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What Drives New Firms into an Industry? An Integrative Model of Entry

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Abstract

The paper focuses on the theoretical and empirical formulation of an entry model that integrates strategic considerations and firms' heterogeneity. Entry decisions are derived from a profit function, and, subsequently, the number of entrants is defined as the sum of firms that have effectively decided to enter a given industry. As the aggregation of individual entry decisions yields a discrete outcome, the econometric methodology is based on panel count data models, rendering a novel departure from previous works. The results suggest that both incumbents' behaviour towards entry and firm-specific characteristics provide additional and interesting insights in understanding entry.

JEL: C23; C25; L10; L60
Key words: entry; firms' heterogeneity; manufacturing; panel count data models

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1. Introduction

The common wisdom of the existing theoretical and empirical literature on entry behaviour emphasises structural and strategic barriers to entry as the main determinants of the number of firms that each period enter a given industry. However, there may be alternative, or even complementary, factors determining entry and industry structure; in particular, the possibility of heterogeneous firms (incumbents and entrants) with regard to costs, demand, and their ability to compete in the industry. The empirical evidence of simultaneity in entry and exit flows in the same industry (cf. Dunne *et al.*, 1988; Agarwal and Gort, 1996) is, in fact, consistent with heterogeneous firms. If entry and exit are exclusively driven by variations in industry profitability, there is no explanation for the observed simultaneity.

The efficiency-based perspective of industry dynamics recognises the relevance of firms' heterogeneity as a driven force. A superior competitive performance might be specific to the firm that has developed a differential advantage in producing and marketing its products (Demsetz, 1973). Firms are heterogeneous in terms of efficiency and competitive capabilities, which would reflect on their competitive performance. Therefore, the importance of firms' heterogeneity as well as strategy-based arguments should be taken into account in entry studies.

The objective of the paper is threefold. First, it attempts to deepen the understanding of entry by specifying a model of entry behaviour that integrates structural, strategic- and efficiency-based arguments. To fulfil it entrants' profit determinants are split into three components: industry-specific characteristics, firm-specific characteristics, and incumbents' strategic behaviour towards entry. The profit or utility function forms the basis of entry decisions, which are assumed to be a discrete choice problem. Second, it considers observable variables that make feasible the econometric testing of the entry model. Third, a novel econometric approach based on panel models for count data is taken. In particular, the paper applies panel count data models that attempt to lessen concern over the use of cross-section data in industry analysis, mainly on account of omitted variables and/or measurement errors (c.f. Schmalensee, 1989), and to overcome the "statistical incongruence between industry profitability and entry" (Geroski, 1995: p. 428) by controlling for variation in entry behaviour between and within industries.

The paper is organised as follows. Section 2 offers a brief review of previous works on entry modelling. In Section 3 the entry model is theoretically formalised, while Section 4 discusses the variables to be used in the empirical application and delineates the propositions that will require attention in the remainder of the paper. The empirical application is discussed in Section 5, by addressing the issues of data selection, econometric modelling, and estimated results. Finally, Section 6 concludes the paper.

2. An Overview of Previous Works in Entry Modelling

The basic idea behind almost all entry models is that entry occurs whenever expected post-entry profits are positive. The work of Orr (1974) can be seen as one of the early empirical models of entry, incorporating the idea that entry intends to eliminate positive economic profits and that entry does not appear to be free. The theoretical foundations are entry models that posit the limit-pricing hypotheses, in which entry is affected by certain industry's structural characteristics that have been described as erecting entry barriers and thereby perpetuating profit differences across industries. The focus is on identification and measurement of barriers to entry, the entry flow being strictly conditioned by industry's structure. No attempt is made to explicitly model potential entrants' decisions with respect to entry. The pool of potential entrants has no active role in determining the number of firms in a given industry.

More recently, the focus on entry modelling has moved away from industry structure to concentrate on entrants' decision process; in particular, on the specification of the underlying profit function that determines whether or not an entry decision would be taken. Bresnahan and Reiss (1987, 1990, 1991) developed static equilibrium entry models that relate a profit function to firms' entry decisions and allow them to assess the effects of entry, in particular, on firms' competitive conduct. The existing market demand is the key exogenous variable used to describe how entrants' unobserved profits vary with changes in demand and market competition. All firms exert identical competitive pressure and the equilibrium number of firms is,

$$N^* = \frac{\left(P_{(n)} - AC(q_{(n)}, \mathbf{C}) - b_{(n)}\right)}{F + B_{(n)}} S. \tag{1}$$

where $P_{(n)}$ is the equilibrium price resulting from the entry of the *n*th firm, AC is its average cost function, $\mathbf{C}$ is a vector of exogenous variables affecting costs, $q_{(n)}$ the firm output, and S the market size proxied by the number of consumers. $B_{(n)} \geq 0$ and $b_{(n)} \geq 0$ are introduced on the profit function to allow for the possibility of the *n*th entrant having a strategic cost disadvantage. These parameters aggregate theoretical implications from strategic entry models; in particular, strategic interactions that may disadvantage entrants by increasing their costs of operating in the industry. The equilibrium number of firms is determined by both industry characteristics and strategic behaviour that may put latter entrants at cost disadvantage. Note however that in the Bresnahan and Reiss long-run model of stable industry incumbents do not have any incentive to exit the industry and entrants' cost disadvantages result mainly from the order of entry. Moreover, the assumptions underlying that work may be empirically unrealistic as most of industries are not in long run stable equilibrium, being instead characterized by patterns of simultaneous entry and exit. The possibility of firms (either incumbents or entrants) being heterogeneous in terms of cost structure and capability to compete within a given industry is not addressed in those works as well.

Berry (1992), who follows Bresnahan and Reiss' work, directly modelled heterogeneity among entrants by specifying firms' underlying profitability as a function of a component that is common to all firms – $\mathbf{v}_j$ - and another one that is firm specific - ϕ_{ij}. The profit function of firm *i* in industry *j* is expressed as

$$\pi_{ij}=\mathbf{v}_j(N)+\phi_{ij}. \qquad \textbf{(2)}$$

where the common component is a decreasing function of the number of firms, implying that entrant profits decrease with rivals' decisions to enter, and rivals' specific characteristics affect entrant *i* profits via the equilibrium number of firms. The relationship between a firm's profits and its specific characteristics supports efficiency-based arguments in explaining entry. Here, firms may possess competitive advantages by being themselves more efficient. A potential entrant is at disadvantage only if his specific characteristics do not allow him to achieve a level of efficiency equal to rival firms.

3. A Model of Entry

This paper proposes an entry model that integrates strategic considerations arising from entry games and firms' heterogeneity resulting from differences in their capabilities and cost structures. Contrary to the works previously discussed, we seek to develop an empirical entry model to understand the effects of incumbents' conduct and firms' heterogeneity on entry rather than the effects of entry on firms' conduct and equilibrium profits. Furthermore, our analysis will focus on the intensity of competition brought to an industry by new firms, measured by the number of entering firms, rather than on individual entry decisions. The guiding concept of our entry model is a latent profit function for an entrant firm into a given industry, which allows us to specify entry decisions and, by aggregation, the number of entrants. The unit of analysis is the industry.

3.1 The Main Assumptions

The entry model is based on the following assumptions. Initially, at a time 0, each industry has N_0 incumbent firms, which possess specific characteristics and may engage in entry-deterring strategies. During the period that lasts until time 0, one or more firms have the opportunity to make strategic commitments that will influence the post-entry competition.

