**Closure and Divestiture by Foreign Entrants:
The Impact of Entry and Post-Entry Strategies**

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# Closure and Divestiture by Foreign Entrants:
# The Impact of Entry and Post-Entry Strategies[*]

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**Abstract**

We analyze the longevity of foreign entrants explicitly considering two possible ways of exit: firm closure and capital divestiture. We find that entry and post-entry strategies affect the longevity of firms and of foreign equity holdings, but in different manners. While the ownership arrangements and organizational structure affect the likelihood of divestment, they exert no significant effect upon closure. The entry mode exerts opposite effects on the two modes of exit, greenfield entrants being more likely to shutdown, but less likely to be divested. Only human capital affects closure and divestment in the same manner. Firms with large endowments of human capital are less likely to exit, irrespective of the exit mode considered.

Key words: closure and divestiture; exit; foreign firms

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# Introduction

In one of the few studies which has analyzed exit of foreign entrants, Li (1995) convincingly showed that the longevity of foreign presence depends on the strategic choices at entry, namely the choice between starting a new company and acquiring an existing one and the choice between running a joint venture and running a fully-owned business.

This work extends previous research by studying the survival of foreign entrants while recognizing that there are also different ways of exiting from foreign markets. Exit may occur through liquidation of the subsidiary firm or simply through divestiture. The two processes are likely to be governed by different forces and understanding the reasons that determine each of them is important to improving our knowledge of the process of international expansion. The analysis is conducted with reference to over 1000 foreign-owned firms that started operating in Portugal during the period 1983-1989.

The topic is not of mere academic interest, and should attract considerable attention from the practitioners as well. Managers considering going into international markets are interested in evaluating the chances of their success. Since the two alternative modes of exit may be determined by different forces, managers should benefit from knowing under which circumstances each type of exit is more likely to occur.

The plan is as follows. First, we present the hypotheses to be tested. The following section discusses methodological issues, including the description of the data source, the methods used in computing the variables, and the statistical methodology employed. Next, we give an overview of the sample characteristics and exit patterns, followed by the presentation of the results. Finally, in the last section we discuss the contribution of the study and offer concluding comments.

# Hypotheses

The framework employed in the analysis is the following. In each period, foreign subsidiaries confront two risks, the risk of closure and that of divestiture, which are assumed here to be independent. In each period, therefore, three outcomes are possible. The firm may continue its operations under foreign ownership, it may be divested or it may close. These outcomes are produced by two separate decisions, represented in Figure 1. One is the decision to divest or not to divest. The other is decision to shutdown or not to shutdown. The common theme of the hypotheses developed below is that the strategies followed by foreign entrants may exert disparate effects upon the two decisions.

insert Figure 1 about here

■ **Entry mode**

One of the crucial decisions when deciding to expand into a new market is the decision on whether to set up a new venture or to acquire an existing firm (Yip 1982, Zejan 1990, Woodcock, Beamish and Makimo 1994). In a recent paper, Shaver (1998) suggested that the choice of entry mode may be endogenous, being determined by the firm's prospects of failure. While we do not

investigate the endogeneity issue, we acknowledge that the choice of entry mode may have different effects upon the probabilities of closure and divestment. The different patterns of dissolution and divestiture experienced by start-ups and diversifying entrants have been investigated by Mitchell (1994), but this has not been studied in the context of foreign entry.

The theory of the multinational corporation emphasizes that the possession of ownership advantages is a key factor in explaining why firms do business abroad, despite the increased costs they incur due to their poorer knowledge of the local conditions (Dunning 1993). The choice of the entry method is largely determined by the nature and extent of these ownership advantages. Acquisition may be the preferred method of entry when the acquired firm possesses some intrinsic advantage such as location, and the advantage of the acquiring firm rests elsewhere than in production technology, for example in marketing. However, if the advantage of the multinational firm rests on the superiority of its production-specific assets, for example, because it has access to a proprietary technology, it may not be easy to find an ongoing business suitable for acquisition, and starting a new company from scratch may be the best alternative.

To the extent that acquisition signals the predominance of non-specific assets while greenfield entry indicates the need to develop a tailored production facility, we would expect that firms that had been once acquired would be more suitable to other potential buyers. Also, if a foreign firm entered by greenfield because it owns some proprietary technology, it is very unlikely that it wants to let others use its technology. Therefore, we would expect acquisition entrants to be more likely to be resold than firms that have been created from scratch. Thus, our first hypothesis is formulated as follows (where the letters $D$ and $C$ after the hypothesis number indicate that the hypothesis refers to divestiture and closure, respectively).

> *Hypothesis 1D) Foreign firms entering by acquisition are more likely to divest from their subsidiaries than are those entering through greenfield entry.*

Furthermore, studies on multinational firms have generally found that, although new ventures promise a higher rate of return, their profits are more variable than those from acquisitions (Caves 1996). The reason why profits from acquisitions are less risky is that those firms which are acquired have already gone into a process of developing procedures and routines that enable them to deal effectively with their environment (Hannan and Carroll 1992). They are, therefore, typically less subject than new ventures to those unforeseen contingencies that may lead to the closure of the productive facility. This leads us to hypothesize that

> *Hypothesis 1C) Foreign firms entering by acquisition are less likely to be shutdown than are those entering through greenfield entry.*

### ■ Ownership advantages

Ownership advantages are typically associated with the ability of firms to develop firm-specific assets, which cannot be imitated by competitors and provide the basis for their competitive advantage (Wernerfelt 1984). Firms with such assets are normally those which conduct R&D activities, spend considerably on advertising, and possess large amounts of human capital. Recent studies on entry, post-entry penetration and survival show that the ability to develop and exploit such assets is crucial for the post-entry performance of firms (Burgelman 1994, Bogner, Thomas and McGee 1996, Chang 1996). We thus expect that firms using larger amounts of human capital will experience higher chances of success in operating in a foreign country. Because human capital

is directly related to the extent of the firm's ownership advantages, we expect it to be influential in the firm's decision to leave the foreign country, regardless of the mode of exit. Therefore, we hypothesize that

> *Hypothesis 2C) New firms with a larger human capital endowment experience a lower probability of closure.*

> *Hypothesis 2D) New firms with a larger human capital endowment experience a lower probability of divestment.*


### ■ Ownership structure

**Joint ventures**   Transaction costs theory contends that joint ventures are a response to failures in markets for particular assets held by different companies. A good example of such assets in the context of multinational investment is tacit knowledge about technology from the potential foreign investor and about the host country from the local partner. The market failure emerges because local firms find it difficult to acquire knowledge about the unspecified details of the technology and foreign firms find it difficult to buy knowledge about the *modus operandi* of local markets. It thus becomes cheaper for the parties to share both assets through a common endeavor than to trade them through the market. On the other hand, joint ventures also have costs. By making both parties residual claimants on firm's profits, they create in both parties incentives to free-ride, which makes these ventures highly unstable.

This instability of joint ventures has been widely recognized in the literature. As the co-operative venture ages, and firms learn about the other party's assets, the benefits of joint ventures are often offset by their costs and the likelihood of joint venture dissolution increases. For example, Hennart (1991) found that Japanese subsidiaries in the U.S. are less likely to be joint ventures, the greater the age of the subsidiary. Kogut (1989) observed that in some circumstances firms may be able to develop strategies to reduce the likelihood of dissolution. He observed that partner firms which had established several simultaneous co-operative agreements, thereby increasing the punishment cost of breaking any particular agreement, were significantly less likely to dissolve a joint venture, than those which had a single common venture. As a consequence of this greater instability, Yamawaki (1997) found that fully-owned subsidiaries of Japanese multinationals were less likely to exit than joint ventures. This leads us directly to our next hypothesis.

