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FIRM COMPETITIVE STRATEGIES AND THE LIKELIHOOD OF SURVIVAL THE SPANISH CASE

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Abstract: The purpose of this paper, based on the ideas of Jovanovic's theory (1982), is to analyse the impact of the main strategies determining the competitive behaviour of firms on their survival rate. We consider those strategies related both to product and price differentiation. Among the former ones, one may think of the specific differentiation due to advertising and new products introduced in the market or the technological differentiation based on R&D expenses or new production processes. Among the strategies of the second group, some are based on capital accumulation, or advantages of fixed costs such as scale economies or absolute cost advantages thanks to production techniques introduced by experience of by process innovations. The use of these firm-specific strategies in a set of Spanish manufacturing firms (1990-2001) is analysed. Firstly, several non-parametric tests for equality of survival functions are computed to check the diversity of survival rates across different competitive characteristics of firms. Secondly, a duration model based on a hazard rate model is estimated to study the impact of the main competitive strategies on firm survival. We find that several aspects on the competitive advantage of the firms play an import role in the likelihood of firm survival. Finally, we also conclude that there exists a different competitive strategy having into account two different size groups of firms.

Keywords: *firm survival, competition, duration models.*

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1. INTRODUCTION

Industrial Organisation is the branch of the Economics that analyses the way firms behave in the market. Within this field of study, Industrial Dynamics analyses aspects related to a firm's behaviour in the various phases of its life-cycle, behaviour that will determine its rate of growth and its ability to survive in the face of competition.

The basic precept underlying the various theories of industrial dynamics concerns the capacity of firms within the same industry, and operating within the same market, to become more efficient than their competitors in a situation of equal opportunities. Among the models based on industrial dynamics, the most influential has, perhaps, been that developed by Jovanovic (1982) in which he concludes that the longer a firm operates within a market, that is, the more experience it acquires, the more efficient it becomes. The moment the firm ceases to be efficient; its competitors will step in and occupy its position in the market.

Jovanovic's model is a model of "passive learning", since the firms concentrate their efforts on making themselves more efficient solely by modifying their behaviour, but without taking into consideration high risks. Other authors, such as Klepper (1993, 1996a and 1996b) have introduced the concept of "capacity" to industrial dynamics, that is, the capacity of the entrepreneurs to adopt innovations in their methods of operating so as to make them much more competitive than their competitors. This is a type of learning similar to that formulated by Ericson and Pakes (1995), known as "active learning", and it is based on the capacity of firms to become more competitive thanks to the adoption of innovations both in their products (MacDonald and Jovanovic, 1994) and in their methods of production and organisation (Klepper, 1993).

In the growth process of the firm, this shift from "passive learning" to "active learning" makes the decisions adopted by the management crucial as they will determine the firm's behaviour. The decisions taken will determine a behaviour of adoption of techniques until then learnt from the other agents working in the industry in which the firm operates (passive learning). Techniques of this type are mainly short-term investments which tend to be modified as other new ones appear among the leading incumbents in the industry. Another type of behaviour is based on improvisation and the adoption of competitive strategies that allow the firm to more rapid in the race to make itself competitive (active learning). They comprise investments of a long-term nature vision in which it will become evident whether their adoption, and subsequent materialisation, has resulted in an increase in competitiveness or not.

Therefore, company behaviour is dictated by the decisions taken by the firms during their lifetime. These will determine their efficiency and, in turn, their survival. The main decisions that a firm can adopt are related to prices and production levels and the investments it chooses to make. The decisions taken regarding prices and those taken regarding production quantities can be modified in the short term; however, the decisions taken regarding investments are decisions that can only be modified in the long term and they require a period of time and of adaptation to see what their actual result will be. Among the latter, we find investments related to a firm's expansion into new markets or industries (diversification), financial investments and investments related to an improvement in the competitiveness of its product vis-à-vis those of its competitors (product differentiation), including technological differentiation (investment in innovation and development) and specific differentiation (investments in advertising).

Aspects related to its capacity to be more competitive include improvements to or implementations of new ways of behaving that will have a bearing on the firm’s competitive strategy. Among the improvements to the product are those factors related with the firm’s capacity to introduce new products or to make modifications to its existing products (incremental innovations) which would give it greater weight vis-à-vis its direct competitors. These would even include the firm’s capacity to diversify itself, in other words, to operate in different markets or different industries. The improvements to its processes (radical innovations) are linked with its capacity to reduce costs and to increase productivity, which would make a firm more efficient and which would translate into a reduction in prices (price competition). Factors of this type are closely linked with process innovations and the implementation of new technologies. Internal improvements, linked to a firm’s organisational capacity (innovations in organisation), are improvements that would modify the firm’s structure. They, therefore, include factors related to its management, ownership and its capacity to expand the number of establishments. Finally, improvements linked to the expansion of the market to which the product or process are destined are fundamental in determining whether a firm is efficient or not.

While firms are able to take decisions that will determine their behaviour, there exist certain aspects, of both an internal and external nature, that condition their capacity to survive over which they have no control. Among the many aspects that might be studied in this respect, those most frequently analysed in the literature are the size of the firm and the market structure in which the firm operates. The size of the firm will have an influence on both the likelihood of survival and the firm’s capacity for growth. Similarly, the market structure, be it

of homogenous goods or with a marked business concentration, will lead to a different competitive strategy being adopted, which will have a direct influence on a firm's survival.

In this article, we seek to analyse how the competitive behaviour adopted by the entrepreneur influences the survival of the firm. In addition to analysing the factors that have previously been studied, factors most closely related with Jovanovic's vision of passive learning, such as advertising or innovation costs, we also analyse aspects related to the type of innovation undertaken by the firm as well as the results of this innovative behaviour.

The article is structured in six parts. Following this introduction, section one undertakes a review of both the theoretical and empirical literature, related to the subject of firm survival. In section two, we describe the methodology, discussing the criticisms and the advantages of the method of analysis chosen. Section three describes the data base and the variables to be introduced in the analysis, and comments at the same time on the expected outcome. We then describe the main results from our study in section four, comparing these with the results obtained in similar studies conducted in other countries. And finally, section six discusses the conclusion that can be drawn from this study.

2. THEORETICAL FRAMEWORK

This study, in common with many others conducted in the field of industrial dynamics, is based on Schumpeter's model of "creative destruction" (1942) in which firms of a certain size and in a context of a split market, need to adopt new processes and behaviours in order to maintain themselves and to grow. Most studies that analyse the problem of a firm's life are centred on two principal factors, the size and age of the firm (Mansfield, 1962). Studies of this type find no relation between the size of the firm and its rate of growth, in addition to being in conflict with the theory of cost adjustments in which all firms grow at the same rate and in which the situation of failure is not considered.

