

ESTUDIOS SOBRE LA ECONOMÍA ESPAÑOLA

**Regional and sector-specific determinants of
industry dynamics and the displacement effect**

**J. M. Arauzo, M. Manjón,
M. Martín and A. Segarra**

EEE 219

February 2006



ISSN 1696-6384

Las opiniones contenidas en los Documentos de la Serie EEE, reflejan exclusivamente las de los autores y no necesariamente las de FEDEA.
The opinions in the EEE Series are the responsibility of the authors and therefore, do not necessarily coincide with those of the FEDEA.

REGIONAL AND SECTOR-SPECIFIC DETERMINANTS OF
INDUSTRY DYNAMICS AND THE DISPLACEMENT EFFECT^{*}

J.M. Arauzo, M. Manjón, M. Martín and A. Segarra
(Department of Economics and GRIT, Rovira i Virgili University)

Address:

Faculty of Business and Economics
Av. de la Universitat, 1
43204 – Reus
Spain

e-mail: mma@urv.net

^{*} The authors are grateful to the *Fundación Caja de Ahorros* and the CICYT (SEJ2004-05860/ECON and SEJ2004-07824/ECON) for their financial support and to M. Callejón and E. Cefis for their helpful suggestions. N. Gras and A. Roda provided excellent research assistance in the construction of the database used in this paper. An early version of this paper was presented to the “IV Encuentro de Economía Aplicada” (Reus, Spain). The current version has benefited from the comments of participants at the ZEW conference on “The Economics of Entrepreneurship and the Demography of Firms and Industries” (Mannheim, Germany). The usual disclaimer applies.

REGIONAL AND SECTOR-SPECIFIC DETERMINANTS OF INDUSTRY DYNAMICS AND THE DISPLACEMENT EFFECT

ABSTRACT

In this paper we analyze the regional and sector-specific determinants of industry dynamics. Concretely, we empirically tested three hypotheses (originally proposed by Shapiro and Khemani 1987) for the relationship between the entry and exit of firms in Spanish regions and sectors. The simplest one claims that entries and exits are independent. The symmetry and simultaneity hypotheses, on the other hand, take the opposite view. The symmetry hypothesis claims that barriers to entry are also barriers to exit, while the simultaneity hypothesis claims that there is a close relationship between entry and exit. Our estimates from a panel data system of equations seem to confirm the simultaneity hypothesis for Spain during the period 1980 to 1994.

Key words: industry dynamics, manufacturing, regions

JEL: C33, R19, R30

1. Introduction

The entry of new firms in a market is linked, among other factors, to the profits they expect to make, to the barriers to entry and to territorial factors that shape the environment in that region. The exit of firms, on the other hand, depends on factors such as the economic cycle, sunk costs and geographical variables that affect the ability of companies to survive (Caves 1998, Geroski 1995). We may therefore be tempted to conclude that the relation between entries and exits is likely to be weak, since the variables that affect the decision to enter are different from the variables that affect the decision to leave. However, this turns out to be a misleading conclusion because these are not isolated phenomena.

Empirical evidence also shows that entry and exit are closely related within regions (Keeble and Walker 1994; Reynolds, Storey and Westhead 1994) and, also, the correlation between the sectorial rates of entry and exit is usually strong. That is, industries with high rates of entry also have high rates of exit, and vice versa (Dunne and Roberts 1991). These two stylised facts suggest that the entries and exits of the markets are not independent processes but ones that are somehow interrelated. Entries can create a displacement effect that causes exits to increase and exits can free niches in the market and business resources that speed up the ability of potential producers to respond by entering (Acs and Audretsch 1990, Audretsch 1995). The question that arises is how to empirically assess these relations.

In this paper we will use a system of equations under three different scenarios to determine the nature of the relationship between the entry and exit of industrial concerns. These scenarios were originally proposed by Shapiro and Khemani (1987) in the form of alternative hypotheses. First, the symmetry hypothesis states that there is a link between entry and exit such that barriers to entry are also barriers to exit. Second, the simultaneity hypothesis states that the interdependence between entry and exit is derived not only from a symmetrical relationship, but also from the effects that entries have on exits, and vice versa. Third, the independence hypothesis states that there is no such link between entry and exit.

Other studies have also used this type of approach but, on the whole, the empirical evidence is rather scarce.¹ This paper aims to fill this void to some extent by presenting results at the Spanish regional level. We will use some simple conditions that characterise the econometric specifications to determine which hypothesis seems to have driven the entry and exit decisions of Spanish manufacturing firms during the 1980's and early 1990's. Specifically, the simultaneity hypothesis implies that there are statistically significant coefficients for the endogenous explanatory variables, while the symmetry hypothesis implies that there are strong correlations between the sample errors from the regression equations. The independence hypothesis would be therefore supported if none of these results were empirically observed.

We have extended the standard framework in this literature along two dimensions: sectors and regions. In brief, our estimates from the equations for entry and exit determine how sectorial and regional variables affect the gross rates of entry and exit of industrial establishments in the Spanish regions. We want to emphasize the regional effect over industry dynamics, given that the spatial dimension of economic activity has becoming increasingly acknowledged by scholars. As an example, the interested reader can go through several empirical contributions that highlight the importance of regional factors over the entry and exit process. In this sense, following cases have been reported: Great Britain (Ashcroft et al., 1991; Barkham, 1992; Fotopoulos and Spence, 2001; Keeble and Walker, 1994), France (Guesnier, 1994), Sweden (Davidsson et al., 1994), Germany (Audretsch and Fritsch, 1994; Fritsch, 1997, 1996; Fritsch and Mueller, 2004), the United States (Rigby and Essletzbichler, 2000; Campbell, 1996; Sutaria and Hicks, 2004), Finland (Kangasharju, 2000), Spain (Arauzo and Teruel, 2005; Callejón and Segarra, 1999; Segarra et al., 2002), Norway (Spilling, 1996), Italy (Garofoli, 1994), Greece (Fotopoulos and Spence, 1999) and Turkey (Gaygisiz and Köksal, 2003), among others.

¹ Evans and Siegfried (1992), for example, reported a close relationship between entry and exit in the manufacturing industries of the United States between 1977 and 1982. Kleijweg and Lever (1996) and Love (1996) reached similar conclusions about the manufacturing industries of Holland and England, respectively. More recently, a study made by Fotopoulos and Spence (1998) on the manufacturing industries of Greece between 1982 and 1998 supported the symmetry hypothesis.

We will also discuss whether the effects of displacement (entry on exit) and replacement (exit on entry) are significant for Spanish regions. As for the econometric specification, we use several estimation methods for panel data. The choice of method depends on the stochastic assumptions sustained by the three hypotheses of interest (see the appendix for details). Apparently, this is the first study to use two latent variables for industries and regions to collect unobservable effects (Baltagi 2001).

We have structured the paper as follows. In Section 2 we discuss the importance of sectorial and regional factors and provide results for Spain under the independence hypothesis. In Section 3 we argue that independence may not a valid framework. We therefore propose the symmetry and simultaneity hypotheses and describe them in detail. In Section 4 we present and compare the estimates under these hypotheses and discuss a number of caveats that may apply to the results. In Section 5 we summarise our main conclusions.

2. Sectorial and regional determinants of entry and exit

2.1 The independence hypothesis

Many studies of business demography have focused on one side of market turnover. That is, they have either analysed the factors determining the entry of new firms (Orr 1974, Geroski 1991, Baldwin 1995) or concentrated on why a productive activity is abandoned (Marcus 1967, Mata and Audretsch 1995, Doi 1999). The arguments in these papers vary, but the basic premise common to all of them is that new firms enter markets when the expected profit, after discounting the costs arising from the barriers to entry, is positive. They also argue that a firm will abandon its activity when the expected profits, taking into account the percentage of sunk costs that are not made up before leaving the market, are negative.²

In practice, the specification of the reduced form model is given by the following expressions, which should be estimated separately using the most suitable method:

$$LNGRE = f(BARENT)$$

² This approach is based on the concept of “limit pricing” developed in the studies of Bain (1949, 1956).

(1)

$$LNGRX = f(BAREXI),$$

where f is a mathematical function – for example, linear – that links entry and exit to their determinants; $LNGRE$ and $LNGRX$ are, respectively, the natural logarithms of the gross rate of entry and exit; and $BARENT$ and $BAREXI$ are vectors of variables that take into account the presence of, respectively, barriers to entry and barriers to exit.³

This approach implies that the stochastic processes generating the data are independent, i.e. the probability of events defined in terms of the gross rate of exit in a given sector and time period is never affected by the behaviour of the gross rates of entry. Generally, given that the moments of the gross rates of entry and exit (and, in particular, the mathematical expectation) are not affected by, respectively, the probability distribution of the gross rates of exit and entry, there is no need to deal with the interdependence of these random variables. Also, we can expect the determinants of the two processes to be different. This asymmetry means that the cost structure is assumed to be homogeneous. This is actually an extremely restrictive assumption, but it is nevertheless very useful as a benchmark. We shall discuss more appropriate frameworks (i.e. symmetry and simultaneity) in section 3.

Notice also that this approach usually focuses on the sectorial determinants of entry and exit. This is justified on the grounds that there are substantial differences between the gross rates of entry and exit, as in e.g. the Spanish manufacturing sectors (see Table 1). However, recent contributions to the literature on industry dynamics have concluded that the spatial dimension also needs to be taken into consideration. International empirical evidence shows that, even after controlling for differences in the industrial mix, there are substantial differences in the regional rates of entry and exit (Keeble and Walker 1994; Reynolds, Storey and Westhead 1994). This suggests that there are (dis)economies at the regional level that directly affect the decisions to enter and exit. In Spain, for example, Segarra et al. (2002) show that entries and exits

³ The semilog specification is the most common one in the literature. See Orr (1974: 62-63), Shapiro and Khemani (1987: 17, note 6) and Fotopoulos and Spence (1988: 255-256) for a discussion on why it is used.

are not randomly distributed over the Spanish regions (also see Table 1) but that there is a close relationship between economic growth and the rates of entry (positive) and exit (negative)⁴.

[Insert Table 1 about here]

Consequently, we should modify the econometric specification in (1) to include a second set of explanatory variables containing specific factors for each region that affect business rotation:

$$\begin{aligned} \text{LNGRE} &= f(\text{BARENT}, \text{REGIO}) \\ \text{LNGRX} &= f(\text{BAREXI}, \text{REGIO}), \end{aligned} \tag{2}$$

where *REGIO* is a vector of variables made up of regional characteristics relevant to the decisions to enter or exit.

2.2 Data and econometric specifications

Table 2 gives the definitions of the variables we used in our study. We calculated the dependent variables LNGRE and LNGRX for each pairing of industry and region obtained for each year between 1980 and 1994. Gross rates of entry and exit were derived from the link between two Spanish data bases: the *Registro de Establecimientos Industriales* (the Register of Industrial Establishments, REI) and the *Encuesta Industrial* (the Industrial Survey, EI).⁵ The REI provides the number of establishments created every year in the region-sector pairing (Entries_t) and the EI provides the number of existing establishments (Estab_t). Therefore, the number of exits (Exits_t) was obtained as $\text{Estab}_{t+1} + \text{Entries}_t - \text{Estab}_t$ (negative values were replaced by zero). Gross rates of entry (exit) were calculated as the ratio between Entries_t (Exits_t) and Estab_{t-1} . We

⁴ Also for the Spanish case, Arauzo and Teruel (2005) show that the territorial differences on industry dynamics are not only at the regional level but also at the urban level.