At the beginning of period 1, of length (0, T], firms contemplating entry in a given industry decide whether to enter or not. Any entry decision, based on a process of gathering information and evaluating profitability, is taken if a firm expects positive post-entry profits. The evaluation of post-entry profits is conditional on the observed competitive environment, which is a result of industry-specific characteristics in terms of cost and demand conditions and past incumbents' strategic behaviour, and on the expected post-entry incumbents' response to entry. The information available at time 0 and their entry strategy, which can be inferred from the firm's characteristic at the moment of entry, allow firms to decide whether or not to enter. Moreover, as potential entrants do not forecast perfectly what will happen after entry, we assume that they know and use all information available at time 0 to predict incumbents' future behaviour, even though the entrant's assessment may be later revised.

The likelihood of future entry and its effects on profits are also critical to the entry decision. At this point we make a simplifying assumption that an entrant cannot know or predict if, and how many, other potential entrants choose to enter in future. Then its entry decision is based only on the number of firms that are considering entry during period 1. Regarding incumbents strategic behaviour, we assume that they anticipate entry and its effects on profitability and, as a result, choose the optimal entry-deterring strategy before time 0. This implies that we impose an exogenous asymmetry in the order in which incumbents and entrants move. Any entry-deterring strategy is implemented and observed before entry occurs. Hence, entrants correctly decide whether or not move into the industry. The observation of effective entries occurs at the end of period 1 (i.e. at time T).

3.2 A Functional Form of Profits and the Number of Entering Firms

Inspired mostly by Berry's (1992) reduced form profit function, we specify that expected profits of a firm *i* entering in industry *j* (π_{ij}) have additively separable components of the form:

$$\pi_{ij} = \mathbf{x}_j\beta + \mathbf{z}_i\gamma + h(\delta, \mathbf{W}), \tag{3}$$

where $\mathbf{x}_j$ is a vector comprising observable industry-specific characteristics, $\mathbf{z}_i$ a vector of observable firm-specific characteristics, reflecting entry strategies, and $h(\delta,\mathbf{W})$ is a function of explanatory variables to capture the relationship between expected profits and rivals' strategic decisions. β, γ, and δ are vectors of unknown parameters. Comparing (3) with (2), the component of profits common to all firms is here separated into industry's structural characteristics ($\mathbf{x}_j$) and strategic aspects ($h(\delta,\mathbf{W})$). The specific index of profitability - ϕ_{ij} - is a linear combination of firms' characteristics ($\mathbf{z}_i$).

The additive component $h(\delta,\mathbf{W})$ can be regarded as an extension of Berry's (1992) profit function. Aside from industry- and firm- specific characteristics profits were specified as a decreasing function of the number of firms in the industry, i.e. $h(\delta,N)$, which accounts for an aggregated and unspecified effect of strategic interactions among firms. Expected profits depend only upon how many firms simultaneously enter a given industry. However, theoretical research examining how incumbents respond to the threat of entry has shown that both the number of incumbents and their strategic behaviour towards entry can affect potential entrants' profits and the magnitude of entry. Thus, the component $h(\delta,\mathbf{W})$ in (3) aims to integrate both the interdependence of entrants' profits via the number of firms and the effect of incumbents' strategic behaviour towards entry.

The proposed entry model is based on entry threshold conditions. Given (3), we define that a firm i will enter in the industry j whenever $\pi_{ij} \geq 0$. In a given period, the equilibrium number of firms is N^*_j, the largest element of the set of integer, $n = (0, 1, ..., N_j)$, that satisfies the entry threshold condition. Formally, the number of firms in the industry j is given by

$$N^*_j = \max_{0 \leq n \leq N_j} \left\{ n : \left(\mathbf{x}_j\beta + \mathbf{z}_n\gamma + h(\delta, \mathbf{W}) \right) \geq 0 \right\} \tag{4}$$

where n only takes integer and non-negative values and the total number of potential firms (N_j) is any finite number[1]. We could presume that there are an infinite number of firms contemplating entry into a variety of industries. However, if entry into an industry, whichever it is, calls for specific or rare firm's characteristics, the supply of potential entrants is necessarily finite. An infinite supply of potential entrants (i.e. $N_j=\infty$) implies that all firms are identical and, as a consequence, equally profitable after entry. Given that equation (4)

[1] See Berry (1992) for a proof of the existence of equilibrium when firms are heterogeneous with respect to profitability.

explicitly allows for heterogeneous entrants, N_j must be a finite, but not necessarily a known, number.

The concept of entry underlying model (3)-(4) is not restricted to moves taken by firms outside the industry. In each period, all firms (incumbents or potential entrants) decide whether or not to be an operating firm within an industry. This kind of decision is broadly understood as an entry decision. In the case of already established firms, it means deciding whether to stay in or exit from the industry, while, in the case of new firms, it means deciding whether or not to be, for the first time, an operating firm in a given industry. The equilibrium number of firms at the end of a given period of time - N^*_j - results from the aggregate outcome of all firms' decisions[2].

However, if the decisions facing incumbent firms were entirely identical to those of entrants, it would imply that there is no room for entry-deterring strategies. At any time, the distinction between incumbents and potential entrants would be meaningless. Aside from industry- and firm-specific characteristics, post-entry profits would depend only upon the number of firms that simultaneously enter, suggesting that incumbent firms do not attempt to take advantage of their previous presence in the industry. They would not attempt to prevent or limit further entries by exploiting, if any, their first-movers' advantages. This however appears to be an unrealistic presumption, at least on oligopolistic industries.

To incorporate in entrants' expected profits the effects of incumbents' strategic deterrence, one has to assume that there is, at some extent, a time lag between incumbents' decisions and new firms' entry decisions. Incumbents firstly decide whether or not to stay in an industry and then how to react to threats of new entries. This sequential decision process for incumbents suggests that at time 0 potential entrants have an indication of incumbents' entry decisions.

As our objective is to understand what drives new firms to enter a given industry, we need to disentangle N^*_j from the equilibrium number of new firms – ENT^*_j – and the equilibrium number of already established firms. Assuming the time lag between incumbents' and potential entrants' entry decisions, the number of incumbents that decide to stay operating in an industry is not an outcome of the current entry process and those two components of N^*_j can be additively separated. Let $N^*_{j,-1}$ be the equilibrium number of firms in industry *j* in the prior period and $\alpha \in [0, 1]$ the exogenous survival rate. N^*_j can then be written as

[2] Existing works treating identically incumbents' and potential entrants' decisions could be seen as explaining actual industry structure rather than entry.

$$N^*_j = int(\alpha\, N^*_{j,-1}) + ENT^*_j. \quad \textbf{(5)}$$

where *int*(.) represents the integer part of $\alpha\, N^*_{j,-1}$. As with equation (4), ENT^*_j, conditional on *int*($\alpha\, N^*_{j,-1}$), can be defined as the largest element of the set of integer *e*=(0,1,…, PE_j) that satisfies the entry condition. That is,

$$ENT^*_j = \max_{0 \le e \le PE_j} \left\{ e : \Pi_{je}\left(e + int\left(\alpha N^*_{j,-1}\right)\right) \ge 0 \right\} \quad \textbf{(6)}$$

where PE_j is the number of potential entrants in industry *j*. $ENT^*_j = k$ means that there are k new firms that are profitable in a N-firm industry, being N composed by the survivors, *int*($\alpha\, N^*_{j,-1}$), and newcomers, k. The substantial implication is that the vector **W** on (3) can now comprise variables measuring incumbents' entry-deterring strategies. Furthermore, entrants' profits are still dependent on the number of firms that can profitably compete in the industry – N –, but its range is now between *int*($\alpha\, N^*_{j,-1}$) and (e+*int*($\alpha\, N^*_{j,-1}$)). This specification allow us to assess the empirical applicability of various theoretical entry models and, hence, to identify which factors are empirically most relevant in the entry decision.