In order to explain the deviations from the law of proportional growth, Jovanovic (1982) proposed a theory of business selection ("noisy selection model"), with incomplete information, according to which firms learn from their efficiency as they acquire experience of operating in the industrial sector. The main premise of the model is that the most efficient firms grow throughout their lifetimes and, therefore, survive the different stages of the cycle, while those that do not grow eventually fail. Jovanovic's model agrees with results obtained by authors who followed Schumpeter's line. This can be summarised as: the size of the firm and its concentration seem to be positively related with the rates of results, profits and

earnings; the correlation over time of the rates of results is greater for large firms in the most heavily concentrated industries; the variability of the rates of results at any given time is greater in the concentrated industries; and finally, a high concentration is associated with great profits for the large firms, but not for the small firms. Thus, this study concludes that the smaller firms grow more rapidly than the large firms and also that they show a greater propensity to failure.

Hopenhayn (1992) and Ericson and Pakes (1995, 1998) forward ideas that follow a similar line of reasoning, but build on Jovanovic's postulates, recognising that a firm has the capacity through R&D investment to accelerate the process of acquired learning.

We should not ignore here the theoretical studies that examine the business skills that ensure a business survives and grows. The group based on the *theory of competitive advantage*, looks to Klepper (1993, 1996a, 1996b) as its main reference, among which the main works are those that stress the importance of accumulative economies of scale in R&D, a characteristic which gives an advantage to firms that enter an industry early on as opposed to late entrants. The literature based on the life cycle of the industry has a series of clearly established factors, which are related with the different stages of a firm's life cycle. Thus we find economies of scale, learning curves and barriers to entry and financial resources which are combined with the maturity and technological change and which determine the competitive behaviour of the firm, which should be considered as the key factors in industrial evolution. The principal results are the existence of a positive relationship between the probability of survival and the size and age of the firm. Among the literature based on a "shakeout" focus, we find MacDonald and Jovanovic's study (1994). They present a model in which the earliest entrants employ a common technology, which after a certain time is replaced by a new technology. This new technology ensures low unit costs and, therefore, a higher level of output per firm. The transition to the new technology incorporates an exit or shakeout of the first generation of firms, and the survival of a small number of firms who now employ this new, large-scale technology.

3. A BRIEF EMPIRICAL REVIEW

There exist a huge amount of literature based on demography of firms; this literature is focused in more detail in the industry and the development of this industry. In recent years, there has been developed a literature that attempt to make an analysis of the individual cases taking into account different determinants of the firms, in this section we try to revise

different works based on a individual case study, we analyse what is the methodology of their study and also what are the determinants that they found relevant to analyse.

There exist a lot of works that estimate duration models, or more specifically, Cox (1972) methodology the proportional hazard models, the motivation of this type of papers are based on different aspects: foreign ownership, changes in ownership, market structure, technological structure and other type of internal characteristics of the firm.

Audretsch and Mahmood (1994) work employs the ordinary proportional Cox hazards model in their analysis, use time-constant covariates measured at the industry level except for the initial size for a sample of US manufacturing industries. Audretsch and Mahmood (1995) is one of the most cited works that analyse different characteristics of the firm, their work is focused in the technological and market structure environments and the internal characteristics that we can find in the literature. Their study is carry on with a sample of US manufacturing firm started in 1976 by tracking their subsequent performance oven a ten year period. The methodology is based on a hazard duration function on individual data, it differs their first one in the introduction of time-varying covariates at the industry level.

The work of Mata *et al.* (1995) examines the longevity of entrants. Their paper analyses the survival of new plants, paying special attention to the post-entry evolution and its effects on survival. Their study is pursued using a dataset of Portuguese manufacturing plants opened during the 1980s. The econometric methodology that they follow to analyse the determinants of new plant survival is the time-varying covariates model framework (following Kalbfleish and Prentice, 1980), basically the Cox proportional Hazard model. The specification of that type of models is flexible allowing us to incorporate constant as well as time-varying explanatory variables.

Tveteras and Eide (2000) using a Norwegian manufacturing plant level data set for ten plants cohorts analyse the survival rate with a semi-proportional hazard model, taking into account the internal firm determinants more used in the literature on firm survival. The work is based on the importance of industry heterogeneity and the structural differences between entrepreneurial entrants; it is basically focused in determinants like plant size, capital intensity and productivity.

Harris and Hassaszadeh (2002) based their study on the changes in ownership and other variable linked with the age of the plant determine the probability of plant closure. They provide a more detailed study of the impact of changes in ownership using panel data, to avoid the problem of misspecification they included also in their study the determinants of exits that have featured in the literature. Their database is biased towards the largest

establishments so for this reason they calculate accurately the sample weights for each establishment to ensure the dataset comprising UK manufacturing plants that opened between 1974 and 1995. Finally, they estimate a time-varying covariates hazard function model applied to population weighted plant level panel data.

Görg and Strobl (2003) examine the nature of the effect of multinationals companies on plant survival in the host country using a Cox proportional hazard model, which they estimate using plant-level data for Irish manufacturing industries. They also introduce in their model other plant- and sector-specific effects they found evidence of this kind of technological spillover effect only in the high-tech sectors.

How I can see, there exist several works related to firm survival and firm demography for different countries around the world; USA (Agarwal and Audretsch, 2001; Audretsch and Mahmood, 1994, 1995; Audretsch, 1991; among others), Ireland (Görg and Strobl, 2003), Portugal (Mata *et al.*, 1994, 1995, 1999 and 2004), Italy (Becchetti and Trovato, 2002; Colombo and Delmastro, 2001), among others. But for the Spain case there exist few works based on the survival of the firms.

For the Spanish case Barrios and Strobl (2002) found that only domestic firms that were likely to be more technologically advanced, as an approximated by the incidence of R&D and /or exporting activity, benefited from foreign presence in Spain. The work of Segarra and Callejón (2002) makes an analysis of the business survival for the cohort of born firms in 1994. They analyses the case for the industrial sectors as other works for reducing the high problems of heterogeneity in the business data, they found that the more large and mature is the firm the more likelihood of survival has. Segarra *et al.* (2002) work found that the likelihood of Spanish firm survival is positively related with the age and the size of the firm; and taking into account the technological intensity of the sector, the firms that belong to high technological opportunity sector has lower likelihood of survival. Finally, the work of Esteve *et al.* (2004) analyses the factors determining Spanish manufacturing firms' survival and exit, and the paper suggests that the probability of exit is higher for small firms and also for young and mature firms. Furthermore, exporting firms and firms performing R&D activities enjoy better survival prospects.

4. METHODOLOGY

The methodology adopted in analysing a firm's behaviour throughout its life, and specifically in surviving a particular event, is related to the science of biometry, which was

developed to explain the evolution of a series of patients that present with a pathology and the probability of these patients surviving this condition in a given time period.

Survival can, therefore, be defined as the analysis of the time that passes until failure occurs. In the case of the patient, this is the analysis of the time following diagnosis until death occurs, and in our case, the time from the moment in which a firm establishes itself in a market until exit.

