Entry, exit, and productivity growth

in Spanish manufacturing during the eighties

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Abstract

This paper provides estimates of productivity growth in Spanish manufacturing at the industry level during the eighties, simultaneously analysing its determinants, with particular attention to the role played by entry and exit. During this period, Spanish manufacturing suffered a sharp competitive pressure (before, during and after the 1986 integration into the EEC) as well as high rates of entry and exit in industries. An equation for the Solow residual including control terms and productivity growth explanatory variables is derived and estimated with GMM techniques, with data on a disaggregation of manufacturing in 75 industries observed during the years 1979-1990. Estimations show an important joint impact on productivity growth of entry, exit, and the competitive pressure derived from import penetration. Evidence also points out that exit was caused by the displacement of less efficient firms by new entrants.

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1. <u>Introduction</u>.

This paper is aimed at measuring productivity growth and the analysis of its sources at the industry level, with particular attention to the role played by entry and exit. It applies the framework developed to Spanish manufacturing during the eighties, the key period of its involvement in the EEC economy. In this period, Spanish manufacturing suffered a sharp competitive pressure (before, during and after the 1986 integration), derived from a continuous increase of the penetration of imports (a form of entry), and experienced an intense restructuring related to a high rate of firm turnover (with high entry and exit in industries). Manufacturing productivity increased at high rates, and the impact of the opening and restructuring of the markets on these rates is a relevant question which has not been previously investigated[1].

The basic facts are as follows. Firstly, manufacturing productivity increased aligned with the highest rates experienced by manufacturing in industrial countries. Table 1 documents this fact with comparable TFP calculations performed with aggregated data. Secondly, markets of manufactured goods opened at an extraordinary pace. The share of imports in domestic demand (import penetration) almost doubled, and the fraction of production that domestic firms sold abroad (export intensity) also increased sharply (see the Data Appendix table). Thirdly, manufacturing industries experienced high gross rates of entry and exit, with a high displacement component (replacement of low productivity firms by more efficient firms).

Table 1 shows, despite the difficulties in finding fully comparable figures, Spanish entry

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[1] Our subject is then closely related to the question of the effects of increased competitive pressure on efficiency and productivity growth. See Caves and Barton (1990) and Vives (1993) for two works that survey the theoretical and empirical literature on the "static" and "dynamic" efficiency effects of competition. We pursue this theme in section 3.

and exit rates were relatively high and, at the same time, unbalanced (the total number of firms was reduced by about 25% from the beginning of the period until the moment at which entry and exit redress). Table 2 provides strong evidence of displacement. While entry and exit are found anywhere to be positively correlated across industries (see, for example, Geroski (1995), stylised fact 3 or Caves (1998)), entry and exit controlling for fixed effects (the industry averages over time of entry and exit) are expected to be negatively correlated under the usual hypothesis of shared expectations (what makes entry higher than average must also make exit lower, and conversely)[2]. Entry and exit in Spanish manufacturing during the eighties turns out to be, on the contrary, positively related even controlling for fixed effects. In addition, when computed, almost 3/4 of intraindustry correlation coefficients give a positive relationship.

In this paper we measure productivity growth for a disaggregation of manufacturing in 75 industries observed over the years 1979-90, using the Solow residual. Proper measurement implies controlling for the effects of market power, non-constant returns to scale, and fluctuations in capacity utilisation, following the type of corrections developed by Hall (1988,1990) and others. But we also show that "true" Solow residuals computed at this level are likely to consist of two parts: a weighted average of the firm-level productivity improvements, and the effect derived from output reallocation among firms with different efficiency levels. Then, we propose and apply an econometric framework aimed at both correcting the conventionally computed residuals and picking up the role of the turnover component along with other productivity growth determinants.

The exercise methodologically draws on a series of previous works on productivity, but

[2] This is, for example, what Dunne, Roberts and Samuelson (1988) found for US manufacturing.

it also contains some contributions. On the one hand, we employ a unified panel econometric framework to simultaneously carry out the exercise of properly measuring productivity growth and the analysis of its sources. In this sense, our work is close to exercises such as Geroski (1989), Nickell, Wadhwani and Wall (1992) or Harrison (1994)[3]. But we also develop an easily applicable variant in a rigorous General Method of Moments (GMM) context to obtain consistency.

On the other hand, there has recently been an increasing interest in the impact of turnover on productivity growth (for an overview see Tybout (1996), and also Caves (1998)). Theoretical works on industry dynamics provide models in which firms' entry and exit decisions are interrelated with their differentials in productivity, and hence they matter for productivity growth[4]. An increasing number of empirical papers have examined in different contexts the role played by turnover in productivity growth[5]. However, these works share the use of firm-level data. We argue that identification of the basic effects is possible using regression methods and information on the industries' entry and exit rates. In addition, the relationship between entry and exit is largely undetermined (see, for example, Geroski (1991,1995) and Caves (1998)). We have already pointed out the evidence in favour of strong displacement effects in our sample. Our exercise sets a simple but useful framework to distinguish and identify these effects.

Our results confirm a strong effect of increased competitive pressure in productivity

[3] Related works for the Spanish industry are Suárez (1992) and Hernando and Vallés (1994).

[4] See Jovanovic (1982) and Hopenhayn (1992). See also Pakes (1999) for a recent summary of the framework developed in a series of works to study industry dynamics.

[5] See, among others, Baldwin and Gorecki (1991), Baily, Hulten and Campbell (1992), Griliches and Regev (1995), Olley and Pakes (1995), Baldwin (1995), Liu and Tybout (1996) and Aw, Chen and Roberts (1997). Turnover has been found in general to have a positive contribution to productivity growth, but only quantitatively important in certain circumstances (deregulation, low sunk costs...).

growth, channeled through two ways: the efficiency gains shown by incumbent firms and the structural change associated with entry and displacement.

The rest of the paper is organised as follows. Section 2 describes the framework for productivity growth measurement. Section 3 discusses the firm level determinants, and section 4 the relationship of industry level productivity growth with the entry and exit rates. Section 5 explains the econometric specification and results. Section 6 performs splitting-up exercises, and section 7 presents some concluding remarks.

2. Framework of measurement.

Industries consist of collections of firms, and the firms of a particular industry will diverge, at a given moment in time, in their levels of efficiency and output shares. Therefore, the growth of productivity at the industry level has two different sources: the increases in the efficiency of the firms that form the industry, given their shares, and the changes in the allocation of the industry output among firms with different degrees of efficiency.