> *Hypothesis 3D) Fully-owned subsidiaries are less likely to be divested than joint-ventures.*

**Minority holdings**   Joint ventures differ with respect to the degree of control exerted by the foreign party. Although the foreign share can vary in a continuous scale between 0 and 100, two thresholds are of particular importance. The first threshold distinguishes portfolio investments from joint ventures in a narrow sense. The second distinguishes majority from minority joint ventures. The distinction between portfolio investments and joint ventures is important because portfolio investments typically do not confer controlling rights. In this study, we are not concerned with this type of investments and will not include firms with such type of foreign ownership (foreign equity below 10%) in our sample.

We are, however, interested in the distinction between minority joint-venture, in which foreign firms have some degree of control rights, and joint ventures in which foreign firms have the majority of the votes. Minority holdings are a risky strategy, since control escapes to the foreign firm, and it may be subject to opportunistic behavior. In fact, the literature comparing the choice of multinationals with respect to the type of control they possess over their subsidiaries has found that the propensity to hold minority stakes in the subsidiary increases with the size of the parent firm (Gatignon and Anderson 1988, Blomstrom and Zejan 1989) and with its degree of diversification (Alzona, Rondi and Vitali 1993, Blomstrom and Zejan 1989). These findings have been interpreted as a consequence of the greater willingness of large parent firms to take risks abroad. Moreover, Gatignon and Anderson (1988) found that the degree of control over subsidiaries varies positively with the intensity of R&D and advertising expenditures. This suggests that minority positions are less likely to be held when asset specificity is important and entry involves a strong commitment to the market.

These arguments lead naturally to our next hypothesis, which posits that

*Hypothesis 4D) Minority holdings are more likely to be divested than are majority holdings.*

**Legal Form**  The reason why there are several legal forms under which firms can operate is to allow for different limitations on the degree of liability incurred by firms' owners. While in unlimited liability firms the owners are personally accountable for the firm's debts, the liability of the owners of a limited liability firm is restricted to the value of their equity in the company. Because the liability of firms is reduced with increases in the degree of complexity of the legal form, the requirements in terms of organization and formalization of the firms' financial reports also increase. There are also minimum requirements to form a limited liability firm (amount of equity capital, number of equity owners) which do not apply to unlimited liability venture. Thus, limited liability companies involve significantly higher set-up and fixed operating costs than do unlimited liability firms. On the other hand, the transaction of one's stake in the firm is easier for limited liability firms than for their unlimited liability counterparts. For example, only limited liability firms can go public and have their shares publicly traded, while the ownership of unlimited liability firms can be changed only with the explicit agreement of all owners.

Legal form may thus have an opposite effect on divestment and closure. The more limited the liability of firms, the easier is the transfer of propriety rights and thus, holding everything else constant, the more likely the firm is to be divested. On the contrary, the more limited the liability of firms, the less likely it is that they will be shut down. On the one hand, given their higher set-up costs, they have a higher option value in waiting and are likely to remain open longer than firms with lower set-up costs (Dixit and Pindyck 1994). On the other hand, because the personal responsibility of the owners decreases with liability, the owners of unlimited liability firms are likely to be more conservative with respect to exit decisions than the owners of limited liability firms. Therefore, they will exit before the moment where a similar decision would be taken by the limited liability firms, who have less to lose in case of bankruptcy. The effect of the choice of legal firm on the survival of firms has been examined by Brüdel, Presiendörfer and Ziegler (1992) and Harhoff, Stahl and Woywode (1996), who found the company legal form to be associated with the chances of success. Harhoff, Stahl and Woywode (1996), in particular, found that limited liability companies are more prone to insolvencies, but less likely to undergo voluntary liquidation, than are other companies.

Thus, we will test the following hypotheses.

*Hypothesis 5C) The likelihood of closure decreases with the limitation of liability.*

*Hypothesis 5D) The likelihood of divestment increases with the limitation of liability.*

## Control Variables

Other variables need to be taken into account in our empirical analysis. At the firm level, we include size, growth, the extent of diversification and of multiplant operations.

Many studies have found a positive relationship between firm size and the probability of survival (Dunne, Roberts and Samuelson 1989, Mitchell 1994, Mata, Portugal and Guimarães 1995). This has been rationalized as resulting from firms having a high degree of uncertainty about their own capabilities when they start (Jovanovic 1982). Because of the irreversibility inherent to most investments, it is optimal for firms to start at a small scale and grow only if they find that they have been successful in the past (Cabral 1995). A second reason why firms may start small and expand afterwards is because their entry size is partially determined by cash constraints. Firms which are not part of a large multinational organization, where cash constraints are less important, may find it difficult to raise enough money to finance entry at their most preferred scale (Evans and Jovanovic 1989). Therefore, large firms less likely to exit than their small counterparts. The relationship between size and the likelihood of divestiture is less obvious and the empirical studies that have analyzed exit by divestment have not found any significant relationship between divestment and the size of firms (Schary 1991, Mitchell 1994).

Most studies that have analyzed the impact of foreign firm diversification upon exit have examined primarily the proximity between the parent firm and the subsidiary main activities. These studies have found that unrelated subsidiaries are more likely to exit than subsidiaries operating in the same activity as the parent firm (Li 1995, Yamawaki 1997). To our knowledge, only Bane and Neubauer (1981) have looked at the effect of subsidiary's internal diversification, finding that narrowly focused branches experienced a lower failure rate than did more diversified ones. This result can be due to the fact that specialized firms experience a greater degree of commitment to their activity and management is less dispersed. On the other hand, the number of plants operated by the firm was found to have a positive impact on firms' prospects of survival by Mata and Portugal (1994). This result can be rationalized by noting that multiplant firms can accommodate the failure of one of their plants without failing themselves, while single plant firms cannot. To the extent that this argument depends on the correlation between the success of different business units in a firm, it also applies to the extent of diversification. We will accommodate these two aspects in our empirical analysis, without making any specific predictions about the relationships.

Furthermore, the environment in which entry occurs is also likely to affect the survival prospects of the firm. We will use a number of industry characteristics to control for the different environments in which firms operate.

The first of such variables is the degree of industry concentration. Based on an Industrial Organization argument, the degree of competition in the market has been hypothesized to increase the likelihood of survival. The argument here is that concentration facilitates collusion among incumbents and hence aggressive responses to entry. Market concentration has been found to negatively affect the chances of survival of new firms by Audretsch and Mahmood (1994), but it has been found to be insignificant by Romanelli (1989) and by Mata and Portugal (1994). Focusing on foreign firms, Li (1995) and Mitchell, Shaver and Yeung (1994) found a positive effect of concentration on new firm survival, although this effect was barely significant.

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We will also control for the entry and growth rates in the industry. Dunne, Roberts and Samuelson (1988) found that there is a strong positive cross-sectional correlation between entry and exit, and this finding has been further corroborated by a number of scholars (see Cable and Schwalbach 1991, for example). This has been explained in terms of symmetry between entry and exit barriers by Eaton and Lipsey (1980), an hypothesis which received empirical confirmation by Shapiro (1983) in the context of multinational firms.

Industries which are growing quickly are likely to be environments in which the probability of exit of new firms is lower. One of the stylized facts established by Schmalensee in his survey of empirical work on Industrial Organization (1989 p. 972) is that profits are in general larger in growing than in otherwise identical industries. This makes survival easier, as new firms do not have to attract costumers away from incumbents. Both Audretsch and Mahmood (1994) and Mata and Portugal (1994) found a positive and significant effect of industry growth upon the survival of new firms.

Survival is also likely to be correlated with the extent of economies of scale in the industry. Firms which operate at a scale smaller than the minimum efficient scale incur a cost disadvantage *vis à vis* efficiently scaled firms. This cost disadvantage puts firms in a fragile position, as they have to develop alternative competitive strategies that enable them to cope with competitive pressures. Therefore, for a firm of a given size, the larger the extent of economies of scale in an industry, the more likely it is that such firm is smaller than the minimum efficient scale, and thus will suffer a cost disadvantage. Everything else being identical, the chances of survival will thus be higher in industries where economies of scale are not very important than in those where they are significant. Audretsch and Mahmood (1994) present empirical evidence supporting this hypothesis.