4. Empirical Specification

To apply the entry model to data requires $\mathbf{x}_j$, $\mathbf{z}_i$ and $h(\delta,\mathbf{W})$ to be expressed in terms of observable variables. It will be done for the case of Portuguese manufacturing industries. Although a number of entry studies have been undertaken in Portugal (Mata, 1991, 1993, 1996a, 1996b), they mainly applied a standardised methodology and intended to identify industry-specific structural characteristics that were likely to impose a deterrent effect on entry. This study, on the contrary, proposes and estimates an entry model that integrates explicative factors relating to industry's environment comprising exogenous, or structural, cost and demand conditions, firm-specific characteristics, and incumbents' strategic behaviour towards entry. Moreover, it does so by using a large panel data that allow us to follow each industry over time and applying a more adequate econometric methodology.

4.1 Specifying Industry-Specific Characteristics

The industry-specific characteristics that affect entrants' profitability are similar to those affecting incumbents' profits. Thus, we can infer industry-specific characteristics through incumbents' profitability. In particular, based on Schmalensee (1985), who found that industry characteristics accounted for about 75 percent of the variation in industry average profitability, industry-specific effects, whatever their nature, on profitability can be proxied by a measure of industry average profitability. Accordingly, we employ the industry-averaged price-cost margin (PCM) as a proxy of industry specific effects.

There are at least two reasons in supporting the choice of PCM as a profitability measure. Since price-cost margin has been frequently used in entry studies, its choice allows us to make direct comparisons between results obtained in this study and previous works. More importantly, when compared with alternative profitability measures, PCM appears to be relatively more stable (Baldwin, 1995). Given that our objective is to measure the specific characteristics of each industry that do not vary much over time and are likely to influence entrants' expected profits, PCM seems to be the most appropriate proxy for that. Moreover, as PCM captures differences between the value of production and production costs (notably, raw materials, labour and electricity), it accounts for industry's costs (as resulting from differences in technology) and demand conditions through the level of industry output.

Despite the relative stability of PCM when compared with alternative profitability measures, it is likely to exhibit some inter-temporal variability that may affect entrants' expected profits. If different price-cost margins are associated with different variability on profits, their effects on entrants' expected profits could be similar. Different price-cost margins may have the same effects on entry if the industry's risk is also different. To control for differences on industry risk (RISK), a measure of the observed inter-temporal variability of price-cost margin is included as an additional industry characteristic.

Another industry characteristic that can affect entrants' profitability is expected demand growth. Higher profits are in general expected in growing than in otherwise identical industries (Schmalensee, 1989). Moreover, in growing industries entrants can more easily cover the cost of entry without attracting a substantial number of customers away from incumbents. In order to keep our model empirically manageable, we assume that entrants have common expectations about demand growth, which are equal to the observed demand growth (GROWTH).

Therefore, we state that *potential entrants respond to profitable opportunities inferred through industry average profitability, its associated variability and, observed demand growth* (propositon 1).

4.2 Firm-Specific Characteristics

Before discussing the sources of firms' differences that are likely to affect post-entry profitability, we shall consider alternative ways of aggregating firms' characteristics.

Basically, our entry model requires some type of aggregation as equation (6) applies at industry level, while entry decisions based on equation (3) have been specified for each potential entrant and directly dependent on entrants' specific characteristics.

The approach chosen is to replace $\mathbf{z}_i$ in (3) by $\mathbf{z}'_j$, the average value of $\mathbf{z}$ across all entrants in industry *j*, measuring firm-specific characteristics of a representative entrant firm. The effects of firms' characteristics on entry can be captured through the absolute value of $\mathbf{z}'_j$, as it may determine the average level of $\mathbf{z}$ required to profitably operate in the industry regardless of incumbents' characteristics. Alternatively, those effects can be captured through the ratio between $\mathbf{z}'_j$ and the average value of $\mathbf{z}$ across all incumbent firms, which emphasises entrants' characteristics relative to those of already established firms. This is the adopted approach, allowing entrant-specific characteristics as well as other firms' characteristics to affect entrant's profits.

Regarding firms' characteristics, firm-specific resource endowments have been argued to be an important factor in determining the ability of firms to compete successfully. Skilled employees, production experience and the capability to innovate and take economic advantage of it are frequently listed as important firm-specific resources (cf. Wernerfelt, 1984; Nelson, 1991). Demsetz (1973) has already highlighted the role of employee skills in deriving firm higher productivity and higher performance as well as reputation, which is difficult to separate from the firm itself. Recently, Röller and Sinclair-Desgagné (1996) stress the role of firms' initial capabilities in affecting firms' profitability divergences.

Although the development of firm-specific resources can be associated, among other things, with R&D activities and advertising expenditures (for example, in developing brand names), the data available is particularly limited in this respect. Nevertheless, the information available to human capital (i.e. employees' characteristics) is particularly rich. This allows us to explore initial employees' skills and schooling as an indicator of the propensity to develop firm-specific resources and to adapt to changes in the competitive environment. Thus, the relative share of college graduates among the labour force (GRAD) will be used to measure entrants' propensity to create firm-specific resources, which can be associated with innovation, management or organisational capabilities. As this variable measures differences in educational background, it can also be thought of as an indicator of the ability to learn about their competitive environment and to react successfully to changes in that environment, which will be crucial to growth and survival. In a similar way, the relative share of skilled employees (SKILL) is included to measure the ability of entrants to raise their productive efficiency and profitability. The definition of skilled employee is the one given by the Portuguese Ministry of Employment.

The entry scale (SIZE) is another source of differences among entering firms. The literature on entry has suggested that new firms tend to enter on a small scale if entrants intend to avoid incumbents' aggressive behaviour (Scherer and Ross, 1990). Choosing to enter on a small scale, entrants project a friendly image that may reduce the likelihood of aggressive response from incumbents to entry (Gelman and Salop, 1983; Sørgard, 1995; Thomas, 1999) since the cost of such a response may be higher than its expected benefit. They may also choose to be small because they are uncertain about their efficiency and profitability. Being small allows entrants to learn from experience (Jovanovic, 1982) and to develop learning abilities (Ericson and Pakes, 1995; Pakes and Ericson 1998), which may reduce the risk of failure and increase the possibility of growth.

The scale of entry, on the other hand, is usually seen as a potential source of entrants' cost disadvantages compared to incumbents since the existence of scale economies may constrain entrants' costs. If entrants choose an entry scale lower than the minimum efficient scale (measured here by the average size of all incumbents), they may be constrained to operate with higher costs than scale-efficient firms (Audretsch, 1995). On the other hand, as Audretsch and Yamawaki (1992) shown, sub-optimal scaled plants may overcome the scale-related disadvantages by deploying and remunerating differently their productive factors; in particular by having more flexible and less hierarchical productive and managerial structures, or by developing other cost-reducing strategies that compensate their size disadvantages. If entrants can implement such compensatory mechanism, possible size-induced disadvantages may not be determinant to their entry mode choice and expected profitability.