The empirical literature has analysed business dynamics, and more specifically firm exit behaviour, using various techniques. A part of the literature uses logit or probit models of discrete choice (Audretsch, 1995; Littunen, 2000; Colombo and Delmastro, 2000, 2001; Heshmati, 2001; Headd, 2002, among others), in which the dependent variable is the probability of exit or otherwise. Another type of modelling used is that of models for censored data, where the dependent variable always takes positive values and is constituted by the months that have passed since the firm's foundation (Audretsch *et al.*, 1999). And finally, some authors have used simple regression by the least squares procedure of the endogenous variable (Van Praag, 2003; Karlsson and Nyström, 2003). But the use of such models fails to consider considerable amounts of information and in most cases depends on data for cohorts of firms so that the study becomes limited to the representativeness of the sample. In order to solve the problems presented by these models, microeconometric techniques were adopted (parametric and non-parametric) for the estimation of duration models. Indeed, many authors are convinced by the efficiency of econometric duration models in the analysis of firm survival (Mata *et al.*, 1994, 1995; Segarra *et al.*, 2002).

The variable of interest in duration analysis is the length of time that passes between the moment at which the phenomenon begins and the moment in which either the phenomenon terminates or the measurement is taken, which might occur at a time before the termination of the phenomenon. Thus, as we can see, on occasions, when the measurement is taken the phenomenon might not yet have finished. For this reason, both the use of conventional statistical methods and estimation by minimum squares are not adequate for the duration analysis of a process, since they fail to consider the censor problem in the data. These methods use the information in an incomplete manner, due to the fact that in the moment of performing the study there exist a series of cases for which we do not know what their life trajectory will be and a further series of variables that will undergo modifications throughout the time period being analysed. In this case, the estimation by ordinary least squares will provide us with biased and inconsistent estimates. Furthermore, in such cases the likelihood of the event occurring (that it exits the market) will not be conditioned to the evolution of the

individual throughout the period being analysed (having remained in the market until the moment immediately before deciding to exit), but rather will be centred on the mean probability of the occurrence of the event during the period under study. For this reason, we will use models that take into consideration the censor inherent in these data, such as the life tables[1], non-parametric contrasts and parametric estimates and proportional hazard models[2].

The econometric duration models consider the dynamics of the whole process, that is, they take into consideration the evolution in a firm's life over time, so not only is it of relevance whether a firm decides to exit a market during the period of study, but it is also important to see the evolution of the risk of exit and the determinants of this event over time. Most studies that analyse growth following the entrance using these techniques only analyse a cohort of firms (Audretsch, 1991; Mahmood, 1992; Mata and Portugal, 1994; Audretsch and Mahmood, 1995; Agarwal, 1997; Agarwal and Audretsch, 2001; Segarra and Callejón, 2002; Segarra *et al.*, 2002). The use of a cohort of firms reduces the study to an analysis of a series of firms that have many characteristics in common and, therefore, we lose information about the different characteristics that arise if the firms decide to enter the market at different times, or what amounts to the same, if the event begins before or after the moment chosen as the initial moment in the time period analysed. Furthermore, as Mata *et al.* (1995) point out, most studies only take into consideration the conditions of the firm at the moment in which it is set up, assuming thereby that the conditions at the moment in which the firm is established will determine its likelihood of survival during its life. However, as a firm operates, it is quite likely that the variables under study will vary over time and it is probable that the most recent observations of these variables will have more influence in predicting survival than those recorded at the beginning of the period. The use of different cohorts of entrants, allowed them to analyse the effect of a firm's age on the probability of survival, something which cannot be done when only one cohort of firms is analysed, since all will have the same age and will have suffered the same changes during their respective lifetimes. Furthermore, it led them to consider the size of the firm over time, leaving to one side the size at the time its foundation, as a possible regressor to explain the likelihood of firm survival.

Taking into consideration the above discussion, in this study we use the most efficient techniques derived from biometry. First, we undertake a number of non-parametric tests of equality of the survival functions for some of the variables, which are subsequently used in

[1] Agarwal and Audretsch, 2001; Segarra *et al.*, 2002.

[2] For more information about these model types, see a good econometrics manual, such as Greene (2003), the pioneering study that gave the name to this type of model (Cox, 1972) or the study conducted by Kalbfleisch and Prentice (1980).

the survival analysis using parametric regressions. The tests analysed are the Peto-Peto-Prentice test, the Wilcoxon-Breslow-Gehan test, the Long-rank test and the Tarone-Ware test, which are based on the χ^2 test. These tests compare two or more distributions and comprise the weighted sum of the differences between the actual number of firm exits and the expected value, for each of the groups being compared. The difference between the tests lies in the method of weighting. Thus, the Long-rank test is used when it is believed that the survival functions are proportional between the groups being compared, the Wilcoxon-Breslow-Gehan test when the survival function might not be proportional and when the censor patterns are believed to be equal between groups, the Peto-Peto-Prentice test when the survival function varies in a non-proportional manner and also when there is a requirement to control for possible differences in the censor patterns of the various groups (Sanchis *et al.*, 2003).

Afterwards, we move on to analyse the factors determining survival in the case of the Spanish firm, using a representative sample of data censored both from the left (firms founded before 1990) and from the right (firms that will survive beyond 2001), in order to obtain the maximum amount of information possible. The analysis of the determinants of the survival of Spanish manufacturers is carried out by estimating a parametric duration model.

Specifically, in order to analyse the survival of Spanish manufacturing firms we use a hazard model with variables that vary over time. In line with Mata *et al.* (1995) and Harris and Hassaszadeh (2002), we define the hazard rate as the probability of a firm exiting the market at time t having survived until this same point in time, t:

$$h(t; X_{(t)}) = \lim_{dt \to 0} \frac{P(t \leq T < t + dt \mid T \geq t, X_{(t+dt)})}{dt}$$

where $X_{(t),}$ is the matrix of explanatory variables at time t[3] and h(t) is a variable instantaneous rate of market exit. In order to implement it empirically, we must first formulate a functional form of the model, and the most frequently selected option is the specification of a Cox Model or a proportional hazard model[4].

$$h\left(t / x(t)\right) = h_0(t) \exp\left\lfloor x_{(t)} \beta \right\rfloor$$

where $h_0(t)$ is known as the baseline function and β is the vector of the regression parameters.

[3] A discrete version of the function could be written in the following form:

$$h(t; X(t)) = P[\text{exit at } t \mid \text{survival at } t; X(t)] = P[T=t \mid T \geq t, X(t)]$$

[4] Cox (1972) suggests that this proportional hazard model could easily be extended to the model with explanatory variables that vary over time.

If the baseline function is not specified, as in our case here, we are dealing with a semi-parametric duration model. This model is adequate, as Cox (1972) suggests, in the presence of explanatory variables that vary over time and when there exists a high incidence of censored data. This model can be endowed with a specific functional form and thus obtain a parametric duration model, which would improve its efficiency, but it would also be associated with a series of inconveniences such as being conditioned by the correct choice of model and the giving rise to inconsistent estimates due to the presence of unobserved heterogeneity, inconveniences that could be solved with the application of the semi-parametric model (Dolton and Van der Klauw, 1995).