⁵ The REI is an administrative register that includes the following information about new entrants (establishments): size, invested capital and location. The EI provides data on e.g. production (gross value added), employment (number of workers) and certain inputs (raw materials, energy, etc.). However, for the period of analysis it also provides the number of existing establishments. Both data sets come from the National Institute of Statistics (INE).

obtained maximum and minimum values of the logs of these variables by adapting the “modified Aitchison procedure” proposed by Fry et al. (2000) to control for the presence of zeros in some observations.⁶

[Insert Table 2 about here]

As for the explanatory variables, *BARENT* and *BAREX* are vectors of structural characteristics that determine the nature and extent of the barriers to entry and the barriers to exit in each industry. For *BARENT* we considered well-known barriers such as measurements of technological intensity (R&DS), product differentiation (DIF), capital requirements (the average initial investment was denoted by *K*, and the average size of the concerns was denoted by *SIZE*) and the market power of the incumbents (profit margins, denoted by *MARGIN*, and market structure, denoted by *MARKET*). We also included a measurement of the benefits ex-post (*BEXP*) and a proxy for market turbulence (the percentage of micro-firms in the sector, denoted by *MICROS*). Among the barriers to exit our regressions included benefits ex-ante (*BEXA*) and several variables that may indicate the magnitude of the sunk costs: technological intensity (R&DS), product differentiation (DIF), initial investment (*K*) and size of the concerns (*SIZE*). Notice that, following Caves and Porter (1976) and Eaton and Lipsey (1980, 1981), most barriers to entry are also considered barriers to exit. This makes it difficult to a priori propose expected signs for the coefficients. In general, however, entry barriers and sunk costs should negatively affect entry and exit, respectively.

⁶ Notice that this may be due to the quality and/or the disaggregation of the data, although we do not have a way of finding out what the cause is. Taking logs causes a mathematical indeterminacy that we solved in the following way: i) when both numerator and denominator were nil (most of these were “cells” in which both the REI and the EI provided zero values throughout the period), we used $LNGRE_t$ ($LNGRX_t$) = 0; ii) when either the entries or the exits in t were nil, we used a modified Aitchison procedure suggested by Fry et al. (2000). However, the design of Fry et al. (2000) uses cross-section data, so here we have opted for replacing the zeros along the time dimension. In particular, our minimum value of replacement is 1 (i.e. one establishment). Therefore, given that the minimum and maximum number of existing establishments in the sample were, respectively, 5 and 8490, the minimum and maximum values of replacement are $1/5$ and $1/8490$. With these limits we can test the sensitivity of the results to the replacements and define the dependent variables of Tables 3, 4 and 5: $\ln gre$ (min), $\ln gre$ (max), $\ln grx$ (min) and $\ln grx$ (max). As a caveat, notice that our final sample only contains 11 sectors. “Ores and metals” and “Office Machinery” were eventually dropped because of the extreme number of indeterminacies we found.

The vector of regional characteristics, *REGIO*, is made up of the following variables: measurements of industrial diversity (DIV) and the relative specialisation (SPE) of the region with respect to the Spanish economy; the level of training of the active population as a proxy for human capital (HUMAN); population structure (POPULATION) as a proxy for the population of potential entrepreneurs; the level of infrastructure (ACCESS) as a proxy for the accessibility to markets; and other general characteristics such as income per capita (INCOME), rate of public to private capital (PUBLIC), the percentage of micro-firms (MICROR), the unemployment rate (U) and the technological intensity (R&D).

The role played at a regional level by industrial diversity (DIV) and specialisation (SPE) over firm entry is ambiguous and has not been deeply analysed in industrial dynamics literature. Most of contributions that take industrial mix into account are embodied mainly to the industrial location literature, as Costa et al. (2004), where both variables act positively over entries. This effect implies that industries consider the existence of firms in the same sector and this is compatible with diversified productive structures that favour inter-sectoral external economies. Our assumption is that a specialised environment favours entries given the advantages linked to the concentration of similar firms (localisation economies) in terms of the “classical” Marshallian external economies⁷ (a pooled labour market, the technological spillovers across firms and the presence of specialised suppliers). At the same time, other scholars argue that firms prefer a more diversified environment. The role played by specialisation and diversity has generated a lot of contributions (Glaeser et al., 1992 and Henderson et al. 1995) about which is environment that enhances local and regional growth, and here what we want to do is to test the importance of those kind of external economies.

The incidence of human capital (HUMAN) over entry decisions is expected to be positive, given the need for available skilled workforce to start-up new firms (Audretsch and Fritsch, 1994; Armington and Acs, 2002), but when the analysis is

⁷ See Marshall (1890).

conducted at the industry level, results show ambiguous results across industries (Audretsch and Fritsch, 1999). Armington and Acs (2002) use a more aggregated classification that includes also service activities and show some, a priori, contradictory results when the human capital is measured by share of college graduates (positive effect over entries) and when is measured as the percentage of the population without a high school degree (positive effect over entries). This later effect can be explained by the need for cheap labour.

The population structure (POPULATION) is an important issue for industry dynamics. Specifically, the most entrepreneurial oriented group is formed by individuals between 30 and 44 years old⁸, so a greater rate of this age group will turn into a higher entry rate. This is the age group with the highest rate of individuals who decide to start-up a new business. But the empirical results are not so clear. In this sense, for instance, Davidsson et al. (1994) obtained ambiguous results (depending on the industry) for the effect of the proportion of the population included in the 25-44 age bracket over firm entries. From an exit perspective the result is unclear given the scarcity of research undertaken in this field.

The level of infrastructure (ACCESS) is expected to have a positive (negative) incidence over entries (exits). There are several contributions that have discussed the effects of transport infrastructures on job creation and firm entries (García-Milà and McGuire, 1992; Carlino and Mills, 1987; Carlino and Voith, 1992; Arauzo, 2005) and, since the services made available by infrastructures are linked to their geographical position, the regions in which the infrastructures are located will enjoy several comparative advantages that can favour firm entries and prevent firm exits. But results from those indicators sometimes are not consistent, as Bade and Nerlinger (2000) show for the German case.

Income per capita (INCOME) is a proxy for regional dynamism. Armington and Acs (2002) use the past income growth in order to capture the growth factors of previous

⁸ Reynolds (1997), for example, concludes that 71% of start-ups are located in the 25-34 age group.

periods that are expected to promote new entries in the subsequent periods, but their results do not support this assumption for the manufacturing (nevertheless, the coefficient for the all industries is positive and statistically significant). Sutaria and Hicks (2004) use the personal income change, by they find no significant relation between this variable and the entry rate. We assume that the rate of public to private capital (PUBLIC) affects negatively firm entry and positively firm exit, given this variable proxies the entrepreneurial activity in a region, compared to the weight of the public sector.

In this paper the role of the structure of industry in the region is proxied by the percentage of micro-firms (MICROR), but this is not the most common way to take into account the effect of the structure of industry. Most of empirical papers use the mean firm sized and expect and find a negative relation with entries (Armington and Acs, 2002; Audretsch and Fritsch, 1999, 1994). The reason is obvious: a larger mean size indicates that regional industry is dominated by large corporations that reduce entries, given their market power. Empirical evidence from French (Guesnier, 1994) and German regions (Blade and Nerlinger, 2000), shows that the proportion of small firms has a positive impact over firm entry.

The concern of unemployment (U) over entries has been extensively analyzed at a regional level. Mainly two types of hypotheses have been formulated: the push hypothesis, considers that unemployment favours entrepreneurship (that is entry of micro-firms) because of the available human resources (Hinz and Jungbauer-Gans, 1999; Audretsch and Fritsch, 1994; Audretsch, 1993; Meager, 1992; Storey, 1991 and 1982; Evans and Leighton, 1990; Guesnier, 1994). This approach considers the unemployment as a supply of entrepreneurship (Ilmakunnas and Topi, 1999). The pull hypothesis argues that, oppositely, low unemployment situations favour entries, given the most positive expectations about the evolution of the markets. But, generally speaking the role of unemployment over entries is ambiguous (Audretsch and Fritsch, 1999; Ritsilä and Tervo, 2002; Delmar and Davidsson, 2000; Spilling, 1996; Tervo and Niittykangas, 1994; Storey, 1991 and Hamilton, 1999), so both effects (positive and negative) could be theoretically argued. And also about the role played by

unemployment, this phenomenon is measured in different ways. That is, some scholars prefer to use the unemployment rate (Armington and Acs, 2002; Audretsch and Fritsch, 1999), others use the annual change in that rate (Ilmakunnas and Topi, 1999) and others use both measures (Audretsch and Fritsch, 1994; Ashcroft et al., 1991; Sutaria and Hicks, 2004). These conflicting results have made it difficult for policy makers to look to this literature for policy guidance. But Sutaria and Hicks (2004) follow a different approach by testing the role of the unemployment change, and show that the unemployment growth has a negative effect on new firm formation, given that the job destruction indicates a high risk levels in the markets and, consequently, a lower rate of firm formation due to the fact that it would be more difficult to survive. It is important to notice that, normally, unemployment has been used only for entry equations, since its effects over exit are controversial (Ilmakunnas and Topi, 1999). There are some exceptions, however. For instance, using county-level data for the UK, Keeble and Walker (1994) show that rising unemployment enhances the likelihood of local small business failure.

About the effect of technological intensity (R&D) over firm dynamics at a regional level, we assume that higher the R&D expenditures, higher the entries and lower the exits will be, but our expectations are not clear, given the differences among industry structure at the Spanish regional level and, consequently, the different weight of more innovative activities.

Most of previous variables are commonly found among the determinants of entry and exit in studies that follow a spatial approach – see e.g. Armington and Acs (2002) and Audretsch and Fritsch (1999, 1994).

Finally, we also considered control variables to allow for the effects of the business cycle (*CYCLE*). These include growth evolution of the whole manufacturing industry (MG), of the sector (IG), of the manufacturing industry of the region (RMG), and of the pairing region-sector (RSG). In principle, entries should be procyclical and exits should be anticyclical.

In summary, the econometric specification estimated under the independence hypothesis is the following (*CONS* is a constant term):

$$\begin{aligned} \text{LNGRE}_{iqt} &= \text{CONS} + \alpha_1 \text{BARENT} + \alpha_2 \text{REGIO} + \alpha_3 \text{CYCLE} + (\mu_i + \lambda_t + \eta_q + \varepsilon_{iqt}) \\ \text{LNGRX}_{iqt} &= \text{CONS}' + \alpha'_1 \text{BAREXI} + \alpha'_2 \text{REGIO} + \alpha'_3 \text{CYCLE} + (\mu'_i + \lambda'_t + \eta'_q + \varepsilon'_{iqt}). \end{aligned} \quad (3)$$

This econometric specification arises from the tenet that empirical studies of the determinants of entry and exit should consider at least two types of explanatory variables: one to control the nature and extent of the barriers to entry and exit in each industry and one for the specific features of each region in which the firm is located. Without doubt, regions are not homogenous in terms of their ability to create and support business projects. In fact, many industries tend to concentrate in certain geographical areas (Fujita, Krugman and Venables 1999). However, one can also argue that the inconsistent results of many regional studies are probably due to the fact that most of them do not differentiate between sectors (Audretsch and Fristch 1999). This specification also helps to alleviate concerns about the endogeneity of some explanatory variables (see e.g. Fotopoulos and Spence 1998) because the dimension over which they are calculated (sectorial or regional) is different from that of the dependent variables.

