, the overall results suggest that, due to their intrinsic advantages, foreign entrants are usually in a better position to overcome the obstacles posed by entry barriers. A correlation matrix for the main variables included in the estimations can be found in Appendix A.II.

4.2. Estimation results

4.2.1. The foreign ownership effect

Table 5 provides our first results on the effect of foreign ownership measured by the share of firm capital held by foreign investors. Table A.III presents a summary of the results obtained

Table 3
Survival rates for domestic and foreign SMEs and LEs (Portugal, 1988–2005).

Survival time	Domestic Firms		Minority FF		Majority FF		Wholly-Owned FF	
	SMEs	LEs	SMEs	LEs	SMEs	LEs	SMEs	LEs
1	0.8059	0.7957	0.9459	1.0000	0.9034	1.0000	0.9127	0.8966
3	0.6001	0.7162	0.8188	0.7500	0.7359	0.9167	0.7927	0.7890
5	0.4686	0.6479	0.7294	0.7500	0.6371	0.8148	0.6950	0.6216
7	0.3790	0.5822	0.6202	0.7500	0.5774	0.6984	0.6245	0.6216
9	0.3160	0.5433	0.5770	0.7500	0.5230	0.6984	0.5498	0.4895
11	0.2661	0.4939	0.5339	0.7500	0.4794	0.5587	0.4980	0.4196
13	0.2240	0.4939	0.4905	.	0.4349	0.5587	0.4481	0.4196
15	0.1909	0.4233	0.4088	.	0.3947	.	0.4252	0.4196
17	0.1652	0.4233	0.3577	.	0.3464	.	0.3753	0.4196
Log-Rank Test $\chi^2(1)$	13.46***		0.10		1.21		0.08	
Wilcoxon Test $\chi^2(1)$	5.93**		0.05		1.74		0.12	

SMEs: Small and Medium Enterprises; LEs: Large Enterprises.
** Significant at 5%.
*** Significant at 1%.

Table 4
Descriptive statistics (mean values) – Portugal, 1988–2005.

	Domestic Firms	Minority FF	Majority FF	Wholly-Owned FF
For. Ownership	0.0000	0.2969	0.7264	1.0000
FF_Minority[a]	0.0000	1.0000	0.0000	0.0000
FF_Majority[a]	0.0000	0.0000	1.0000	0.0000
FF_Wholly Owned[a]	0.0000	0.0000	0.0000	1.0000
Age	4.7777	5.8604	5.5523	5.9005
Size	1.6476	3.2959	3.2432	3.6857
Firm Performance	10.1401	11.0170	11.2076	11.2745
Human Capital	0.0174	0.1054	0.0995	0.1169
Urban[a]	0.3680	0.4593	0.4225	0.4891
MES	6.5954	6.8858	7.0600	6.9880
HH Index	0.0024	0.0039	0.0035	0.0034
Industry Agglomeration	0.1857	0.1584	0.1763	0.1881
Regional Agglomeration	0.0743	0.0810	0.0750	0.0774
Foreign Presence in Industry	0.1088	0.1344	0.1390	0.1524
Industry Openness	1.9627	2.1910	2.2775	2.5533
Industry Growth	−0.0058	−0.0133	−0.0116	−0.0098
Entry Rate	0.0586	0.0549	0.0560	0.0551

[a] Indicator variable.

from the estimation of an alternative specification of the global model, after replacing the *Foreign Ownership* variable by three indicator variables for each type of Foreign Firms (FF): Minority, Majority or Wholly Foreign-Owned firm.

Model 1 in Table 5 shows the effect of foreign ownership on the risk of failure, without controlling for any other firm-level or industry-level characteristics. The results of these first estimations are in line with those obtained from previous firm survivor functions (Fig. 3) – unconditionally, foreign ownership decreases firm exit risk. When we consider foreign ownership measured by the three indicator variables for Minority, Majority and Wholly-Owned FF, we find that, without controlling for any other observable characteristics, all the three groups of firms have about 29–36% lower rates of hazard than domestic firms (by taking the exponents of the coefficients of model 1, in Table A.III). For the period 1983–1989, Mata and Portugal (2002) had found as well that, unconditionally, FF were 51% less prone to exit than domestic firms. However, the magnitude of the coefficients is not directly comparable because the periods of analysis are significantly different.

