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The Determinants of Entry are not Independent of Start-up Size: Some evidence from Spanish manufacturing

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ABSTRACT

In this paper we explore the determinants of firm start-up size of Spanish manufacturing industries. The industries' barriers to entry affect the ability of potential entrants to enter the markets and the size range at which they decide to enter. In order to examine the relationships between barriers to entry and size we applied the quantile regression techniques. Our results indicate that the variables that characterize the structure of the market, the variables that are related to the behaviour of the incumbent firms and the rate of growth of the industries generate different barriers depending on the initial size of the entrants.

Keywords: Entry, regression quantiles, start-up size

JEL classification: L110, L600

1. INTRODUCTION

In most countries empirical studies of market turbulence in manufacturing suggest that the average size of new firms is lower than the average size of incumbent firms. The number of small firms in the new cohort is very important in all industries, although the gross entry rate and the entry barriers differ between industries (Acs et al., 1996). This empirical evidence shows that the size distribution of new cohorts is more skewed than market structure. In the first years of life the survival rate of small firms is lower than the average rate of the cohort and over long periods of time there is no convergence on firm size (Geroski et al., 2003). Incumbent firms tend to have lower average growth, lower growth rate variances and a lower mortality risk than new firms. The barriers to entry into the market not only affect the rotation rate: they also determine the firm size distribution of new cohorts and the growth path of the newcomers towards the different long-run equilibrium size.

The determinants of firm start-up size have attracted increasing interest in the theoretical and empirical literature in industrial economics. The barriers to entry and exit of the markets affect not only the turbulence rate and the size of newcomers, but also the size distribution of new cohorts and the growth path of surviving firms. If we assume that, in the long run, firms grow towards different size ranges, the determinants of initial size affect the innovation rate and the global competitiveness of the economy.

In this paper we analyze the determinants of initial size in Spanish manufacturing industries. We consider the hypothesis that the determinants of the newcomer initial size differ between industries, and that in each industry the specific barriers to entry and exit determine a specific distribution size. Following Acs and Audretsch (1989), we also test whether the determinants of entry are independent of firm size as an important topic in industrial dynamics.

In manufacturing industries the initial size of new firms is below the average size of existing firms, and the cost of suboptimal size is greater than in the service sector (Audretsch et al., 2002). This is why in manufacturing markets a post-entry size adjustment is very important, especially in the first few years. Suboptimal size affects a lot of newcomers and selection is very painful. Many newcomers fail during the first few years and those that survive grow proportionately faster than larger firms (Dunne et al., 1988; Evans, 1987; Hall, 1987; Wagner, 1994).

The relationship between the initial size of the firm and the likelihood of survival has been analyzed by several scholars in recent years (Audretsch, 1995; Audretsch and Mahmood, 1995; Dunne and Hughes, 1994; Mata and Portugal, 1995, 1999). The empirical evidence shows that there is a positive relationship between size at start-up and the likelihood of survival. In Spain the survival patterns of new manufacturing firms are similar to those of other countries (Segarra and Callejón, 2002; Segarra (dir.) et al., 2002). Other surveys in the literature have studied turnover, survival and the growth patterns of new firms (Geroski, 1995, Caves, 1998). However, the determinants of firm start-up size have received little attention in the empirical literature. The impact of certain factors (minimum efficient scale, financing channels and profile of founders, etc.) on the determinants of start-up size in manufacturing industries have been analyzed in Portugal (Mata, 1996; Mata and Machado, 1996) and Ireland (Görg, Strobl and Ruane, 2000; Görg and Strobl, 2002). The determinants of firm start-up size in technology-based industries has been analyzed in Italy (Colombo, Delmastro and Grilli, 2002).

The industrial dynamics literature presents a set of entry barriers that affect the initial distribution of the cohort. In each industry there are technological barriers (economies of scale, market power, capital requirements, R&D intensity, advertising) and market barriers (demand growth, turnover rate, the degree of external opening, the risk of failure) that affect the turbulence of markets and the size distribution of the new cohort. We analyze a set of these determinants of the entry rate and initial size of 32,997 new manufacturing plants in Spain.

Firms that enter and exit the manufacturing industries are predominantly small, so studies of the determinants of industrial rotation that treat the determinants of the entrance of small firms as identical to those of medium or large firms are considerably biased. Moreover, the literature on the determinants of entry barriers has paid little attention to the size of new companies (Machado and Mata, 2000). The dominance of small industrial establishments among the entrants shows that we need to pay them greater attention, especially when the literature of firm rotation has not done so.