A change in the allocation of the industry output can simply modify the shares of the set of firms that form the industry at a given moment in time or, on the contrary, involve entry and exit. In fact, the most important part of allocation changes is generally expected to be derived from the process of entry and exit[6]. Entrant firms must be considered as expanding their shares from zero to positive numbers, exiting firms contracting them from positive values to zero. In addition, entry and exit are likely to induce changes in the shares of other firms. Thus, the industry-wide productivity growth will embody, in general, an industry composition effect, and this effect is likely to be related to entry and exit. In what follows, we devise a framework to take these effects into account in a Solow residual productivity growth measurement setting.

Assume that the typical industry consists of N firms indexed by i that show different degrees of efficiency, specified by idiosyncratic terms that multiply a common basic technology represented by the production function f(.) that, for the moment, we will assume linearly homogeneous. For the firm i we will write $q_i = [1/(1-a_i)]\, f(x_i)$, where q_i represents output, x_i is a vector of K inputs, and a_i gives the (approximate) proportional difference in efficiency of firm i with respect to the benchmark firm (a_i=0), or its (exact) proportional advantage on unit or marginal costs.

Aggregating across firms, we obtain the production relationship

$$q = \frac{1}{1-\sum_i a_i s_i} f(x) \tag{1}$$

where q and x stand for the aggregated output and vector of inputs respectively. We use the fact that $\sum_i f(x_i) = f(x)$, $s_i = q_i/q$ represents the market share of firm i, and $1/(1-\sum_i a_i s_i)$ is an aggregate efficiency index (see Appendix A). Industry productivity growth, measured by the industry Solow residual, can be written starting from (1) as

$$q \equiv \frac{dq}{q} - \sum_k e_k \frac{dx_k}{x_k} = \sum_i s_i \, da_i + \sum_i a_i \, ds_i \tag{2}$$

where the e_k's represent the output elasticities of inputs. The first term of the last equality in (2) amounts to the weighted sum of firms' changes in efficiency or individual Solow residuals ($da_i = \frac{dq_i}{q_i} - \sum_k e_k \frac{dx_{ki}}{x_{ki}}$); the second term gives the composition or turnover effect.

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[6] This has been the traditional look at industry dynamics. See, for example, Geroski (1991).

If f(x) cannot be taken as linearly homogeneous, but it can be supposed homogeneous of degree γ, we can write $\sum_i f(x_i) = [1 - I(a,s)(\gamma - 1)] f(x)$, where I(a,s) is an index that depends on the distribution of industry output (see Appendix A). Then, decomposition (2) will include two extra terms, reflecting the productivity effects of individual growth and turnover due to the differences in the degree to which firms exploit the existing scale economies. These effects are likely to be of second order and we will not try to disentangle them from the two effects described by (2).

Assume now firms produce their output from the use of labour, capital and materials. The industry Solow residual of the left hand of (2) can be computed using the log-differences of output (y), labour (l), capital (k) and materials (m), provided that the unobservable elasticities ε_L, ε_K and ε_M are approximated. Traditional productivity analysis supposed that technology is linearly homogeneous and firms are in a long run competitive equilibrium, replacing the elasticities by income shares. The works by Hall (1988, 1990) and others have developed the corrections in order to obtain the proper approximation in the presence of market power and non-constant returns to scale.

Let μ be the ratio price/marginal cost and let γ be the returns to scale parameter. It can be shown that the relationship between the traditional (income shares) residual estimation θ^s and the one corrected for the presence of market power and non-constant returns to scale θ^c is

$$\theta^s = -(\mu - 1)[\omega_L(k - l) + \omega_M(k - m)] + (\gamma - 1)k + \theta^c \qquad (3)$$

where ω_L and ω_M are the income shares of labour and materials. These corrections do not solve a difficult problem, the question of the possible biases induced by the unobservability of the degree of utilisation of the quasifixed inputs. This fact has, however, often been dealt with empirically by adding a utilisation term in equations such as (3)[7]. In what follows we will assume that, in adopting this solution, we can obtain a good measure of the true productivity increases θ.

The previous remarks suggest an econometric framework to measure productivity growth and, at the same time, analyse its determinants. On the one hand, the partial unobservability of the corrections to be introduced in the computation of the Solow residual advises the use of an econometric model, with the conventional residual θ^{s}_{jt} computed for every industry j and year t as the dependent variable, including corrections as explanatory variables. On the other hand, the analysis of the determinants of true productivity growth can be achieved by modelling the unobserved remaining growth as a combination of systematic and stochastic components. We will specify $\theta_{jt} = \theta_j + \theta_t + x_{jt}\beta + \xi_{jt}$, where θ_j represents time invariant individual (industry) specific components of the increases in productivity, θ_t represents industry invariant time productivity effects that might stem from macroeconomic factors, x_{jt} is the vector of productivity growth determinants, and ξ_{jt} residual productivity shocks that we will assume uncorrelated across industries and time. Notice that, according to our previous remarks, the vector x_{jt} of determinants must include two very different types of variables: the micro or firm level determinants of the efficiency increments, and the variables included to pick up the industry composition change effects. The complete model can be written as

$$\theta^{s}_{jt} = \theta_j + \theta_t - (\mu_{jt} - 1)\, WR_{jt} + (\gamma_j - 1)\, k_{jt} + \alpha\, v_{jt} + x_{jt}\beta + u_{jt} \qquad (4)$$

[7] See, however, Delgado, Jaumandreu and Martín (1999) for a more structural approach to this problem and some possible corrections.

where $WR_{jt} = w_{Ljt}(k_{jt} - l_{jt}) + w_{Mjt}(k_{jt} - m_{jt})$ is a weighted variation of the capital/labour and capital/materials ratios, v_{jt} is a measure of the degree of utilisation, and u_{jt} is a zero mean uncorrelated disturbance that includes x_{jt} as a component.

Equation (4) must be seen as an accounting relationship, which enables us to allocate measured productivity growth among different sources, fully consistent with different firms' behaviour across industries and varying patterns of entry and exit. Productivity growth (and profitability) as well as the determinants we are going to detail in the following sections (the incumbent firms' decisions about innovative activities as well as the penetration decisions - imports by foreign firms and entry/exit-) must, of course, be taken as jointly determined in long-run equilibrium at each industry, with values that depend on the specific game firms play. However, the estimation of equation (4) as a separate relationship can be useful and legitimate under two premises.

Firstly, specification must be flexible enough to accommodate individual differences beyond the facts explained on average. This is why our specification allows for unexplained time persistent heterogeneity in productivity growth across industries. Secondly, explanatory variables must at least be assumed to be determined in advance of the dependent variable (predetermined variables) to avoid endogeneity biases. In the case of productivity, it seems sensible to assume that R&D, import and entry/exit decisions have been adopted by firms prior to the current realisation of productivity growth[8]. The fact that these explanatory variables should probably be taken as jointly determined among them has no consequence for the estimation of equation (4). The remaining econometric problems, related with the

[8] Explanatory variables can, however, be freely correlated with the time persistent heterogeneity in productivity growth. See section 5.

practical implementation of the equation, are discussed in Section 5.