5. DATABASE[5]

The database used is the Survey of Entrepreneurial Strategies (*Encuesta sobre Estrategias Empresariales,* henceforth ESEE) produced by the "Public Enterprise Foundation" of Spain for what is today the Ministry of Science and Technology (previously the Ministry of Industry and Energy). The Public Enterprise Foundation's Economic Research Programme designed the survey, supervises its annual production and maintains the database. The ESEE is a statistical research project that surveys a number of companies representing manufacturing industries in Spain on an annual basis. Its design is relatively flexible and it has two applications. On the one hand, it provides in-depth knowledge of the industrial sector's evolution over time by means of multiple data concerning business development and company decisions. The ESEE is also designed to generate microeconomic information that enables econometric models to be specified and tested. As far as its coverage is concerned, the reference population of the ESEE is companies with ten or more workers in what is usually known as manufacturing industry. The geographical area of reference is Spain, and the variables have a timescale of one year. One of the most outstanding characteristics of the ESEE is its high degree of representativeness. The ESEE contemplates the production activity of firms aggregated to a 2-digit level corresponding to the manufacturing sector. This aggregation in 20 industries corresponds to the NACE-CLIO[6].

[5] For further information concerning the data, you can see Fariñas and Huergo (1999) and Fariñas and Jaumandreu (1994, 1999).

[6] NACE is a general industrial classification of economic activities within the European Union and CLIO is the Classification and Nomenclature of the Input-Output table. Both classifications are officially recognised by the Accounting Economic System (National Institute of Statistics INE: http://www.ine.es)

6. VARIABLES

In order to analyse the effect that the competitive strategy adopted by the firm has on its survival, the following explanatory variables have been included drawn from both the leading theoretical and empirical studies conducted in the field.

First, the variables related to cost competition were introduced. Thus, the marginal price-cost ratio (*mpcr*) of the firm in the year under analysis was included, as it has been by other authors albeit for the whole industrial sector to which the firm belongs (Audretsch and Mahmood, 1995; Segarra and Callejón, 2002; Segarra *et al.*, 2002). This variable is constructed as the total value of the production minus the variable costs of production divided by the total value of production, where the total value of production constitutes the sum of sales and the variation in sales stocks and the cost variables of production, where the latter is the sum of the intermediate consumer goods and the labour costs. The intermediate consumer goods are calculated by summing the purchases and the external services and subtracting the variation in the sales stocks. According to Audretsch and Mahmood (1995), industries that present high margins for this variable will tend to compensate for the disadvantages of costs relative to the size of the firm, thereby reducing the risk of newly founded establishments. *The hypothesis formulated is that in the case of high ratios, the probabilities of survival are much greater.*

In the case of competition through product differentiation, we need to consider the two possible types of differentiation analysed earlier: specific differentiation and technological differentiation.

In order to examine the specific differentiation, we constructed a dichotomous variable that takes the value of 1 when the firm makes any investment in advertisement in the year under review and zero when no investment is made *(adv).* The effect of advertisement on industrial dynamics has been analysed elsewhere for the case of Spain (Lafuente and Lecha, 1988; Aranguren, 1999; Segarra and Callejón, 2002; Segarra *et al.*, 2002). The variable that seeks to explain the technological differentiation is a dichotomous variable that takes the value of 1 when the firm incurs research and development costs and null when it has no such costs *(rdc).* This variable was constructed in line with Heshmati (2001). The effect of investment in innovation on the probability of market survival has been analysed by several authors (Mahmood, 2000; Segarra and Callejón, 2002). *The hypothesis that is formulated from the introduction of these variables is that the use of some type of product differentiation gives the firm a greater probability of survival.*

If we continue to adhere to the theory of active learning (Klepper, 1993; Jovanovic and McDonald, 1994), a number of variables have been introduced to reflect the effects not just of the expenses incurred in innovation, but also those attributable to the type of innovation made by the firm (product or process innovation) on the probability of a firm's survival. An initial focus involves analysing the influence that product innovations can have[7]. This requires the introduction of a variable that describes the number of new products introduced on to the market in a given year by the firm being analysed (*prod)*. This is done in order to observe both the intensity of the effort made by the firm in seeking to obtain a positive result from its investment in innovations and the effect of the introduction of new products on the market in which the firm operates on its likelihood of survival. Littunen (2000) introduces a dichotomy that takes the value of 1 if the firm introduces one product and a value of 2 if the firm launches more than one new product on the market. Using a logit model, and in the case of Finnish manufacturers, he reports that the introduction of products on the market by the firm increases the probability of its remaining in the market.

Similarly, the number of process innovations[8] made in a given year by the firm is introduced (*proc)* in order to observe the effect of these innovations on its likelihood of survival. This variable will show if the competitive strategy adopted by the firm is due to a strategy based on production flexibility. To complement this, in order to see what type of modification in the production process has been adopted, two variables are introduced. First, the variable *mach* is a dichotomous variable which takes a value of 1 when the modification made involves the introduction of new machinery, and the variable *org* is a dichotomous variable that takes a value of 1 when the firm has adopted new methods in its organisation of production and a null value when the opposite is the case. *The hypothesis that is formulated from an analysis of the theoretical literature is that firms that adopt strategies in order to make their production more flexible obtain cost savings which mean that their likelihood of survival is greater than those who do not adopt such strategies.*

Finally, if we continue to focus on a firm's product differentiation strategies with respect to its direct competitors, our study introduces a series of variables that allows us to observe which strategies favour the probability of market survival in the case of the Spanish manufacturing industry. Thus, we introduce variables that define the *type* of product innovation with respect to the products that were previously being produced. The variable *mat*

[7] Product innovations are defined as completely new products or modifications that mean that the new product is quite different from the product previously being produced.
[8] Process innovations are defined as major modifications in the production process.

is a dichotomous variable that takes a value of 1 when the product is new thanks to the use of new materials being used in its production. The variable *comp* takes a value of 1 when the new product incorporates new components or intermediate products and the *des* variable takes a value of 1 when the product incorporates a new design or means of presentation, and finally, the *func* variable is a dichotomous variable which takes a value of 1 when the new product fulfils a different function or functions. *The hypotheses that are formulated from the use of these variables are that the presence of these variables has a positive effect on a firm's likelihood of survival, given that the firm uses strategies to differentiate its product from that of its competitors and, thus, it wins a greater market share in the industry in which it operates.*

Below we present the description and construction of a set of variables, and their corresponding hypotheses, which while they have not been related to the competitive strategy of the firm before, they have been analysed in the literature as determinants of firm survival.