Also, the descriptive statistics in Table 1 highlight the need for variables that control for the unobservable heterogeneity from both the sectorial and the territorial points of view. This is further supported by previous empirical evidence in Spain (Segarra 2002, Segarra et al. 2002). A classic solution for panel data models is to introduce these unobservable components as an error component with sectorial (*i*) and territorial (*q*) effects. The sectorial classification we used was the NACE R-25 (the European industrial classification, two-digits) and we distinguished between 11 manufacturing branches, $i = 1, \dots, 11$. The territorial disaggregation is given by the *Comunidades Autónomas* (Spanish regions, except Ceuta and Melilla, according to the European NUTS-2 classification), $q = 1, \dots, 17$. We have also included a sectorial- and territorial-invariant component (*t*) to allow for time-specific effects, $t = 1980, \dots, 1994$. This is

therefore an extension to three dimensions of the model with error components for panel data (Baltagi 2001).

2.3 Results

Results under the independence hypothesis are presented in Table 3. These include OLS and random-effects estimates. However, OLS estimates should just be taken as a starting point because they are biased and asymptotically inefficient. In contrast, the random effects estimator is consistent and asymptotically efficient under the null hypothesis of independence between covariates and latent effects. In the Spanish data set analysed in this study this hypothesis tends to be rejected using a Hausman test.⁹ We interpret this as a sign of misspecification that is somehow addressed in the next section.

[Insert Table 3 about here]

The most important results of our first econometric approach are as follows. Sectorial variables that appear to be barriers to the entry of new companies are product differentiation and the average requirement of capital (in terms of initial investment). On the other hand, sectors whose established firms are larger and invest in R&D provide opportunity for new operators to enter. Moreover, there is no clear evidence that sectorial barriers to exit exist.

If we consider the regional factors affecting the creation of new firms, we find that human capital has positive effects on entries (as most of scholars theoretically argued) and specialisation has negative effects. Public capital prevents entries (as expected)

⁹ To compute the test we obtained the Fixed Effects estimates using the following transformation matrix:

$$P = I_N \otimes I_T \otimes I_Q - I_N \otimes \bar{J}_T \otimes \bar{J}_Q - \bar{J}_N \otimes I_T \otimes \bar{J}_Q - \bar{J}_N \otimes \bar{J}_T \otimes I_Q + 2\bar{J}_N \otimes \bar{J}_T \otimes \bar{J}_Q,$$

with $\bar{J}_N = J_N/N$, $\bar{J}_Q = J_Q/Q$ and $\bar{J}_T = J_T/T$, and where J_N , J_T and J_Q are matrices of ones of dimension N (regions), T (years) and Q (sectors), respectively. Estimates of the variance of the resulting estimators should be adjusted for the loss of degrees of freedom caused by estimating the model transformed in

this way by OLS (see Baltagi 2001). The ratio of adjustment is $\frac{NTQ - k}{(NTQ - N - T - Q + 2) - k}$, where k is the number of explanatory variables. However, since the ratio turned out to be practically 1 in our models the correction was judged unnecessary.

but it plays no role for the exits. If we look at exits, there seem to be fewer in the more sectorially specialised regions. Also, exits are sensitive to the percentage of micro firms in the region and to its unemployment rate, supporting the pull hypothesis. However, the effects of the regional variables are often ambiguous. Notice also that the sense and the value of the estimates from the two estimation methods are closer. This should be interpreted as (indirect) proof that regionally the latent factors are less important.

Entries are clearly related to the economic cycle. As expected, the behaviour of entries is procyclical and is negatively affected by ex-post profits. New firms grow especially with the upswing of the aggregate activity of both the industrial sector and the manufacturing industry. But while entries are more sensitive to the intraindustrial effects, exits are more sensitive to the economic cycle in the region. Moreover, exits depend little on ex-ante profits. However, the parameters obtained are of little statistical significance.

3. Alternative hypotheses on the relationship between entry and exit

Despite the interest that these inferences may have, the independence hypothesis clearly constitutes too simplistic a framework. The overall result we expect to see empirically under independence is a negative relationship between the rate of entry and the rate of exit, since we are assuming that the first is greater when extraordinary profits are expected (it is procyclical) and the second is greater in recession periods (it is anticyclical). Indeed, the partial correlation between the annual aggregate values for the Spanish manufacturing industry in the sample we analysed is $r = -0.47$.

However, further descriptive analyses of our data set reveal that, in both sectorial and territorial disaggregation, the patterns of entry and exit are not always conflicting (see Table 1). During the period of analysis the average correlations between the gross rates of entry and exit sectorially and territorially were $\bar{r} = 0.62$ and $\bar{r} = 0.25$, respectively. This apparent contradiction is not exclusive to Spain. Actually, it happens regularly for other countries and periods. Moreover, studies on the American economy show that extraordinary profits in an industry affect both the decision to

enter and the decision to leave.¹⁰

These stylised facts of the industrial dynamics suggest that results under the independence hypothesis can only be seen as preliminary evidence of the determinants of entry and exit. In fact, even though we are controlling for unobservable heterogeneity our results are likely to be biased because of correlations between the disturbances and the omission of relevant variables suggested by the Hausman test (see Table 3). A more complex framework is therefore required. In this paper we will focus on the following two scenarios.

First, the determinants of the rate of entry and the rate of exit are identical (or are highly correlated). In this context the barriers to entry become barriers to exit. Second, the entry of new companies encourages the closure of active companies, and vice versa. Entrances influence exits since they increase the pressure of competition in the market and displace the least efficient companies, and the companies that decide to abandon the market leave behind niches of unsatisfied consumers that encourage new companies to enter. The first scenario leads to a symmetry in the incidence of the variables for explaining entry and exit, while in the second scenario entries and exits have a certain simultaneity. We will now analyse each of these scenarios in more detail.

3.1 Symmetry

From the available empirical evidence we can deduce that, unlike what is said to happen when we assume independence, some factors acting as barriers to the entry of new firms also affect the exit of existing ones. Even assuming that the cost structures are heterogeneous, this may be due to the specificity and durability of some assets that eventually become sunk costs – see Caves and Porter (1976) and Eaton and Lipsey (1980, 1981). These specific investments signal to the potential entrants the barriers they must face if they are to compete in this market. Paradoxically, once the new

¹⁰ For Spain see, for example, Callejón and Segarra (1999). A comparison of international evidence is found in Reynolds, Storey and Westhead (1994), Siegfried and Evans (1994), Geroski (1995) and Caves (1998). On how entries and exits behave when there are supranormal profits, see Austin and Rosenbaum (1990), Dunne and Roberts (1991) and Rosenbaum and Lamort (1992).

company has entered the market, the investment becomes a disincentive to leave it. Following on from this argument, the ratios of exit should, on average, be lower in industries whose technological characteristics require capital investment with a long redemption period (Dunne, Roberts and Samuelson 1988, Dunne and Roberts 1991). However, this is difficult to prove, precisely because it is difficult to know the proportion of sunk costs.

From the statistical point of view, the symmetry hypothesis states that the specification of the equations for entry and exit should be similar. This means modifying (3) and using a new vector of exogenous variables that is common to both equations and that includes both barriers to entry and barriers to exit. Notice also that if the main determinants of entering or leaving the market were analogous we would expect to see a strong sample correlation between the errors in equations (3). This is due to the omission of relevant variables as well as to common unobservable factors, as suggested by Shapiro and Khemani (1987). Formally, we have:

$$\begin{aligned} \text{LNGRE}_{iqt} &= \text{CONS} + \alpha_1 \text{BARENT} + \alpha_2 \text{REGIO} + \alpha_3 \text{CYCLE} + \alpha_4 \text{BAREXI} + (\mu_i + \lambda_t + \eta_q + \varepsilon_{iqt}) \\ \text{LNGRX}_{iqt} &= \text{CONS}' + \alpha'_1 \text{BAREXI} + \alpha'_2 \text{REGIO} + \alpha'_3 \text{CYCLE} + \alpha'_4 \text{BARENT} + (\mu'_i + \lambda'_t + \eta'_q + \varepsilon'_{iqt}). \end{aligned} \quad (4)$$

However, the literature advocates incorporating certain differential features to control for the peculiarities of each phenomenon. This also helps to identify the coefficients of the model. In this study, for example, the differences between the entry and exit equations arise from measurements of market power (entry barriers) and benefits ex-ante (barrier to exit) and ex-post (barrier to entry). Similarly, Shapiro and Khemai's seminal study (1987) includes the structure of the market as a specific determinant of entry and the growth of the industry as a specific determinant of exit. In the equations of Austin and Rosenbaum (1990), the difference lies in the efficient minimum scale and the ratio of investment to sales. In Evans and Siegfried (1992) the difference is between profits and margins. Rosenbaum and Lamort (1992) categorise incentives, barriers and other structural characteristics. Among the determinants of entry Love (1996) includes variables related to the structure of the population (density and

percentage of people employed in administrative posts), and among the determinants of exit he includes the percentage of homes owned in the area. Kleijweg and Lever (1996) distinguish between types of entry and exit and use lags. Finally, Fotopoulos and Spence (1998) apply lags to price-margin and the presence of small firms.

3.2 Simultaneity

Many of these studies have also investigated whether the rates of entry and exit in a given sector or region can be considered to be simultaneously determined in the model. The argument used to support the interdependence of the two decisions goes as follows (Acs and Audretsch 1990, Audretsch 1995). On the one hand, the entry of new firms in a market may cause established firms to leave. This is the so-called displacement effect. On the other hand, the “vacuum” left by those who leave liberalises useful resources and improves the chances of success of those who enter. This is the replacement effect.

From the econometric point of view, the general formulation of the equations is similar to that in (4), except that the endogenous variables now appear as covariates:

$$\begin{aligned}
 LNGRE_{iqt} &= CONS + \alpha_1 BARENT + \alpha_2 REGIO + \alpha_3 CYCLE + \alpha_4 BAREXI + \alpha_5 LNGRX + \\
 &\quad + (\mu_i + \lambda_t + \eta_q + \varepsilon_{iqt}) \\
 LNGRX_{iqt} &= CONS' + \alpha'_1 BAREXI + \alpha'_2 REGIO + \alpha'_3 CYCLE + \alpha'_4 BARENT + \alpha'_5 LNGRE + \\
 &\quad + (\mu'_i + \lambda'_t + \eta'_q + \varepsilon'_{iqt}).
 \end{aligned} \tag{5}$$

However, there is some controversy about whether this approach is consistent. While the first relationship between entry and exit seems to be generally accepted, the second (i.e. that exits affect entries) is more debatable. What is true is that the decision to enter always involves an exit at some time in the future, but the disappearance of a company does not necessarily involve the appearance of another. Empirical evidence confirms these doubts, as only in a few of the above-mentioned studies are the exit variables included in the entry equation statistically significant. We must therefore ask whether a displacement-vacuum effect is actually involved or whether it is simply a

continuous process of trial and error, i.e. natural churning.

The answers are still not conclusive. The results of Fotopoulos and Spence (1998) for the Greek manufacturing industry, for example, raise doubts about the nature and extent of the relationship between entries and exits. These authors conclude that most changes in the identity of active firms take place in the short term and on the fringes of the industries. A similar study of the British manufacturing industry made by Love (1996) concluded that the interaction between entry and exit is mainly a product of a “revolving door” effect. In this study we have found evidence of a displacement-replacement effect between entries and exits in Spain.