3. Firm level productivity growth determinants.

The first set of productivity growth determinants consists of the variables that are likely to generate productivity increases at the firm level. We must specify them if we want to identify the impact of turnover separately. These variables include industry environmental factors that enable or stimulate firms to internalise or generate productivity increases. We will consider in turn the innovative activities, the role played by demand conditions, and the competitive pressure exerted by imports[9].

Productivity increases at the firm level are primarily intended as the result of (process) innovative activities undertaken by firms. In fact, there is a vast tradition that models the idiosyncratic efficiency of each firm as the result of its accumulated "knowledge capital," constructed by using the series of R&D expenditures and a knowledge depreciation rate[10]. According to this tradition, productivity growth should be related to knowledge capital increases, but since we do not have any estimation of the industries' knowledge capital readily available, we will use the conventional effort indicator of R&D expenditures over value-added. In some circumstances this can give a good approximation to yearly capital increases. On the other hand, since we are working at the industry level, the coefficient of this variable is expected to simultaneously pick up the industry spillover effects. In this paper, we use two

[9] These are otherwise the basic incumbent firms' productivity growth sources considered in Geroski (1989) and Caves and Barton (1990). Nickell, Wadhwani and Wall (1992) also similarly identify "innovation" and "effort" as the basic sources. Harrison (1994) focuses on the role played by a trade reform, and hence on the third of the sources considered above, using only alternative measures of the degree of competitive pressure (tariffs and import penetration).

[10] This tradition begins with Griliches (1979). See Griliches (1995) for a recent survey on the series of results produced by this empirical literature.

separate indicators whose addition gives total technological effort: the ratio R&D expenditures/ value-added (RDVA), and the ratio technological payments/value-added (TPVA).

Some productivity-enhancing technological innovations come to the firm embodied in new (more sophisticated) machinery and equipment. OECD studies have documented that technology diffusion through this capital-embodied form contributed importantly to total factor productivity growth in the eighties[11]. Spanish manufacturing firms imported most of their machinery and equipment during this period, often with the aim of implementing superior technologies, and the direct productivity effect of these investments must be accounted for[12]. As a (rough) indicator of their importance, we will use the ratio of the current variation in the stock of capital (net investment) to the number of workers (II)[13]. Of course this ratio also enters the productivity growth computations, but with a constrained coefficient. Hence, the investment effect can in principle be identified separately.

Productivity growth turns out to be highly procyclical in practice. In addition to a higher utilisation of capacity, whose productivity effects are only imperfectly controlled for the inclusion of a utilization variable, high demand states are likely to encourage the introduction of innovations, more efficient ways of organising the work processes, and also a greater effort[14]. Consequently, empirical studies usually control for these effects, including an output growth related variable. Here we assume that these effects are linked to the pace of the

[11] See, for example, OECD (1996). The impact of technology diffusion is estimated globally to account for more than half of productivity growth during the eighties, although it must be taken into account that this effect is obviously especially important outside manufacturing.

[12] The Spanish Ministry of Industry estimated that by 1990 almost 50% of machinery in manufacturing firms with more than 200 workers were of foreign origin.

[13] In using this variable we follow Caves and Barton (1990)

[14] The result of these effects in a higher productivity growth when output grows is sometimes called

growth of demand faced by firms, and we measure this growth by a weighted sum of the growth rates of buyers' activities (DEM). This demand variable avoids the endogeneity problems presented by the output growth measures (see the Data appendix for details).

The most important environmental factor to be included is competitive pressure derived from foreign competition. Let us briefly focus on the justification and specification of this factor. From a theoretical point of view, a low degree of competition has been shown to be likely to sustain productive inefficiencies in different ways[15]: X-inefficiencies can persist more easily, perhaps linked to high degrees of managerial slack[16]; information flows and experimentation are lower, making the evolution of firms' efficiency[17] more difficult; enhanced market power, sometimes interwined with regulation, creates incentives for socially inefficient strategic decisions and investments.

Weak competition may be the result of a low degree of foreign interaction in markets. Tariffs and other restrictions to trade, intended to protect internal markets and giving market power to domestic producers, create such a situation. Moves toward free trade are then expected to have an effect on profitability and efficiency[18]. And, in fact, a vast amount of

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Verdoorn's law. See, for example, Caves and Barton (1990).

[15] See Caves and Barton (1990) and Vives (1993).

[16] Hart (1983) and Scharfstein (1988) are two fomal models that link market competition to efficiency via managerial effort.

[17] In Jovanovic (1982) and Hopenhayn (1992) firms learn about their costs through experience, and this type of model shows that policies that inhibit entry reduce average productivity through a selectivity effect. The dynamic imperfect competition framework developed by Pakes and associates (see for a summary Pakes (1999)) allows to explore further these effects. In addition these models are directly connected with the main question of this article, in what they theoretically support industry equilibria with entry and exit of firms, where turnover plays a role in productivity growth.

[18] See Helpman and Krugman (1989) for an overview of models on the impact of protection in imperfectly competitive markets in international trade. See also Grossman and Helpman (1990) on the endogenous growth effects of trade policies. In a recent example of this literature Traca (1999) formalises how import-competition is likely to foster innovation and productivity of a domestic industry endowed with market power when the technological gap with respect to advanced world producers is low.

literature has documented the effects of increased trade on profitability[19], although only a few papers have directly tackled the effects on productivity. Evidence, however, confirms the positive effects of trade reforms and import penetration on productivity[20]. To pick up the role of increasing foreign competition among the productivity growth determinants in Spanish manufacturing industries during the period, we will include the ratio of imports to domestic demand or import penetration (IMP) as an explanatory variable.

4. Entry, exit, and productivity growth.

Entrant firms are usually supposed to have some productivity advantages, or at least gain them after some market experience. And surviving entrants typically expand their shares during their first years of life, from the initial value of zero to significant values. This implies a positive contribution of entry to industry productivity growth. Exiting firms are usually supposed to suffer some productivity disadvantages, and their shares fade away[21].

The specification and interpretation of the impact of entry and exit requires some discussion. Firstly, we do not observe the shares of the entrant and exiting firms, and we dispose only of information on the gross entry and exit rates (GENR and GEXR). Therefore, we must establish the relationship that we expect between industry productivity growth and the rates of entry and exit. Secondly, entry and exit can be related to each other in different

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[19] See Pearce Azevedo (1998) for an example of this literature applied to the Spanish manufacturing sector during the eighties.