Model 2 adds to the *Foreign Ownership* variable the other firm-level characteristics. Model 3 controls for industries' specificities. Model 4 introduces the macroeconomic control, by adding the two indicator variables for downturn periods. From these results, we conclude that when controlling for other firm and industry characteristics, and also macroeconomic conditions, the effect of foreign ownership turns out to be positively and significantly related to firm hazard. This means that, overall, during normal/average conditions, foreign firms have higher exit rates than their domestic counterparts. Results in Table A.III show that this is true particularly for the groups of Majority FF, though the differences are rarely statistically significant.

The inclusion of indicator variables for downturn periods in model 4 also allows us to verify that firm exit is countercyclical, increasing during recessive periods. Moreover, the effect of the first downturn (1991–1994) was greater in magnitude, suggesting that the international crisis had a larger negative effect on overall firm survival, when compared to the second domestic shock. Taking the exponents of both coefficients, we see that firms' hazard increased on average by 27% during the first downturn period and by nearly 10% in the second.

With model 5, we are able to answer our central research question about the effect of foreign ownership during periods of economic slowdown. It were included the terms *For.Own.*Downturn9194* and *For.Own.*Downturn0103* in the estimation of the global model. Our results show that foreign firms suffered comparatively higher exit risks, but only when the crisis added also an international dimension. For the downturn of 1991–1994, we verify that foreign ownership increases firm exit risks even more. Results from Table A.III show that Majority FF were particularly more exposed to failure during the first downturn period, presenting about 57% (exp(0.4535) = 1.5738) higher hazard rates than domestic firms. Hence, the differences that already existed between both sets of firms were intensified during the first downturn.

Regarding the second downturn period, the coefficient of *For.Own.*Downturn0103* is negative but not statistically significant. The higher hazard rates observed during normal periods for foreign firms vanished during the 2001–2003 crisis. Hence, compared to foreign firms, domestic firms were more penalized by this second downturn. Foreign-owned firms might have resisted slightly better to that shock, possibly owing to their internal resources, networks or to the capacity to explore the international market.

Hence, overall, foreign firms may act as stabilizer agents during downturns driven by a domestic shock, if this is not accompanied by declines in international demand. Álvarez and Görg (2009) found foreign firms to have higher risk rates than domestic ones during an economic downturn, but also concluded that export-oriented multinationals were less susceptible to adverse changes in the host economy as compared to domestic market oriented multinationals. The former may have substituted exports for domestic output and hence were able to fend off negative effects and able to sustain their operations in Chile.

Therefore, the extent to which the foreignness effect matters to explain exit may, on the one hand, depend on the type of crises. If the crisis is more related to a domestic demand contraction, foreign firms may indeed overcome better the downturn. Being normally larger than domestic firms and often less reliant on the domestic market, they may switch their sales from host countries to export markets (Lipsey, 2001), and may be better able to face the adverse economic conditions. On the other hand, the type of FDI may also play a role, as horizontally- and vertically-integrated foreign firms may react differently to a shock in the host economy. While the former – by often replicating an identical production process across countries and thus sharing a substituting relationship with the parent multinational firm (e.g., Yeaple, 2003) – are expected to be more volatile and shift production back home when facing demand contractions in the host country, vertically-integrated foreign firms may, instead, be more resilient during a crisis, owing to the stabilizing role of vertical production linkages and to the complementarities established with home country production (Alfaro & Chen, 2012; Bogach & Noy, 2012). Unfortunately, our data do not allow the distinction between horizontally- and vertically-integrated foreign firms, so future research should explore whether and how the type of FDI acts as a relevant channel through which foreign ownership can affect firm behavior during a crisis.