To sum up, we should state that *the extent and structure of the labour force at the moment of entry and the entry size play a relevant role in deriving superior performance from the firm* (proposition 2). Specifically, *a high level of graduate employees tends to promote the creation of firm-specific resources*, *notably those associated with the ability to learn about and to react successfully to changes in the competitive environment* (proposition 2a), and *a relatively large share of skilled employees may raise productive efficiency and performance* (proposition 2b). Furthermore, *the choice of the scale of entry takes into account incumbents' potential aggressive response and potential cost disadvantages associated with scale* (proposition 2c).

4.3 Specifying Incumbents' Behaviour and its Relationship with Entry

From the entrants' viewpoint a crucial factor in evaluating entry profitability is the assessment of the incumbents' propensity to respond aggressively in the event of entry. It is plausible to argue that incumbents are in general more able to behave aggressively towards entry when they have profitable market positions to be protected. Yet, since aggressive behaviour needs to be funded, more profitable incumbents with surplus funds at their disposal (resulting from past profitable operations) may be more protective of their market positions by engaging in such strategic activities (Kessides, 1990). On the other hand, incumbents might find it easier to engage in and co-ordinate aggressive behaviour against entrants when they operate in concentrated industries where firms' profitability is likely to be strategically linked and the free rider problem may be smaller. Potential entrants observing incumbents' performance and the degree of competition in the industry are able to infer such propensity and take it into account in their entry decisions.

We use information on industries' average profitability, measured by the average price-cost margin (PCM), and an index of industry concentration (CONC) to assess the propensity of incumbents to engage in strategic behaviour towards entry (PROP_STRA). We expect PROP_STRA to attain high values if incumbents' profitability and industry concentration are both high. Conversely, low industry concentration and/or low incumbents' profitability are likely to discourage incumbents from engaging in strategic behaviour, since expected benefits from that may not cover its costs and the free rider problem may be an important disincentive as well. Therefore, we define PROP_STRA as the product of PCM and CONC, which will only attain high values if both factors are important.

Another factor that entrants are likely to take into account in assessing expected profits is incumbents' entry deterrence strategies. A wide variety of entry deterrence strategies are available to incumbents. Empirical evidence has already shown that incumbents design strategies to protect their market from newcomers (cf. Smiley, 1988; Singh *et al.* 1998). The critical point in any entry-deterring strategy is its credibility, which depends on the extent of pre-commitments, leading to sunk costs, and their observation and correct assessment by potential entrants (Bonanno, 1988). In the absence of sunk costs and given complete information, deterrence activities may not be credible and may not influence entry decisions (Kessides, 1990).

Instead of attempting to directly measure sunk costs[3] due to incumbents' strategic commitments, past entry and exit rates in the industry were used. Apart from profit considerations on entry decision, entry may occur because it is easy (sunk costs are low) to begin operating in the industry. On the other hand, potential entrants may infer from high exit rates that there are reduced losses in case of failure and entry mistakes can costlessly be corrected. Measuring the extent of simultaneous entry and exit we can therefore assess the relevance of sunk costs whatever their nature (i.e. exogenous or endogenous, according to Sutton's (1991) terminology). If past entry and exit are both important, the product of their rates will attain high values, which reveal high firm turnover and can be understood as a signal of low sunk costs. By contrast, high sunk costs will yield low entry and exit rates.

The advantage of considering both entry and exit rates as an indirect measure of sunk costs is that both exogenous and endogenous sunk costs are likely to be accounted for, although their separate effects cannot be identified. Since any exit decision is expected to be taken by considering entry costs as well as competitive pressure after entry, the effective extent of both type of sunk costs determines any exit decision. Observing the extent of past entry and exit rates, potential entrants may infer more accurately the importance of exogenous and endogenous irrecoverable costs. Therefore, we propose to measure the magnitude of sunk costs (SUNK) by computing the product of past entry and exit rates, assuming that potential entrants take past incumbents' behaviour to predict their actual behaviour in response to the threat of entry.

Unfortunately, the available data prevent us from testing the adoption of specific entry-deterring strategies and their effects on entry. One exception is the possibility of exploring the interaction between strategic investment in patenting and branding and entry. According to Gilbert and Newberry's (1982) model, incumbents may speed up R&D and patenting in response to the threat of entry. If entrants need to gain a patent to compete in the industry, incumbents may deter entry by increasing their R&D and patenting budget in the pre-entry period. Similarly, Schmalensee (1978) argued that incumbents might engage in brand proliferation in the pre-entry period to entirely fill up the product space and leave no

[3] The role of sunk costs in influencing entry has been subjected to an intensive scrutiny, notably after the contestable markets theory had been proposed. According to this theory, the absence of sunk costs yields an optimal performance and a cost-minimising market structure. However, the presence of sunk costs appears to be a very common industry feature, which tends to have significant effects on entry (Kessides, 1990). Examining the impact of sunk costs and market demand on the number of innovative companies in the U.S. pesticides industry, Ollinger and Fernandez-Cornejo (1998) found a negative relationship between sunk costs and the number of firms in the industry. Despite that, some empirical works have also reported weak or non-existent relationships between sunk costs and entry. Investigating the relationships between entry and exit, barriers to entry and sunk cost, Rosenbaum and Lamort (1992) concluded that the magnitude of sunk costs does not appear to have a significant effect on entry. Studying entry dynamics in Portuguese manufacturing, Mata (1995) reaches similar conclusion.

profitable market niche to entrants. To test the possibility of strategic behaviour through investment in patenting and branding we include the variable PAT as an explanatory variable. It measures the relative importance of patenting and branding expenditures in the pre-entry period compared to the average expenditures for the whole sample period.

Another exception is the possibility of exploring the interaction between capacity expansion and entry. Several studies show how investment at high capacity level could be strategically used to deter entry (see, for instance, Spence (1977), Dixit (1980) or Eaton and Ware (1987)). By investing in capacity expansion in the pre-entry period, incumbents can expand output and reduce price after entry. This strategic action will reduce expected profits of entrants who may operate on the residual demand. To test the possibility of strategic behaviour through expansion capacity in the pre-entry period, we include the explanatory variable EXPCAP, which measures the relative importance of capacity added by incumbents in discrete quantities (i.e. capacity associated with the construction of new plants) to total industry capacity.

Blending all those arguments, our proposition 3 states that *as in a concentrated and highly profitable context incumbents are likely to react aggressively in the event of entry, notably by exploring specific entry-deterring strategies, entrants tend to account for it in their assessment of entry profitability*. In particular, *high past entry and exit rates are perceived as a signal of low irrecoverable (sunk) costs due to incumbents' less aggressive response, rendering entry attractive* (proposition 3a), while *pre-entry speeding up of investments in patenting and branding or capacity expansion can be detrimental to entry* (proposition 3b).

Finally, as ENT^{*}_{j} (equation (6)) is conditional to the number of incumbent firms that decide to continue operating in an industry, the number of survivors (N) at time 0 is included as an explanatory variable. We should expect that *entrants' profits decrease as the number of incumbents increases, leading to a reduction on entry* (proposition 4).