[20] In their 285 US industries sample, Caves and Barton (1990) found an efficiency effect of imports increasing with the degree of concentration, and productivity growth effects of lagged imports. Harrison (1994) documents a case of higher productivity growth after a trade reform. Tybout (1996) quotes other examples.

[21] This also implies a positive contribution to industry productivity growth. In addition, total contribution of entry and exit can be positive in even more general circumstances. For example, entrant firms can be less productive than the average but more than exiting firms, and increase their shares at

ways, and results must be interpreted with relation to these possibilities. Let us discuss in turn these two points.

If all the firms (entrant, continuing and exiting firms) were of an identical and invariable size, the changes in the shares following entry and exit would be virtually proportional to the entry and exit rates. But firms' sizes can of course differ and, in addition, relative sizes must be considered varying. However, sizes can be seen determined endogenously according to the condition of competition that entry and exit, jointly with other factors, contribute to create. Models of imperfect competition invariably relate output advantages to cost advantages positively and to the toughness of competition. This endogenous determination can justify, under very general circumstances, a definite impact for the entry and exit rates.

In general, productivity growth will be positively related to both the entry and exit rates, with a direct impact derived from the share effects of both the numbers of (entrant and exiting) firms and an indirect effect derived from sharpened competition, but with a lower impact of the exit rate due to its simultaneous market concentration effect. Appendix B shows these effects more formally in the simplified context of a market with two types of firms.

Now, let us discuss the relationship between the rates of entry and exit. It is customary to distinguish at least two different sources of entry and exit (see the discussion in Geroski (1991)). One source is market enlargements or contractions, with origin in demand or cost changes. Market enlargements would allow the entry of new firms, and market contractions would induce the exit of redundant firms[22]. The other source is the competitive process, with the replacement of firms already established in the industry by new entrants, typically because

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the expense of the latter. This is the particular industry dynamics found, for example, in Aw, Chen and Roberts (1997).

the latter enter the market with superior technologies. Entry of this type is said to have a displacement effect. To give a precise content to these two forms of entry and exit, and see their implications, we will formalise them in the simplified context of a market with two types of firms.

Assume a market with two types of firms, 1 and 2 say, where firms of type 1 are more efficient than firms of type 2 and, for simplicity, there is no way to transform a type 2 firm into a type 1 firm. Entry consists of type 1 firms and exit affects the type 2 firms. Assume that operation in the industry implies some fixed cost or minimum profits. Then, given the demand and cost conditions, and given conduct, there will be a maximum number of firms of type 2 that will be able to operate with non-negative profits for each number of type 1 firms. This defines a frontier of possibilities of firm numbers in the market, as depicted in panel A of figure 4[23].

We will identify entry with displacement effects with the entry and exit associated with movements along this frontier. The rate dN_2/dN_1, which we expect to be greater (in absolute value) than unity, reports the number of type 2 firms that will be replaced by a firm of type 1. We will identify the entry and exit by market enlargements or contractions with the entry and exit associated with movements of the frontier. Movements of the frontier to the right will induce entry of (type 1) firms, and movements to the left will cause exit of (type 2) firms. Panels B and C of Figure 4 depict the mix of displacement effects and market enlargement or contraction effects for two supposedly observed changes of firm numbers in the industry.

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[22] One source of market contractions may be the increase of imports of equivalent products.

[23] In Appendix C we derive, as an example, the frontier equation when demand is linear and firms compete à la Cournot.

The operation of these two types of entry and exit raises the possibility of very different relationships between the entry and exit rates over time. To see this, call $\acute{a}_t$ the entry rate with displacement effects at time t, and call ë the rate of displacement. At the same time, let d_t be the rate of change in the number of firms induced by the change in demand at time t, which will be a rate of either entry or exit according to the sign of the change in demand. Then, the entry and exit rates, e_t and s_t, will be generated over time according to the following expressions

$$e_t = a_t + 1\ (d_t \geq 0)\ d_t$$

$$s_t = l\, a_t + 1\ (d_t < 0)\ d_t$$

where 1(.) stands for the indicator function. If competitive entry and displacement effects dominate, entry and exit rates will be strongly positively correlated over time. If demand effects dominate, entry and exit rates will be negatively correlated[24]. A consequence of this analysis is that, in the case of important displacement effects, it can be impossible to identify productivity effects of the rates of entry and exit simultaneously, basically because both rates refer to a basic common fact (there is a problem of collinearity).

5. <u>Econometric specification and results</u>.

Firstly, estimation of (4) must deal with the problem of the imperfect observability of $\grave{\imath}_{jt}$. A substitute for the true ratio is available at the industry level: the usual price/cost margin (PCM). The main shortcomings of this margin are that it ignores the cost of the use of capital

[24] This is the base to interpret the results reported in Table 2 as strong evidence of the operation of displacement effects in Spanish manufacturing during the eighties.

and it can also become a poor approximation when returns to scale are not constant. However, we are going to use the expression PCM/(1-PCM) as an approximation to (ì -1), instrumenting the compound variable $MWR_{jt}=[PCM_{jt}/(1-PCM_{jt})]*WR_{jt}$ by its past values in the framework of the general method of moments (see, for example, Arellano and Bond (1991)). We expect to obtain a coefficient close to -1 on this term. If this restriction holds, we will interpret it as a confirmation of the presence of market power and the reliability of the approximation.

On the other hand, we do not know the value of the returns to scale parameter for every industry, and we are not able to estimate a specific coefficient for each one. However, drawing on previous work[25], we are able to group the sectors in which we expect increasing, constant or decreasing returns to scale. This allows us to construct a set of three dummies (IRD, KRD and DRD) that, interacted with the capital growth variable, give estimates of three average values for the scale parameter. Given these specifications, we have

$$q^{s}_{jt} = q_{j} + q_{t} + a_{o}\,\mathrm{MWR}_{jt} + a_{1}\,\mathrm{KID}_{jt} + a_{2}\,\mathrm{KCD}_{jt} + a_{3}\,\mathrm{KDD}_{jt} + a_{4}\,\mathrm{v}_{jt} + \mathrm{X}_{jt}\,b + \mathrm{u}_{jt} \qquad (5)$$

where KID=IRD*k_{jt}, KCD=CRD*k_{jt}, KDD=DRD*k_{jt}, á$_1$=(ã$_{IR}$-1), á$_2$=(ã$_{CR}$-1), á$_3$=(ã$_{DR}$-1) and we expect ã$_{IR}$ > 1, ã$_{CR}$ = 1 and ã$_{DR}$ < 1 and á$_0$=-1. This equation may be rewritten more compactly as

$$q^{s}_{jt} = q_{j} + q_{t} + \mathrm{Z}_{jt}\,a + \mathrm{X}_{jt}\,b + \mathrm{u}_{jt} \qquad (6)$$