4.2.2. Firm and industry-level determinants of firm survival

Regarding the effect of other variables on firm survival, we observe that firm-level variables, are all statistically significant. Firm age, though weakly, exerts an inverted U-shaped effect upon exit rates; estimated coefficients suggest that firm hazards increase during the first eight years of firm life and start to decrease thereafter. Firm size, in turn, has a U-shaped effect on firm hazards; firms employing about 200 workers are estimated to have the lowest exit risks on average, while very small and very large firms face the greatest hazards. Firm performance is found to be negatively related to firm hazard.

Contrary to our expectations, human capital increases the firms' exit risk. Though surprising, such an outcome may have a reasonable explanation and similar conclusions have already been obtained by other studies for Portugal using QP database. Teixeira and Vieira (2005), based on data relative to 28 NUTs and 275 Portuguese municipalities between 1990 and1999, found that human capital intensive regions were those that, on average, had higher rates of firm failure. According to their study, hiring top educated workers may increase firm failure risk, at least in the medium-long run, since these workers tend to absorb firm total industry specific knowledge quicker than their less educated counterparts, and therefore require higher wage levels, otherwise they exit to rival firms, which may make the firm unprofitable. For USA, Acs and Armington (2009) also found puzzling results on the link between human capital and firm survival and did not discard the hypothesis that higher shares of college degrees lead to higher rates of failure among new firms, especially during recessions. Actually, better educated workers may require higher wages, which leads to increasing costs for firms. More recently, Campbell, Ganco, Franco, and Agarwal (2012) stress that employees with higher earnings (which are positively related with their education) are less likely to leave the firm relative to employees with lower earnings, but if they leave, they are more likely to create a new

Table 5
The effect of foreign ownership (share of foreign capital in the firm).[a]

	Model 1	Model 2	Model 3	Model 4	Model 5
For. Ownership	−0.4671***	0.1242**	0.1338**	0.1358**	0.1217
	(0.0947)	(0.0621)	(0.0614)	(0.0626)	(0.0798)
Age		0.2902	0.3143*	0.3220*	0.3218*
		(0.1842)	(0.1841)	(0.1843)	(0.1843)
Age^2/100		−1.7375*	−1.9009*	−1.9067*	−1.9065*
		(1.0076)	(1.0072)	(1.0081)	(1.0081)
Size		−0.6136***	−0.6002***	−0.6163***	−0.6162***
		(0.0136)	(0.0136)	(0.0141)	(0.0141)
Size^2		0.0582***	0.0570***	0.0582***	0.0582***
		(0.0031)	(0.0031)	(0.0032)	(0.0032)
Firm Performance		−0.0112**	−0.0112**	−0.0124**	−0.0122**
		(0.0051)	(0.0051)	(0.0052)	(0.0052)
Human Capital		0.3210***	0.2884***	0.2814***	0.2845***
		(0.0500)	(0.0496)	(0.0508)	(0.0507)
Urban		0.1748***	0.1400***	0.1399***	0.1400***
		(0.0110)	(0.0148)	(0.0153)	(0.0153)
MES			−0.0436***	−0.0640***	−0.0640***
			(0.0068)	(0.0073)	(0.0073)
HH Index			6.1368	5.1442	5.0165
			(3.8362)	(3.9173)	(3.9195)
Industry Agglomeration			−0.4552	−0.7698**	−0.7651**
			(0.3796)	(0.3862)	(0.3863)
Regional Agglomeration			0.6015***	0.6386***	0.6374***
			(0.1602)	(0.1650)	(0.1650)
Foreign Presence in Industry			−0.7578**	−0.2064	−0.2012
			(0.3334)	(0.3354)	(0.3355)
Industry Openness			0.0404***	0.0713***	0.0715***
			(0.0125)	(0.0130)	(0.0130)
Industry Growth			−0.2148***	−0.1075**	−0.1070**
			(0.0420)	(0.0419)	(0.0419)
Entry Rate			5.1561***	3.5316***	3.5213***
			(0.3691)	(0.3974)	(0.3974)
Downturn9194				0.2377***	0.2356***
				(0.0187)	(0.0188)
Downturn0103				0.0916***	0.0929***
				(0.0127)	(0.0128)
For. Own.*Downturn9194					0.2949**
					(0.1485)
For. Own.*Downturn0103					−0.1694
					(0.1437)
Constant	−3.4715***	−1.4196***	−1.4425***	−1.2875***	−1.3179***
	(0.0712)	(0.1835)	(0.1903)	(0.1916)	(0.1915)
Industry Dummies	YES	YES	YES	YES	YES
Duration Dummies	YES	YES	YES	YES	YES
N	360,145	360,145	360,145	360,145	360,145
Log Likelihood	−160,514.94	−129,281.64	−127,492.04	−127,394.48	−127,391.07
χ^2	1035.07***	10,622.81***	11,332.53***	10,996.99***	11,002.87***
σ_u	2.7656	0.4241	0.3577	0.4505	0.4503
ρ	0.8230	0.0986	0.0722	0.1098	0.1097
$\chi^2(\rho)$	373.58***	35.59***	18.76***	39.00***	39.00***