Thus, in order to incorporate the size of the firm as an explanatory variable, we use the number of employees as at the 31 December of the year under review (*size*)[9]. It can be seen that by adopting panel data we can incorporate the size of the firm for each year and, thereby, we use more information than those studies that only consider this variable at the time of the firm's start-up (Mahmood, 2000; Colombo and Delmastro, 2001; Becchetti and Trovato, 2002; Harris and Hassaszadeh, 2002) or at the time of its closure (Audretsch, 1995). Furthermore, according to Mata *et al.* (1995), this variable is a better predictor of the probability of failure than the variable of the size of the firm at the time of establishment, which other authors have tended to use. *The hypothesis that is formulated is that the larger the firm, the greater is its likelihood of survival or the lower its risk of failure.*

In the case of the age of the firm, four dichotomous variables were constructed in order to describe the effect of having passed a given stage in the life-cycle of a firm. These variables classify the firms in four groups: those that have been operating for between 6 and 10 years (*age10*), between 10 and 25 years (*age25*), between 25 and 50 years (*age50*), and finally, over 50 years (*aget*). *By introducing this variable, we are seeking to determine whether firms that have reached a certain age have a greater likelihood of surviving another year.*

In line with those studies that consider ownership structure and the firm's capital to be important explanatory variables of firm survival, we also incorporated the participation of

[9] This variable has been defined in line with Mata *et al.* (1995), Heshmati (2001), Harris and Hassaszadeh (2002), Görg and Strobl (2003), among others.

foreign capital, or more specifically, the percentage of foreign participation in the a firm in the year under review *(for).* Most of the articles that introduce this variable as an explanatory factor do so as a dichotomous variable that takes the value of 1 when the firm is a multinational company (Headd, 2002; Harris and Hassaszadeh, 2002; Görg and Strobl, 2003) or when it forms part of a foreign holding group (Colombo and Delmastro, 2000). *The hypothesis that is formulated from a reading of the literature is that the greater the percentage of foreign participation, the greater the firm's likelihood of survival.*

In addition, we also incorporated the dichotomous variables corresponding to the different sectors of activity according to the Spanish business classification index, CNAE 93. These were analysed, in order to see how the fact of belonging to a given sector of activity affects a firm's likelihood of survival. Among the many articles that incorporate sector dichotomies in their analyses of industrial dynamics, we find Colombo and Delmastro (2000, 2001), Becchetti and Trovato (2002), Harris and Hassaszadeh (2002). *The hypotheses we seek to test by introducing these variables are, first, whether the sectors with greatest dependence on technology present a lower likelihood of survival, and second, if the sectors of homogenous goods present higher risk rates due to the fact that they have fewer possibilities to compete.*

7. RESULTS

Table 2 shows the results of the non-parametric tests of homogeneity for some of the variables that below are included in the regression analysis. As can be seen, given the characteristics of the data base and in order to reduce the heterogeneity, we proceeded to conduct a differentiated analysis with the firms grouped according to size. This differentiation allowed us to observe in greater detail the differences between the competitive strategies that the firms adopted in relation to their size.

It can be seen that the tests vary according to the samples used. In the sample that includes all the firms, all the tests were significant and, therefore, the hypothesis of homogeneity was rejected, except in the case of those firms that base their product innovations on improvements to their internal organisation. Likewise, all the hypotheses of homogeneity were rejected in the case of small firms, with the exception of the variable that describes the differentiated groups that do or do not have a participation of foreign capital, though here the differences were not significant. As for the large firms, the differences between groups were not significant in most cases. Only the fact of their incurring or not

incurring research and development costs, undertaking process innovations and using new machinery in the production process seem to involve the most significant differences.

According to the test results, it can be concluded that the firms that incur research and development expenses and that invest in advertisement present a survival function that differs from that of those that do not adopt these strategies of product differentiation. The same result is also observed for those firms that opt for an active innovation in placing themselves ahead of their competitors, both as regards process and product innovations.

Finally, in terms of the characteristics of differentiation that are presented by the new products that are launched on the market, in the case of product innovations, it can be accepted that the survival function differs in the case of those firms that opt to innovate in product design or to developing new functions for their product. And in the case of process innovations, it appears the decision as to whether or not to adopt a competitive strategy based on new machinery or a production process results in a difference in the firm's risk rate.

Below we analyse the results of the Cox regressions. As can be seen, the competitive strategies adopted for firm survival by the Spanish manufacturers play a determining role, given the high number of explanatory variables that are significant in the regressions used.

First, we offer a brief interpretation of our results obtained from the duration models. The effect of the explanatory variables in this type of model is determined by the hazard ratios. Thus, a parameter value greater than one implies that this variable has a negative effect on the expected survival of the firm, while a value below one is indicative of a positive effect on the likelihood of survival or a negative effect on the firm's risk of failure rate, given that the two are inverse concepts.

The main conclusion to be drawn from our results, bearing in mind the different samples analysed, is that the results obtained when considering the whole sample of firms approximate more closely to the results obtained when only the sample of small firms is used. This is due above all to the fact that Spain's industrial sectors are, in the main, composed of small and medium-sized firms, which adopt very different strategies from those of their larger counterparts that compete with them in the market.

Most studies that analyse firm survival assume that firms have full knowledge of what their competitors are doing and act accordingly. Thus, in such studies most of the variables that account for firm survival with industry-based data are the same. Here, however, we take the view that a firm's behaviour is not so rational, in the belief that an analysis of the way in which the competitive strategy adopted by the firm might influence its survival is determined exclusively by the individual strategic decisions that the firm adopts. It is for this reason that a

firm's internal variables have been included and why no variables that give information about the industry to which it belongs or the market in which it operates have been included. Thus, our results show the effect of the behaviour adopted by the firms following, in part, the line adopted by Ericson and Pakes (1995, 1998) when studying market entry in a situation in which the entrepreneurs act as optimising agents who take into consideration market conditions and what they hope to obtain from the market when deciding to enter. In our study, the entrepreneurs need to modify their business behaviour in order to remain in the market. Additionally, the results of our study are controlled by a series of dichotomous sector variables that explain the effect of belonging to one sector or another.

Among the main conclusions to be drawn from our analysis, the first and the issue most commonly dealt with elsewhere, is the effect of the size of the firm. As we can see from our results, as the firm becomes larger in size, its likelihood of survival increases. This is a highly standard finding in the literature on survival, with many studies drawing the same conclusion both in the case of Spain (Fariñas and Moreno, 2000; Segarra *et al.*, 2002; Sanchis *et al.*, 2003) and at an international level also (Agarwal, 1997; Tveteras and Eide, 2000; Görg and Strobl, 2003; among many others). Harris and Hassaszadeh (2002) likewise point to the fact that the size of the firm is a determining factor in the likelihood of firm survival, and according to these authors, this variable is of greater importance than the inclusion of the size of the firm when it is founded.

Various explanations are forwarded in the literature to account for the marked effect of the size of a firm on its survival. Tveteras and Eide (2000) claim that the absolute size of the firm can, in addition to other variables, be correlated with the ability of the firm to raise capital to invest in production equipment and to cover operational costs when its sales income is not sufficient to cover all the costs of the financial year. They argue that such a situation occurs, above all, in firms with more than one establishment, given that firms that have only one tend to work in market niches that are characterised by smaller production scales. Colombo and Delmastro (2001) suggest that the actual size of the firm can be understood as a predictor of its efficiency. In this way, we are corroborating Jovanovic's (1982) theory of firm selection in the market, where the most efficient firms are those that survive and remain in the market whereas those that do not present an efficient behaviour fails in this study.