Finally, the survival of the new foreign owned firms is likely to be related to the previous presence of foreign firms in the market. Shaver, Mitchell and Yeung (1997) found that foreign presence mostly affects the survival of foreign entrants if entrants are already operating in the country, but in a different industry than that in which entry is attempted. They argue that firms which are already in the country are in the best position to benefit from the learning spillovers generated from foreign presence, and that those which do not possess direct information about the industry will benefit the most from these spillovers. We do not have information on previous experience, and therefore, we will not be able to take this qualification into account. As a consequence, if such qualification is indeed important, we will obtain weaker results than if we could control for previous experience. In an earlier study, the same authors present evidence that foreign presence affects the survival of foreign entrants, but they argue that one should expect an inverse U-relationship between foreign presence and survival (Mitchell, Shaver and Yeung 1994). They claim that foreign survival at the earlier stages of foreign presence should be more difficult due to lack of market knowledge, while at the latter stages it should again be more difficult due to congestion effects. This argument is developed in a time-series context, in which the same market is observed over time. In our case, we have essentially a cross-section variation. We thus expect previous foreign presence to signal the presence of those characteristics which make foreign survival more likely.

## Methods

### Data

Our data were obtained from a survey conducted by the Portuguese Ministry of Employment (*Quadros de Pessoal* hereafter QP). This is a comprehensive survey covering all firms with wage earners in Portugal, which has been conducted every year since 1982. Moreover, its longitudinal capacity, i. e. firms are identified through a unique number, allows firms to be followed over time. What makes this data source really unique and particularly valuable from the point of view of the analysis of foreign entry and exit is that, among other data, the survey records the share of equity held by non-residents. Taken together with its longitudinal characteristic, this allows us to compute measures of entry of foreign capital and to establish the longevity of these investments in Portugal.

We identified changes in foreign capital participation with a three step procedure. First, we identified all firms which held foreign capital in at least one year from 1983 to 1989 and which did not have foreign capital in the previous year. This enabled us to date the moment of entry of foreign capital. Second, we searched for the existence of the firm itself in the year before entry in order to be able to classify foreign entry as acquisition *versus* greenfield. This could be easily done because firms' identifiers are numbers supplied sequentially when firms first report to the survey. Identification of new firms can thus be achieved by comparing firms' identifiers with the highest identification number in the file in the previous year. Finally, the last step was the establishment of the life span of foreign capital. For this we had to be able to identify the moment in which the foreign participation ceased. As previously discussed we are interested in distinguishing two alternatives: foreign firm closure, where the foreign owned firm ceases its operations, and foreign capital divestiture, where the firm continues to operate, but no longer with foreign capital participation. To identify the moment of divestiture we searched for the first year when the firm reported foreign participation below 10%, while for identifying closure we searched for the moment when the firm ceased to report to the survey.

The database has limitations that should be made clear. First, we do not know the identity of the foreign owners. This is unfortunate because it prevents us from using the parents' characteristics to explain the exit of subsidiaries, and because we are not able to identify the sale of a foreign equity participation by one foreign firm to another. Another potential limitation of our data set is that we cannot tell mergers from true exits. What typically happens when one of such movements occurs is that one of the identifiers of the firms involved in the merger is transmitted to the resulting firm, while the others disappear, and are counted as exits in our data. Furthermore, with such a large database, one can never be sure that no coding errors are made.

We took special care to minimize the number of false foreign entries and exits that were included in our sample. In the sake of economy, we do not describe here all the procedures employed to check the reliability of the data base, which consisted in comparing our data with data from other sources and in double checking the moment of exit. In summary, we were able to conclude that the measurement of the entry and exit flows is quite reliable, and that mergers and changes in ownership due to simultaneous investment and divestment by foreign owners are not significant. The details of all the procedures employed to perform these checks are described in a methodology appendix, which is available from the authors upon request.

## Statistical Model

The key concept in duration analysis is the hazard rate, that gives the probability that a unit exits within a particular time interval, given that it survived until then. In our context, we will work with two distinct hazard rates, corresponding to the two types of exit we are interested in. Rather than imposing a parametric functional form for the hazard function, a simple flexible hazard model (Kalbfleisch and Prentice, 1980) was employed

$$h(m) = \lambda_m \qquad m = 1, 2, \ldots, M \qquad 0 < \lambda_m < 1,$$

where $\lambda_m$ is just the hazard rate for the time interval $m$. Thus, the sequence from $\lambda_1$ to $\lambda_M$ exhibits the yearly evolution of the exit probabilities for a given firm.

The effects of the explanatory variables (some of which may vary over time) are incorporated by allowing the hazard function to be influenced proportionally by the covariates, as suggested by Cox (1972):

$$h(m) = exp(\beta X_m)\lambda_m,$$

where $X_m$ is the vector of independent variables observed at $m$, and $\beta$ is the corresponding vector of regression coefficients.

In this model it is assumed that, at each period, the firm decides whether to continue, to divest or to shutdown. Technically, this is known as a competing risks model. In this setup, there are two latent durations: time until divestment and time until closure. The observed duration is the minimum value between those two latent durations, which are governed by two distinct hazard functions. Accordingly, when a foreign firm is observed to close down, this observation is treated as censored in the divestment equation. Conversely, when divestment is observed, this observation is treated as censored in the closure equation.

Estimation is performed by maximum likelihood methods. In writing the likelihood function, a distinction has to be made between firms that exited and those firms that survived until the end of the survey. To the former, we can assign both a lower and an upper interval for the corresponding durations (interval censored durations). To the latter, all we know is that their duration exceeds a given limit (censored durations). The derivation of the likelihood function that accommodates our sampling plan is provided in the appendix, which is available upon request.

Following the discussion of the hypotheses, the following explanatory variables were computed.

*Entry Mode: Greenfield* — Dummy variable which takes the value 1 if entry is greenfield, 0 if entry is by acquisition.

*Human Capital* — Proportion of college graduates in the firm's work force.

*Size* — Logarithm of the number of employees.

*Fully–Owned Subsidiaries* — Dummy variable which takes the value 1 if foreign capital has a 100% stake in the company, 0 otherwise.

*Majority Joint–Ventures* — Dummy variable which takes the value 1 if the foreign capital's stake in the company is greater or equal to 50% but less than 100%, 0 otherwise.

*Limited Liability* — Dummy variable which takes the value 1 if the firm is a limited liability company, 0 otherwise.

*Plants* — Logarithm of the number of plants operated by the firm.

*Diversification* — 1 minus the Herfindahl index of firm specialization. The shares of the firm's activities in different industries were used to compute this index.

*Concentration* — Herfindahl index of industry concentration.

*Scale Economies* — Logarithm of the estimate of the Minimum Efficient Scale in the industry, computed as suggested by Lyons (1980).

*Entry* — Share of the employment in new firms in total employment in the industry.

*Industry Growth* — Growth rate of industry employment, computed as the difference in the logarithms of the employment in the industry in two consecutive years..

*Foreign Presence* — Share of industry employment in foreign owned firms.

With the exception of *Greenfield*, which refers to the conditions at the time of entry, all variables are time-varying. That is, they may assume different values over the lifespan of firms. In some cases, these variables reflect post-entry decisions, in others they simply reflect the evolution of the environment. As we observe firms on an annual basis, we are able to measure all of these variables annually. Our empirical model assumes the most recent observations of these variables to be the determinants of the exit decisions, that is, we specify exit between moment $t-1$ and $t$ as a function of the independent variables observed at moment $t-1$.