To interpret the above results in terms of odds ratios, we must take the exponent of estimated coefficients. ρ measures the proportion of total unexplained variance that is contributed by individual specific effects; σ_u corresponds to the standard deviation of the heterogeneity variance; $\chi^2(\rho)$ is the Chi-squared test for the significance of unobserved heterogeneity.

[a] Complementary log-logistic model with piece-wise constant hazard rates and Inverse Gaussian unobserved heterogeneity.

* Significant at 10%.

** Significant at 5%.

*** Significant at 1%.

venture than join another firm, which may be harmful for the source firm.

Regarding the influence of location, being located in urban centers is found to increase the risk of failure, so despite the wealth of diverse resources often found in urban areas, the intensity of competition or diseconomies of agglomeration lowers the survival prospects of firms. With respect to the effect of industry variables, higher entry rates and higher openness to trade increase the risk of exit. Higher minimum efficient scale of the industry instead reduces firm hazards. The larger the industry growth, the lower are the estimated hazard risks for firms. Firms operating in more agglomerated regions (in terms of employment) face higher exit risks. The effect arising from foreign presence is not statistically significant.

However, we must be aware that some of these variables may be endogeneous, being jointly determined with firm hazard rates and correlated with the error term. According to prior literature, firm size and firm performance are the main regressors potentially suffering from endogeneity problems (see, for instance, Blanchard, Dhyne, Fuss, & Mathieu, 2012). In other words, there may be unobservable factors that affect firm hazard rates and that also impact on these variables. Demand shocks or a great idea for a new product are only some of the unobservable factors that may affect not only firm exit but also firm size and performance. In addition, the shadow of death phenomenon (e.g., Griliches & Regev, 1995) may also play a role, as firm productivity or size tend to decline prior to exit, so these variables may be endogeneous with respect

to the exit decision. Accordingly, robustness checks taking into account the potential endogeneity of these regressors must be performed.

4.2.3. Endogeneity issues and robustness checks

According to the literature, there is neither a standard Instrumental-Variable (IV) estimation in the context of hazard models, nor a test of instrument validity under non-linear hazard estimation (Bandick & Görg, 2010; Bascle, 2008; Wang, 2013). Consequently, results are reliable under the assumption of instrument validity, which, so far, cannot be tested in this type of models. Even so, the use of lagged values of endogeneous covariates as instruments is a common – and less compromising – practice (e.g., Blanchard et al., 2012; Girma & Gong, 2008; Haskel, Pereira, & Slaughter, 2007; Wang, 2013), thus offering a satisfactory alternative when the suitability of instruments is not testable.

Concerning the way to introduce IV in non-linear regressions as discrete time hazard models, this seems to be an issue still under development, particularly when the potentially endogeneous regressors are continuous (instead of binary/choice variables). Prior procedures found in similar literature typically follow one of the two most common practices: either (1) use the lagged terms of the endogeneous variables instead of their current values, assuming that contemporaneous values are affected by their lags, while these lagged terms do not correlate (or are, at least, much less correlated) with the error term (e.g., Wang, 2013); or (2) follow the typical IV methods adopted in linear models, by regressing the endogeneous variable(s) on a set of exogeneous variables – that include the exogeneous variables from the main model and additional instruments (typically, the lagged value(s) of the endogeneous variable(s)), and then introducing the fitted value of the endogeneous variable(s) from this first-step regression(s) in the original model (e.g., Bandick & Görg, 2010; Blanchard et al., 2012).[2]