The presence of foreign capital seems to increase the risk of failure. It is expected that firms that with foreign capital are, as Colombo and Delmastro (2000) argue, more likely to survive and to be less sensitive to failure than the firms in the country of origin. But the results in our study are the same as those reported by Sanchis *et al.* (2003), although the latter

undertook their analysis using a dichotomous variable that only describes whether or not a firm has foreign capital independently of the intensity of its effects. When conducting the regressions by the size of the firm, this effect appears significant in the case of small firms but it does not appear to occur in large firms. A number of authors in other countries draw the same conclusion. Görg and Strobl (2003) claim that foreign-owned establishments are more likely to represent stronger competition with the multinationals in the sector that export the same product and it might be that they suffer a negative effect form this strong competition. Furthermore, they suggest that the explanation might lie in the fact that firms of this type have to pay tariffs and other types of taxes which the domestic firms do not have to pay. This means that the costs of establishing such firms are often higher and that when they fail to reach their expected targets they exit the market.

As for the "classic" competitive strategy based on investing in advertisement and research and development, in the light of the results obtained here, we can conclude that it would seem to be a type of strategy more in line with that adopted by smaller firms, but that it is also of considerable importance when we look at the whole of the sample.

Thus, research and development costs have a positive effect on a firm's likelihood of survival. This effect seems to be significant in small firms, yet by contrast, it does not appear to exist in large firms. Audretsch (1995) and Audrestch *et al.* (2000) also report a positive effect for this variable on the probability of a firm surviving. “A greater investment in R&D reduces the firm's hazard rate.” However, this view responds to that of start-up firms, and as such they are more reticent to enter sectors where they will have to invest heavily in R&D, because if these investments are not financed from their own funds, the income obtained will be lower. “Therefore, the failure rate of firms will be lower and the probability of survival will increase” (Segarra *et al.*, 2002). Yet, the same authors are cautious in discussing these results since on occasions, in the case of this variable and taking into consideration the sectors of activity, the results are somewhat ambiguous.

Investment in advertisement as a factor in product differentiation and as a means of reducing the risk of failure appears to be significant in Spanish firms. This effect is a determining factor in the case of small firms, but not in that of large firms. In most cases, the large firms understand this set of costs as part of their ordinary activity and, therefore, not a determining factor in their survival. Caves and Porter (1977) work claims that the theory of strategic groups operating in an industry in which mobility barriers exist suggest that a strategy based on product differentiation would facilitate viability in cases in which the scale of results is small. Segarra and Callejón (2002) report that the greater the intensity of

investment in advertisement in an industry, the higher the hazard rate will be among those entering the sector. They claim that, in the markets in which customer information and the salesman's reputation are important, start-up firms face greater entry barriers. Thus, in our results, we can see that advertisement exercises a barrier effect on survival for smaller firms, but not for their larger counterparts. Segarra *et al.* (2002) also report an effect between advertisement costs and the survival of small firms.

As for the variable that describes possible cost competition, we note that the higher a firm's marginal price-cost ratio becomes, the lower is its risk of failure. This effect, while noticeable in small and medium-sized firms, is not so apparent in the case of larger firms. This variable also describes the effect of firms within an industry that operate below an efficient minimum production level. The effect is more prominent in the case of small firms than in that of their larger counterparts, which are more closely affected by economies of scale in their production. In line with Audretsch and Mahmood (1995), the positive impact of this variable can be attributed to the fact the marginal price-cost ratio is higher in concentrated industries where it is easier to detect and penalise the new entrants to the sector (a situation that occurs frequently in Spanish industry, above all in those sectors dominated by small and medium-sized firms). Lippman and Rumelt (1982) claim the stochastic probability of success among start-up companies has the effect of increasing the number of entrants due to the possibility of obtaining higher than average profits, which leads us to think that, in firms which enjoy higher than average profit levels, there is a tendency for these establishments to be more concentrated. This means that the marginal price-cost ratio is much more important for the latter group than it is for firms that do not enjoy profits of this type. Likewise, Audretsch *et al.* (2000) and Audretsch (1991) comment that high margins ensure the survival of firms that have just been created or which have a sub-optimal production scale in the short term, though not in the long term. In the case of Spain, this effect has been analysed by Segarra *et al.* (2002) and by Segarra and Callejón (2002), who both reach the same conclusion.

The effect of implementing constant innovations, both as regards effort (*gid*) and the results of investments (*prod* and *proc*), appears to have a determining role in a firm's probability of survival. In the case of small firms, some studies, such as Audretsch (1991), claim that their ability to innovate will determine the likelihood of their remaining in business. These results would appear to be significant in the case of large firms too, but as can be seen, the result is the opposite of that expected in the case of product innovations (*prod*). According to Geroski (1995), the likelihood of survival might tend to be lower for new firms

in those industries in which the degree of hazard with respect to product viability is higher. This finding is in agreement with our own results, provided, that is, we consider Spanish industries as a type of industry based on markets with risks of product viability.

Process innovations *(proc)* have a significant positive effect on the likelihood of survival. It is an effect that appears in all the regressions analysed, which suggests that the competitive strategy of Spanish firms focuses more on improving production techniques that, in most cases, have a direct effect on the reduction of costs both in personnel (with the introduction of computerised techniques) and in production costs. Few studies include a similar variable to this one, though Colombo and Delmastro (2001) analyse the role of differences in productivity based on the adoption of advanced manufacturing technologies on the closure of firms. According to their study, the costs structure and the possibility of incurring irretrievable expenses can influence exit behaviour. Technologies of this type affect the design and engineering as well as the manufacturing area of the activity. Colombo and Delmastro (2001) claim that while the adoption of new basic equipment directly affects production costs, the adoption of more advanced categories of production equipment might be a sign of a firm's greater ability to differentiate and innovate its product as well as alleviating cost competition. Firms that have used this type of advanced technology present a lower closure rate.

If we focus on the type of innovations introduced, it can be seen that competitive strategies involving the incorporation of new machinery *(mach,* and the design of new products that are then launched on the market *(des),* are those that have a significant effect on firm survival. The latter constitutes a significant strategy because in most cases providing a product with a new design implies making major changes to the production process, due in part to the use of new materials in the manufacturing of products of a new design.

The tables shown here do not show the results for the coefficients corresponding to the sector dichotomies, but a number of aspects are, nevertheless, worth highlighting. Thus, the fact of belonging to sectors which include the industries of rubber and plastics, metal products and machinery or machine equipment appears to have a positive effect on a firm's likelihood of survival, while the hazard rates are higher for sectors such as leather. In line with Mahmood (1992), an explanation for this differentiation between sectors might lie in the fact that firms less dependent on technology and producing more homogenous goods are more strongly influenced by the presence of scale economies which means their likelihood of surviving is lower (the case in fact of the rubber industry). Agarwal (1998) adds that those firms that are less dependent on technology and which have been in the market for a

considerable number of years face higher risks of closure, whereas, firms that operate in a sector in which the dependence on technology is higher appear to have a greater likelihood of surviving (the case of the machinery and metal product industries).