## Sample

Our sample includes 1033 foreign firms, which entered during the period 1983-89, which were identified using the procedures previously discussed. The sample is described in Table 1.


insert Table 1 about here


Table 1 shows that almost 60% of our entrants are greenfield entrants. Almost one half of the total number of entrants are fully-owned by foreign owners while, among the remaining, majority owned firms are slightly more than minority holdings. The vast majority of our foreign entrants are established as limited liability firms, only 8% operating under unlimited liability. On average, entrants employ 57 persons, of which around 10% hold a college degree (the employment figure cannot be read from the table, as the size variable is in logarithms). Most firms operate a single establishment at the time of entry, but a significant number (175) operate more than one, resulting in an average of 1.64 per firm (as with size, the figures reported in the table are in logarithms). The subsidiaries in our sample tend to be relatively specialized as well, and the diversification index is rather small. The statistics on the industry variables presented in Table 1 are less straightforward to interpret than the data on firm variables, as these averages refer to industries but come from a sample of firms. For completeness Table 1 also presents the correlations between the independent variables.

### Patterns of Exit

Figure 2 plots the failure rates over the first years after entry, that is, the proportion of firms that have already exited by a given year. In the first plot, the failure rates for the whole set of foreign entrants is displayed. It is clear that the two types of exit display quite identical levels and a rather similar pattern over time. While exit by firm closure experiences an average yearly rate of 5.9% over the period, the corresponding rate for divestiture is 5.7%. The timing of the two types of exit seems to be different, however. Exit by divestiture is lower than exit by closure during the first years, but it increases at such a pace that it is greater than exit by divestiture in the fifth year.

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The distinction between types of entrants produces more contrasting results. For example, while for greenfield entrants the probability of closure is always greater than that of divestment, the opposite result holds (at least from the second year onwards) for acquisition entrants. Although for greenfield entrants this result changes at the eighth year, there is no reason to make a strong case based on this single figure. One should keep in mind that our estimates for the last year are produced using the survivors of a single cohort. Those correspond to a very small number of observations, and thus the estimates are much less precise. Moreover, comparing the two plots, one also sees that while acquisition entrants face a higher probability of divestment than do greenfield ones, these experience a higher probability of closure.

The split of the sample according to the type of ownership arrangement is also instructive. For majority and fully-owned subsidiaries, the probability of closure is always lower than that of exit by divestment (again this changes at the eighth year for fully-owned subsidiaries). However, the evolution of these probabilities over time displays a rather similar pattern. In contrast, during the first year, minority holdings are less likely to be divested than closed. However, in subsequent years their probability of being divested increases quite dramatically, and the evolution of the two probabilities is quite disparate. As a consequence, after the third year, these firms experience a much higher probability of divestment than majority and fully-owned subsidiaries do.

## Results

Table 2 presents the results of the estimation of our empirical model for the two modes of foreign exit. For each exit mode the second column excludes includes those variables which were not statistically significant in the first column, thus constituting our preferred parsimonious specification.

The results indicate that the determinants of exit are different for the two destinations. Most variables attract opposite signs in the two equations or are significant in only one. One variable (*Human Capital*), however, is an unsurprising exception. The proportion of college graduates in the labor force exerts a sizeable negative effect upon the exit decision in both equations. This effect is significantly associated with lower failure rates for both types of exit, which indicates that the extent of ownership advantages (broadly considered) determines the decision to leave the country.

On the contrary, the entry mode exerts an opposite effect on firm closure and capital divestiture. Greenfield entrants are more likely than acquisitions to be closed, but they are less likely to be sold, although the statistical significance of this latter effect is only marginal. From the estimated coefficients associated with *Greenfield* in Table 2, one can estimate that the conditional probability of closure is 30% higher for greenfield entrants than for acquisition ones, while the

conditional probability of divestment is 15% lower. These discrete rate of change in the probability of exit is simply calculated by $exp(\hat{\beta}) - 1$, where $(\hat{\beta})$ is the corresponding instantaneous rate displayed in Table 2. This confirms our hypothesis that the acquisition of an ongoing business reflects the existence of some business-specific advantage, which makes it less likely to shut down. On the other hand, the fact that it has been acquired, also signals that the business is not owner specific to any great extent, which makes it more likely to be sold.

The ownership structure and internal organization seems to affect mostly the likelihood of divestiture rather than closure. The coefficients of both *Majority Joint-Venture* and *Fully-Owned Subsidiaries* are negative in the firm closure equation, which indicates that these ownership arrangements experience a lower probability of failure than does the omitted category, minority holdings. The coefficient associated with *Majority Joint-Venture* in the capital divestiture equation is, however, greater (in absolute values) than the one associated with *Fully-Owned Subsidiaries*. This suggests that the probability of divestiture is higher for fully-owned firms than it is for majority holdings, which is contrary to our expectations, but the difference is not statistically significant.

The legal form variables have the expected signs. In the firm closure equation, the omitted category (unlimited liability) is the most likely type of firm to be closed, the probability of being shut down varying inversely with the complexity of the legal form. In the capital divestiture equation, the opposite result holds, reflecting the greater difficulty inherent in selling an unlimited liability business.

Firm size is clearly significant in the closure, but not in the divestiture equation. This indicates that it is not the amount of money invested that deters divestment by foreign firms; rather, the size of the firm seems to summarize a number of relevant characteristics that affect their ability to compete and survive.

The last comment on the effects of firm variables goes to the variables reflecting internal organization. Firms with a larger number of plants are less likely to be sold, but after controlling for the number of plants, the coefficient associated with firm's diversification is not significant.

With respect to industry variables, the overall impression is that industry structure matters for the survival of firms, but not for capital divestiture. However, concentration does not capture the industry effect. Rather, the minimum efficient scale and the entry rate in the industry are the two variables which come out to be important. Foreign presence in the industry is the only variable that exerts a similar effect on the two modes of foreign capital exit. Foreign firms are more likely to survive and to remain foreign owned in those industries which were already more heavily populated by foreign firms. This is not surprising, since foreign firm presence signals the existence of location conditions that attract foreign ownership.

A final comment goes to the evolution of the probabilities of exit over time. As an outcome of our estimation procedures, we obtain estimates of the baseline hazard parameters, which measure the probability of closure/divestiture at each moment. Figures 3 depicts such estimates for a firm with average characteristics and compares them with the estimates obtained without controlling for the characteristics of firms. For computing the estimates reported here, we have used our preferred specifications in columns (2) and (4) of Table 2. For making both sets of estimates comparable, in both cases the estimates are reported as if the overall conditions of the economy were kept constant. That is, in both cases the estimates are obtained when one particular annual dummy is set to one and the others to zero. The reported estimates are for the case where the 1987 dummy is set to one.

insert Figure 3 about here

Two substantive comments are in line here. First, as a consequence of the flexibility in our estimation procedure, our estimated baseline hazard rates conform quite closely to the observed pattern (that is, the estimates without covariates). Second, the evolution of baseline hazard rates appear to be very different for the two types of exit. While the parameters of the closure equation display a decreasing pattern over time, reflecting the learning process that follows entry, the parameters of the capital divestiture are remarkably constant, except at the second year, when it peaks. In reading Figure 3, we should remember that the hazard rate in the last year is estimated with a very small number of observations and being, therefore, estimated with much less precision. Accordingly, we should not put much emphasis on the fact that the hazard rate for the divestment in this year is quite out of line with the previous ones. However, despite these apparently divergent patterns of exit over time, a comparison of the estimated baselines against the hypothesis of a constant baseline over the period, does not allow one to reject the null in any of the equations.

## Conclusion

This work contributes to the literature on the survival of foreign owned firms by analyzing two alternative forms of exit by foreign entrants. The analysis distinguishes between the closure of foreign owned businesses and foreign capital divestiture, interpreted here as the end of the match between firms and foreign owners. The study shows that the decisions to shutdown and to divest are governed by different factors.