5. Empirical Application

5.1 Data and Definition of Variables

The data were mainly obtained from an annual compulsory survey - *Quadros de Pessoal* (henceforth QP) - that has been conducted every year since 1982 by the Portuguese Ministry of Employment. It is reliable micro-data that cover all firms with wage-earning employees operating in Portugal and contains abundant information on firms' human capital and on other relevant aspects of firms' characteristics. No other regularly produced source of statistical information attempts to be as comprehensive as this source. The identification of each firm is done through a unique number that is assigned sequentially on the first report to the survey. It allows firms to be followed over time, conferring to the data a longitudinal dimension. The key procedure, however, is that the same number is never assigned to different firms, allowing us to identify new firms by simply comparing firms' identifiers in each year.

As some coding errors can occur in such a large database, some data editing procedures were performed. First, information on a firm's plants were aggregated by the main economic activity performed. This enables us to identify in each year the new firms as well as already existent firms that begin to operate in a diversified industry. The aggregation of plants within a firm, according to their main activity, lessens the risk of over-recording due to entry of multi-plant firms. Second, as, theoretically, one firm can be recorded as new in the database but not yet operate effectively in the industry, we searched for firms with a positive number of employees in a given year and with zero employees or an omitted entry in the previous years. Finally, in the last step the number of entrants is counted for each industry and entrants' characteristics at the moment of entry are measured. To be recorded as an entry, a firm has to fulfil two conditions: (i) to be absent from the raw data files for all years previous to the year it was firstly spotted, and (ii) to record a positive number of employees to exclude entry without creation of a new production unit.

Complementary data on the gross value of production, total wages, value added, and expenditure on patents and brands come from published industrial statistics. Conditional on the coverage of these statistics, 134 industries were observed over 6 years. Table 1 presents the empirical distribution of the number of entrants, showing interesting features of the entry data.

INSERT TABLE 1 HERE

Firstly, over the observed period, zero is the modal, most frequent value, implying that a significant number of industries did not effectively attract new firms at some point in the sample period. Moreover, the median value is between one and two, which suggest a great concentration of zero and one observations. Overall, entry is not a highly frequent phenomenon, although there are some highly attractive industries, recording a large number of entrants. The sparseness of tail responses is also clear from Table 1, mainly caused by a group of a few highly attractive industries such as clothing and footwear and leather products. Secondly, the variance significantly exceeds the mean, motivating a careful choice of the econometric approach. Finally, despite the large range of values recorded and the long right tail of the distribution, nearly 80% of observations record 10 or less entrants. These features of the entry data guide us to employ count data models in analysing entry.

Theoretical arguments and data availability lie behind the definition of the explanatory variables. Table 2 reveals definitions as well as some descriptive statistics of the constructed explanatory variables. As one knows the year of entry but is interested in the variables that affect an entry decision, one has to take into account the time between entry decision and the year when entry effectively occurs. Based on empirical evidence cited and analysed by Schwartz (1986), which suggests that the entry response to profit opportunities only occurs after a lag of time, the explanatory variables related to profit opportunities are computed as 3-year lagged variables. Ghemawat (1984, 1987), who reports that large chemical industry plants take at least four years to build and assumes that a typical industrial plant takes two-three years to build, also corroborates the time-lag choice. The remaining variables have been put back one period in accordance to the main assumptions of our entry model; in particular, the sequential decision assumption in which first incumbents decide whether or not stay operating in the industry and then potential entrants take their entry decisions, and the informational assumption in which decisions are based on the information available at time 0. These assumptions and the resulting one-period lag intend to mitigate potential endogeneity problems due to the role entrants may play in the incumbent's decision. This was the most feasible alternative to deal with potential endogeneity as appropriate instruments for the number of remaining incumbents are difficult to find, making impossible to deal econometrically with it.

INSERT TABLE 2 HERE

As the descriptive statistics reveal, the industries are very heterogeneous. In terms of profitability they vary between a negative profitability (-24.715%) and a positive profitability of more than 50%, whereas the risk associated with each industry is less changeable. The other industry-specific variables also vary substantially; for example, the 3-year lagged average growth varies between –9.7% and 96.2%. This is consistent with the observed variability on entry patterns (Table 3) and entry rates (Figure 1). In almost all industries the maximum value of entry was record in 1988 or 1989, suggesting that the number of entrants is increasing over time. More interestingly, during the observed period there are no changes on the group of highly attractive industries and the group of lowly attractive industries, though the variability on entry rates is not negligible. Despite their absolute values of entry, industries such as chemical products, textiles and food and beverage record a considerable relative turnover of firms.

INSERT TABLE 3 AND FIGURE 1 HERE

5.2 Econometric Modelling

The non-negativity and discrete features of entry data suggest the use of count data models, which literature has evolved quite rapidly. The standard count data model is the Poisson regression model, which allows inference to be drawn on the probability of event occurrence. Denoting ENT_j as the number of entrants in industry j, j = 1, 2, ..., n, in a given year, its probability function is given by

$$Pr\left(\mathrm{ENT}_j = y_j\right) = f_P\left(y_j \middle| \lambda_j\right) = \frac{exp\left(-\lambda_j\right)\lambda_j^{y_j}}{y_j!}, \qquad y_j = 0, 1, 2, ... \text{ and } \lambda_j > 0, \tag{7}$$

where y_j is the realised value of the random variable ENT_j, and λ_j is its expected number. Observed heterogeneity among industries is introduced by parameterizing

$$E\left(\mathrm{ENT}_j \middle| \mathbf{x}_j\right) = \lambda_j = exp\left(\mathbf{x}_j \beta\right) \qquad j = 1, 2, ..., n \tag{8}$$

where $\mathbf{x}_j$ is a $(1\times K)$ vector of exogenous variables and β a conformable vector of coefficients.

The presence of overdispersion, a situation in which the variance exceeds the mean, is a feature of the entry data, resulting in a larger variance of the estimator than predicted by the Poisson model, as well as in a possible loss of efficiency (Winkelmann and Zimmermann, 1995). Note that the evidence of overdispersion is a prevalent condition in entry studies (see, among others, Chappell *et al*. (1990)), which may be due to unobserved heterogeneity in the mean function. To account for this, often a random variable (u_j) is added to the mean function, assuming that it is uncorrelated with the exogenous variables. The mean function is now given by

$$\tilde{\lambda}_j = exp\left(\mathbf{x}_j \beta + u_j\right) = exp\left(\mathbf{x}_j \beta\right)\varepsilon_j = \lambda_j \varepsilon_j . \tag{9}$$

Different distributional assumptions for u_i lead to different compound Poisson models. The standard compound Poisson model is the negative binomial model (Negbin) that assumes u_j as following a gamma distribution.

The data used in this paper comprise repeated observations of the sampled industries. If the longitudinal aspect of the data is not accounted for, one can employ these cross-section count data models, presuming that unobserved heterogeneity is industry and time varying. Conversely, the unobserved heterogeneity may result from industry-specific effects that induce observations within industries to be correlated over time. In this context, random-effects (RE) or fixed-effects (FE) models are applied, differing on the econometric treatment of industry-specific effects. Winkelmann (1997) and Cameron and Trivedi (1998) offer a useful an insightful discussion on cross-section and panel count data models.