4. Results under symmetry and simultaneity

4.1 Symmetry hypothesis

Under the symmetry hypothesis we estimated the coefficients using a system of seemingly unrelated regressions (see the appendix for details on the estimation procedure). This means that we assumed that there was no direct relationship between entry and exit. However, these variables may be dependently distributed at the population level because of the correlation between the error terms of equations (3).

The empirical results from our sample of Spanish entries and exits do not support the assumptions of the symmetry hypothesis. Partial correlations between the OLS residuals were 0.2260 (using $\ln gre\text{-}max$ and $\ln grx\text{-}max$ as dependent variables) and 0.0946 (using $\ln gre\text{-}min$ and $\ln grx\text{-}min$ as dependent variables), while those from the fixed-effects residuals were 0.2162 (ibid.) and 0.0953 (ibid.). Therefore, the relation between the decision to enter and the decision to exit seems to require more advanced hypotheses. In the next sub-section we explore the possibility of a simultaneous framework. However, as the sample correlations are not negligible, we think it is worth commenting briefly on the results of the estimations. As Table 4 shows, estimates based on OLS residuals and those based on fixed-effects residuals are quite similar. We will therefore analyse the statistical significance of the coefficients irrespective of whether they are from OLS or fixed-effects residuals.

[Insert Table 4 about here]

The average stock of capital per establishment is an important barrier to entry and the average number of workers per establishment is an important barrier to exit. Entrances react negatively to ex-post profits and behave pro-cyclically. However, exits are not strongly linked to ex-ante profits. Moreover, they increase during recessions (especially when there is less industrial activity in the region) and are higher in labour- and technologically-intensive sectors.

As far as the geographical factors behind industrial rotation are concerned, a high degree of sectorial specialisation and a high percentage of citizens aged between 30 and 44 negatively affect both the flow of entry and the flow of exit in a region. This later result is exactly the opposite we expected, given the theoretical assumption that most of new firms are being created by those individuals between 30 and 44 years old (but it is also true that empirical findings about this particular are ambiguous: Davidsson et al., 1994). A high ratio of public infrastructure to private capital may also act as a barrier to entry, which could be analysed in terms of lack of entrepreneurial activity. This result is in line with those of Segarra et al. (2002) also for the Spanish regions. On the other hand, human capital, technological intensity and small incumbents increase industrial rotation, especially in terms of entry. In terms of exits, industrial rotation is higher in regions with a wide industrial diversity and a high income per capita.

4.2 Simultaneity hypothesis

Under symmetry, the relationship between entry and exit arises from the existence of common determinants. The empirical evidence in Spain, however, suggests that the source of interdependence may be more sophisticated. Entries may affect exits in the short term via a displacement effect, and exits may affect entries via the liberalisation of business resources (resource release) or the appearance of segments of demand that are not covered (market room). The simultaneity hypothesis therefore considers that entries are a factor that determines exits, and vice versa. In this way it takes the

complexity of the structure of the equations a step further by introducing the endogenous variables as explanatory factors.

From an econometric point of view, the SUR used under symmetry is not unlike the first stage of the two/three stage procedures for estimating simultaneity –although as we show in the appendix, this is less clear-cut in error component models. In fact, the two estimation methods we used, EC2SLS and EC3SLS, differ only in terms of efficiency (incomplete and complete information, respectively). As we can see in Table 5, the results from the two methods are generally very similar, but as the sample correlations between the error terms of the equations of the model appear not to be nil, we will take the EC3SLS estimates as our main guide.

[Insert Table 5 about here]

Our results show that there is a clear relation between the creation and the closure of firms in the Spanish manufacturing industry. The gross rate of exits shows positive and significant values in the entry equation, while the gross rate of entries shows positive and significant values, albeit less so, in the exit equation. That is, industrial sectors and regions with a strong flow of entries record a displacement effect that causes more firms to leave the market, while industrial sectors and regions with a strong flow of exits record a reassignment of business resources that manifests itself in the creation of more new firms.

Barriers to entry are created only by the requirements of initial capital and no sectorial variable seems to affect the exit of firms. The exception to this is technological intensity, which does contribute to business rotation. As expected, profit margins appear to be a good incentive for new entrepreneurs. Moreover, R&D expenditure helps to increase industrial rotation, i.e. technologically-intensive sectors have higher entries and exits than the average Spanish manufacturing sector.

If we look at the regional variables, we can see that a large supply of human capital, a high index of industrial diversity and a large number of micro companies in a region

favour the creation of industrial establishments. This evidence is consistent with previous work of Audretsch and Fritsch (1994) and Armington and Acs (2002) about the role played by skilled workers in the creation of new firms; Costa et al. (2004) about the importance of industrial diversity to stimulate entries and Guesnier (1994) about the function of existing firms as a incubator of new ones. The ratio of public capital to private capital, the age distribution of the population and the specialisation of production, on the other hand, have a negative effect on the creation of firms. The structure of the population, the diversity of the industrial mix and the percentage of micro companies provide conflicting results regarding exits. However, income per inhabitant, if anything, seems to encourage them.

The relationship between entry/exit and ex-ante/ex-post profits is more tenuous than in the other specifications. However, entries (exits) are still positively (negatively) related to the economic cycle. In particular, start-up establishments are closely related to the expectations formed around the macroeconomic evolution of the Spanish manufacturing industry, while the closure of concerns has much more to do with the microeconomic conditions in the region. It is also interesting that cyclical effects follow the same pattern under all of our hypotheses.

4.3 Further discussion

The estimates from the symmetry and simultaneity hypotheses tend to agree in their signs and significance. With obvious differences, all show that sectorial, regional and business cycle variables are important for analysing industrial rotation. In fact, the main difference is in the (lack of) significance the sectorial variables have in the exit equation. This suggests that the comparatively higher number of exits observed under symmetry in labour-intensive sectors was actually caused by a displacement of the incumbents on the part of the entrants. Moreover, the overall significance of the models is not statistically rejected according to the F- and Wald-type tests. Our results therefore appear robust, although they may be affected by a number of specification errors, the most important of which may be linearity, dynamics and data sources. These issues are clearly beyond the scope of this paper, so here we will just provide a brief discussion of them and leave a more thorough analysis for future research.

Very few studies have examined the non-linear relationships between the processes of entry and exit. We can cite the use of a bivariate Poisson model by Mayer and Chappel (1992), who found, as we did, that allowing for a framework of interrelationship between entries and exits may alter the nature of the conclusions obtained under independence (see also Chappel et al 1990). They also agree with our findings regarding the effects of the business cycle and product differentiation (i.e. advertising expenditure). Differences in the nature of the dependent variable (counts versus rates), however, make it difficult to properly compare their results with those in mainstream literature.

Similarly, the absence of dynamic analyses is surprisingly a common feature in this literature. This reinforces the impression that the factors determining the rates of exit are far from clear, both from the theoretical and from the empirical points of view. Some studies have included lags of the dependent variable on the right hand side of the model, but their real aim was to solve problems of identification, endogeneity and/or data availability —see e.g. Shapiro and Khemani (1987), Austin and Rosembaum (1990), Evans and Sigfried (1992) and Fotopoulos and Spence (1998). One exception to this is Manjón (2004), who used autoregressive models to analyse the dynamics of entry and exit in the Spanish manufacturing sectors (see also Carree and Thurik 1996). As expected, he reported statistically significant estimates for the lagged dependent variables. He also found evidence of the existence of a “conical revolving door” phenomenon, as described by Audretsch (1995).

As for the data sources, we can refer to the related studies collected in Segarra (2002) that analysed industrial rotation in the Spanish manufacturing industry during the period 1994 to 1999. Interestingly, their conclusions were not substantially different from ours. First, they found a broad heterogeneity between the gross rates of entry and exit, and second they provided evidence of a displacement-replacement effect. As they used different statistical sources and periods from the ones we have used in this study, we can conclude that our results seems robust to this potential criticism.

Finally, we want to emphasize that there is a third dimension that has to be taken into account besides the time and industry dimensions, which is the spatial one. Every time more the territorial factors are taken into account as for the industrial organization and not only as an independent dimension of time and industry, but perfectly (and necessarily) integrated (Audretsch and Firtsch, 1999).

5. Conclusions

We have analysed the sectorial and regional factors determining the entry and exit of Spanish industrial concerns from three perspectives. The independence hypothesis assumes that entries and exits are independent processes and that the link between them, if any, is very weak. The symmetry hypothesis assumes that there is a link between entries and exits such that the barriers to entry are also barriers to exit. The simultaneity hypothesis assumes that the interdependence between entry and exit is derived from the influence of entries on exits, and vice versa. Our main conclusions from this empirical study are the following.

First, all three groups of variables (sectorial, regional and business cycle) provided significant estimates in all the specifications we analysed. This supports the idea that they are all important for analysing industrial rotation. Second, independence seems to be too simplistic a framework for analysing entry and exit. Third, estimates from the symmetry and simultaneity hypotheses are relatively stable and jointly statistically significant. Results under these two hypotheses therefore seem rather robust. We could improve them by exploring aspects such as the linearity of the specification, the absence of dynamics and the incidence of our data sources but we will leave these aspects for future studies. Fourth, our results show that regional dimension is essential in order to understand industry dynamics. A deeper insight into their significance should rely on the identification of the most relevant variables in order to catch up the regional characteristics that influence entry and exit decisions.

Finally, we aimed to determine which initial hypothesis future studies should take as the reference for analysing the determinants of industrial rotation in Spain. Although our study does not provide a definite answer, the simultaneity hypothesis and the

displacement-vacuum effects appear to be the most plausible tenets guiding business demography in Spain. The statistical significance of the endogenous variables and the relatively low sample correlation of the errors between equations clearly point in this direction. Decisions to enter and leave an industry are thus strongly related. Entrances may create a displacement effect that causes exits to increase, and exits may lead to an increase in the number of potential entrants aiming to fill the vacuum in the markets and exploit the business resources that are freed.

6. Appendix: Estimation methods

The econometric framework is given by a system of M equations ($m = 1, \dots, M$):

$$y_m = X_m \beta_m + u_m \quad (6)$$

and an error component structure:

$$u_m = Z_\mu \mu_m + Z_\lambda \lambda_m + Z_\eta \eta_m + \varepsilon_m \quad (7)$$

in which $Z_\mu = I_N \otimes e_T \otimes e_Q$, $Z_\lambda = e_N \otimes I_T \otimes e_Q$, $Z_\eta = e_T \otimes e_N \otimes I_Q$; e_N , e_T and e_Q are vectors of ones and I_N , I_T and I_Q are identity matrices of dimension N , T and Q , respectively. ε_m is an idiosyncratic shock with classical properties and $\mu' = (\mu_1, \mu_2, \dots, \mu_n)$, $\lambda' = (\lambda_1, \lambda_2, \dots, \lambda_i)$ and $\eta' = (\eta_1, \eta_2, \dots, \eta_q)$. Also, y_m is a vector $(NTQ) \times 1$. X_m is a matrix of explanatory variables whose dimension is $(NTQ) \times (k_m + 1)$ and β_m is the vector $(k_m + 1)$ of model coefficients. In the application in this paper, $M = 2$ (entry and exit), $N = 17$ (regions), $T = 15$ (1980 to 1994) and $Q = 11$ (sectors), so that $NTQ = 2805$.