Here we use a quantile regression (QR) approach. Our method will be to consider the existing heterogeneity between the incoming establishments, as well as the different impacts that the determinants of entry have over the entrants according to size (Mata and Machado, 1996). The results thus obtained will be much more complete than those provided by Ordinary Least Squares (OLS). Still, we perform our estimations using both methods (QR and OLS) so that we can compare the results.

We would like to highlight three previous studies of the demography of firms that take into account the size of the incoming establishments (and which agree on the use of the quantile regression method): Mata and Machado (1996) for Portugal and Görg et al. (2000) and Görg and Strobl (2002) for Ireland.

In this paper we analyse the determinants of the initial size of industrial establishments in Spanish manufacturing industries in greater detail. Our starting assumption is that establishments that enter an industry find different barriers to entry because of their initial size. This paper is organised as follows. The second section presents the empirical evidence for the entrance of new firms in Spain. The third section develops the model, the econometric estimation and the variables used. The fourth section presents our main results. Finally, the fifth section contains conclusions and remarks.

2. DATA

Our information about new firms is from the Spanish Manufacturing Establishments Register (REI), which has plant-level microdata about the creation and location of new industrial establishments (e.g. municipality, industry, number of workers and investments) for the period 1990-1996.

We concentrate our analysis on new plants with more than 2 employees. If we consider that a large number of small establishments are more the result of self-employment strategies than the realization of a firm project, it is advisable to remove the very small establishments from the sample. Firms with less than three wage-earning workers are therefore not included in our econometric estimations. Between 1990 and 1996, 32,997 manufacturing plants with between 3 and 100 employees were created in the Spanish manufacturing industries. The size distribution of newcomers is very skewed: only 24.7 % of these had more than 9 employees (8,163).

It is important to notice that in the Spanish economy most firms are either small or medium-sized[1]. Moreover, in recent decades the presence of small firms inside manufacturing industries has increased (Acs et al., 1996). This larger share of small firms is due to the following factors: i) new data processing technologies reduce the optimal scale of the productive phases; ii) increasing external openings increase competition in the industrial markets due to the flatter and more flexible profiles adopted by the industrial organizations; iii) changes in the training of manufacturing

[1] Of the OECD countries, Spain is, after Italy and Japan, the country with the largest share of small firms (Acs, 1996).

workers favour more qualified workers and enhance the mechanism for initiating the creation of small firms; iv) increasing market segmentation encourages the manufacture of specialized products; and v) the development of new products facilitates the entry of innovating firms that generate a process of destructive creation.

In Spain these processes have been extended since the country became a member of the European Union. Among the effects of this process has been a commercial adjustment of intraindustrial character and significant changes in the industrial composition, the structure of industrial markets and the nature of incumbent firms.

From our sample of entering firms, it is clear that the size distribution of new plants in manufacturing industries between 1990 and 1996 is very skewed (see Table 1). Establishments with between 3 and 9 employees represent 75.3 % of the total number of entrants, 42.9 % of the total number of workplaces and 43.3 % of total investment.

[Insert Table 1 about here]

Indicators of the size of entering establishments for all industrial sectors shows that the size of new establishments ranges from 3 to 100 workers (with a mean number of 8.53), indicating strong dispersion (see Table 2). The curve that measures asymmetry is shifted from the normal distribution, with a tail toward the right.

[Insert Table 2 about here]

The percentage of new entering firms decreases as we move towards larger sizes. Therefore, the distribution of the entrants by size does not correspond to a normal distribution, as we can see from the values of asymmetry and kurtosis. This implies that estimation by OLS would not be appropriate.

Our aim in this study is to analyze the determinants of the creation of establishments according to establishment size. In this regard, the creation of smaller firms is different from the creation of larger firms. The situation is very similar for Ireland and Portugal, where the determinants of entry are not the same for the whole range of firm sizes. Specifically, the variables that explain initial size have greater importance for larger establishments (Mata and Machado, 1996; Görg et al., 2000; Görg and Strobl, 2002).

The turnover of firms in the manufacturing industries is related to the initial size of the entrants, especially during the first few years of life. In Spain the survival rate of new firms in the manufacturing industries is directly related to their initial size. Only 50.47 % of the firms that started up in 1994 were still in operation at the end of 2000. The cumulative rate of survival among firms with less than three workers was 45.73 % and among firms with 50 or more workers it was 62.63 %. It is important to note that the survival pattern differs less across industries than across the size range in the same industry.