[25] We group the sectors according to the results of a previous estimate of their cost functions. Velázquez (1993), using longitudinal data for six size classes of establishments, adjusts sectoral curves of the type log AVC=a+bq+c/q+time dummies, where AVC=average variable cost and q represents output. Under the assumption of homotheticity, the results allow us to classify the cost functions as flat, U, decreasing or L-shaped. Sectors with flat curves are attributed constant returns. Other sectors' returns are specified according to the slope of the interval of the curve corresponding to the value of the Florence median of plant shipments.

where Z_{jt} stands for the vector of variables aimed at correcting the conventionally computed Solow residual. Given the presence in (6) of the individual effects q_j, and their likely correlation with the other explanatory variables, it seems advisable to begin the estimation of any version of it by differencing out these effects to ensure consistency. In what follows, we summarise the results of estimating equation (6) with data on 75 manufacturing industries from 1979 to 1990[26].

Table 3 reports the results. Estimates 1 to 6 present selected alternatives of specification. Every estimation is carried out taking first differences and instrumenting the variable MWR at t with its cross-section lagged values at t-2 and t-3. The Sargan test of overidentifying restrictions is presented at the bottom of the columns, as well as the residual autocorrelation tests m1 and m2. The validity of instruments is accepted, and residuals show a nice structure. As far as the controls are concerned, we can make the following observations. The coefficient of the variable MWR shows the expected sign, it is very significant, and not far from unity in almost every equation, confirming the validity of the way chosen to control for the effects of market power. The interactions between the returns to scale dummies and the growth of capital variable attract the correct sign and show more or less sensible values for the parameters. The coefficients corresponding to the industries with increasing and constant returns to scale are in general not significantly different from zero, and hence everywhere the restriction $\tilde{a}_{IR}=\tilde{a}_{CR}=1$ can be accepted at the 5% level. However, all the return parameters cannot be constrained to have a value of one, even if the equation does not change very much

[26] Details on the construction of the variables and the sample used, as well as some descriptive statistics, can be found in the Data Appendix.

(estimate 2) with the exception of the investment term[27]. The degree of utilisation indicator, when included, is not significant (estimate 3). This tells us that the industry demand indicator is more efficiently picking-up the changes in productivity due to fluctuations in utilisation.

As far as the determinants of productivity growth are concerned, we can observe the following facts. Firstly, R&D expenditures have a positive and significant impact on productivity with a lag, while it has been impossible to find a significant impact with any specification for the other technological determinant, the technological payments. This suggests an asymmetric impact on productivity during the period of the innovative activities carried out inside the walls, with respect to the acquisition of licenses of available technologies. On the contrary, investment intensity tends to show a positive and significant contemporaneous impact on productivity, which confirms the role of embodied innovations.

Secondly, import penetration attracts a strong and significant positive coefficient when included in the equation with a lag[28]. We interpret this effect as the increase in firms' productivity induced by competitive pressure, as explained in section 3.

Finally, gross entry and exit rates appear to be positive and significant determinants of productivity when included separately (estimates 1 to 3 and 4 respectively), but the effect of the exit rates tends to fade away when both rates are included simultaneously (estimate 5). In addition, the coefficient attracted by the exit rates is lower[29]. These estimates are fully

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[27] The point estimate for $\tilde{a}_{DR}$ is obviously very low ($\cong$0.4), but it can be interpreted as picking-up the short-run difficulties for a number of industries to reproduce the productive process in the presence of new capital investments that require some lags to become fully productive.

[28] Export intensity was also tried and did not show any additional effect.

[29] A more structural model would include separate entry and exit equations. Under the displacement hypothesis, exit could be modelled as a function of demand growth and entry, and entry as a function of demand and other factors (comforming profitability expectations). The rates of entry and exit present a low simple correlation with demand growth (0.19 and 0.08 respectively), but even the naivest model along the commented lines performs very well. The entry and exit rates give the following equations:

consistent with the theoretical insights developed in section 4, by which we expect a positive effect of entry and exit on productivity with a lower marginal impact of exit. Therefore, they point out that turnover was an important determinant of productivity growth. In addition, collinearity reveals that entry and exit rates are at the origin of the same productivity gains, confirming both the presence and importance of displacement.

The time interval used for estimation, which includes time periods elapsed before and after Spanish integration in the EEC, suggests the exploration of possible changes in the impact of some variables. Structural change tests of the impact of imports and the entry rate have been performed by allowing a different coefficient in the post-entry subperiod (1987-1990). A change in the impact of imports is clearly rejected, but the test on turnover suggests that its role was somewhat more important in the period previous to integration (see estimate 6).

The R^2 of these estimates is around 0.15. Notice that estimations are carried out in differences of growth rates, and hence this is a good score (we are explaining the variance of the changes of a rate of change).

6. The sources of productivity growth.

From equation (6) it seems natural to define the expression

$$\bar{q} = \frac{1}{JT} \sum_j \sum_t x_{jt} \hat{b} = \sum_k \hat{b}_k \bar{x}_k$$

GEXR= 4.60 - 0.20DEM + 0.81GENR+u and GENR= 5.8 + 0.52DEM+v
(12.5) (-3.8) (15.9) (22.8) (5.3)

Notice that multivariate coefficients in Table 3 must be interpreted as giving the effects of entry, exit and demand growth once controlled for the part of the variable explained for the other variables already included. All this suggests that entry and demand growth have clearly independent roles.

where $\bar{x}_k$ is the sample mean of the k-th variable and $\hat{b}_k$ its estimated coefficient, as an estimate of the systematic component of productivity growth[30]. This estimate can be used to evaluate the role played by each determinant[31]. Table 4 presents the decomposition of the productivity growth, using the coefficients of the estimation 1[32]. This decomposition provides a picture of the sources of the productivity increase in the Spanish manufacturing sector during the eighties.

The decomposition shows an extremely important influence of the pressure derived from imports in productivity growth. Half of the average productivity growth during the period can be attributed to productivity changes introduced by firms under this pressure. The other important source is the structural change in industries derived from entry and exit. This change accounts for almost one third of average productivity growth. On the other hand, the contribution of R&D activities emerges as the other important determinant to productivity growth.

In addition, equation (6) can be used to assess the role of the corrections to the conventionally computed Solow residual and hence to evaluate the true overall productivity growth. Rearranging the estimated version of this equation, we have

$$q_{jt} - Z_{jt}\hat{a} = \hat{q}_j + \hat{q}_t + X_{jt}\hat{b} + \hat{u}_{jt}$$

and, aggregating as before across industries and time, we obtain

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[30] It also seems natural to define $\bar{q}$ including a constant $\hat{b}_0$ (i.e. the vector x_{jt} includes the value 1 in the first position), whose value cannot be estimated separately from $è_j$ and $è_t$ except under the assumption $E(è_j)=(è_t)=0$.