5.3 Results

The overall explanatory power of covariates is quite high. The R^2_d measure attains a value above 0.9, providing evidence that the covariates highly explain the observed entry flow. The significant and positive value of σ^2, both in the pooled Negbin model and RE Poisson model, shows that, even conditional on explanatory variables, the variance of ENT_j significantly exceeds the mean, corroborating the evidence of overdispersion illustrated in Table 1. Moreover, this leads us to focus our attention mainly on FE and RE models that control for industry-specific effects, forming the time varying variation in the explanatory variables the basis for the panel estimation results. Note however that there are no substantial differences in terms of sign and significance between estimates yielded by RE and FE Poisson models and by RE and FE Negbin models, controlling the latter for unobserved heterogeneity in a more complex manner.

INSERT TABLE 4 HERE

The estimated results seem to suggest that potential entrants take into account in their entry decisions industry average profitability and, to a lesser degree, its temporal variation. Holding everything else constant, potential entrants are more likely to take an entry decision in profitable industries. However, the speed of entry in response to profitable opportunities seems to be fairly slow. The estimate associated with PCM is approximately 0.03, suggesting that an increase of one point on the 3-years lagged average price-cost margins induces an increase on the entry flow of around 3%, *ceteris paribus*. Bearing in mind that around 60% of the sampled industries observe an entry flow of less than 4 new firms each year, the expected industry profitability needs to rise considerably to provoke a noticeable increase in the entry flow. The attraction effect inherent to profitable industries is higher in growing than in otherwise identical industries. This result appears to indicate that, holding everything else constant, in growing industries entrants can more easily cover the entry costs and be successful without provoking aggressive behaviour by incumbents than in otherwise identical industries. Furthermore, the significantly positive effect of industry growth on entry seems to indicate that it is mostly absorbed by new firms entry rather than by expansion of incumbents. Overall, it is in agreement with the conventional wisdom in which potential entrants monitor these variables as a signal of opportunities open to them, confirmed in several empirical studies (see, among others, Kessides (1990), Chappell *et al.* (1990), Mayer and Chappell (1992), Mata (1993), Fotopoulos and Spence (1999)).

We find evidence that the ease of entry and exit from an industry, as an indirect measure of irrecoverable (sunk) costs, is significant in shaping the intensity of competition brought to an industry by newcomers. Once one controls for industry time-invariant specific effects, high rates of entry and exit are statistically significant in lowering entry flow. It appears counterintuitive at least at first glance. One would expect that high values of SUNK, which are reached only when both past entry and exit rates are high, might be understood as a signal of low sunk costs and thereby convey a signal that entry is easy and costlessly reversible, as the theory of contestable industries postulates. If so, a positive relationship would be expected between the observed entry pattern and the variable SUNK, but it occurs only on the pooled regressions.

However, as the control for industry time-invariant specific effects makes the correction for variation in fixed entry costs across industries (Geroski, 1995), the effect on entry is due to the time varying variation in the variable SUNK, reflecting the abnormal degree of turbulence in a given industry. Entrants may perceive it as a signal that entry may be relatively easy, but survival is not. Periods of high entry and exit appear to be followed by periods of low entry, suggesting that if entry attempts are predestined to failure, regardless of the degree of losses that may be involved, then few firms will find entry appealing. Another plausible argument, though related to the previous one, is that potential entrants may recognize simultaneous high entry and exit rates as the effect of incumbents' post-entry aggressive behaviour, which may not be credibly taken by previous entering firms. If so, high intensity in entry and exit movements may currently strengthen the credibility of incumbents' entry-deterring strategies, regardless of their nature, which are more likely to be accounted for by actual prospective entrants in evaluating their entry success.

The effect of the relative share of college graduate employees among the labour force (GRAD) is statistically insignificant. At first glance, we may be tempted to conclude that we do not find evidence to support the proposition that a high level of graduate employees tends to promote the creation of firm-specific resources, notably those associated with the ability to learn about and react successfully to changes in the competitive environment (proposition 2a). However, the weak results associated with GRAD may well be understood in the context of the Portuguese labour market during the 80's. During the sample period, which is fully encompassed on the 80's, the supply of highly educated employees in the Portuguese labour market was quite small. Only at the end of the 80's and the beginning of the 90's we observe a significant growth in the vacancies opened by Portuguese universities and the subsequent increase in the stock of graduate employees. This inflicted a decisive constraint on firms' entry mode choice. Thus, the insignificant effect on entry may reflect the inability of firms to freely hire graduate employees rather than a scenario in which they do not value the employment of graduate employees as a strategy to improve performance and survival.

A plausible argument corroborating that explanation is the strong significance and the positive sign of the relative share of skilled employees (SKILL). It suggests that entrants choose the structure of their labour force as an important firm-specific resource. Firms that have chosen a relatively high share of skilled employees are more likely to enter than otherwise identical firms. It seems to indicate that they value their capabilities underlying the human capital structure as a way to raise their productive efficiency and performance, confirming our proposition 2b.

It is interesting that when we compare the effects of human capital related variables with profit opportunities variables, the former appear to have a greater effect on entry than the latter. In particular, an increase of one point in the relative share of skilled employees of the firms that each year contemplate entry is likely to induce an increase on entry of around 9%, *ceteris paribus*, while a similar variation in the average pre-entry profitability appears to provoke a smaller effect on entry, around 3%. Bearing this comparison in mind, entrants seem to follow more strictly their own capabilities in assessing their potential success in a given industry rather than the average capabilities of their actual rivals.

It is also interesting that entry scale (measured by SIZE), despite its strong significance, captures mixed results. Based on estimated results from the pooled Poisson model, SIZE appears to have a negative effect on entry, suggesting that entrants tend to opt for being small as a way to avoid incumbents' aggressive response to entry even so possible size-induced disadvantages may not be easily overcome. Conversely, once one control for industry time-invariant specific effects (FE and RE models), the effect of entry scale on entry appears to be positive, suggesting that firms do not fear incumbents' response and the potential risk of failure, choosing a large scale as a way to shape favourably their expected profits. In that case, large firms would be the most active group with respect to entry moves, reflecting firms' concern to choose an efficient entry scale instead of to choose a technologically unconstrained entry size. Conditional on the variation on fixed entry costs across industries, firms tend to enter on a scale that allows them to operate efficiently, even though this may imply choosing a large scale. The concern apparently devoted to efficient scale might be taken as an indication of the value attained by potential entrants to potential size-induced cost-disadvantages. In fact, if economies of scale act as a barrier to entry, as some empirical works on entry have suggested (see, among others, Duetsch (1984), Chappell *et al.* (1990), Mata (1993), Fotopoulos and Spence (1999)), only firms that are able to overcome such barriers are likely to enter. The focus on economies of scale gives some support to the finding that firms who are more likely to enter are those that have chosen a comparatively large entry scale.

The strongly significant negative coefficient associated with PROP_STRA confirms our proposition that entrants use their perceptions of incumbents' performance and degree of competition in an industry to infer the propensity of incumbents' strategic behaviour towards entry, thereby taking it into account in their entry decisions (proposition 3). More specifically, highly concentrated and profitable industries are the least attractive industries to potential entrants, as they seem to ascribe a significantly higher probability of incumbents reacting aggressively in the event of entry. However, this finding is only obtained once one control for time-invariant industry-specific effects. This may well explain the mixed and often rather imprecise evidence found in previous empirical works on entry since most of them have adopted a cross-section methodology. In particular, for the Portuguese case, Mata (1993) argues that previous works for Portugal led to the rejection of the hypothesis that fear of aggressive behaviour would deter entry. But again, his conclusion is based on estimated results from cross-section models. Comparing the consistency and robustness of our results with those previously obtained, remarkably from empirical studies using a similar sample of industries, we have to reckon on the superior performance and adequacy of panel data methodology for modelling and researching sectoral entry.