We find that the entry mode and the extent of the firm's liability exert opposite effects upon the two modes of exit. Being a greenfield entry increases the likelihood of closure while reducing that of divestiture. Limited liability firms are more likely to divest, but less likely to shutdown than unlimited liability ones. Furthermore, ownership arrangements and organizational structure affect the likelihood of capital divestment, but have little effect on the survival of firms. Only the human capital in the firm and the previous presence of foreign firms exert a similar effect upon both modes of exit. Moreover, while the probability of closure seems to decline with experience, the probability of divestment is roughly constant over time.

Our results provide important insights for managers considering entry into a foreign market, by showing to what extent the decisions taken during the entry and post-entry periods may affect the likelihood of exiting by one and the other exit modes. In attempting to learn from our study, however, managers should be careful in drawing prescriptive measures. One should keep in mind that, in many circumstances, exit is the best decision, if that option is available. Actions that create that option may thus be valuable, especially if the firm has little experience with international operations in general, or with that country in particular. In our context, this suggests that firms with little previous experience should avoid making highly specific investments, as this may decrease the chances of finding a suitable buyer, enabling them to leave the country.

The results of our study can also be of interest from an economic policy perspective. Some countries have policies of attracting foreign direct investment. Such policies are pursued in the belief that foreign investment creates spillovers to the rest of the economy and, therefore, will be the more valuable the longer the foreign firm remains in the country. Our study shows that greenfield investments are likely to have a longer lasting presence in the host country than

investments by acquisition of ongoing concerns, which may lead policy makers to handle the two types of investment differently.

For scholars interested in the survival of foreign owned firms, our work creates new challenges. Most of the literature on survival in foreign countries implicitly identifies exit with the failure of the foreign subsidiary. However, exit may be due to reasons other than failure. In the finance literature, the acquisition of companies followed by its reorganization and subsequent sell-off has been clearly identified as a means of making a profit (Kaplan and Weisbach 1989). In the context of international business, Tsetekos and Gombola (1992) and Ghertman (1988) noted that divestment of foreign subsidiaries does not necessarily indicate problems in the subsidiary, nor in the parent company. Rather, it may be due to strategic re-orientation of the parent company and to the perception that the subsidiary no longer fits with the parent. All of these reasons suggest that the two modes of exit may be associated with different pre-exit performances of the exitors.

Measuring the performance of subsidiaries of foreign companies is tricky, not least because of the problems associated with transfer pricing. However, evaluating the extent to which the performance of these two types of exitors differs in the pre-exit period is crucial for knowing the magnitude of the costs involved in the trade-off between the adequacy of the productive facilities to the foreign firm and the specificity of capital, which leads to the subsequent increased difficulty in exiting from the country. Our understanding of the entry and post-entry performance in foreign countries would benefit greatly from such knowledge.

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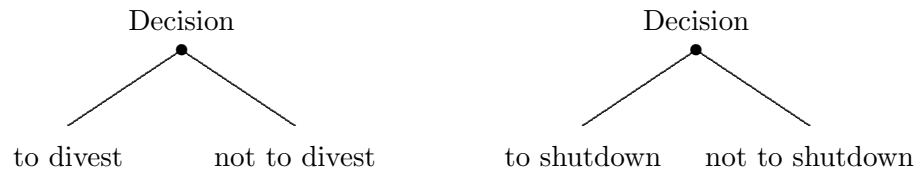
Figure 1: Exit Decisions

Decision

to divest          not to divest

Decision

to shutdown     not to shutdown

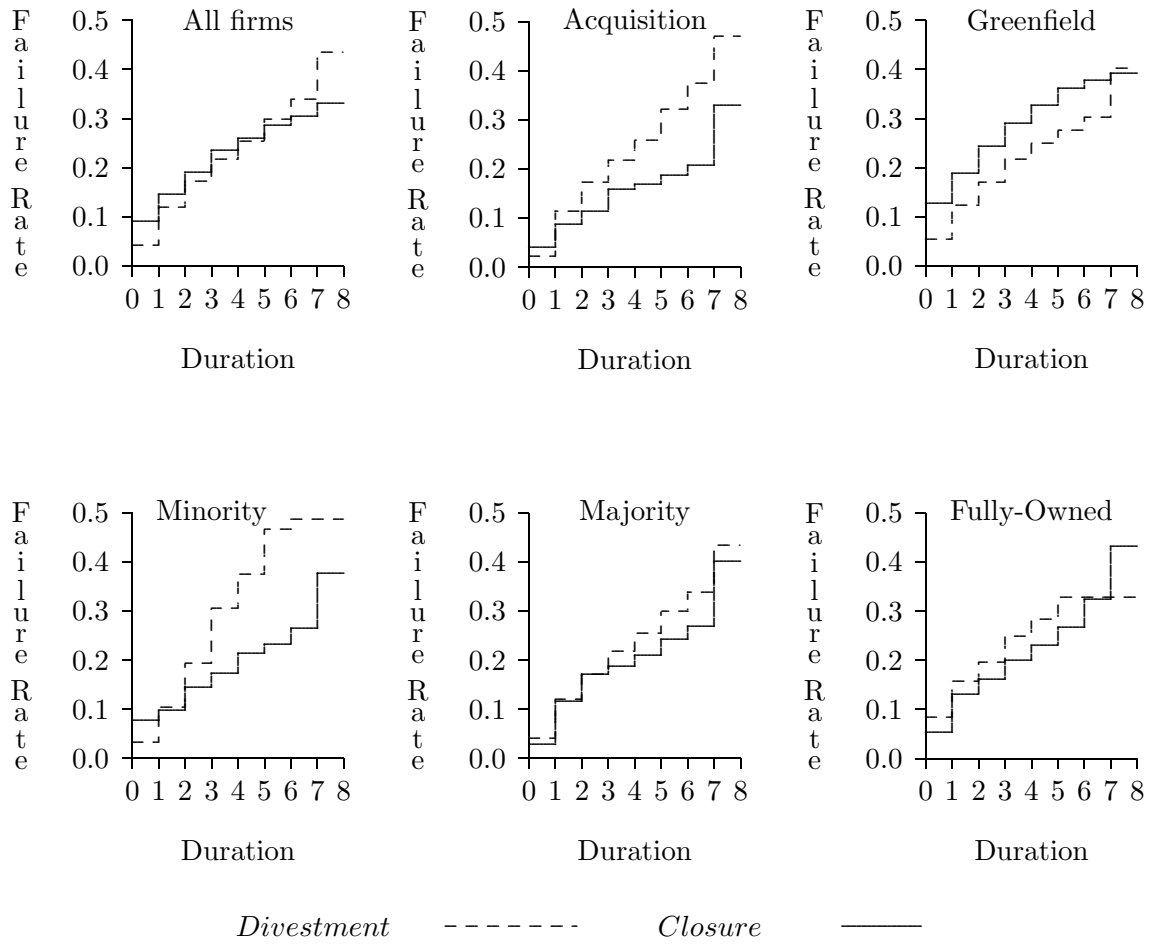Figure 2: Failure Rates of Foreign Entrants, by Exit Mode