To decide which is the most suitable method for estimating the parameters of equations (3) and systems (4) and (5), we must take into account the underlying assumptions in the various hypotheses regarding the stochastic behaviour of the variables and the error terms. Under the independence hypothesis we used OLS and Random Effects estimators (see Table 3). Details of the algebra of these estimators are omitted because they are so widely used —see e.g. Baltagi (2001) for details. Under the simultaneity hypothesis we are dealing with a system of simultaneous equations model (SEM), while under the symmetry hypothesis the analytical reference corresponds to the particular case that defines a system of seemingly unrelated regressions (SUR). These are less familiar estimation techniques, so they probably need the following short descriptions.

6.1 Symmetry hypothesis: SUR

From (6) and (7), we assume without loss of generality that the latent variables are random and independent vectors of the form $\mu \sim (0, \Sigma_\mu \otimes I_N)$, $\lambda \sim (0, \Sigma_\lambda \otimes I_T)$, $\eta \sim (0, \Sigma_\eta \otimes I_Q)$ and $\varepsilon \sim (0, \Sigma_\varepsilon \otimes I_{NTQ})$, where $\Sigma_\mu = [\sigma_{\mu_{ml}}^2]$, $\Sigma_\eta = [\sigma_{\eta_{ml}}^2]$, $\Sigma_\lambda = [\sigma_{\lambda_{ml}}^2]$ and $\Sigma_\varepsilon = [\sigma_{\varepsilon_{ml}}^2]$ are matrices of dimension $M \times M$. Also, the matrix of variances and covariances of the system $\Omega = [\Omega_{ml}]$ will be (Wansbeek and Kapteyn 1982):

$$\Omega = \sum_{s=1}^5 \xi_s \otimes V_s \quad (8)$$

in which $\xi_1 = \Sigma_\varepsilon$, $\xi_2 = TQ\Sigma_\mu + \Sigma_\varepsilon$, $\xi_3 = NQ\Sigma_\lambda + \Sigma_\varepsilon$, $\xi_4 = NT\Sigma_\eta + \Sigma_\varepsilon$ and $\xi_5 = TQ\Sigma_\mu + NQ\Sigma_\lambda + NT\Sigma_\eta + \Sigma_\varepsilon$ are the characteristic roots of Ω . Moreover, $V_1 = P$, $V_2 = E_N \otimes \bar{J}_T \otimes \bar{J}_Q$, $V_3 = \bar{J}_N \otimes E_T \otimes \bar{J}_Q$, $V_4 = \bar{J}_N \otimes \bar{J}_T \otimes E_Q$, $V_5 = \bar{J}_N \otimes \bar{J}_T \otimes \bar{J}_Q$ are the corresponding matrices of eigenprojectors, in which $E_N = I_N - \bar{J}_N$, $E_T = I_T - \bar{J}_T$ and $E_Q = I_Q - \bar{J}_Q$. Given that for every scalar r it can be demonstrated that $\Omega^r = \sum_{s=1}^5 \xi_s^r \otimes V_s$, from (8) the vector of parameters in (6)

can be estimated by GLS. Further, to obtain feasible GLS we must first estimate the characteristic roots of Ω . One way is to use ANOVA estimates like $\hat{\xi}_s = u'V_s u / \text{tr}(V_s)$, $s = 1, 2, 3, 4$ and substitute the vector u with the residuals from the OLS (Avery 1977) or fixed-effects (Baltagi 1980) estimates. Both techniques provide asymptotically efficient estimates of the model coefficients. These are reported in Table 4.

6.2 Simultaneity hypothesis: SEM

In this case the model is analogous to that from expressions (6), (7) and (8), except that there are endogenous variables on the right-hand side of the equation. Of the various methods in the literature for estimating SEM with panel data, the properties and simplicity of the one proposed by Baltagi (1981) make it best suited to our application (see Baltagi and Li 1992). The estimation methods are based on two-stage least squares (2SLS) with limited information and three-stage least squares (3SLS) with complete information. The identification condition is simply that the number of exogenous variables not included in the corresponding equation is greater than or equal to the number of endogenous variables.

Let the model given by (6) be rewritten in this case in compact form. A transformation matrix A is applied such that $y^* = Ay$, $Z^* = AZ$ and $u^* = Au$. If the matrix of instruments used is W , the vector of coefficients will be given by $\beta_w = (Z^{*'}P_w Z^*)^{-1} Z^{*'} P_w Y^*$, where $P_w = W(W'W)^{-1}W'$ is the projection matrix of the instruments. In particular, if we define the transformation matrix in terms of the elements of the main diagonal of the matrix of variances and covariances of each equation ($A = \Omega_{mm}^{-1/2}$), and apply 2SLS to the transformed model, we obtain the error component two-stage least squares (EC2SLS) estimator (Cornwell *et al.* 1992). Similarly, if we use the complete matrix ($A = \Omega^{-1/2}$) and 3SLS we obtain the error component three-stage least squares (EC3SLS) estimator. Both GLS estimates are consistent and in their feasible version they are based on the residuals from an initial 2SLS estimation. These estimates are reported in Table 5.¹¹

7. References

- Acs, Z.J. and Audretsch, D. (1990): *Innovation and Small Firms*, The MIT Press.
- Arauzo, J.M. (2005): "Determinants of Industrial Location. An Application for Catalan Municipalities", *Papers in Regional Science*, 84 (1): 105-120.
- Arauzo, J.M. and Teruel, M. (2005): "An Urban Approach to Firm Entry: The Effect of Urban Size", *Growth and Change*, 36 (4): 508-528.
- Armington, C. and Acs, Z.A. (2002): "The determinants of regional variation in new firm formation", *Regional Studies*, 36 (1): 33-45.
- Ashcroft, B. and Love, J.H. (1996): "Firm births and employment change in the British

¹¹ Since the EC3SLS estimator is based on complete information, it is generally more efficient than EC2SLS. However, Baltagi (1984: 616) showed in Monte Carlo experiments with a similar model to ours that "going from EC2SLS to EC3SLS may not be worth the effort".

- counties: 1981-1989", *Papers in Regional Science*, 25: 483-500.
- Ashcroft, B., Love, J.H. and Malloy, E. (1991): "New firm formation in the British counties with special reference to Scotland", *Regional Studies*, 25 (5): 395-409.
- Audretsch, D. (1995): *Innovation and Industry Evolution*, The MIT Press.
- Audretsch, D. (1993): "New-firm formation activity in US manufacturing" in Karlsson, C., Johannisson, B. and Storey, D., *Small Business Dynamics. International, national and regional perspectives*, Routledge, London - New York: 40-56.
- Audretsch, D. and Fritsch, M. (1999): "The Industry Component of Regional New Firm Formation Process", *Review of Industrial Organization*, 15: 239-252.
- Audretsch, D. and Fritsch, M. (1994): "The geography of firm births in Germany", *Regional Studies*, 28 (4): 359-365.
- Austin, J.S. and Rosenbaum, D.I. (1990): "The Determinants of Entry and Exit Rates into US Manufacturing Industries", *Review of Industrial Organization*, 5: 211-223.
- Avery, R.B. (1977): "Error Components and Seemingly Unrelated Regressions", *Econometrica*, 45: 199-209.
- Bain, J. S. (1949): "A Note on Pricing in Monopoly and Oligopoly", *American Economic Review*, 39: 448-464.
- Bain (1956): *Barriers to New Competition*, Harvard University Press.
- Baldwin, J.R. (1995) *The Dynamics of Industrial Competition*, Cambridge University Press.
- Baltagi, B.H. (1980): "On Seemingly Unrelated Regressions with Error Components", *Econometrica*, 48: 1547-1552.
- Baltagi, B.H. (1981): "Simultaneous Equations with Error Components", *Journal of Econometrics*, 17: 189-200.
- Baltagi, B.H. (1984): "A Monte Carlo Study for Pooling Time-Series of Cross-Section Data in the Simultaneous Equations Model", *International Economic Review*, 25: 603-625.
- Baltagi, B.H. (2001): *Econometric Analysis of Panel Data*, John Wiley & Sons.
- Baltagi, B.H. and Li, Q. (1992): "A Note on the Estimation of Simultaneous Equations with Error Components", *Econometric Theory*, 8: 113-119.
- Baptista, R., Escária, V. and Madruga, P. (2005): "Entrepreneurship, Regional Development and Job Creation: the case of Portugal", Discussion Papers on Entrepreneurship, Growth and Public Policy #0605-2005, Max Planck Institute for Research into Economic Systems, Jena.
- Barkham, R. (1992): "Regional variations in entrepreneurship: some evidence from the United Kingdom", *Entrepreneurship & Regional Development*, 4: 225-244.
- Blade, F.J. and Nerlinger, E.A. (2000): "The spatial distribution of new technology-based firms: Empirical results for West-Germany", *Papers in Regional Science*, 79: 155-176.
- Callejón, M. and Segarra, A. (1999): "Business Dynamics and Efficiency in Industries and Regions. The case of Spain", *Small Business Economics*, 13: 253-271.
- Campbell, C.M. (1996): "The Effect of State and Industry Economic Conditions on New Firm Entry", *Journal of Economics and Business*, 48: 167-183.
- Carlino, G.A. and Mills, E.S. (1987): "The determinants of county growth", *Journal of Regional Science* 27(1): 39-54.
- Carlino, G.A. and Voith, R. (1992): "Accounting for differences in aggregate state productivity", *Regional Science and Urban Economics* 22: 597-617.
- Carree, M.A. and A.R. Thurik (1996): "Entry and Exit in Retailing: Incentives, Barriers, Displacement and Replacement", *Review of Industrial Organization*, 11: 155-172.
- Caves, R.E. (1998): "Industrial Organization and New Findings on the Turnover and Mobility of Firms", *Journal of Economic Literature*, 36 (4): 1947-1982.
- Caves, R.E. and Porter, M. (1976): "Barriers to Entry", in R.T. Masson and P.D. Qualls (eds.), *Essays on Industrial Organization in Honour of Joe Bain*, Ballinger: 39-69.
- Chappel, W.F., M. Kimenyi and W.J. Mayer (1990): "A Poisson Probability Model of Entry and Market Structure with an Application to U.S. Industries during 1972-1977",