[31] In practice we operate as if there were a constant with a value proportional to $\sum_k \hat{b}_k \bar{x}_k$.

[32] We discard the non-significant variables.

$$\bar{q} - \sum_m \bar{Z}_m \hat{a}_m = \frac{1}{J}\sum_j \hat{q}_j + \frac{1}{T}\sum_t \hat{q}_t + \bar{q}$$

where $\bar{Z}_m$ is the sample mean of the m-th control variable and $\hat{a}_m$ its estimated coefficient.

Table 5 summarises the results of the left hand of this decomposition, when coefficients of estimation 1 are used. The average of the conventionally computed Solow residual (our dependent variable) is 0.97%. Average corrected productivity growth is evaluated at 1.58% per year. Therefore, the conventional Solow residual is, in this case, a downward biased approximation of the true productivity growth.

7. Concluding remarks.

This paper measures productivity growth in a sample of 75 Spanish manufacturers during the eighties, at the same time analysing its determinants. The exercise is particularly relevant because it draws on the period in which Spanish manufacturing was under intense competitive pressure derived from the EEC integration and showed an intense structural change, reflected mostly in high and unbalanced gross rates of firm entry and exit.

The exercise develops a way to proceed statically in order to simultaneously determine productivity growth and its determinants when using sectoral data and, particularly, includes elaborated insights as to how entry and exit must be specified and interpreted. The results show an important role for competitive pressures and for structural change through the displacement of inefficient firms (which account for, in total, 80% of productivity growth during the period). Hence, results fully validate the idea that moves towards economic integration and free trade have important positive efficiency consequences, even if an important part may come through processes of creative destruction.

From the point of view of industrial policy, the results of this paper firstly confirm the likelihood of the accumulation of productive inefficiencies when competition is weak, particularly in the case of insufficient interaction with a more competitive environment, as was the case for Spanish manufacturing in relation to Europe by the beginning of the eighties. But they also indicate that the easing of market constraints, together with agents' expectations of the irreversibility of this process, may generate a market dynamics able to change market structure and performance in a relatively short time, as is shown by the important increase of the degree of efficiency experienced by Spanish manufacturing during the eighties. In any case, it remains unknown to what degree this type of change must necessarily be associated with such an intense process of displacement and destruction of inefficient units, as happened in the Spanish case. The presence of an important fringe of small inefficient manufacturing firms at the time favoured this characteristic; but perhaps public policies directed to flexibilize firms, remove barriers to mobility, and encourage investments and innovation can shift an additional part of the weight of this type of process to the positive reaction of incumbent continuing firms, which is also observed as an important component of the Spanish case.

Appendix A: Firms' heterogeneity, industry composition and productivity growth.

Let $q_i=[1/(1-a_i)]f(x_i)$ be the production function of firm i, i=1,..,N, and assume $f(x_i)$ is linearly homogeneous. The associated cost function is $C(w,q_i)=c(w)(1-a_i)q_i$, where w represents the vector of input prices, and input demands can be written as $x_i = \frac{\partial c(w)}{\partial w}(1-a_i)\, q_i$ (Shephard's lemma). Using linear homogeneity, it can be inmediatly shown that $\sum_i f(x_i) = f(x)$, where $x = \sum_i x_i$. Hence, $q = 1/(1-\sum_i a_i s_i)\, f(x)$. Taking logs, using the fact that $\ln(1+x) \cong x$ and differencing, we obtain expression (2). Now let $f(x_i)$ be homogeneous of degree γ. Then $\sum_i f(x_i) = [\,(1-\sum_i a_i s_i)/(\sum_i (1-a_i)^{\frac{1}{g}} s_i^{\frac{1}{g}})^{g}\,]\, f(x) \cong [1 - I(a,s)\,(g-1)]\, f(x)$, where

$$I(a,s) = \ln \sum_i (1-a_i)\, s_i - \sum_i \frac{(1-a_i)\, s_i}{\sum_i (1-a_i)\, s_i} \ln(1-a_i)\, s_i,$$

and the last (approximate) equality is obtained by doing a first order approximation of the multiplicative term around ã=1. If all firms were equally efficient (a_i=a), I(a,s) would take the value of the entropic index $-\sum_i s_i \ln s_i$, and if all the firms were of the same size (s_i=1/N), the index would simply be lnN.

Appendix B: Productivity growth and the rates of entry and exit.

A market consists of two types of firms. Firms of type 1 present a productivity or cost advantage "a" over the firms of type 2. For simplicity, there is no way to transform a type 2 firm into a type 1 firm. Entry consists of type 1 firms and exit affects type 2 firms. Let N_1 and N_2 be the numbers of firms, $N_1+N_2=N$, and s_1 and s_2 their market shares. Call the joint shares $N_i s_i$, S_1 and S_2. Productivity change derived from a change in the industry composition of firms is adS_1 or $-adS_2$.

Let us discuss how the S_1 share changes are linked to the processes of entry and exit. Firstly, note that S_1 can be written as a function of the proportion of firms of type 1 in the marketplace, $w=N_1/N$, and the relative advantage in output of this type of firm, $v=(q_1-q_2)/q_1$, as $S_1=w/(1-(1-w)v)$. At the same time, given the productivity or cost advantage of firms of type 1 and the behaviour in the market, v itself must be considered a function of w and N. Both w and N are expected to have a positive impact on v. This is the case, for example, when market demand is either linear or of the constant elasticity type and firms compete à la Cournot. Therefore S_1 can be expressed as $S_1=S_1(w,v(w,N))$, where $\frac{\partial S_1}{\partial w} > 0, \frac{\partial S_1}{\partial v} > 0$, and we can assume $\frac{\partial v}{\partial w} > 0$ and $\frac{\partial v}{\partial N} > 0$. Differencing S_1 and expressing dw and dN/N in terms of the entry and exit rates, $e=dN_1/N$ and $s=dN_2/N$, an equation of the type $dS_1 = b_e e + b_s s$ is easily obtained, where the â's depend on three effects of the entry and exit rates: "direct," "competition" and "concentration." The effect of the entry rate is expected to always be positive, and the coefficient of the exit rate will be positive if the direct and competition effects of exit prevail over the concentration effects (as we can expect).

Appendix C: A case of the frontier of possibilities of firm numbers.