Figure 3: Hazard Functions
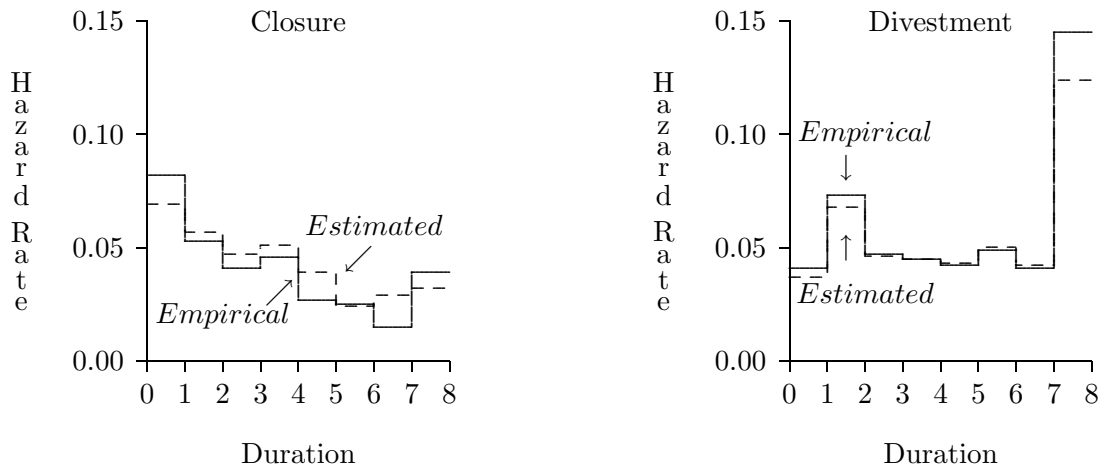
Table 1: Independent Variables at Entry (N=1033)

| | Average | Standard Deviation | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Entry Mode: Greenfield | 0.59 | - | - | | | | | | | | | | | |
| (2) College | 0.11 | 0.20 | 0.14 | - | | | | | | | | | | |
| (3) Size | 2.61 | 1.61 | -0.38 | -0.27 | - | | | | | | | | | |
| (4) Plants | 0.20 | 0.53 | -0.24 | -0.11 | 0.46 | - | | | | | | | | |
| (5) Diversification | 0.01 | 0.07 | 0.14 | 0.06 | -0.25 | -0.43 | - | | | | | | | |
| (6) Limited Liability | 0.92 | - | 0.02 | -0.11 | 0.04 | 0.02 | 0.00 | - | | | | | | |
| (7) Majority Joint-Ventures | 0.32 | - | 0.01 | -0.07 | -0.02 | -0.01 | 0.01 | 0.15 | - | | | | | |
| (8) Fully-Owned Subsidiaries | 0.47 | - | 0.06 | 0.01 | -0.03 | -0.02 | 0.04 | -0.24 | -0.65 | - | | | | |
| (9) MES | 3.51 | 1.04 | -0.09 | -0.16 | 0.44 | -0.05 | -0.02 | 0.00 | 0.01 | -0.04 | - | | | |
| (10) Concentration | 0.05 | 0.12 | -0.05 | 0.04 | 0.04 | 0.06 | -0.05 | -0.02 | -0.01 | 0.00 | -0.02 | - | | |
| (11) Entry | 0.07 | 0.08 | 0.19 | 0.11 | -0.11 | -0.07 | 0.03 | 0.02 | -0.02 | 0.05 | -0.21 | 0.21 | - | |
| (12) Industry Growth | 0.06 | 0.18 | 0.11 | 0.05 | 0.01 | -0.02 | 0.02 | -0.03 | -0.04 | 0.02 | 0.02 | 0.07 | 0.54 | - |
| (13) Foreign Presence | 0.15 | 0.17 | -0.05 | 0.09 | 0.18 | 0.13 | -0.10 | 0.03 | -0.01 | 0.01 | 0.09 | 0.37 | 0.13 | 0.15 |

Table 2: The Determinants of Exit by Divestment and Closure ($N = 3766$).

|  | Capital Divestiture | | Firm Closure | |
|---|---|---|---|---|
|  | (1) | (2) | (3) | (4) |
| Entry Mode: Greenfield | -0.151 | -0.162 | 0.278 | 0.266 |
|  | (0.147) | (0.147) | (0.160) | (0.160) |
| Human Capital | -0.922 | -0.919 | -0.896 | -0.908 |
|  | (0.505) | (0.503) | (0.384) | (0.383) |
| Size | -0.054 | -0.059 | -0.479 | -0.487 |
|  | (0.061) | (0.061) | (0.058) | (0.063) |
| Plants | -0.322 | -0.295 | -0.437 | 0.072 |
|  | (0.183) | (0.170) | (0.233) | (0.215) |
| Diversification | -0.372 |  | -0.266 |  |
|  | (0.997) |  | (1.328) |  |
| Limited Liability | 0.918 | 0.916 | 0.135 | -0.453 |
|  | (0.424) | (0.424) | (0.204) | (0.233) |
| Majority Joint-Ventures | -0.513 | -0.506 | 0.062 | 0.148 |
|  | (0.186) | (0.186) | (0.200) | (0.203) |
| Fully-Owned Subsidiaries | -0.281 | -0.283 | -0.365 | 0.060 |
|  | (0.171) | (0.171) | (1.244) | (0.200) |
| Scale Economies | -0.051 | -0.046 | 0.207 | 0.214 |
|  | (0.084) | (0.084) | (0.078) | (0.081) |
| Concentration | 0.468 |  | 0.707 |  |
|  | (0.633) |  | (0.545) |  |
| Entry | 0.172 | 0.169 | 2.773 | 3.122 |
|  | (1.560) | (1.570) | (0.928) | (0.893) |
| Industry Growth | 0.167 |  | 0.108 |  |
|  | (0.128) |  | (0.172) |  |
| Foreign Presence | -1.669 | -1.601 | -0.755 | -0.588 |
|  | (0.517) | (0.518) | (0.469) | (0.462) |
| $\chi^2$ | 99.234 | 97.337 | 145.773 | 143.892 |

Notes: Figures in parentheses are asymptotic standard errors. Annual time dummies and age dummies (not reported in the table) were also included in all regressions.

# Appendix: Data and Methodology

■ **Data Source**

Our data were obtained from a survey conducted by the Portuguese Ministry of Employment (*Quadros de Pessoal* hereafter QP). This survey has been conducted every year since 1982, covering all firms with wage earners in Portugal. There are no other regular statistics which aim to be as comprehensive as this source. However, for manufacturing the Census of Manufacturers conducted in 1984 provides a natural benchmark against which the survey representativeness can be checked. Comparison of these two sources indicates that QP records a larger number of firms in all employment classes than the Census itself, except in the class of firms employing less than 5 persons. There is no *a priori* reason to believe that QP may be less comprehensive in other sectors than in manufacturing and we are thus led to conclude that, except for the self-employed (which are not our concern here), our source is a highly comprehensive one.

The survey has a longitudinal dimension, i. e. firms are identified through a unique number which allows firms to be followed over time. With respect to this characteristic, the crucial point for our analysis is to be sure that these numbers permit the identification of true entries and exits, rather than false movements due to miscoding. Of course, with such a large database, one can never be sure that no errors are committed, and we took special care to minimize the number of false entries and exits that were included in our sample, through a number of procedures described in the following section.

What makes this data source really unique and particularly valuable from the point of view of the analysis of foreign entry and exit is that, among other data, the survey records the share of equity held by non-residents. Taken together with its longitudinal characteristic, this allows us to compute measures of entry of foreign capital and to establish the longevity of these investments in Portugal.

All of these characteristics make this data source an excellent one for studying changes in foreign capital participation in Portugal, in particular entry and survival of foreign capital and foreign owned companies.

■ **Computing Duration Data**

We identified changes in foreign capital participation with a three step procedure. First, we identified all firms which held foreign capital in at least one year from 1983 to 1989 and which did not have foreign capital in the previous year. This enabled us to date the moment of entry of foreign capital. Second, we searched for the existence of the firm itself in the year before entry in order to be able to classify foreign entry as acquisition *versus* greenfield. This could be easily done because firms' identifiers are numbers supplied sequentially when firms first report to the survey. Identification of new firms can thus be achieved by comparing firms' identifiers with the highest identification number in the file in the previous year. Finally, the last step was the establishment of the life span of foreign capital. For this we had to be able to identify the moment in which the foreign participation ceased. As previously discussed we are interested in distinguishing two alternatives: foreign firm closure, where the foreign owned firm ceases its operations, and foreign capital divestiture, where the firm continues to operate, but no longer with foreign capital participation. To identify the moment of divestiture we searched for the first year when the firm reported foreign participation below 10%, while for identifying closure we searched for the moment when the firm ceased to report to the survey.