Another relevant difference that may explain those dissimilarities is the way the empirical variable PROP_STRA was computed. Previous studies have frequently used only industry concentration levels as a proxy for the propensity of incumbents' aggressive behaviour, arguing that firms in highly concentrated industries are more likely to overcome the free-rider problem, thereby more likely to react aggressively. They have nonetheless neglected the needs of funding associated with such aggressive behaviour, which tend to be significant and only available to profitable incumbents with surplus funds at their disposal. Moreover, even in highly concentrated industries, incumbents' propensity to engage in aggressive behaviour is expected only if they have profitable industry positions to protect from other firms. Thus, such propensity is clearly triggered off by the joint effect of both factors (industry concentration level and profitability) and not by only one of them, though high industry concentration levels are frequently correlated with high profitability.

The results also show that, holding everything else constant, larger industries attract more entrants than small ones, indicating a follower-type behaviour as entrants are more likely to choose an industry populated by a medium or large number of firms than industries with a relatively concentrated structure. This finding also confirms the indication that entrants use their perceptions of the degree of competition in an industry, highly correlated with the industry's size, to infer the propensity of incumbents to engage in strategic behaviour towards entry and therefore to rationally decide whether to enter or not. The value of the estimated industry's size elasticity offers an additional insight; as this value is approximately 1, entry appears to perpetuate the pattern of specialisation of the Portuguese manufacturing industry.

The estimates results yield statistically insignificant coefficients associated with the variables PAT and EXPCAP, which are the only two explanatory variables uniquely devoted to capturing the effects on entry due to specific entry-deterring strategies. This seems to indicate that potential entrants infrequently take into account in their entry assessment the use of speeding up investments in capacity or patenting and branding to either deter or react to entry. They do seem to be unresponsive to those two sorts of strategies, which are ineffective in deterring entry.

6. Conclusion

This paper attempts to provide a more complete picture of how industry features, firm-specific characteristics, and strategic actions towards entry are related to entry behaviour. The chief objective is, using data from a set of industries, to find regularities on incumbents' response towards entry and the role of initial entrants' characteristics, which may be of considerable value to either industry analysts or policy-makers.

Overall, the empirical results are quite encouraging, suggesting that both incumbents' behaviour and firm-specific characteristics provide additional insights in understanding entry. Moreover, when compared with other empirical studies using a similar sample of industries, the consistency and robustness of the results confirm the superior performance and adequacy of panel data methodology for modelling and researching sectoral entry.

The weak results related to entry-deterrent strategies hinge on the difficult to find empirical measures of incumbents' strategic behaviour. Even in the case of statistically significant coefficients associated with variables related to the adoption of entry-deterring strategies, the empirical results only reveal a correlation between entry and those variables but not whether incumbents divert from a profit maximizing behaviour. To address this issue, a substantial amount of cost information is required and, therefore, this issue is left to future work. Moreover, one might not find robust and consistent evidence on the adoption of entry-deterring strategies without a direct and explicitly oriented observation of firms' reaction to entry. Alternatively, one could follow the Singh *et al.* (1998) data collection approach that uses a questionnaire to enquire from firms whether they adopt entry-deterring strategies and, if so, what strategies are more frequently adopted. The evidence on incumbents deviating from a profit- maximising behaviour may nonetheless be difficult to support.

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Table 1: Distribution for the number of entering firms in the sample 6-digit industries

Counts	**Frequency** (percentage)						
Counts	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1984-1989**
0	28.4	33.6	32.1	34.3	28.4	23.9	30.1
1	17.2	19.4	18.7	18.7	18.7	15.7	18.0
2	9.0	8.2	9.7	9.0	5.2	16.4	9.6
3	6.7	10.4	8.2	2.2	9.7	6.7	7.3
4	6.0	6.0	2.2	5.2	3.7	2.2	4.2
5	6.0	2.2	5.2	6.0	4.5	6.0	5.0
6	2.2	2.2	2.2	3.7	6.0	1.5	3.0
7	3.0	1.5	2.2	-	1.5	3.0	1.9
8	3.0	3.0	2.2	0.7	-	3.0	2.0
9	0.7	1.5	0.7	2.2	2.2	4.5	2.0
10	1.5	-	1.5	1.5	0.7	0.7	1.0
>10 and ≤20	8.3	3.9	4.6	6.0	8.3	5.6	6.0
>20 and ≤50	5.0	5.1	7.5	6.7	5.3	5.2	5.8
>50	3.0	3.0	3.0	3.8	5.8	5.8	4.0
Observations	134	134	134	134	134	134	804
Maximum	187	212	312	465	554	485	554
Mean	8.0	6.8	9.1	11.1	12.8	12.9	10.1
Variance	433.6	450.2	961.0	1908.5	2610.8	2156.6	1416.7
Variance/Mean	**54.3**	**66.3**	**106.0**	**172.6**	**204.0**	**166.8**	**140.3**

Source: Quadros de Pessoal; Author's calculations.

Table 2: Acronyms, definition, and descriptive statistics of the dependent and independent variables

Variable	Definition	Mean	Standard Deviation	Minimum	Maximum
Entry	Number of new firms at end of each year. Source: *Quadros de Pessoal*, Ministry of Employment.	10.106	37.639	0	554
PCM	3-year lagged average of price cost margins (i.e. average of price cost margin from period *t*-3 until *t*-1). The price cost margin is calculated as (Value added-Total wages)/(Gross value of production), all measured at the end of each year. Source: *Estatísticas Industriais*, INE.	14.803	9.430	-24.715	59.815
RISK	3-year lagged standard deviation of price cost-margins. Source: *Estatísticas Industriais*, INE.	3.571	2.950	0.0463	18.633
GROWTH	3-year lagged average of production growth rate before entry. Source: *Estatísticas Industriais*, INE.	22.662	12.308	-9.663	96.222
PAT	One year lagged of the deviation of the expenditures in patenting and branding from its *long-run* average value, i.e. the average value for whole sample period. Source: *Estatísticas Industriais*, INE.	-0.181	1.194	-1	10
N	The logarithmic of the number of incumbent firms at time t-1 that decide to stay operating in the industry. Source: *Quadros de Pessoal*, Ministry of Employment.	3.742	1.583	0	8.009
PROP_STRA	One year lagged of the price cost margin multiplied by an index of industry concentration. Source: *Estatísticas Industriais*, INE and *Quadros de Pessoal*, Ministry of Employment	9.182	10.451	-11.284	65.770
SUNK	Product of the rate of entry and the rate of exit at the end of year *t*-1. Source: *Quadros de Pessoal*, Ministry of Employment	0.232	0.602	0	11.111
EXPCAP	Ratio of the capacity added in discrete quantities in the year *t* (i.e. capacity associated with the construction of new plant) to the total capacity in the previous year. The total number of employees measures the capacity available or added in an industry. Source: *Quadros de Pessoal*, Ministry of Employment	0.873	5.450	0	98.112
GRAD	The average of the ratio of the number of graduate employees to the total number employees of entrant firms, normalised by incumbents' average. Source: *Quadros de Pessoal*, Ministry of Employment	0.994	3.213	0	60.357
SKILL	The average of the ratio of the number of skilled employees to the total number employees of entrant firms, normalised by incumbents' average. Source: *Quadros de Pessoal*, Ministry of Employment	0.646	0.799	0	15.532
SIZE	The entrants' average size at the end of each year. The total number of employees measures the size of entrant firms, normalised by incumbents' average. Source: *Quadros de Pessoal*, Ministry of Employment	0.503	0.987	0	21.562