Assume that, at any given moment, the market consists of N_1 type 1 firms and N_2 type 2 firms, $N_1+N_2=N$, that compete à la Cournot with constant marginal costs $c_1<c_2$. The inverse market demand function is $p=d-bQ$, with $Q=N_1q_1+N_2q_2$.

Assuming a fixed cost of F, profits of a type 2 firm can be written as

$p_2 = \frac{1}{b}\left[\frac{d - c_2}{N+1} - \frac{N_1(c_2 - c_1)}{N+1}\right]^2 - F$. Equating this expression to zero and reordering, we obtain the equation of the frontier

$$N_2 = \left(\frac{d - c_2}{\sqrt{b\,F}} - 1\right) - \left(1 + \frac{c_2 - c_1}{\sqrt{b\,F}}\right) N_1$$

Data appendix

The sample consists of 75 of the 81 industries in which manufacturing is disaggregated by the yearly Spanish industrial survey (Encuesta Industrial, from now on referred to as EI) of the Instituto Nacional de Estadística (INE). There are no entry and exit data for the other 6. The period covered by the main data is 1979-90, and their source is the EI if another is not stated. We detail the construction of the variables below. Table A1 gives some statistics.

Productivity growth (è^{S}): computed using the Tornqvist index $q^{S} = y - n_{kt}\, k - n_{Lt}\, l - n_{Mt}\, m$, where y, l and k respectively stand for the log differences (%) of real gross product, total hours of work, real capital stock and real consumption of materials. n_{Lt} and n_{Mt} are computed as the average shares of labour costs and material expenditures in gross production between the years t and t-1, and $n_{kt} = 1 - n_{Lt} - n_{Mt}$.

Capital stock (K): Computed as $K_t=(P_t/P_{t-1})[(1-ä)K_{t-1}]+I_t$, starting from an initial estimation based on official engineering estimates of capital-product ratios at the time, and referring its value to 1980 prices. Investment was estimated as the sum of the current investment by existing firms plus the invesment in new plants. Depreciation rates were calculated as the inverse of the average life of the assets estimated from the same source as the capital-product ratios. The price index used was common to all the industries and comes from the published industrial price indexes (INE).

Price-cost margin (PCM): Calculated as (GP-L-SUB-M)/S, where GP represents gross production, L labour costs, SUB subsidies, M the cost of materials, and S total sales. Production for inventories, valued at cost, cancels out with its cost in the numerator.

Utilisation indicator (v): Yearly average of an indicator of use of capacity (Ministry of Industry). Only available for a disaggregation of manufacturing in 24 industries.

R&D intensity (RDVA): Ratio R&D expenditures/Value added (‰). The R&D data come from two different sources: the OCDE "Main Science and Technology Indicators" for the years 1979-81, and the Spanish firms' R&D statistics (INE) for the remaining period. Available for a disaggregation of manufacturing in 28 industries.

Technological payments intensity (TPVA): Ratio Technological payments/Value added (‰). The technological payments abroad are registered by the Bank of Spain and the Ministry of Finance. Available for a disaggregation of manufacturing in 28 industries.

Investment intensity (II): Ratio Real capital stock variation/Number of workers.

Gross entry rate (GENR): Plant creation in each industry divided by the total number of plants in the industry the preceding year. The yearly plant creation data come from the records of the Ministry of Industry ("Registro Industrial"), and were matched to the total number of plants given by the EI for 75 industries.

Gross exit rate (GEXR): Plant exit divided by the total number of plants in the preceding year. Plant exit was deducted from the entry and total plant data.

Export penetration (EXP): Ratio Exports/Domestic demand (Sales+Imports-Exports). Export data come from the official trade statistics of the Ministry of Economy. Available for the period 1980-86 for a dissagregation of manufacturing in 81 industries. For the rest of the years available for 13 industries.

Import penetration (IMP): Ratio Imports/Domestic demand. Import data come from the same source as exports.

Industry demand (DEM): Industry demand rate of change indicator computed for each industry as a weighted average of the rates of change of production in the industries that buy from that industry, and the rates of change of consumption of the final consumers that buy the produced goods. Constructed using weights from the 1980 Input-Output Table, and the EI and National Accounts data.

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TABLE 1
International comparison of productivity growth and entry and exit rates in manufacturing.

Country	TFP[1] (%)	Entry rate[2] (%)	Exit rate[2] (%)
Belgium	3.4	5.8	6.3
Canada	0.4	4.0	4.8
France	1.9	5.0	3.9
Germany	1.3	3.8	4.6
Japan	2.5	N.A.	N.A.
Norway	1.0	8.2	8.7
Portugal	N.A.	12.3	9.5
UK	3.0	6.5	5.1
USA	1.3	7.7	7.0
Spain	2.7	7.3	9.7

Notes:
[1] Annual accumulative rates for the period 1978-90. TFP is computed here with the manufacturing aggregates in each country, using value-added as output, and the number of workers as labour input. Calculations based on "The OECD Stan Data Base for Industrial Analysis 1974-1993" and "Flows and Stocks of Fixed Capital" (OECD).
[2] Averages of annual industry rates for different time periods: Belgium (1980-84), Canada (1971-79), France (1980-82), Germany (1983-85), Norway (1980-85), Portugal (1983-86), UK (1974-79), USA (1963-82), and Spain (1979-90). Source: *Cable and Schwalbach (1991)* for all the countries but France and Spain, *Armington (1986)* for France, and our sample for Spain.

TABLE 2

Correlations between manufacturing entry and exit rates across subperiods[1]

No correction for fixed industry effects

	Exit rate		
	1979-82	**1983-86**	**1987-90**
Entry rate			
1979-82	0.73	0.58	0.57
1983-86	0.53	0.83	0.76
1987-90	0.37	0.66	0.92

Correction for fixed industry effects

	Exit rate		
	1979-82	**1983-86**	**1987-90**
Entry rate			
1979-82	0.83	0.15	-0.79
1983-86	0.10	0.66	-0.46
1987-90	-0.76	-0.44	0.89

Notes:

[1] We do not report yearly correlations for the sake of clarity, but very similar results are obtained.