Due to the identified limitations, we analyze the endogeneity of firm size and performance in an exploratory manner, using the two aforementioned alternatives. However, unfortunately, when using IV approach, there seems to be no formal test to choose between the standard and the IV estimation in the context of survival models (Wang, 2013). Thus, we provide the results obtained from IV approach as a robustness test, just to compare with the baseline results (model 5 from Table 5).[3]

We report the results from our robustness tests in Table 6. In the first column we report the results for model 5, after replacing the variables *Size* and *Firm Performance* by their lagged values. This approach, though simpler, allows attenuating simultaneity bias. In the second column, we follow the typical IV method and replace both variables by their fitted value, obtained from the first stage estimation (whose results are reported in Table A.IV).

Table 6
Robustness checks to the endogeneity of some regressors.[a]

	1-Year lag	IV estimation
For. Ownership	0.0507	0.0918
	(0.0848)	(0.0886)
Age	0.3232	0.3663*
	(0.2027)	(0.2080)
Age²/100	−1.8601*	−2.0917*
	(1.0511)	(1.0787)
Size (§)	−0.4975***	−0.5294***
	(0.0134)	(0.0162)
Size² (§)	0.0495***	0.0532***
	(0.0033)	(0.0037)
Firm Performance (§)	−0.0532***	−0.1032***
	(0.0059)	(0.0090)
Human Capital	0.4367***	0.5268***
	(0.0580)	(0.0606)
Urban	0.1295***	0.1176***
	(0.0160)	(0.0166)
MES	−0.0693***	−0.0643***
	(0.0088)	(0.0091)
HH Index	7.5871	7.9842
	(4.7295)	(4.8240)
Industry Agglomeration	−0.0906	0.0800
	(0.4336)	(0.4475)
Regional Agglomeration	0.6986***	0.8354***
	(0.1774)	(0.1822)
Foreign Presence in Industry	−0.2414	−0.4586
	(0.3874)	(0.3974)
Industry Openness	0.0704***	0.0728***
	(0.0151)	(0.0156)
Industry Growth	−0.1849***	−0.1772***
	(0.0480)	(0.0494)
Entry Rate	3.9121***	4.1918***
	(0.4677)	(0.4793)
Downturn9194	0.1631***	0.1427***
	(0.0228)	(0.0236)
Downturn0103	0.1866***	0.1845***
	(0.0143)	(0.0147)
For. Own*Downturn9194	0.4810***	0.4800***
	(0.1644)	(0.1700)
For. Own*Downturn0103	−0.1993	−0.1267
	(0.1596)	(0.1621)
Constant	−1.4890***	−1.0296***
	(0.3747)	(0.3916)
Industry Dummies	YES	YES
Duration Dummies	YES	YES
N	284,049	284,049
Log Likelihood	−99,136.40	−94,970.37
χ^2	7531.14	7157.55
σ_u	0.0824	0.1084
ρ	0.0041	0.0071
$\chi^2(\rho)$	0.01	0.12
Hausman test (*p*-value)	–	0.000

[a] We extend model 5 of Table 5 to attenuate the simultaneity bias caused by some potential endogeneous regressors – explanatory variables with "(§)" in this table. In the first column, we replace each of the covariates with "(§)" by their lagged value (1-year lag). In the second column, we use instrumental variables estimation and replace those variables by the fitted value of each variable obtained from the first step equations. The results of the first stage are presented in Table A.IV.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

Results on most of the firm and industry-level covariates remain qualitatively unchanged when correcting – or at least moderating – potential problems caused by endogenous regressors. However, some new results emerge. After taking into account that firm size and performance are endogeneous and correlated with the error term, firm-level unobserved heterogeneity is no longer statistically significant. Also, the U-shaped effect of firm size on hazards now reaches its inflexion point between 145 (according to IV estimation) and 152 employees (when using lagged valued

[2] A less conventional approach is also explored by Hyytinen and Ilmakunnas (2007) and Blanchard et al. (2012). They include the residual from the first step estimation in the original model and test the significance of the coefficient of that residual. If the corresponding coefficient is statistically significant, this may be a sign of significant endogeneity problems, confirming that the endogeneous variables should be instrumented. We have also followed this exploratory approach, which confirmed that this was the case for both variables under analysis – firm size and firm performance. The results from those additional estimations are available upon request from the authors.