To analyze what determines the initial size of industrial establishments, we must choose a variable to determine the size of industrial establishments. The legal nature of the firm, its resources, volume of sales and number of workers are some of the more frequently used indicators. However, the information supplied by the Registry of Industrial Establishments only provides information on the number of workers and the investment in physical assets. Like most similar studies, the variable we chose to measure the size of the establishment is the number of employees when the firm is created.

3. EMPIRICAL MODEL

Theoretical literature provides a wide range of models of the mechanisms governing the entrance of new firms in the manufacturing markets. Traditional approaches from Orr (1974) indicate that expected profits attract the entry of new firms and, conversely, that the barriers make the entry of new producers difficult. From this perspective, the main incentive for the entry of new firms is the industry's long-term excess profits. Also, the entry of new firms erodes the power of the established firms by increasing competition in the market and bringing about a displacement process that causes the less efficient firms to leave (Geroski, 1989). For this reason the entry and exit of firms are closely related phenomena.

The process of firm rotation has both a static and a dynamic dimension. Unlike the traditional approaches, the dynamic approaches explain industrial rotation by means of innovation-imitation processes, asymmetries in expectations and the generation of dynamic economies of learning[2].

In the static approaches, the incoming firms do not encounter entry barriers at the levels of technology or management of the established firms. In the dynamic approaches, the entry and exit of firms in a given industry takes place due to asymmetries in the technological levels, the organizational systems and the nature of information available to the agents.

[2] The dynamic approaches to the entry and exit of firms contain four perspectives: i) the processes of innovation -*creative destruction*- inspired by the evolutionist and product-cycle models (Audretsch, 1995); ii) the generation of learning economies after entry -*learning by doing*- (Jovanovic, 1982, Ericson and Pakes, 1995); iii) the asymmetries in the expectations and information from agents on the future yield of an innovation -*insiders and outsiders*- (Audretsch and Acs, 1991); iv) the incorporation of more efficient capital assets -*vintage models*- (Campbell, 1997).

Although the characteristics of the industry are identical for all firms, the barriers to entry differ according to the initial size of the firm. Our objective is to determine whether the impact of barriers to entry differ according to the size chosen by the new firm.

In this paper we first analyze the determinants of the size distribution of new entrants by the Ordinary Least Squares (OLS) method and then by Quantile Regression (QR) (Koenker and Bassett, 1978). QR overcomes some of the disadvantages of the most common OLS estimations. In particular, when using QR we can analyze different conditional distributions instead of just one measurement (the mean), which is what happens with OLS. This provides much more complete results since the possible heterogeneity between firms is not caught by the explanatory variables. OLS is not the optimal method in our case because the size of the entering establishments does not have a normal distribution.

Specifically, QR divides the population into *n* parts (quantiles), with equal proportions of the population in each quantile. In this way we can analyze the relationship between the dependent variables and the independent variables in each quantile, but not in a summative form as happens with OLS.

If we assume (Koenker and Bassett 1978) that y_t (where t =1,…,T) is a random sample of the regression process $u_t = y_t - x_t\beta$ with distribution function F, the θth regression quantile (0< θ <1) is defined as any solution to the minimization problem,

$$\min_{\beta \in R^K} \left[\sum_{t \in \{t: y_t \geq x_t\beta\}} \theta \left| y_t - x_t\beta \right| + \sum_{t \in \{t: y_t < x_t\beta\}} (1-\theta) \left| y_t - x_t\beta \right| \right] \qquad [3]$$

This expression is normally represented by,

$$\min_{\beta \in R^K} \sum_t \rho_\theta \left(y_t - x_t\beta \right)$$

where,

$$\rho_\theta(\varepsilon)=\begin{cases}\theta\varepsilon & if\ \varepsilon\geq 0\\ (\theta-1)\varepsilon & if\ \varepsilon<0\end{cases}$$

We assume that y_t represents the size of the incoming establishment. With this model we can specify the *θth* quantile of the conditional distribution of y_t, for independent variables x_t (it is assumed that the *θth* quantile is linear in x_t). If we assume that there are i = 1,…,18 two-digit industries of the *Standard Industrial Classification* (SIC) we have:

$$Q_{yit}(\theta|x)=x_{it}\beta(\theta)$$

where $Q_{yi}(\cdot)$ is the quantile function and $ß(\theta)$ is an unknown vector of parameters that can be estimated for different values of θ in (0,1). The first quantile is obtained by setting θ=0.25, and so on. As θ is increased from 0 to 1, we obtain the complete distribution of y conditional in X.