- Southern Economic Journal*, 56: 918-927.
- Cornwell, C. *et al.* (1992): "Simultaneous Equations and Panel Data", *Journal of Econometrics*, 51: 151-181.
- Davidsson, P., Lindmark, L. and Olofsson, Ch. (1994): "New firm formation and regional development in Sweden", *Regional Studies*, 28 (4): 395-410.
- Delmar, F. and Davidsson, P. (2000): "Where do they come from? Prevalence and characteristics of nascent entrepreneurs", *Entrepreneurship & Regional Development*, 12: 1-23.
- Doi, N. (1999): "The Determinants of Firm Exit in Japanese Manufacturing Industries", *Small Business Economics*, 13: 331-337.
- Dunne, T. and Roberts, M.J. (1991): "Variation in Producer Turnover across US Manufacturing Industries in Entry and Market Contestability", en P.A. Geroski and J. Schwalbach (eds.), *Entry and Market Contestability*, Blackwell: 187-203.
- Dunne, T.; Roberts, M.J. and Samuelson, L. (1988): "Patterns of Firm Entry and Exit in US Manufacturing Industries", *Rand Journal of Economics*, 19: 495-515.
- Eaton, B.C. and Lipsey, R.G. (1980): "Exit Barriers and Entry Barriers: The Durability of Capital as a Barrier to Entry", *Bell Journal of Economics*, 11: 721-729.
- Eaton, B.C. and Lipsey, R.G. (1981): "Capital, Commitment and Entry Equilibrium", *Bell Journal of Economics*, 12: 593-604.
- Evans, L.B. and Siegfried, J.J. (1992): "Entry and Exit in United States Manufacturing Industries from 1977 to 1982", en D.B. Audretsch and J.J. Siegfried (eds.), *Empirical Studies in Honour of Leonard W. Weiss*, Kluwer: 253-273.
- Evans, D.S. and Leighton, L.S. (1990): "Small business formation by unemployed and employed workers", *Small Business Economics*, 2: 319-330.
- Fotopoulos, G. and Spence, N. (2001): "Regional Variations of Firm Births, Deaths and Growth Patterns in the UK, 1980-1991", *Growth and Change*, 32: 151-173.
- Fotopoulos, G. and Spence, N. (1998): "Entry and Exit from Manufacturing Industries: Symmetry, Turbulence and Simultaneity - Some Empirical Evidence from Greek Manufacturing Industries, 1982-1988", *Applied Economics*, 30: 245-262.
- Fritsch, M. (1997): "New firms and regional employment change", *Small Business Economics*, 9: 437-448.
- Fritsch, M. (1996): "Turbulence and growth in West Germany: a comparison of evidence by regions and industries", *Review of Industrial Organisation*, 11: 231-251.
- Fritsch, M. and Mueller, P. (2004): "Effects of New Business Formation on Regional Development over Time", *Regional Studies*, 38 (8), 961-975.
- Fry, J.M. *et al.* (2000): "Compositional Data Analysis and Zeros in Microdata", *Applied Economics*, 32: 953-959.
- Fujita, M., Krugman, P. and Venables, A. (1999): *The Spatial Economy. Cities, regions and International Trade*, MIT press, Cambridge, Massachusetts.
- García-Milà, T. and McGuire, T.J. (1992): "The contribution of publicly provided inputs to states' economies", *Regional Science and Urban Economics* 22: 229-241.
- Garofoli, G. (1994): "New firm formation and regional development: the Italian case", *Regional Studies*, 28 (4): 381-393.
- Gaygisiz, E. and Köksal, M.Y. (2003): "Regional Variation en New Firm Formation in Turkey: Cross-Section and Panel Data Evidence", *Economic Research Center Working Papers in Economics* 03-08.
- Glaeser, E.L., H. Kallal, J.A. Scheinkman, and A. Shleifer (1992): "Growth in cities", *Journal of Political Economy*, 100: 1126-1152.
- Geroski, P.A. (1991): "Domestic and Foreign Entry in the United Kingdom: 1983-1984", in Geroski, P.A. and J. Schwalbach (eds.) *Entry and Market Contestability: an International Comparison*, Basil Blackwell.
- Geroski, P.A. (1995): "What Do We Know about Entry?", *International Journal of Industrial*

- Organization*, 13: 421-440.
- Guesnier, B. (1994): "Regional variations in new firm formation in France", *Regional Studies*, 28: 347-358.
- Hamilton, R. T. (1999): "Unemployment and business formation rates: reconciling time series and cross-section evidence", *Environment and Planning*, 21: 249-255.
- Henderson, V., A. Kuncoro, and M. Turner (1995): "Industrial development in cities", *Journal of Political Economy*, 103(5): 1067-1090.
- Hinz, T. and Jungbauer-Gans, M. (1999): "Starting a business after unemployment: characteristics and chances of success (empirical evidence from a regional German labour market)", *Entrepreneurship & Regional Development*, 11: 317-333.
- Ilmakunnas, P. and Topi, J. (1999): "Microeconomic and Macroeconomic Influences on Entry and Exit of Firms", *Review of Industrial Organization*, 15: 283-301.
- Johnson, P. (1983): "New manufacturing firms in the UK regions", *Scottish Journal of Political Economy*, 30: 75-79.
- Johnson, P. and Parker, S. (1994): "The interrelationships between birth and deaths", *Small Business Economics*, 6: 283-290.
- Kangasharju, A. (2000): "Regional variations in firm formation: panel and cross-section data evidence from Finland", *Papers in Regional Science*, 79: 355-373.
- Keeble, D. and Walker, S. (1994): "New Firms, Small Firms and Dead Firms: Spatial Patterns and Determinants in the United Kingdom", *Regional Studies*, 28: 411-427.
- Kleijweg, A.J.M. and Lever, M.H.C. (1996): "Entry and Exit in Dutch Manufacturing Industries", *Review of Industrial Organization*, 11: 375-382.
- Love, J.H. (1996): "Entry and Exit: A County Level Analysis", *Applied Economics*, 28: 441-451.
- Manjón, M. (2004): "Firm Size and Short-Term Dynamics in Aggregate Entry and Exit", CentER Discussion Paper.
- Marcus, M. (1967): "Firms' Exit Rates and Their Determinants", *Journal of Industrial Economics*, 16: 10-22.
- Marshall, A. (1890): *Principles of economics*. Macmillan. New York.
- Mata, J. and Audretsch (eds.) (1995): "The Post-Entry Performance of Firms", *International Journal of Industrial Organization*, 13 (Special Issue).
- Mayer, W.J. and Chappel, W.F., (1992): "Determinants of Entry and Exit: An Application of the Compounded Bivariate Poisson Distribution to U.S Industries, 1972-1977", *Southern Economic Journal*, 58: 770-778.
- Meager, N. (1992): "Does unemployment lead to self-employment?", *Small Business Economics*, 4: 87-104.
- Orr, D. (1974): "The Determinants of Entry: A Study of the Canadian Manufacturing Industries", *Review of Economics and Statistics*, 56 (1): 58-66.
- Reynolds, P., Miller, B. and W.R. Maki (1995): "Explaining regional variation in business births and deaths: U.S. 1976-1988", *Small Business Economics*, 7: 389-407.
- Reynolds, P., D.J. Storey and P. Westhead (1994), "Cross-national Comparisons of the Variation in New Firm Formation Rates", *Regional Studies* 28 (4): 443-456.
- Rigby, D. and Essletzbichler, J. (2000): "Impacts of industrial mix, technological change, selection and plant entry / exit on regional productivity growth", *Regional Studies*, 34 (4): 333-342.
- Ritsilä, J. and Tervo, H. (2002): "Effects of unemployment on new firm formation: micro-level panel data evidence from Finland", *Small Business Economics*, 19 (1): 31-40.
- Rosenbaum, D.I. and Lamort, F. (1992): "Entry Barriers, Exit and Sunk Costs: An Analysis", *Applied Economics*, 24: 297-304.
- Segarra, A., Arauzo, J.M., Manjón, M. and Martín, M. (2002): "Demografía industrial y convergencia regional en España", *Papeles de Economía Española*, 93: 65-78.
- Segarra, A. (ed.) (2002): *La creación y la supervivencia de las empresas industriales*, Civitas.
- Shapiro, D. & Khemani, R.S. (1987): "The Determinants of Entry and Exit Reconsidered",

- International Journal of Industrial Organization*, 5: 15-26.
- Siegfried, J.J. and L.B. Evans (1994): "Empirical Studies of Entry and Exit: A Survey of the Evidence", *Review of Industrial Organization*, 9: 121-155.
- Spilling, O.R. (1996): "Regional variation of new firm formation: the Norwegian case", *Entrepreneurship and Regional Development*, 8: 217-243.
- Storey, D. J. (1991): "The birth of new firms. Does unemployment matter? A Review of Evidence", *Small Business Economics*, 3: 167-178.
- Storey, D. J. (1982): *Entrepreneurship and the new firm*, Croom Helm, London.
- Sutaria, V. and Hicks, D.A. (2004): "New firm formation: Dynamics and determinants", *The Annals of Regional Science*, 38: 241-262.
- Tervo, H. and Niittykangas, H. (1994): "The impact of unemployment on new firm formation in Finland", *International Small Business Journal*, 13: 38-53.
- Wansbeek, T. and Kapteyn, A. (1982): "A Class of Decompositions of the Variance-Covariance Matrix of a Generalized Error Components Model", *Econometrica*, 50: 713-724.

Table 1		
Sectorial and Regional Rates of Entry and Exit (Average 1980-1994)		
Sectors (NACE R-25)	Gross Rate of Entry	Gross Rate of Exit
Ores and metals	0,82	5,60
Mineral Products	4,57	6,77
Chemical Products	7,32	8,45
Metal Products	6,74	7,49
Ag./Ind. Machinery	8,46	9,99
Office Machinery	2,56	3,08
Electrical Goods	12,95	14,19
Transport Equipment	15,05	15,81
Food/Bev./Tob.	3,23	5,43
Textiles	8,35	11,85
Paper/Printing	7,50	6,72
Rubber/Plastic	10,66	10,27
Other Manufacturing	7,61	9,77
<i>Total Manufacturing</i>	6,17	7,90
Regions (NUTS-2)		
Andalusia	6,81	7,90
Aragon	6,66	7,69
Asturias	5,66	7,07
Balearic Islands	5,39	8,03
Canary Islands	6,70	7,51
Cantabria	5,59	7,65
Castile-Leon	4,42	6,61
Castile-la Mancha	4,64	6,29
Catalonia	6,13	7,55
Valencia	7,32	7,52
Extremadura	3,54	6,76
Galicia	4,72	6,68
Madrid	9,46	10,43
Murcia	7,33	8,64
Navarre	4,53	5,40
Basque Country	5,70	7,10
La Rioja	4,73	6,78
<i>Spain</i>	6,17	7,90

Note: Gross rates of entry (exit) were calculated as the ratio between $Entries_t$ ($Exits_t$) and $Estab_{t-1}$ for each region and sector in period t , where $Entries_t$ is the number of establishments created in year t (source: REI), $Estab_t$ is the number of existing establishments in year t (source: EI) and $Exits_t = Estab_{t+1} + Entries_t - Estab_t$ (negative values were replaced by zero).