Figure 4: The Sampling Plan
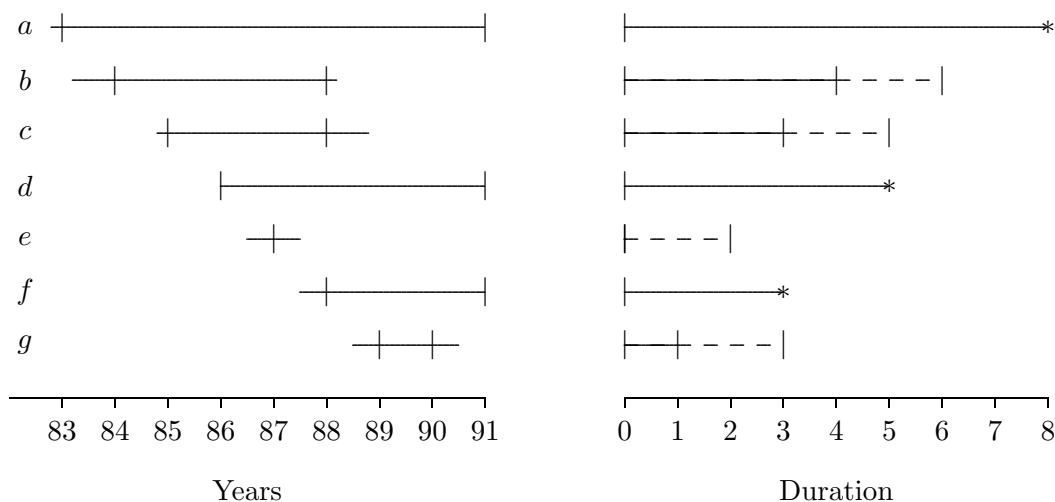
With such a large database, there are inevitably some coding errors in the files. To be on the safe side in computing life spans with such a data base, we performed some data editing upon the original data file. Specifically, some firms may fail to report data on equity participation. We assumed that all firms with missing data in these fields are private domestic firms and thus they were not included in the analysis. However, in order to be able to classify an equity change as foreign divestiture we required that, when a previously foreign owned company reported zero foreign equity there were valid data in the other equity fields, i. e., that the percentage of all the other participations added up to one hundred.

Similarly, we performed additional controls before classifying a firm closure. Namely, we required that a firm be absent from the file for at least two years in order to be classified as a closure. A temporary exit may occur for a number of reasons other than cessation of activity, a likely reason being that the survey form was not received in the Ministry of Employment before the date when the recording operations were closed. Accordingly, we recoded the status of firms which were absent from the files for just one year. Firms that were in the files in years $t-1$ and $t+1$ were considered to be active in year $t$ even if they were not actually in the file and the firm's record was amended for that year. Therefore, for a closure to be recorded in $t-1$ a firm had to be absent from the file in $t$ and $t+1$. For this reason, in our subsequent analysis we use data only until 1990, although our data files go until 1992. Data from 1992 is used only to check the presence of the firm in 1991 and the last year for which we can identify an exit is 1990. Nevertheless, the information on 1991 is used to distinguish between complete and censored durations among those operating in 1990.

Figure 4 represents the sampling plan from this survey and illustrates this point. The left panel displays the longevity of foreign capital, represented on a calendar time, while the right panel presents the corresponding measured durations. For expositional convenience, only an arbitrary single spell is depicted for each of the seven cohorts of firms (1983 to 1989).

The horizontal lines depicted in the left panel represent the longevity of foreign capital since the moment of entry until the moment of divestment (or, alternatively, the moment of firm closure), while the vertical lines indicate the first and last surveys in which a firm is observed.

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Of course, these dates are not the exact dates of start and exit, as it is clear from the fact that the horizontal lines may cross the vertical ones.

The diagram also makes it clear that duration is measured with some imprecision, since we are unable to date the starting and ending moments exactly. However, since we can track the presence of the firm on a yearly basis we are able to define the proper limits of the duration interval, which are depicted in the left panel. In this figure, the solid lines represent the lower limit of the duration intervals, whereas the dotted lines represent the width of the interval. Thus, the right end of the dotted lines gives the upper limit of the duration interval.

If a firm is observed in a single survey, its duration interval is recorded as being delimited between 0 and 2 (in our example, the duration labeled $e$), if it is observed in two surveys its duration is recorded as [1,3] (that labeled $g$), and so on. This last life span is observed in 1990, but not in 1991. Its exit time is properly established in 1990 and the duration is recorded complete. In contrast, durations $a$, $d$, and $f$ are also observed in 1990 but are once again observed in 1991. Therefore, all we know is that their exit time is beyond 1991. We marked the end of these observations' duration with a star in the right panel of Figure 4, and treat them as censored in the analysis. Our statistical models will pay particular attention to this fact.

Finally, the figure makes it clear that whereas the firms from the 1983 cohort can reach a maximum of eight years of duration, the ones from the 1989 cohort can reach, at most, two years. An obvious consequence to be kept in mind is that, while the exit rates for the first and second years are estimated using data from the seven cohorts, the subsequent rates are estimated using fewer cohorts. In particular, our estimates for the exit rate after eight years is produced solely with data from the 1983 cohort.

### ■ Limitations of the data

The database has also limitations that should be made clear. First, we do not know the identity of the foreign owners. This is unfortunate because it prevents us from using the parents' characteristics to explain the exit of subsidiaries, and because we are not able to identify the sale of a foreign equity participation by one foreign firm to another. We cross-checked for the occurrence of such movements with the raw data from the Balance of Payments computed by the Bank of Portugal. The data are not strictly comparable because the Balance of Payment file does not record the share of foreign ownership at each moment but, rather, the transactions of foreign currency which were actually performed by each foreign investor. Moreover, these data are available for the period 1990-1992 only, and therefore do not coincide with the period we are analyzing. We used these data for computing the number of cases where a foreign investor divests totally or partially from a continuing domestic firm, and another foreign investor invests in the same firm during the same year. We found that such simultaneous divestment–investment, occurs only in 5% of the total number of cases of divestment. Therefore, we conclude that this is not a serious problem in our analysis.

Another potential limitation of our data set is that we cannot tell mergers from true exits. What typically happens when one of such movements occurs is that one of the identifiers of the firms involved in the merger is transmitted to the resulting firm, while the others disappear, and are counted as exits in our data. There are no published data on mergers for Portugal, and it is not easy to have an accurate estimate of the number of mergers that occur every year. To obtain a crude estimate of the importance of mergers, we used the Firms Register file. This file records data on all firms that existed when it was created (1988) or have been created since that date. For each firm, only the most current information is maintained. This is not really a problem for firms that were liquidated (including mergers), since the last information available for these firms

is that they were liquidated.

Data on liquidations have two problems, however. The first problem is that there is no information on the date of the liquidation/merger. Therefore, the best we can do is to calculate the number of firms that merged during the period 1988-1997 and compare this number to the number of liquidations during the same period. The second problem is that most businesses never de-register, even if they cease operations. The number of registered liquidations is, therefore, an underestimate of the number of exits. In fact, the number of total liquidations during the whole period is only 2.5% of the stock of registered firms, while additions to the stock of registered businesses vary between 5% and 10% per year. Underestimation of exit flows is not likely to be a problem for limited liability firms, which constitute the majority of our sample. The proportion of such firms which were liquidated is about 20%. As limited liability firms are typically much larger than the average business, and the conventional wisdom is that size is negatively related to exit, the figure above suggests that underestimation of exit is less important than it is for the whole set of firms. Underestimation, likewise, is not a problem for firms that undergo a change in their legal status, such as those that merge. By definition, in order for a change in status to produce legal effects, firms have to register it. Keeping in mind the caveats above, we divided the number of mergers by the total number of liquidations for limited liability firms. Our calculations indicate that mergers are only 2.2% of the registered liquidations. Given that the numerator is measured accurately and the denominator is an underestimate of total exits, our figure is an upper bound for the proportion of mergers in total exits. We, therefore, maintain that our inability to trace mergers in our data set is not likely to greatly bias our results.