Literature on firm turnover has identified several variables to explain the entry of new firms in an industry. In particular, entry is positively related to explanatory variables linked to expected profits and market growth, and negatively affected by capital and technological requirements and product differentiation.

However, empirical studies carried out by scholars have offered contradictory results. It seems that larger minimum efficient sizes restrain the entrance of new operators (Geroski, 1991) but market structure tests provide ambiguous results for the rate of entry. In concentrated markets, for example, small entrants have a greater ability to find a market niche, while in less concentrated markets the response of incumbent firms to new entrants can be more forceful. High fixed costs can be a barrier to entry, especially when this capital investment causes non-recoverable sunk costs (Baumol and Willing, 1981). Small firms are more important in industries with low capital-to-labour ratios, in industries that are less vertically integrated, industries that are growing rapidly and in local markets (White, 1982).

Having studied the size determinants of start-up firms, we now consider one set of variables to test the impact of entry-inducing factors (industry growth, price-cost margin, share held by firms of suboptimal size and exit rate) and another set to test the effect of barriers to entry (minimum efficient size, market concentration, technological requirements and product differentiation).

Assuming that the determinants of entry are not independent of firm start-up size, we used the start-up size as the dependent variable and studied how the entry-inducing factors and the barriers to entry determine the size distribution of the new cohort[3]. In other words, we studied how the explanatory variables for entry affect the initial size of manufacturing firms. We expected the impact of entry-inducing factors to be positive and the impact of barriers to entry to be negative on start-ups, but we expected the impact of the determinants of entry to differ according to the size of the firm.

Given that Mata and Machado (1996) have extensively discussed the implications of start-up size, we follow them and present this empirical model of the relationship between start-up size (measured by employment: E_i) and industry characteristics:

$$E_i = \beta_0 + \beta_1 IG_i + \beta_2 PCM_i + \beta_3 SZ_i + \beta_4 GER_i + \beta_5 MES_i + \beta_6 MC_i + \beta_7 AC_i + \beta_8 R\&D_i + \varepsilon_i$$

[3] Following Gibrat's Law (Sutton, 1998), a sequence of independent investment opportunities appears over time. Each opportunity is of the same size (in terms of sales revenue and profit) and allows only one firm to take it up, and each opportunity would be unprofitable if more than one single firm took it up. If we denote these opportunities by $t = 1, 2 \ldots T$, a firm's size is measured by the number of opportunities that the firm has taken up. That is, we denote by $n_{i,t}$ the number of firms of size i at a moment t, and by N_t the number of active firms at moment t: $N_t = \sum_{i=1}^{T} n_{i,t}$. We assume that the entering firms take up a different number of opportunities and, as a consequence, differ in their size.

where IG_i (Industry Growth) shows market growth; PCM_i shows Price-cost Margin; SZ_i (Suboptimal Size) shows the existence of scale economies; GER_i (Gross Exit Rate) shows turnover in the markets; MES_i (Minimum Efficient Scale) shows the average size of establishments; MC_i (Market Concentration) shows the concentration of the market; AC_i (Advertising Costs) shows the advertising intensity of the industry; $R\&D_i$ (R&D Expenditure) shows the technological intensity of the industry and ε_i is an error term.

In accordance with earlier studies, we used several proxies for the entry-inducing factors. *Industry Growth* reflects market growth. This is the annual growth rate of added value for the industry between 1990 and 1996. We expect the effect of *Industry Growth* to be positive on entry, especially for the small and medium-sized newcomers. *Price-cost Margin* reflects the market power of incumbent firms and the expected profitability of potential new firms. The expected effect of PCM is ambiguous because, if the incumbents earn supernormal profits in the long run, they can create technical or strategic barriers to entry, while a high PCM encourages potential producers to enter. When a new firm overcomes the barriers to entry we expect a positive effect, especially if these firms are large. We empirically calculated *Price-cost Margin* as the ratio of sales minus the value of intermediate inputs plus the amount of payroll, divided by sales. In general, we expect entry by larger firms to be more sensitive to *Price-cost Margin* and entry by small and medium-sized firms to be more sensitive to changes in the market. However, it is important to remember that "*entry rates are hard to explain using conventional measures of profitability*" (Geroski, 1995).