[3] Bandick and Görg (2010) also recognize that, hitherto, there is no formal method to choose between the two models. Even so, they suggest that the results from a standard Hausman test would be a rough indicator of whether or not the assumption of exogeneity holds. We follow their approach and compare the baseline model (model 5) with the results from IV estimation (column 2 in Table 6). The test, reported at the bottom of Table 6, suggests that the exogeneity assumption can be rejected. In addition, the log-likelihood is higher in IV estimation. Overall, the results suggest that IV estimation results might be preferable to the baseline results.

for the endogeneous variables), a much lower threshold than those indicated by the baseline results (about 200 employees). For the remaining variables, the correction of endogeneity did not substantially change the conclusions, though the magnitude of some effects slightly changes. The previous conclusions on the effect of foreign ownership during crises – which are the main focus of the study – remain qualitatively the same after controlling for the endogeneity of firm size and firm performance.[4]

Despite this analysis is still exploratory, it shows that ignoring the endogeneity of some firm-level variables may produce biased estimations. However, most of the literature addressing issues related with firm survival has been overlooking that some of the firm-level characteristics predicting exit are in fact endogeneous and jointly determined with exit decision. In view of that, further research is needed, not only regarding the effect of some (endogeneous) variables on firm survival, and moreover regarding the way to deal with such endogeneous covariates in duration models.

5. Conclusion

By using a unique data set with firm- and industry-level information for Portugal, this paper examines the link between foreign ownership and firm exit in Portuguese manufacturing industry over an 18-year period and during two periods of economic slowdown in particular. We investigated two main questions: if foreign affiliates have different failure rates than domestic firms during economic downturns and if the foreignness effect differs between two different economic downturns.

First, the results highlight the importance of taking firm-level heterogeneity into account when analyzing the survival patterns of firms. Unconditionally, foreign firms survive longer than their domestic counterparts. However, when controlling for other variables, the share of capital held by foreign investors is found to increase firms' hazard rates. During the downturn periods observed in the Portuguese economy, both groups of firms were severely affected, suffering higher risks of failure. Nevertheless, while in the first crisis foreign firms were markedly more affected, partially supporting the footloose argument (Hypothesis 1), in the second downturn period, the overall differences in hazard rates between domestic and foreign firms were attenuated, partially supporting Hypothesis 2.

This is the first study that systematically evaluates the foreign ownership effect upon exit during such a long time period and covering two different economic downturns. Further studies are needed also in other economies. A careful investigation of the causes behind the observed differences – taking into account, for instance, the type of FDI and MNEs' motivations – seems to be in order for a deepening of our understanding on the prospects of survival in international markets during crisis.

For the policy-maker concerned with FDI, our results on survival dynamics are not against policies stimulating inward investment. According to our results, there is no need to fear that foreign firms destabilize more than usual the host economy during economic slowdowns by immediately closing down operations.

Appendix

Table A.I
Description of variables.