Finally, in order to observe more closely the effect of the age of a firm, we included a number of dichotomous variables (*age10, age25, age50, aget*) which provide us with examples of how a firm's age affects its likelihood of survival. Thus, it can be seen that the age of a firm seems to be a relevant factor in firm survival in all stages of the life-cycle, although the effect does not appear to be linear. If we examine the sub-samples analysed here, it can be seen that this effect appears to be more important in the likelihood of survival of the smaller firms that present significant parameters for all the dichotomous variables analysed. By contrast, in the case of the larger firms, only the dichotomous variable corresponding to firms aged between 25 and 50 years was significant. An explanation for this can be clearly found in Jovanovic's (1982) passive learning model, according to which, once the firms have entered the market and become aware of their abilities and their levels of efficiency, firm survival rates increase the larger the firm becomes. However, in the case of Spain, Fariñas and Moreno (2000), after conducting a kernel-based analysis, failed to find that the rates of failure fell with an increase in the age of the firm. According to their findings, the learning effects do not extend beyond twenty years in the case of Spain's manufacturing industries, which might in part explain why for the large firms the fact of having been operating for more than 20 years is a crucial factor. Segarra *et al.* (2002), again in the case of Spain's manufacturers, report that firms that survive the first few years have a higher probability of survival, and this effect is particularly apparent in sectors with high concentrations of technology. Internationally, many studies have analysed the effect of age and similar conclusions have been reached in most cases as those presented here (Dunne, Roberts and Samuelson, 1988; Phillips and Kirchhoff, 1989; Audretsch, 1991; among many others). Agarwal (1997) notes how cases illustrative of the “senility effect” arise, that is, in very late stages of a firm's life cycle, the probabilities of surviving slowly fall. Colombo and Delmastro (2001) work claims that the probability of market exit falls as the age of the firm increases. With the passing of time, according to their findings, the information acquired by the firm leads them to revise the estimates of their efficiency which means they gradually reduce the probability of receiving “unwelcome news” that might lead to their closure.

Our results, therefore, point to the fact that, in general, the competitive strategies of Spanish manufacturers include those concerned with price competition and product differentiation, as well as with the introduction of new innovations that facilitate Jovanovic's

process of passive learning. While this describes the situation for all the firms, independently of their size, our conclusions are quite different if we analyse two groups of firms according to their number of employees: those with more than 200 workers and those with fewer. Thus, we see that while the smaller firms adhere to Jovanovic's pattern of passive learning, the larger firms appear to opt for a more innovative strategy based on production changes that enable them to introduce greater economies of scale. It should be borne in mind that often this type of firm belongs to a sector with a high presence of scale economies and with highly homogenous products that do not need to be differentiated.

If size is considered as a proxy of business growth, then it is possible to understand Jovanovic's (1982) hypothesis that entrepreneurs who set up a company understand the skills of active firms but are unaware of what their own are, with the result that they begin their activity by making investments which will either pay dividends when they have acquired experience or which will meet with failure if they do not manage to be efficient enough to reap the benefits.

8. CONCLUSIONS

In this study, we have conducted a detailed analysis of the principal strategies that have determined the competitive behaviour of firms operating in the Spanish manufacturing sector since the 1990s. We have based this analysis on the importance of the innovations made within these firms as a motor for their business survival.

The theory underpinning industrial dynamics is today richly abundant but it continues to base its main arguments on the theory of market selection formulated by Jovanovic (1982), who devised a model in which be claimed market selection should be based on the business efficiency acquired by a firm operating within that market. Thus, firms that fail to learn from those that are already well established or from their own experience, because of a lack of efficiency, are forced to abandon the market leaving the firms that know how to be efficient as the market's sole survivors. Over the years, it has been shown that in addition to the experience that a firm might acquire, other factors might also be significant in determining its competitive strategies, such as the theory that relates improvements in competitiveness with business innovation (Klepper, 1996; Ericson and Pakes, 1995). In this study, basing our analysis on Jovanovic's theory and the improvements made to it by Ericson and Pakes and Klepper, among others, we have selected the principal strategies adopted by firms concerned to make themselves as competitive as possible. Following a review of the empirical literature,

these strategies were modelled using a series of variables that had either been adopted elsewhere in the literature or which were implemented here after first running non-parametric tests of homogeneity and an econometric model of duration in order to consider the dynamics of the whole process.

On conducting the study so that different firm sizes were taken into consideration, it was noted that the results tended to differ, indicating that the strategies adopted by the firms vary in accordance with their size - a characteristic that has been widely studied elsewhere. The behaviour of Spanish industry as a whole seems to approximate more closely to that of the small firm as the strategies adopted tended to be more similar to the strategies of these firms than to those of the large firm.

If we look at the various strategies analysed, in the case of price differentiation, the effect of competition on absolute costs was analysed by introducing the marginal price-cost ratio. This was found to be one of the strategies to have an impact on the survival of the small firm and, on occasions, there was evidence to suggest that it is the start-up firms that take the risk of sacrificing income for a time until they are firmly established in the market.

In the case of a strategy based on product differentiation, investment in advertisement appears to reduce the hazard rate of firm failure, as does investment in research and development. However, this effect is only observed, in common with price and cost differentiations, for the sample as a whole and for the smaller firms.

The introduction by a firm of product and process innovations, which ensure it obtains a higher market share in the case of the former or reduced production costs manifest in lower prices in the case of the latter, appears to have a varying influence on the firm exit rate. Thus, the introduction of product innovations appears to be a determining factor in large firms, but it has a negative impact on the likelihood of survival. By contrast, the introduction of major changes in the production process has a markedly positive effect on the likelihood of survival of Spanish manufacturers. Modifications of this type appear to be significant in the case of improvements to, or the introduction of, machinery used in the productive process, being determining factors in all the samples of firms analysed.

Among the variables introduced here, and studied previously in other analyses of the Spanish industrial sectors, it can be seen that the hazard rate falls as the size and age of the firm increases, although the relationship is not linear. By contrast, the presence of foreign capital appears to have a negative influence on the probability of survival of the Spanish manufacturing firm.

To conclude, having analysed a sample of Spanish firms throughout the nineties and the first few years of this decade, it can be seen how the effect of the competitive strategies adopted by these firms differs in accordance with the size of the firm, and that both investment in innovations and the innovative behaviour undertaken by the firm throughout its life cycle emerge as the main factors determining the likelihood of their surviving.