Suboptimal Size is a proxy for the existence of scale economies but it also shows that there are market niches that allow the entry of suboptimally sized firms. Accordingly, more flexible production technologies, empty market niches and lower wages, among other factors, allow the entry and survival of many suboptimally sized plants (Fotopoulos and Spencer, 1998a). Finally, given that entry and exit firms are highly correlated, we used *Gross Exit Rate* as a proxy for turnover in the markets (Geroski, 1995). When a firm exits the market, there are available resources (e.g. capital and workers) and a non-covered niche in the market where this firm operated. We expect entries to increase if the *Gross Exit Rate* in the industry, especially for small newcomers, is high.

With regard to barriers to entry, the empirical studies of several scholars provide ambiguous results. For example, the variables for the behaviour of incumbent firms present varying results. Advertising expenditure, as a proxy for horizontal product differentiation, changes the height of entry barriers. We expect barriers to entry caused by advertising expenditure to be higher for large firms than for small and medium-sized firms. The effects of expenditure on R&D are also ambiguous. In most industries, technological activities create entry-inducing opportunities because newcomers enter an industry to put an innovation into practice or as a consequence of invention.

We used two sets of determinants of entry barriers. The first set is related to scale economies. When the scale economies of production or distribution are important, suboptimally sized firms have a cost disadvantage in relation to the incumbents. In such cases the technological characteristics of the industry create high barriers to entry. We incorporated two explanatory indicators of scale economies into the econometric specification. *Minimum Efficient Scale* is the average size, in terms of the number of employees, of each establishment. We expect high entry barriers when the *Minimum Efficient Scale* is high (especially for the larger newcomers). Several studies have suggested that in industries where *Minimum Efficient Scale* is high, many small firms enter the market and the survival rate of these small firms is usually high (Audretsch, 1995). This suggests there are submarkets inside these industries where small and medium-sized firms are at less risk (Sutton, 1998) and that over long periods of time firms show no tendency to converge to a common size (Geroski et al., 2003).

The second indicator of scale economies is related to market structure; when scale economies are important, the concentration index is high. *Market Concentration* is a partial concentration index of the market (CR10) calculated with data from the *Encuesta Industrial* (EI; the Spanish Industrial Survey). We expect *Market Concentration* to have a negative effect on new entries.

The second group of explanatory variables related to entry barriers are linked to the performance of incumbent firms in the markets. The strategies of the incumbents with regard to advertising costs and R&D activities have an important effect on the turbulence of markets. We used *Advertising Costs* to indicate product differentiation in the market. The advertising intensity of the industry is measured as the ratio of advertising costs to industrial sales in 1991. We obtained the advertising costs for each industry from the Spanish Input-Output Table. Finally, we used *R&D Expenditure* to indicate the technological intensity of the industry. This is measured as the ratio of expenditure on R&D to industrial sales in 1991. Earlier studies led us to expect ambiguous results from the variables for the strategic performance of incumbents. These effects clearly depend on the industry and the size of the new firm.

In our econometric analysis we calibrated the determinants of the entry of new firms according to size using the structural variables of each industry (minimum efficient scale, market structure, firm capitalization, growth of demand) and the variables related to the behaviour of firms (R&D activities, advertising costs).

4. RESULTS

The last few decades have seen growing interest in the effects of entry on market dynamics and in the determinants of business start-ups. The most common approach is to analyse industrial patterns of business creation without regard to the initial size of the firms. There are several articles on this in the context of the United States (Dunne et al., 1989; Evans and Siegfried, 1992; Acs and Audretsch, 1990), Canada (Baldwin and Gorecki, 1991), Germany (Wagner, 1994), Sweden (Davidsson et al., 1994), Italy (Vivarelli, 1991; Garofoli, 1994), Portugal (Mata, 1994; Mata and Portugal, 1995), Greece (Fotopoulos and Spence, 1998b) and Spain (Aranguren, 1998; Callejón and Segarra, 1999). Recently, however, scholars have tried to distinguish new firm entries by firm size since the effects of barriers to entry clearly depend on the size of the entering firm. There are several articles in the context of Italy (Audretsch et al., 1999; Lotti and Santarelli, 2001), Portugal (Mata, 1996), Greece (Fotopoulos and Spence, 1998b) and Spain (Fariñas and Moreno, 2000, Segarra et al., 2002). Most of these studies have used non-parametric approaches, logit models, least squares estimation (GLS) or ordinary least squares (OLS).