<u>**TABLE 3**</u>

Productivity growth corrections and determinants

Dependent variable: θ_{jt}.Estimation method: Instrumental variables of the first differences.[1]

Variables	Estimates 1	2	3	4	5	6
MWR	-0.84 (-4.88)	-0.74 (-3.81)	-0.93 (-5.58)	-0.80 (-4.70)	-1.02 (-5.99)	-0.89 (-6.54)
KID	0.14 (1.15)	--	0.13 (1.10)	0.14 (1.07)	0.08 (0.63)	0.10 (0.87)
KCD	-0.14 (-1.70)	--	-0.13 (-1.51)	-0.01 (-0.12)	-0.06 (-0.73)	-0.12 (-1.57)
KDD	-0.61 (-3.79)	--	-0.59 (-3.58)	-0.61 (-3.72)	-0.59 (-3.63)	-0.61 (-3.84)
K	--	-0.17 (-1.64)	--	--	--	--
V	--	--	0.02 (0.91)	--	--	--
RDVA(-1)	0.03 (2.93)	0.03 (2.60)	0.03 (2.45)	0.04 (3.53)	0.04 (2.72)	0.04 (4.04)
TPVA	-0.02 (-1.13)	-0.02 (-1.06)	-0.01 (-0.79)	-0.01 (-0.45)	0.00 (0.33)	-0.01 (-0.71)
II	3.14 (2.13)	0.75 (0.79)	3.21 (2.13)	2.65 (1.76)	3.10 (2.14)	3.10 (2.09)
GENR	0.12 (4.00)	0.13 (4.91)	0.13 (3.76)	--	0.08 (1.46)	0.18 (4.22)
GEXR	--	--	--	0.05 (2.77)	0.03 (0.83)	--
						-0.09[2] (-3.18)
DEM	0.07 (1.34)	0.06 (1.11)	0.08 (1.56)	0.09 (1.82)	0.06 (1.24)	0.08 (1.56)
IMP(-1)	0.08 (3.14)	0.09 (3.06)	0.09 (3.50)	0.07 (2.69)	0.08 (2.79)	0.09 (3.38)
TIME DUMMIES	YES	YES	YES	YES	YES	YES
INSTRUMENTS	GMM(MWR)	GMM(MWR)	GMM(MWR)	GMM(MWR)	GMM(MWR)	GMM(MWR)
SARGAN TEST	S(18)=16.5	S(18)=14.6	S(18)=18.9	S(18)=17.8	S(18)=23.2	S(18)=17.81
m_1	-3.541	-3.477	-3.626	-3.579	-3.646	-3.570
m_2	1.404	1.408	1.424	1.397	1.452	1.512
INDUSTRIES	75	75	75	75	75	75
YEARS	1981-90	1981-90	1981-90	1981-90	1981-90	1981-90

Notes: [1] Robust t-statistics in parentheses. GMM(.) means that we have used general method of moments instruments. m_1 and m_2 are statistics of first and second order serial correlation. Their detailed interpretation, as well as the meaning of the Sargan test, may be found in Arellano and Bond (1991).

[2] This number is the coefficient estimated for the variable GENR multiplied by a dummy variable that takes the value 1 when the year belongs to the period 1987-1990 and the value 0 elsewhere.

TABLE 4

Decomposition of the average productivity growth

COMPONENTS	VARIABLE	CONTRIBUTION %
R&D EXPENDITURES	RDVA(-1)	13.3
INVESTEMENT INTENSITY	II	3.2
ENTRY	GENR	30.7
IMPORT PENETRATION	IMP	52.7

TABLE 5

Average corrected productivity growth in the period 1981-90 and its decomposition

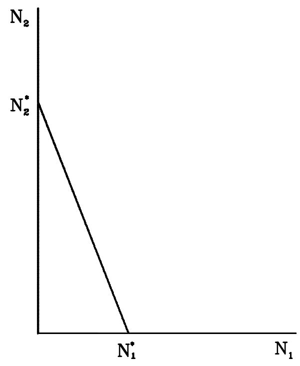
COMPONENTS	VARIABLE	CONTRIBUTION
CONVENTIONAL SOLOW RESIDUAL	è	0.968
MARKET POWER	MWR	0.043
DECREASING RETURNS TO SCALE	KRD	0.567
AVERAGE CORRECTED PRODUCTIVITY GROWTH 1981-90		1.578

Table A1
Variable Statistics (sample means)

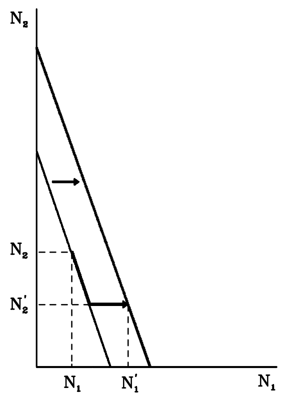
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Productivity growth (è) (%)	0.76	0.9	0.8	0.2	1.4	-0.3	1.2	1.3	1.6	1.4	0.8	1.3
Capacity utilisation (v) (rate of change %)	-1.2	-3.3	1.9	2.3	-1.7	-0.2	-0.8	0.0	-2.1	1.3	4.9	-2.7
R&D expenditures/value-added (RDVA) (‰)	5.5	6.6	6.9	8.8	7.6	12.6	18.1	19.7	21.2	20.7	20.1	26.2
Technological payments/value-added (PTVA) (‰)	7.6	7.6	8.8	9.9	9.5	8.4	13.7	13.7	11.2	16.3	23.5	21.0
Investment intensity (II) (thousands ptas. per worker)	16.0	-20.7	-7.8	-0.6	-13.6	-31.6	-3.0	71.4	41.1	75.2	87.4	113.4
Gross plant entry rate (GENR) (%)	4.4	3.3	4.6	6.1	7.3	7.8	7.4	8.8	11.0	10.7	9.4	9.0
Gross plant exit rate (GEXR) (%)	7.1	7.1	9.3	12.3	9.3	11.1	10.1	11.1	13.7	10.0	9.3	9.4
Number of plants (N) (rate of change %)	-2.6	-1.8	-5.6	-6.0	-2.3	-4.0	-2.5	-2.4	-2.4	0.0	0.6	0.2
Industry demand (DEM) (rate of change %)	0.6	1.6	0.0	0.8	2.4	1.0	3.0	3.6	7.6	6.6	6.8	4.7
Import intensity (IMP) (%)	15.9	16.3	16.5	17.6	18.7	20.5	20.4	23.0	25.2	25.7	27.2	27.6
Export penetration (EXP) (%)	12.8	13.0	16.2	16.9	19.8	24.6	25.5	24.6	22.8	21.4	19.9	20.7

<u>Figure 1</u>

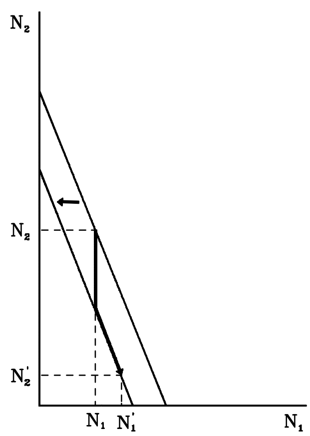
Entry and exit: displacement and market effects



A. Frontier of possibilities of firm numbers



B. Competitive entry and market enlargement



C. Market contraction and competitive entry