Variables	Description
Main variables of interest	
For. Ownership	Share of capital held by foreign investors in time *t*.
FF_Minority	Dummy = 1 if 10% ≤ share of capital held in *t* by foreign investors < 50%; 0 otherwise.
FF_Majority	Dummy = 1 if 50% ≤ share of capital held in *t* by foreign investors < 100%; 0 otherwise.
FF_Wholly Owned	Dummy = 1 if 100% of the capital is held in *t* by foreign investors; 0 otherwise.
Downturn9194	Dummy = 1 for the years 1991, 1992, 1993 and 1994; 0 otherwise.
Downturn0103	Dummy = 1 for the years 2001, 2002 and 2003; 0 otherwise.
For. Own*Downturn$_i$	Interaction term between foreign ownership and the dummy for the downturn *i* (*i* = 1991–1994; 2001–2003).
FF_Minority*Downturn$_i$	Interaction term between FF_Minority dummy and the dummy for the downturn *i*.
FF_Majority*Downturn$_i$	Interaction term between FF_Majority dummy and the dummy for the downturn *i*.
FF_Wholly Owned *Downturn$_i$	Interaction term between FF_Wholly Owned dummy and the dummy for the downturn *i*.
Firm-level controls	
Age	Number of years since the entry of the firm.
Age^2/100	Squared number of years since the entry of the firm, divided by 100.
Size	Ln(number of employees), by year.
Size^2	Squared value of Ln(number of employees), by year.
Firm Performance	Operational Performance measured through the log of the ratio Firm Sales[a]/Firm Employment, by year.
Human Capital	Share of workers with a college degree, by year.
Urban	Dummy = 1 if the firm operates in large urban areas (i.e., in the districts of Porto or Lisbon); 0 otherwise.
Environment controls (industry and regional context)	
MES	Median of 2-digit industry's employment, by year.
HH Index	Herfindahl–Hirschman Index – sum of the squared share of each firm in total 2-digit industry's employment, by year.
Industry Agglomeration	Share of 2-digit industry's employment in total Manufacturing employment, by year.
Regional Agglomeration	Share of regional employment (NUT3) in total employment in the country, by year.
Foreign Presence in Industry	Share of FF's employment in total 2-digit industry's employment, by year.
Industry Openness[b]	Ratio 2-digit industry (Exports + Imports)/2-digit industry Gross Value Added, by year.
Industry Growth	Ln(2-digit industry Employment$_t$) − Ln(2-digit industry Employment$_{t-1}$)
Entry Rate	Ratio (Entrants' employment in year *t*/2-digit industry total employment in year *t*)
Industry Dummies	Dummy = 1 for each 2-digit industry where the firm operates; 0 otherwise.

[a] Firm sales in real terms (2005 constant prices).
[b] Data at 2-digit industry level (ISIC rev. 2) on exports and imports come from Statistics Portugal; Gross Value Added at the industry-level was obtained from Bank of Portugal.

[4] Additional estimations using two year lags for both endogeneous variables were also performed, though producing qualitatively similar results.

Table A.II
Correlation matrix.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Age	(1)													
Size	(2)	0.21												
Firm Performance	(3)	0.15	0.02											
Human Capital	(4)	0.01	0.04	0.17										
Foreign Ownership	(5)	0.03	0.20	0.12	0.12									
Urban	(6)	−0.01	0.02	−0.01	0.06	0.02								
MES	(7)	−0.15	0.21	−0.21	−0.06	0.02	−0.05							
HH Index	(8)	−0.04	−0.01	0.15	0.06	0.04	0.04	−0.01						
Industry Agglomeration	(9)	−0.05	0.15	−0.22	−0.07	0.00	−0.08	0.60	−0.34					
Regional Agglomeration	(10)	−0.04	0.06	−0.07	0.03	0.00	0.68	0.17	−0.04	0.17				
Industry Openness	(11)	0.11	−0.01	0.11	0.06	0.05	−0.04	−0.11	0.11	0.38	−0.01			
Industry Growth	(12)	−0.03	−0.03	−0.01	−0.01	−0.00	0.07	−0.11	−0.01	−0.11	0.02	−0.08		
For. Presence in Industry	(13)	0.06	−0.01	0.16	0.07	0.05	−0.03	−0.13	0.21	0.31	−0.07	0.68	−0.01	
Entry Rate	(14)	−0.03	−0.05	−0.03	−0.04	−0.02	0.03	−0.18	−0.15	−0.16	−0.02	−0.15	0.11	−0.21

Table A.III
The effect of foreign ownership (indicator variables for Minority, Majority and Wholly-Owned FF).[a]