### ■ Statistical Model

For analyzing in detail the time pattern of the exit of firms and of foreign capital divestment, we rely on statistical models belonging to a class of models known as duration analysis or event history analysis. Conventional multivariate statistical approaches such as linear regression methods are ill-suited to properly analyze data when the phenomena under scrutiny is the time elapsed within a state (e.g., activity) before a transition occurs to a different state (e.g., shutdown). This is because at the end of the survey period the duration is still incomplete for a number of observations (in our case, because a number of firms are still operating). Furthermore, since we are interested in depicting the evolution of the exit rates as time proceeds, the use of standard binary choice models is also inadequate.

The key concept in duration analysis is the hazard rate. The hazard rate gives the probability that an observation exits within a particular time interval, given that it survived until then. In our context, we will work with two distinct hazard rates, corresponding to the two types of exit we are interested in.

Given that with our sampling plan we can only assign to firms discrete durations, we proceed by dividing the time axis into eight intervals, corresponding to our eight measured durations, and defining the hazard rate $[h(m)]$ for the $m^{th}$ interval as the probability of exiting during the $m^{th}$ interval, conditional upon having survived until then.

Rather than imposing a parametric functional form for the hazard function, a simple flexible hazard model (Kalbfleisch and Prentice, 1980) was employed

$h(m) = \lambda_m \qquad m = 1, 2, \ldots, 8 \qquad 0 < \lambda_m < 1,$

where $\lambda_m$ is just the exit rate for the interval m. Thus, the sequence from $\lambda_1$ to $\lambda_8$ exhibits the yearly evolution of the exit probabilities for a given firm.

The effects of the explanatory variables (some of which may vary over time) are incorporated by allowing the hazard function to be influenced proportionally by the covariates, as suggested

Figure 5: Hazard Functions
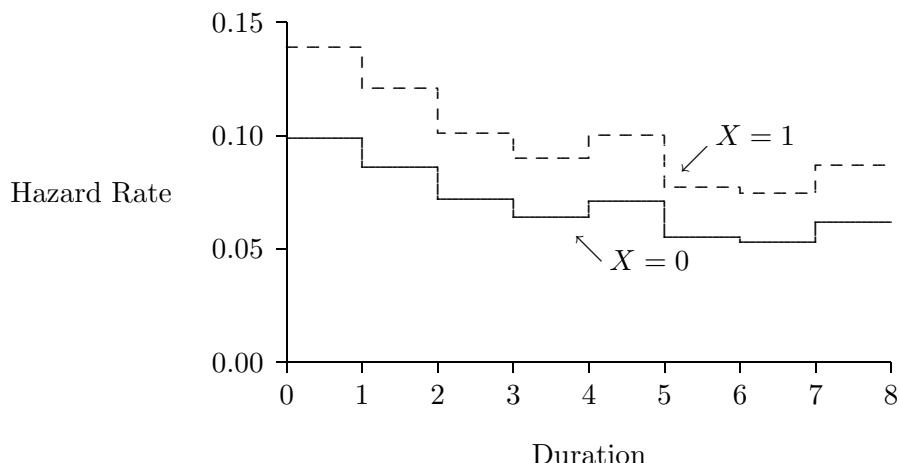
by Cox (1972):

$$h(m) = exp(\beta X_m)\lambda_m \qquad m = 1, 2, \ldots, 8,$$

where $X_m$ is the vector of independent variables observed at $m$, and $\beta$ is the corresponding vector of regression coefficients. To facilitate the interpretation of the parameters, the previous function can be rewritten in a linear form as:

$$log\, h(m) = log(\lambda_m) + \beta X_m \qquad m = 1, 2, \ldots, 8.$$

making clear that the effect of a unit increase in a covariate $X_j$ is to increase $h(m)$ by $100\beta_j$ percent.

The hazard model is diagrammatically sketched in Figure 5. The graph represents the hazard functions for two firms that differ with respect to characteristic $X$. For the sake of simplicity we assume that $X$ is a binary variable that indicates the presence of a risk of failure, for example that the firm is fully foreign owned *versus* joint venture. With the necessary adaptations, all of this also applies to continuous variables. The solid line represents the absence of a failure risk (called the baseline hazard function) and the dotted line marks the presence of such risk. The comparison of the two hazard functions shows that the effect of the regressor is to increase proportionally the odds of failure at each time interval. The assumed proportionality implies that the ratio of the hazard rates for the two firms remains constant along the time span, which is the reason for calling this a Proportional Hazards Model.

Risk factors may, however, change over time. For example, firms may change their legal form and an earlier joint venture may become totally foreign controlled. As we are able to update the risk indicators every year, we incorporate such information in the statistical model. Going back to Figure 5, suppose, for example, that after a number of periods the firm value for $X$ changes from 1 to 0. This change would be represented simply by the displacement of the hazard function for that firm from the dotted to the solid line starting at the time where that change occurred.

Estimation is performed by maximum likelihood methods. In writing the likelihood function, a distinction has to be made between firms that exited and those firms that survived until the end of the survey. To the former, we can assign both a lower and an upper interval for the corresponding durations (interval censored durations). To the latter, all we know is that their duration exceeds a given limit (censored durations). The derivation of the likelihood function

that accommodates our sampling plan is provided below.

This statistical methodology applies to both the duration of the firm and the duration of the foreign capital. In order to separate the determinants of these two different exit modes a clear distinction has to be made between a firm closure and a foreign capital divestment. Accordingly, when a foreign firm closes down, this observation is treated as censored in the divestment equation. Conversely, when divestment is observed, we treat this observation as censored in the closure equation.

In summary, maximum likelihood methods were employed to estimate a simple flexible hazard model that accommodates the grouped nature of the duration data, distinguishes between two competing risks of failure, and incorporates time-varying explanatory variables.

The hazard rate can be formally expressed as

$h(m) = P(Exit\ at\ m | Survival\ to\ m)\ \ m = 1, 2, \ldots, 8$, or

$h(m) = P(Exit\ at\ m)/P(Survival\ to\ m)\ \ m = 1, 2, \ldots, 8$ or, even more specifically, as

$h(m) = f(m)/(1 - F(m))$ ,

where $f(m)$ denotes the discrete probability mass function at the time interval $m$, and $1 - F(m)$ gives the probability that a firm survived up to the upper limit of the $m$ interval, that is, gives the survival function $S(m)$.

For our statistical model, the survival function can be written as:

$S(m) = exp[-\sum_{j=1}^{m} exp(\beta X_j) \lambda_j]$.

Thus, the likelihood contribution for a firm which exits at interval $m$ equals $S(m) - S(m-1)$. Alternatively, the contribution for a firm whose duration is censored at m is given by $S(m-1)$.

In general, the likelihood function for firm $i$ can be expressed as

$L_i = \prod_{m=1}^{8}[(S_i(m-1) - S_i(m))^{\delta_i}(S_i(m-1))^{1-\delta_i}]^{\delta_{m_i}}$,

where $\delta_i$ identifies an uncensored duration and $\delta_{m_i}$ equals 1 if the firm's duration falls into the $m$ interval, and 0 otherwise.

Accordingly, the log-likelihood function is

$LogL = \sum_{i=1}^{n}\{\delta_i \sum_{m=1}^{7} \delta_{m_i} log[1 - e^{-exp(\beta X_{m_i})\lambda_m}] - \sum_{m=2}^{8} \delta_{m_i} \sum_{j=1}^{m-1} exp(\beta X_{j_i})\lambda_j\}$.