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APPENDIX

	ALL FIRMS				SMALL FIRMS				LARGE FIRMS			
	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.
SIZE	268.42	849.34	1	25363	44.31	47.39	1	200	759.44	1395.01	201	25363
FOR	17.97	36.41	0	100	7.33	24.43	0	100	41.15	46.17	0	100
RDC	0.24	0.43	0	1	0.14	0.35	0	1	0.45	0.50	0	1
ADV	0.40	0.49	0	1	0.37	0.48	0	1	0.49	0.50	0	1
MPCR	0.72	0.42	-17.06	18.58	0.08	0.27	-17.06	5.46	0.05	0.64	-14.47	18.58
PROD	2.88	22.20	0	950	1.92	17.50	0	950	5.04	30.10	0	950
PROC	2.65	3.96	0	94	1.97	3.56	0	94	4.13	4.38	0	76

Table 1. Descriptive Statistics

	ALL FIRMS				SMALL FIRMS				LARGE FIRMS			
	Long Rank	Peto-Peto-Prentice	Wilcoxon Breslow	Tarone-Ware	Long Rank	Peto-Peto-Prentice	Wilcoxon Breslow	Tarone-Ware	Long Rank	Peto-Peto-Prentice	Wilcoxon Breslow	Tarone-Ware
EXT	1.92	2.17	3.35	2.66	2.12	1.70	0.46	1.07	1.74	1.79	1.62	1.77
	(0.1654)	(0.1405)	(0.0672)	(0.1031)	(0.1453)	(0.1927)	(0.4958)	(0.3010)	(0.1874)	(0.1812)	(0.2036)	(0.1833)
RDC	36.87	36.67	33.66	36.08	15.14	14.60	11.37	13.49	5.25	5.45	7.29	6.38
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0007)	(0.0002)	(0.0220)	(0.0196)	(0.0069)	(0.0115)
ADV	10.90	11.08	11.07	11.36	10.67	10.55	8.95	10.18	1.10	1.03	0.42	0.74
	(0.0010)	(0.0009)	(0.0009)	(0.0008)	(0.0011)	(0.0012)	(0.0028)	(0.0014)	(0.2939)	(0.3107)	(0.5147)	(0.3912)
MAT	4.51	4.38	2.92	3.75	6.10	5.65	3.15	4.57	2.03	1.93	1.32	1.66
	(0.0337)	(0.0364)	(0.0873)	(0.0527)	(0.0135)	(0.0175)	(0.0760)	(0.0325)	(0.1546)	(0.1649)	(0.2501)	(0.1982)
COMP	5.26	5.26	4.31	4.89	6.12	5.95	4.36	5.34	1.85	1.80	1.44	1.64
	(0.0218)	(0.0218)	(0.0379)	(0.0270)	(0.0133)	(0.0147)	(0.0367)	(0.0209)	(0.1739)	(0.1793)	(0.2294)	(0.2008)
DES	15.77	15.85	14.39	15.37	9.54	9.26	7.00	8.36	0.40	0.47	1.01	0.71
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0020)	(0.0023)	(0.0081)	(0.0038)	(0.5258)	(0.4937)	(0.3139)	(0.4009)
FUNC	8.03	8.28	7.75	8.07	5.92	5.96	4.88	5.56	0.00	0.00	0.03	0.00
	(0.0046)	(0.0040)	(0.0054)	(0.0045)	(0.0150)	(0.0147)	(0.0272)	(0.0184)	(0.9464)	(0.9784)	(0.8591)	(0.9537)
MACH	27.17	27.91	29.08	28.98	20.41	20.85	20.69	21.25	5.15	5.38	6.94	6.21
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0232)	(0.0204)	(0.0084)	(0.0127)
ORG	0.03	0.02	0.02	0.00	0.18	0.24	0.62	0.42	0.58	0.58	0.59	0.59
	(0.8585)	(0.9024)	(0.8897)	(1.0000)	(0.6726)	(0.6223)	(0.4295)	(0.5167)	(0.4463)	(0.4467)	(0.4416)	(0.4410)
PROD	24.40	24.87	24.94	25.42	11.35	11.24	9.77	10.83	0.99	1.13	2.32	1.64
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0008)	(0.0008)	(0.0018)	(0.0010)	(0.3197)	(0.2878)	(0.1280)	(0.2003)
PROC	62.09	60.94	51.91	57.93	27.54	26.41	20.46	24.23	17.03	17.15	17.11	17.39
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Table 2. Non-parametric tests

	ALL FIRMS				SMALL FIRMS				LARGE FIRMS			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
AGE												
AGE10			0.3169***	0.3433***			0.2934***	0.3156***			0.9453	0.8417
AGE25			0.3863***	0.3685***			0.3484***	0.3178***			0.6638	0.7399
AGE50			0.2955***	0.3200***			0.3312***	0.3578***			0.3888***	0.4413**
AGE T			0.4048***	0.3940***			0.3982***	0.4040***			0.7546	0.7567
SIZE	0.9992***	0.9994**	0.9992***	0.9994**								
FOR	1.0052***	1.0057***	1.0048***	1.0055***	1.0065***	1.0075***	1.0052**	1.0061***	1.0053*	1.0065**	1.0045	1.0060**
RDC	0.6180***	0.5685***	0.6879**	0.6288***	0.6344**	0.5624**	0.7066*	0.6232**	0.7221	0.7566	0.7384	0.7671
ADV	0.7897**	0.8062*	0.8693	0.8850	0.7489**	0.7654**	0.8333	0.8546	1.1317	1.1314	1.1990	1.2029
MPCR	0.8147***	0.8135***	0.8252***	0.8219***	0.8192***	0.8204***	0.8289***	0.8281***	0.8492	0.8607	0.8570	0.8720
PROD	1.0009		1.0018		0.9977		0.9994		1.0032**		1.0036**	
MAT		0.9462		0.9143		0.6774		0.6450		1.7940		1.7518
COMP		1.3355		1.3153		1.0516		1.0378		1.9249		1.9924
DES		0.6730*		0.6857*		0.7469		0.7675		0.5465		0.5428
FUNC		0.9173		0.8986		0.9180		0.8997		0.7150		0.7002
PROC	0.9224***		0.9175***		0.9345***		0.9253***		0.8926***		0.8984***	
MACH		0.4418***		0.4393***		0.4571***		0.4535***		0.4019*		0.3990*
ORG		1.1273		1.1358		1.5020		1.4559		0.4574		0.5017
Sectorial Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N observ.	19133	17594	19133	17594	13300	12143	13300	12143	5833	5451	5833	5451
N indiv.	3351	3118	3351	3118	2530	2317	2530	2317	1073	1034	1073	1034
N failures	419	367	419	367	353	304	353	304	66	63	66	63
LR χ^2	193.63***	172.61***	385.41***	326.89***	135.38***	139.94***	317.96***	291.96***	37.63***	36.99	4805**	3.90*
Log –Likelihood	-3089.40	-2676.64	-2993.51	-2599.50	-2494.14	-2109.09	-2402.86	-2033.08	-400.59	-380.13	-395.38	-376.67

*** indicates significance at the 1% level, ** at the 5% level and * at the 10% confidence level.

Table 3. Regression Results for Cox Model