In our study we use two techniques (QR and OLS) and highlight the differences between them. Specifically, we provide results for five different quantiles[4]: 0.15, 0.25, 0.50 (median), 0.75 and 0.90. The fact that a large percentage of new firms are small indicates that the added estimations incur a certain bias because although OLS estimations are based on the central tendency of the data (the mean), quantile regression shows the effects of the explanatory variables for the different quantiles (at different firm sizes).

Table 3 shows the significant differences between the results obtained by OLS and those obtained by QR. We should expect the impact of the variables to be greater for larger firms, i.e., the size of larger firms should be better explained by the economic variables tested here, while the size of smaller firms should be better explained by other kinds of variables (usually non-economic ones). See Arauzo and Manjón (2004)

[4] For each quantile we cumulate observations.

for a detailed explanation. This means that we should carry out specific analyses to understand what happens in the smaller firms.

For example, according to OLS, *Industry Growth* has a positive effect on entry but, according to QR, *Industry Growth* has ambiguous results in the first three quantiles (positive and significant, negative and significant and negative and non-significant) and a clearly higher and positive impact in the higher quantiles. These results show that at higher quantiles firms are more sensitive to the dynamism of the manufacturing industries. Our results for *Industry Growth* are fairly similar to those obtained by Mata (1996), Mata and Machado (1996), Görg et al. (2000) and Görg and Strobl (2002) in the sense that *Industry Growth* is a more important variable for larger start-ups.

[Insert Table 3 about here]

Price-Cost Margin has a negative effect and the coefficients do not increase with the increase of quantiles. We had expected Price-Cost Margin to have a positive and increasing effect but our results are not surprising given the ambiguous effect of this variable—at first sight this variable shows the market power of incumbent firms, which should be an inducing factor in entry, but it could also show the existence of technical or strategic barriers created by incumbent firms to protect their market power.

S*uboptimal Size* shows the presence of newcomers with a suboptimal scale size (i.e., the size of entrants compared to the size of incumbents). The results of other scholars show that this variable has a negative and increasing effect (Mata, 1996; Mata and Machado, 1996; Görg et al., 2000 and Görg and Strobl, 2002). This means that a large number of suboptimally sized firms implies the existence of market niches, i.e., if a large percentage of firms operate at a suboptimal scale, the cost disadvantage to these firms is smaller and the new entrants will choose smaller sizes. See Görg and Strobl (2002). However, because of how *Suboptimal Size* has been formulated, the results should be interpreted in the opposite way, since a higher value of this variable shows that entrants have a more optimal size. Our data therefore show that the fewer the suboptimal size firms, the greater the effect on firm size. Our data also show that this effect increases with the quantile.

As a proxy for the turbulence of the markets, we used the *Gross Exit Rate*. Other scholars have measured turbulence as "the product of employment shares in firms that enter or exit industry" (Görg et al., 2000, p. 212). We can assume that both of these variables measure this phenomenon if we acknowledge that there is a high correlation between exit and entry in manufacturing industries. In previous research we found a close relationship between entry and exit in Spanish manufacturing industries (Segarra et al., 2002). Our results do not agree with those of other studies (Mata, 1996; Mata and Machado, 1996; Görg et al., 2000 and Görg and Strobl, 2002) and show that the sensitivity of new entrants to market turbulence is higher for small start-ups than for large ones.

Our results for *Minimum Efficient Scale* are as expected and perfectly match those of other scholars. *Minimum Efficient Scale* creates barriers to entry in both the OLS estimation and in the QR estimation, where it has a positive and increasing effect. It is realistic to expect that if the *Minimum Efficient Scale* is high, entrants will adopt a larger size in order to compete in the market, as the results of Mata and Machado (1996), Görg et al. (2000) and Görg and Strobl (2002) show.

Market Concentration shows ambiguous results[5], since it is positive for the OLS estimation and negative for most quantiles of the QR estimation, where the curve is U-shaped (the effect is higher at the lower and upper quantiles). We had expected a negative sign and that the impact would be greater for higher quantiles. More work is therefore needed to obtain a good measure of market concentration.

Advertising Costs are more important in determining the start-up size of large firms than they are for determining the start-up size of small firms, i.e., a larger share of the start-up size can be explained in terms of advertising costs for large firms than for smaller firms. We expected the sign to be negative for this variable because product differentiation usually creates entry barriers. As our results show, these barriers are higher at the upper quantiles.