Table 2. Definition of variables		
Variables	Definition	Source (*)
Dependent		
Gross Rate of Entry (GRE)	Entries _t / Number of Existing Establishments _{t-1}	REI and EI
Gross Rate of Exit (GRX)	Exits _t / Number of Existing Establishments _{t-1}	REI and EI
Sectorial		
Profit margins (MARGIN)	(Turnover - Staff costs - Intermediate inputs)/Turnover	EI
Technological intensity (R&DS)	R&D expenditure/Turnover	EIT and EI
Product differentiation (DIF)	Advertising expenditure/Turnover	TIO and EI
Capital requirements (K)	Capital stock _t / Number of Existing Establishments _t	IVIE and EI
Average size (SIZE)	Workers _t /Number of Existing Establishments _t	EI
Micro firms (MICROS)	Number of Existing Establishments with less than 10 workers/Total Number of Existing Establishments _t	EI
Market structure (MARKET)	Concentration index, CR4	EI
Benefits ex-ante (BEXA)	Yearly variation of the Gross Operational Surplus _{t-1}	EI
Benefits ex-post (BEXP)	Yearly variation of the Gross Operational Surplus _{t+1}	EI
Regional		
Industrial diversity (DIV)	Inverse of the Herfindhal index	CRE
Relative specialisation (SPE)	Specialisation index (*)	CRE
Human capital (HUMAN)	% of population holding a degree + % of population with secondary education	CRE
Public Capital (PUBLIC)	Public capital stock (estimated value) /Private capital stock (estimated value)	IVIE
Market accessibility (ACCESS)	Road and port infrastructures (estimated value)/ Public capital stock (estimated value)	IVIE
Population structure (POPULATION)	% of population aged between 30 and 44	CRE
Income per capita (INCOME)	Regional income per inhabitant	CRE
Micro-firms (MICROR)	Entries _t with less than 10 workers/Total Entries _t	REI and EI
Unemployment (U)	Regional rate of unemployment	CRE
Technological intensity (R&DR)	R&D expenditure/Turnover	EIT and CRE
Business Cycle		
Manufacturing growth (MG)	Yearly variation of the Gross Added Value in manufacturing	EI
Industrial growth (IG)	Yearly variation of the Gross Added Value in the sector	EI
Regional manufacturing growth (RMG)	Yearly variation of the Gross Added Value in the manufacturing industry of the region	CRE
Region-sector growth (RSG)	Yearly variation of the Gross Added Value in the pairing region-sector	CRE

Notes (*): *SPE* is calculated as the added value of a sector in a region over the added value of manufacturing in the region divided by the added value of the sector in Spain over the added value of manufacturing in Spain. *EIT* denotes the “Technological Innovation Survey” (Source: National Institute of Statistics, INE); *CRE* denotes “Regional Accounts” (Source: INE); *TIO* denote Input-Output Tables (Source: INE); *IVIE* is the “*Instituto Valenciano de Investigaciones Económicas*” (Valencian Institute of Economic Research).

Table 3 Independence								
	Entry				Exit			
	Ingre (min)		Ingre (max)		Ingrx (min)		Ingrx (max)	
	LS	RE	LS	RE	LS	RE	LS	RE
BARENT, BAREXI								
MARGIN	0,0049 (0,0074)	0,0012 (0,0104)	0,0079 (0,0053)	0,0216 (0,0075) *				
R&DS	0,2571 (0,0311)*	0,0923 (0,0646)	0,2806 (0,0224)*	0, 0711 (0,0476)	0,2817 (0,0813)*	0,2048 (0,1326)	0,1163 (0,0237)*	-0,0270 (0,0475)
DIF	-0,1849 (0,0470)*	-0,1362 (0,1596)	-0,0659 (0,0339)**	0, 0084 (0,1403)	-0,1096 (0,1111)*	-0,0522 (0,2062)	-0,0090 (0,0324)	-0, 0644 (0,0879)
K	-0,0013 (0,0002)*	-0,0015 (0,0006)*	-0,0008 (0,0002)*	-0,0012 (0,0004)*	-0,0007 (0,0007)*	-0,0007 (0,0011)	-0,0011 (0,0002)	-0,0004 (0,0004)
SIZE	0,0095 (0,0021)*	0,0132 (0,0030)*	0,0071 (0,0015)*	0,0071 (0,0022)*	0,0061 (0,0045)*	0,0110 (0,0067)**	0,0112 (0,0013)	0,0082 (0,0022)*
MICROS	-0,0009 (0,0007)	-0,0006 (0,0016)	-0,0003 (0,0005)	-0,0010 (0,0012)				
MARKET	0,0048 (0,0039)	0, 0037 (0,0128)	0,0098 (0,0028)*	0, 0252 (0,0107)*				
BEXA					-0,0002 (0,0028)*	0,0002 (0,0028)	0,0021 (0,0008)	-0,0018 (0,0008)*
BEXP	-0,0018 (0,0009)*	-0,0013 (0,0008)	-0,0019 (0,0006)*	-0,0017 (0,0005)*				
REGIO								
DIV	-0,0162 (0,0130)	-0,0439 (0,0148)*	-0,0396 (0,0093)*	-0,0458 (0,1024)*	0,1147 (0,0360)*	0,1101 (0,0375)*	-0,0528 (0,0105)*	-0,0446 (0,0112)*
SPE	-0,0004 (0,0001)*	-0,0001 (0,0001)	-0,0006 (0,0001)*	-0,0004 (0,0001)*	-0,0007 (0,0004)*	-0,0004 (0,0004)	-0,0004 (0,0001)**	-0,0002 (0,0001)*
HUMAN	0,0109 (0,0043)*	0,0208 (0,0053)*	0,0071 (0,0031)*	0,0161 (0,0036)*	0,0095 (0,0118)	0,0156 (0,0125)	-0,0023 (0,003)	-0,0042 (0,0038)
PUBLIC	-0,0426 (0,0071)*	-0,0410 (0,0089)*	-0,0193 (0,0051)*	-0,0178 (0,0061)*	-0,0187 (0,0198)	-0,0198 (0,0209)	-0,0013 (0,0034)	0,0034 (0,0064)
ACCESS	2,50*10 ⁻⁰⁷ (1,47*10 ⁻⁰⁷)**	-1,27*10 ⁻⁰⁷ (1,87*10 ⁻⁰⁷)	-7,31*10 ⁻⁰⁸ (1,06*10 ⁻⁰⁷)	-2,96*10 ⁻⁰⁷ (1,28*10 ⁻⁰⁷)*	-1,98*10 ⁻⁰⁸ (4,05*10 ⁻⁰⁷)*	-4,57*10 ⁻⁰⁸ (4,32*10 ⁻⁰⁷)	-4,59*10 ⁻⁰⁷ (1,18*10 ⁻⁰⁷)	-4,28*10 ⁻⁰⁸ (1,33*10 ⁻⁰⁷)*
POPULATION	-0,1887 (0,0298)*	-0,2059 (0,0381)*	-0,1001 (0,0215)*	-0,1146 (0,0259)*	-0,3579 (0,0822)	-0,3382 (0,0871)*	0,0254 (0,0240)*	0,0386 (0,0269)
INCOME	0,0001 (0,0002)	-0,0001 (0,0003)	0,0002 (0,0002)	0,0001 (0,0002)	0,0021 (0,0007)	0,0017 (0,0007)*	-5,37*10 ⁻⁰⁶ (0,0002)*	-7,13*10 ⁻⁰⁶ (0,0008)
MICROR	0,0148 (0,0007)*	0,0155 (0,0006)*	0,0002 (0,0005)	3,45*10 ⁻⁰⁶ (0,0004)	0,0034 (0,0019)**	0,0051 (0,0020)*	0,0009 (0,0006)**	0,0012 (0,0005)*
U	0,0049 (0,0049)	-0,0071 (0,0055)	0,0018 (0,0035)	-0,0036 (0,0038)	0,0644 (0,0134)	0,0060 (0,0139)*	0,0028 (0,0039)*	0,0020 (0,0041)
R&DR	0,1729 (0,0417)*	0,1841 (0,0478)*	0,1390 (0,0301)*	0,1170 (0,0331)*	0,1163 (0,1150)*	0,0990 (0,0159)	0,0996 (0,0336)	0,0905 (0,0360)*
CYCLE								
MG	0,0178 (0,0057)*	0, 0019 (0,0055)*	0,0187 (0,0041)*	0,0203 (0,0038)*	0,0203 (0,0159)	0,0200 (0,0159)	0,0042 (0,0046)	0, 0061 (0,0046)
IG	0,0055 (0,0023)*	0,0024 (0,0022)	0,0052 (0,0016)*	0,0012 (0,0015)	0,0073 (0,0069)**	0,0064 (0,0069)	0,0036 (0,0020)	0,0025 (0,0020)
RMG	0,0053 (0,0027)*	0,0046 (0,0026)**	0,0028 (0,0019)	0,0019 (0,0018)	-0,0238 (0,0076)	-0,0247 (0,0077)*	-0,0029 (0,0022)*	-0,0030 (0,0021)
RSG	0,0011 (0,0004)*	0,0010 (0,0003)*	0,0009 (0,0003)*	0,0008 (0,0002)*	-0,0022 (0,0010)	-0,0022 (0,0010)*	0,0005 (0,0003)*	0,0004 (0,0002)
F-test	44,49*	34,04*	41,02*	16,74*	8,84*	7,89*	21,18*	8,05*
Hausman		45,27*		84,67*		72,75*		6,31

Note: Definitions of Ingre (min, max) and Ingrx (min, max) can be found in footnote 5 of the text. All the explanatory variables are defined in Table 2. LS (RE) denotes Least Squares (Random Effects) estimates. * and ** mean that coefficients are statistically significant at 5% and 10%, respectively. Standard errors are given in brackets. F-test is the F-type statistic for testing the joint hypothesis that all coefficients are zero. Hausman is the χ^2 -type statistic for testing the null hypothesis that covariates and latent effects are not correlated.