Table 3: Number of new firms per 3-digit industries over the period 1984-1989

Codes	Description of 3-digit industries	1984	1985	1986	1987	1988	1989	Average
311, 312, 313	Food and beverage	118	106	117	125	137	140	123.8
314	Tobacco	0	0	0	0	0	0	0.0
321	Textiles	78	84	89	117	147	155	111.7
322, 323	Clothing	189	214	313	465	554	487	370.3
324	Footwear and leather products	89	79	140	153	160	147	128.0
331	Wood and cork	81	98	112	132	148	159	121.7
332	Furniture	106	67	103	113	113	141	107.2
341	Paper	4	4	6	4	2	10	5.0
342	Publishing and printing	57	38	36	47	61	89	54.7
351, 352	Chemical products	23	17	19	16	26	19	20.0
353	Oil refineries and products derived from oil and coal	0	0	0	0	0	0	0.0
355, 356	Rubber and plastic products	38	19	37	30	35	41	33.3
361	Porcelain, glazed and painted pottery	24	17	25	44	52	58	36.7
362, 369	Glass and other non-metal minerals	78	41	57	70	73	86	67.5
	Basic metals	18	12	17	15	25	17	17.3
381	Metallic products, except machines and transporting materials	54	34	52	58	51	57	51.0
382	Non-electrical machines	48	34	54	50	69	60	52.5
383	Electrical machines	25	22	24	22	31	30	25.7
384	Transport equipment	29	19	5	13	22	21	18.2
385	Scientific and professional tools	8	3	4	4	2	6	4.5
390	Other manufacturing industries	4	2	5	4	7	9	5.2
	Total	1071	910	1215	1482	1715	1732	

Legend: Minimum value; Maximum value.

Source Quadros de Pessoal; Author's calculations

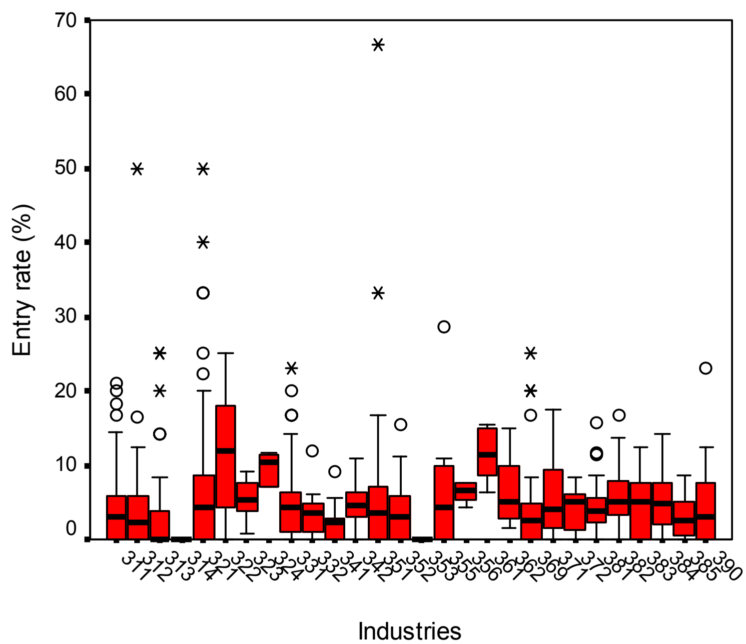

Figure 1: Box-plots of the number of entrants by 3-digit industries

Table 4: Maximum likelihood estimates of regression coefficients along with standard errors

	Poisson			Negbin		
Variable	*Pooled*	*FE*	*RE*	*Pooled*	*FE*	*RE*
Constant	-4.3187***	-	-3.5546***	-3.6754***	-	-2.3466***
	(0.3126)		(0.1962)	(0.1734)		(0.2786)
PCM	0.0017	0.0398***	0.0263***	0.0025	0.0346***	0.0228***
	(0.0095)	(0.00741)	(0.0065)	(0.0069)	(0.0094)	(0.0073)
RISK	-0.0344**	0.0043	0.0105	-0.0021	0.0000	0.0093
	(0.0172)	(0.0111)	(0.0102)	(0.0125)	(0.0134)	(0.0115)
GROWTH	0.0181***	0.0109***	0.0107***	0.0062***	0.0062***	0.0090***
	(0.0029)	(0.0017)	(0.0016)	(0.0025)	(0.0024)	(0.0019)
PAT	-0.0296**	0.0023	0.011	-0.0227	-0.0414	0.0036
	(0.0128)	(0.0093)	(0.0092)	(0.0226)	(0.0141)	(0.0106)
N	1.2419***	0.9957***	1.020***	1.0723***	0.4269***	0.9640***
	(0.0682)	(0.0738)	(0.0375)	(0.0313)	(0.1565)	(0.0425)
PROP_STRA	0.0046	-0.0438***	-0.0344***	-0.0054	-0.0345***	-0.0311***
	(0.0161)	(0.0113)	(0.0093)	(0.0100)	(0.0135)	(0.0106)
SUNK	0.3827***	-0.1336***	-0.1036***	0.2586***	-0.1984***	-0.0838*
	(0.0731)	(0.0421)	(0.0374)	(0.0559)	(0.0664)	(0.0498)
EXPCAP	-0.0649	-0.0187	-0.0255	-0.0306	-0.0025	-0.0141
	(0.0432)	(0.0170)	(0.0189)	(0.0222)	(0.0133)	(0.0182)
GRAD	0.0007	0.0034	0.0029	0.0050	0.0055	0.0021
	(0.0150)	(0.078)	(0.0073)	(0.0095)	(0.0091)	(0.0081)
SKILL	0.0493	0.0822***	0.0856***	0.1896***	0.1020***	0.0953***
	(0.0522)	(0.0336)	(0.0293)	(0.0534)	(0.0355)	(0.0297)
SIZE	-0.6120***	0.0747***	0.0656**	0.0413	0.0897***	0.0810***
	(0.1380)	(0.0294)	(0.0287)	(0.0387)	(0.0304)	(0.0291)
σ^2	-	-	0.1931***	0.2152***	-	-
			(0.0342)	(0.0244)		
a	-	-	-		-	20.8479***
						(4.7218)
b	-	-	-		-	7.9551***
						(1.6500)
ln L	-2091.7	-1100.2	-1548.7	-1580.5	-1068.7	-1524.2
R^2_d	0.9183					
Sample	804	804	804	804	804	804

Legend: Pooled: the data is assumed to be a long cross-section data; FE: fixed effects model; RE: random effects model. In the case of RE Poisson model, the industry-specific effects were specified as being drawn form a gamma distribution with parameters (σ^{-2}, σ^{-2}), while, in the case of RE Negbin model, industry-specific effects are assumed to be distributed as a Beta(a,b). R^2_{d}: the deviance R^2 proposed by Cameron and Windmeijer (1996).

Notes: Standard errors in parenthesis. Based on t-values, *, ** and *** mean that coefficients are statistically significant at 10%, 5% and 1% significance level, respectively.

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