	Model 1	Model 2	Model 3	Model 4	Model 5
FF_Minority	−0.4496**	0.1392	0.1537	0.1604	−0.0390
	(0.2091)	(0.1420)	(0.1403)	(0.1428)	(0.2025)
FF_Majority	−0.3468***	0.1638*	0.1754*	0.1770*	0.0882
	(0.1311)	(0.0905)	(0.0897)	(0.0914)	(0.1249)
FF_WhollyOwned	−0.4427***	0.0849	0.0942	0.0957	0.1165
	(0.1020)	(0.0713)	(0.0704)	(0.0717)	(0.0900)
Downturn9194				0.2377***	0.2348***
				(0.0187)	(0.0188)
Downturn0103				0.0917***	0.0924***
				(0.0127)	(0.0128)
FF_Minority*Downturn9194					0.5352
					(0.3572)
FF_Majority*Downturn9194					0.4535**
					(0.1966)
FF_Wholly Own*Downturn9194					0.0982
					(0.1876)
FF_Minority*Downturn0103					0.3458
					(0.3170)
FF_Majority*Downturn0103					−0.2041
					(0.2472)
FF_Wholly Own*Downturn0103					−0.1450
					(0.1614)
Industry Dummies	YES	YES	YES	YES	YES
Duration Dummies	YES	YES	YES	YES	YES
N	360,145	360,145	360,145	360,145	360,145
Log Likelihood	−160,540.95	−129,280.99	−127,491.23	−127,393.66	−127,387.93
χ^2	1058.28***	10,624.49***	11,334.77***	10,999.36***	11,011.17***
σ_u	2.4087	0.4242	0.3577	0.4505	0.4497
ρ	0.7791	0.0986	0.0722	0.1098	0.1095
$\chi^2(\rho)$	317.46***	35.60***	18.76***	38.99***	38.86***

[a] Complementary log-logistic model with piece-wise constant hazard rates and Inverse Gaussian unobserved heterogeneity. Models 1–5 correspond to the same specifications presented in Table 5, but replacing the variable *For.Ownership* by the several indicator variables for Minority, Majority and Wholly-Owned FF. Accordingly, Model 1 estimates the effect of foreign ownership, without controlling for any other variables. Model 2 controls for firm-level differences. Model 3 adds industry-level variables. Model 4 includes the effect of downturns and Model 5 corresponds to the final global specification, including all variables.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

Table A.IV
First stage estimations for the endogeneous explanatory variables.

	Firm Size	Firm Performance
For. Ownership	0.1947***	0.3416***
	(0.0078)	(0.0166)
Age	−0.0042***	−0.0108***
	(0.0007)	(0.0011)
Size		−0.0016
		(0.0013)
$Size_{t-1}$	0.9620***	
	(0.0007)	
Firm Performance	−0.0812***	
	(0.0011)	
Firm $Performance_{t-1}$		0.6750***
		(0.0029)
Human Capital	0.0321**	0.6224***
	(0.0134)	(0.0207)
Urban	−0.0167***	−0.0310***
	(0.0019)	(0.0034)
MES	0.0122***	0.0025
	(0.0011)	(0.0023)
HH Index	2.0271***	−0.4241
	(0.5200)	(1.1171)
Industry Agglomeration	0.5884***	−0.5106***
	(0.0530)	(0.1017)
Regional Agglomeration	0.1278***	0.1713***
	(0.0202)	(0.0377)
Foreign Presence in Industry	−0.3922***	−0.1650**
	(0.0418)	(0.0789)
Industry Openness	−0.0004	0.0270***
	(0.0018)	(0.0036)
Industry Growth	0.0089*	−0.0713***
	(0.0048)	(0.0113)
Entry Rate	0.3113***	0.1403
	(0.0552)	(0.1083)
Downturn9194	−0.0365***	−0.0267***
	(0.0029)	(0.0061)
Downturn0103	−0.0147***	−0.0167***
	(0.0016)	(0.0029)
Constant	0.8472***	3.6346***
	(0.0135)	(0.0344)
Industry Dummies	YES	YES
Year Dummies	YES	YES
N	313,984	284,049
F-Statistic	74,178.05	4192.07
R^2	0.9052	0.5865

Values in parenthesis correspond to heteroskedastic robust standard errors. The number of observations in the second equation is lower due to some missing values for firm sales, needed to compute our measure of firm performance.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

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