Table 4
Symmetry

	Entry				Exit			
	Ingre (min)		Ingre (max)		Ingrx (min)		Ingrx (max)	
	LS	FE	LS	FE	LS	FE	LS	FE
BARENT, BAREXI								
MARGIN	0,0047 (0,0108)	0,0037 (0,0111)	0,0136 (0,0077)**	0,0112 (0,0079)				
R&DS	0,0960 (0,0655)	0,0663 (0,0699)	0,0809 (0,0483)**	0,0598 (0,0508)	0,2245 (0,1325)**	0,2907 (0,1459)*	-0,0239 (0,0477)	-0,0957 (0,0565)**
DIF	-0,1809 (0,1601)	-0,2010 (0,2279)	-0,0063 (0,1404)	0,0010 (0,2294)	-0,0225 (0,2057)	0,0871 (0,2420)	-0,0582 (0,0879)	-0,0925 (0,1533)
K	-0,0013 (0,0006)*	-0,0011 (0,0007)	-0,0012 (0,0005)*	-0,0013 (0,0005)*	-0,0011 (0,0011)	-0,0020 (0,0012)	-0,0005 (0,0004)	-0,0001 (0,0005)
SIZE	0,0126 (0,0031)*	0,0123 (0,0032)*	0,0074 (0,0022)*	0,0072 (0,0023)*	0,0121 (0,0067)**	0,0162 (0,0072)*	0,0084 (0,0023)*	0,0061 (0,0026)*
MICROS	-0,0001 (0,0018)	0,0004 (0,0019)	-0,0012 (0,0013)	-0,0013 (0,0014)				
MARKET	-0,0025 (0,0130)	-0,0045 (0,0171)	0,0223 (0,0108)*	0,0248 (0,0162)				
BEXA					0,0027 (0,0030)	0,0153 (0,0038)*	-0,0008 (0,0009)	0,0006 (0,0011)
BEXP	-0,0005 (0,0011)	-0,0003 (0,0011)	-0,0023 (0,0007)*	-0,0024 (0,0008)*				
REGIO								
DIV	0,0025 (0,0170)	0,0104 (0,0253)	-0,0187 (0,0115)	0,0251 (0,0171)	0,1315 (0,0464)*	0,1064 (0,0546)**	-0,0515 (0,0106)*	-0,0187 (0,0187)
SPE	-0,0002 (0,0001)	-0,0001 (0,0001)	-0,0005 (0,0001)*	-0,0005 (0,0001)*	-0,0005 (0,0004)	-0,0005 (0,0004)	-0,0003 (0,0001)*	-0,0003 (0,0001)*
HUMAN	0,0099 (0,0061)*	0,0151 (0,0089)**	0,0056 (0,0040)	0,0090 (0,0063)	0,0083 (0,0152)	0,0034 (0,0205)	-0,0016 (0,0036)	-0,0054 (0,0064)
PUBLIC	-0,0372 (0,0093)*	-0,0372 (0,0137)*	-0,0096 (0,0063)	0,0092 (0,0093)	-0,0064 (0,0255)	0,0156 (0,0299)	-0,0009 (0,0058)	0,0021 (0,0102)
ACCESS	1,88*10 ⁻⁰⁷ (1,86*10 ⁻⁰⁷)	8,68*10 ⁻⁰⁸ (2,66*10 ⁻⁰⁷)	-1,33*10 ⁻⁰⁷ (1,26*10 ⁻⁰⁷)	-4,22*10 ⁻⁰⁷ (1,81*10 ⁻⁰⁷)*	-3,26*10 ⁻⁰⁷ (5,16*10 ⁻⁰⁷)	-6,21*10 ⁻⁰⁸ (5,88*10 ⁻⁰⁷)	-4,58*10 ⁻⁰⁷ (1,19*10 ⁻⁰⁷)*	-3,64*10 ⁻⁰⁷ (1,99*10 ⁻⁰⁷)**
POPULATION	-0,1954 (0,0409)*	-0,2321 (0,0825)*	-0,1018 (0,0273)*	-0,1117 (0,0526)*	-0,3698 (0,1115)*	-0,3260 (0,1385)*	0,0223 (0,0241)	0,0199 (0,0508)
INCOME	0,0002 (0,0003)	0,0001 (0,0006)	0,0004 (0,0002)*	0,0001 (0,0004)	0,0024 (0,0009)*	0,0023 (0,0012)*	1,86*10 ⁻⁵ (0,0002)	0,0002 (0,0004)
MICROR	0,0157 (0,0007)*	0,0156 (0,0007)*	0,0002 (0,0005)	0,0000 (0,0005)	0,0046 (0,0020)*	0,0036 (0,0020)**	0,0014 (0,0006)*	0,0011 (0,0006)**
U	0,0091 (0,0067)	-0,0017 (0,0092)	0,0032 (0,0045)	-0,0083 (0,0064)	0,0671 (0,0166)*	0,0247 (0,0214)	0,0031 (0,0042)	0,0072 (0,0069)
R&DR	0,1779 (0,0569)*	0,1884 (0,1003)**	0,1419 (0,0381)*	0,0850 (0,0662)	0,1372 (0,1564)	0,2674 (0,1885)	0,0985 (0,0337)*	0,0015 (0,0687)
CYCLE								
MG	0,0225 (0,0112)*	0,0210 (0,0146)	0,0238 (0,0069)*	0,0209 (0,0131)	0,0186 (0,0177)	0,0298 (0,0496)	0,0039 (0,0058)	0,0019 (0,0101)
IG	0,0035 (0,0023)	0,0036 (0,0023)	0,0021 (0,0016)	0,0023 (0,0016)	0,0037 (0,0071)	-0,0101 (0,0075)	0,0016 (0,0021)	0,0003 (0,0022)
RMG	0,0021 (0,0027)	0,0018 (0,0027)	0,0015 (0,0019)	0,0016 (0,0019)	-0,0229 (0,0076)*	-0,0147 (0,0077)**	-0,0022 (0,0022)	-0,0006 (0,0023)
RSG	0,0011 (0,0004)*	0,0011 (0,0003)*	0,0009 (0,0002)*	0,0009 (0,0002)*	-0,0022 (0,0010)*	-0,0023 (0,0010)*	0,0004 (0,0003)	0,0004 (0,0003)
F-test	29,95*	26,82*	7,86*	4,95*	6,11*	3,39*	9,01*	2,76*

Note: Definitions of Ingre (min, max) and Ingrx (min, max) can be found in footnote 5 of the text. All the explanatory variables are defined in Table 2. LS (FE) denotes SUR estimates based on Least Squares (Fixed Effects) residuals. * and ** mean that coefficients are statistically significant at 5% and 10%, respectively. Standard errors are given in brackets. F-test is the F-type statistic for testing the joint hypothesis that all coefficients are zero.

Table 5

Simultaneity

	Entry				Exit			
	Ingre (min)		Ingre (max)		Ingrx (min)		Ingrx (max)	
	EC2SLS	EC3SLS	EC2SLS	EC3SLS	EC2SLS	EC3SLS	EC2SLS	EC3SLS
BARENT, BAREXI								
MARGIN	-2,42*10 ⁻⁵ (0,0112)	0,0004 (0,0107)	0,0212 (0,0079)*	0,0128 (0,0066)**				
R&DS	0,0647 (0,0673)	0,0404 (0,0664)	0,1125 (0,0488)*	0,1003 (0,0477)*	0,2555 (0,1353)**	0,2276 (0,1338)**	-0,0541 (0,0478)	-0,0714 (0,0467)
DIF	-0,1382 (0,1622)	-0,1338 (0,1608)	0,0849 (0,1427)	0,0870 (0,1402)	0,0559 (0,2050)	0,0686 (0,2039)	-0,0557 (0,0866)	-0,0485 (0,0861)
K	-0,0014 (0,0006)*	-0,0012 (0,0006)*	-0,0012 (0,0005)*	-0,0009 (0,0005)**	-0,0013 (0,0012)	-0,0006 (0,0012)	-0,0001 (0,0004)	0,0002 (0,0004)
SIZE	0,0101 (0,0034)*	0,0091 (0,0033)*	0,0052 (0,0023)*	0,0024 (0,0022)	0,0098 (0,0076)	0,0040 (0,0075)	0,0056 (0,0024)*	0,0031 (0,0023)
MICROS	0,0001 (0,0018)	0,0001 (0,0017)	-0,0014 (0,0013)	-0,0009 (0,0011)				
MARKET	0,0083 (0,0140)	0,0047 (0,0134)	0,0170 (0,0110)	0,0075 (0,0092)				
BEXA					0,0125 (0,0040)*	0,0116 (0,0038)*	-0,0013 (0,0010)	-0,0007 (0,0009)
BEXP	-0,0001 (0,0011)	9,9*10 ⁻⁵ (0,0010)	-0,0020 (0,0007)*	-0,0013 (0,0006)*				
REGIO								
DIV	-0,0167 (0,0226)	-0,0232 (0,0223)	0,0286 (0,0159)**	0,0513 (0,0149)*	0,0677 (0,0394)**	0,0583 (0,0390)	-0,0465 (0,0108)*	-0,0431 (0,0105)*
SPE	-0,0001 (0,0001)	-0,0001 (0,0001)	-0,0003 (0,0001)*	-0,0002 (0,0001)*	-0,0005 (0,0004)	-0,0004 (0,0004)	-0,0002 (0,0001)	2,15*10 ⁻⁵ (0,0001)
HUMAN	0,0137 (0,0072)**	0,0136 (0,0072)**	0,0099 (0,0050)**	0,0095 (0,0048)**	0,0022 (0,0148)	-0,0014 (0,0146)	-0,0027 (0,0038)	-0,0047 (0,0036)
PUBLIC	-0,0376 (0,0117)*	-0,0333 (0,0116)*	-0,0043 (0,0079)	-0,0052 (0,0077)	0,0014 (0,0216)	0,0104 (0,0213)	0,0015 (0,0059)	0,0016 (0,0057)
ACCESS	1,15*10 ⁻⁰⁷ (2,32*10 ⁻⁰⁷)	1,98*10 ⁻⁰⁸ (2,29*10 ⁻⁰⁷)	-7,48*10 ⁻⁰⁹ (1,68*10 ⁻⁰⁷)	2,20*10 ⁻⁰⁷ (1,58*10 ⁻⁰⁷)	5,11*10 ⁻⁰⁷ (4,27*10 ⁻⁰⁷)	5,21*10 ⁻⁰⁷ (4,23*10 ⁻⁰⁷)	-4,34*10 ⁻⁰⁷ (1,20*10 ⁻⁰⁷)*	-3,34*10 ⁻⁰⁷ (1,16*10 ⁻⁰⁷)*
POPULATION	-0,1657 (0,0632)*	-0,1242 (0,0623)*	-0,1317 (0,0378)*	-0,1372 (0,0371)*	-0,2591 (0,0980)*	-0,1987 (0,0964)*	0,0420 (0,0252)**	0,0628 (0,0245)*
INCOME	-0,0001 (0,0005)	-0,0003 (0,0005)	0,0002 (0,0003)	0,0002 (0,0003)	0,0020 (0,0007)*	0,0019 (0,0007)*	-0,0001 (0,0002)	-0,0001 (0,0002)
MICROR	0,0153 (0,0007)*	0,0150 (0,0007)*	-0,0004 (0,0005)	-0,0008 (0,0005)	-0,0025 (0,0063)	-0,0112 (0,0061)**	0,0013 (0,0006)*	0,0012 (0,0006)*
U	-0,0033 (0,0081)	-0,0056 (0,0080)	-0,0053 (0,0054)	-0,0066 (0,0053)	0,0264 (0,0160)**	0,0255 (0,0159)	0,0035 (0,0043)	0,0044 (0,0041)
R&DR	0,1350 (0,0821)**	0,0952 (0,0810)	0,0657 (0,0530)	0,0168 (0,0512)	0,2010 (0,1266)	0,1584 (0,1251)	0,0685 (0,0349)**	0,0430 (0,0339)
CYCLE								
MG	0,0214 (0,0098)*	0,0198 (0,0098)**	0,0206 (0,0073)*	0,0198 (0,0072)*	0,0132 (0,0425)	-0,0129 (0,0420)	-0,0043 (0,0068)	-0,0103 (0,0067)
IG	0,0035 (0,0023)	0,0028 (0,0022)	0,0011 (0,0016)	0,0018 (0,0015)	-0,0083 (0,0074)	-0,0097 (0,0072)	0,0008 (0,0021)	-0,0015 (0,0020)
RMG	0,0034 (0,0028)	0,0043 (0,0027)	0,0022 (0,0019)	0,0029 (0,0019)	-0,0163 (0,0076)*	-0,0175 (0,0076)*	-0,0022 (0,0022)	-0,0027 (0,0022)
RSG	0,0013 (0,0004)*	0,0015 (0,0004)*	0,0007 (0,0002)*	0,0006 (0,0002)*	-0,0028 (0,0011)*	-0,0034 (0,0011)*	0,0000 (0,0003)	-0,0003 (0,0003)
INGRE					0,1459 (0,1379)	0,3471 (0,1322)*	0,3493 (0,0962)*	0,6672 (0,0844)*
INGRX	0,2405 (0,1241)*	0,4454 (0,1194)*	0,4586 (0,0956)*	0,7721 (0,0822)*				
F, χ^2 -tests	26,76*	633,88*	7,21*	212,56*	4,61*	103,11*	8,86*	225,18*

Note: Definitions of Ingre (min, max) and Ingrx (min, max) can be found in footnote 5 of the text. All the explanatory variables are defined in Table 2. EC2SLS (EC3SLS) denotes Error Components Two-

(Three-) Stage Least Squares estimates. * and ** mean that coefficients are statistically significant at 5% and 10%, respectively. Standard errors are given in brackets. F-(χ^2)-test is the F-(Wald-)type statistic for testing the joint hypothesis that all coefficients are zero in EC2SLS (EC3SLS).