Finally, for *R&D Expenditure* the sign is negative for OLS and there are mixed results for QR. However, the expected sign of R&D intensity is undetermined. This is because in sectors with low R&D intensity, the technological barriers are important for the larger newcomers, and in sectors with high R&D intensity, technological spillovers encourage the birth of new firms, especially smaller ones. As we can see from Table 3, the effect of *R&D Expenditure* is negative at the lower quantiles and positive at the upper quantiles. We can also see that for smaller firms high R&D expenditure favours the entry of small technology-based firms, while for the upper quantiles this expenditure favours larger firms.

[Insert Table 4 about here]

[5] Other scholars (Görg and Strobl, 2002) reported little significance for this variable.

Table 3 shows that the coefficients differ between the quantiles, but this result needs to be verified more rigorously. The results for the differences between the quantiles are given in Table 4 in order to examine whether this effect is the same for each quantile.

In summary, our results show that for *Minimum Efficient Scale* and *Market Concentration* the effects are different for all the contiguous quantiles (the 0.15 quantile in regard to the 0.25 quantile, the 0.25 quantile in regard to the 0.50 quantile, the 0.50 quantile in regard to the 0.75 quantile and the 0.75 quantile in regard to the 0.90 quantile). They also show that for *Price-Cost Margin*, *Suboptimal Size*, *Advertising Costs* and *R&D Expenditure* the effects are different for most of the contiguous quantiles. Also, for almost all the variables (except for *Market Concentration*), the interquantile regression between the first and the last quantile shows that the coefficients are different between these extremes. These results validate the econometric estimations in Table 3.

5. CONCLUSION AND REMARKS

In this paper we analyzed the determinants of entry barriers in the various quantiles of the size distribution of new firms. The fact that a large percentage of start-ups are small suggests that we should rely on quantile regressions, which estimate the effects of the entry variables in relation to the initial size of the entrants.

We have presented some empirical evidence about the determinants of start-up size using data from Spanish manufacturing firms for the period 1990-1996. As several scholars point out[6], the determinants of entry are not independent of start-up size. Our data clearly show that size matters and that the effect exerted on the start-up size of new firms by the characteristics of the markets depends on the start-up size itself. They

[6] See Acs and Audretsch (1989), Görg, Strobl and Ruane (2000), Görg and Strobol (2002), Mata (1996), and Mata and Machado (1996).

also show that entering firms should not be considered homogeneous and that there are certain characteristics of these firms (here we have focused on size) that determine their strategic decisions about entry.

We show that in the Spanish case the barriers to entry are not the same for all establishments, i.e., the determinants of entry for small establishments are not the same as those for large ones. We also show that the barriers to entry in the manufacturing industries depend on the characteristics of the manufacturing firms. These results highlight the fact that public policies to promote entry need to consider the specific characteristics of each sector and firm size, since they affect different entrants in different ways.

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APPENDICES

Appendix 1
Variable definition and sources of data

Variable name	Definition	Source

Inducing factors on entry		
Industry Growth	Growth rate of Value Added (1990-1996)	Spanish Industrial Survey
Price-Cost Margin	Ratio of sales minus intermediate inputs and the amount of payroll divided by sales	Spanish Industrial Survey
Suboptimal Size	Size of the entrants / size of the incumbents	Spanish Manufacturing Establishments Register
Gross Exit Rate	Gross Exit Rate	Spanish Manufacturing Establishments Register, Spanish Industrial Survey
Entry barriers		
Minimum Efficient Scale	Average size of incumbent establishments (employees)	Spanish Manufacturing Establishments Register
Market Concentration	Share of the market of 10 bigger firms	Spanish Industrial Survey
Advertising Costs	Ratio of advertising costs to sales of industry (1991)	Spanish Input-Output Table
R&D Expenditure	Ratio of expenditure on R&D to sales in industry (1991)	Spanish Industrial Survey

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Table 1
Investment and size of entrant establishments (1990-1996)

Employee Size	Establishments	Employees	Investment	Investment / Establishment	Investment/ Employees
3-9	24,834	120,767	2,154	0.09	0.02
10-19	5,528	72,073	984	0.18	0.01
20-49	2,281	64,953	1,268	0.56	0.02
50-100	354	23,659	574	1.62	0.02
Total	32,997	281,452	4,980	0.15	0.02

Note: investment data shown in million euros from 1990.
Source: REI (Spanish Manufacturing Establishments Register).

Table 2
Indicators of the size of entering establishments

	Total entrants
Observations	32,997
Mean size	8.53
Standard deviation	9,37
Minimum	3
Maximum	100
Asymmetry	4,103
Kurtosis	26,568

Source: calculated with data from REI (Spanish Manufacturing Establishments Register).

Table 3
Econometric estimation results: OLS and QR

	OLS	Q 0.15	Q 0.25	Q 0.50	Q 0.75	Q 0.90
Inducing factors on entry						
Industry Growth	25.544***	4.939***	-8.292**	-6.891	51.268***	56.687***
	(4.624)	(1.158)	(3.739)	(5.451)	(9.142)	(6.446)
Price-Cost Margin	-3.544*	-26.805***	-22.488***	-30.530***	-25.974***	-4.166
	(2.123)	(0.532)	(1.411)	(4.124)	(3.351)	(5.082)
Suboptimal Size	9.929***	6.964***	6.964***	11.216***	20.927***	28.046***
	(0.061)	(2.77e-07)	(1.70e-07)	(4.21e-08)	(0.489)	(9.06e-07)
Gross Exit Rate	-0.126***	-0.395***	-0.402***	-0.166***	-0.148***	-0.060
	(0.021)	(0.002)	(0.014)	(0.046)	(0.054)	(0.039)
Entry barriers						
Minimum Efficient Scale	0.013***	0.006***	0.008***	0.013***	0.029***	0.079***
	(0.001)	(0.000)	(0.000)	(0.001)	(0.002)	(0.004)
Market Concentration	1.268***	-2.892***	-1.459***	1.073***	-1.073***	-2.839***
	(0.305)	(0.097)	(0.254)	(0.208)	(0.125)	(0.150)
Advertising Costs	-0.260***	-0.183***	-0.197***	-0.250***	-0.335***	-0.288***
	(0.008)	(0.002)	(0.005)	(0.016)	(0.013)	(0.025)
R&D Expenditure	-0.083***	-0.149***	-0.137***	0.030***	0.031	0.310***
	(0.007)	(0.003)	(0.004)	(0.006)	(0.046)	(0.021)
Constant	7.367***	11.078***	11.158***	9.575***	7.142***	0.818
	(0.496)	(0.114)	(0.279)	(1.168)	(0.824)	(1.444)
Wald statistic	3424.08***	1411.81***	520.83***	4400.49***	5105.51***	4164.73***
Obs.	32997	32997	32997	32997	32997	32997

Note: (***) significant at 1%, (**) significant at 5% and (*) significant at 10% (standard errors within brackets).

Table 4
Interquantile range regressions for comparisons of quantiles

	0.25-0.15	**0.50-0.25**	**0.75-0.50**	**0.90-0.75**	**0.90-0.15**
Inducing factors on entry					
Industry Growth	-13.231***	1.400	58.159***	5.419	51.748***
	(3.882)	(5.256)	(7.026)	(8.931)	(6.672)
Price-Cost Margin	4.318*	-8.042**	4.556	21.808***	22.640***
	(2.344)	(3.520)	(5.574)	(5.944)	(5.923)
Suboptimal Size	6.18e-08	4.252***	9.711***	7.119***	21.082***
	(3.29e-07)	(2.08e-07)	(0.692)	(1.011)	(7.20e-07)
Gross Exit Rate	-0.007	0.237***	0.017	0.088	0.335***
	(0.014)	(0.039)	(0.071)	(0.057)	(0.045)
Entry barriers					
Minimum Efficient Scale	0.002***	0.005***	0.016***	0.050***	0.073***
	(0.000)	(0.000)	(0.002)	(0.004)	(0.003)
Market Concentration	1.433***	2.531***	-2.146***	-1.766***	0.053
	(0.419)	(0.309)	(0.360)	(0.251)	(0.299)
Advertising Costs	-0.014	-0.030***	-0.085***	0.048*	-0.105***
	(0.009)	(0.013)	(0.022)	(0.025)	(0.024)
R&D Expenditure	0.0128***	0.167***	0.002	0.279***	0.460***
	(0.005)	(0.007)	(0.036)	(0.040)	(0.021)
Constant	0.079	-1.582*	-2.434	-6.324***	-10.260***
	(0.484)	(0.912)	(1.477)	(1.584)	(1.532)

Note: (***) significant at 1%, (**) significant at 5% and (*) significant at 10% (standard errors within brackets).