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A Dynamic Panel Data Approach for Manufacturing Industries

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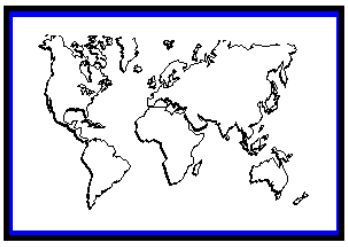

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DETERMINANTS OF OUTSOURCING PRODUCTION:
A Dynamic Panel Data Approach for Manufacturing Industries[♣].

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Abstract:

The present paper investigates the determinants of outsourcing production using a panel of 93 Spanish manufacturing industries for the period 1993-2002. Outsourcing is measured as production tasks which are contracting out to independent suppliers, a more direct and suitable indicator. After controlling for unobserved heterogeneity and simultaneity, our results show a high persistence of the outsourcing intensity. Moreover, outsourcing of production is positively related to unit labour costs, skills requirements and national ownership.

JEL classification: L23, L60.

Key words: Outsourcing, Manufacturing Industries, Subcontracting, Unit Labour Costs.

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I. INTRODUCTION

According to international empirical evidence, a new and complex production organization strategy is currently being developed. This strategy, called fragmentation of production, favours the splitting up of production processes into more specialized and discernible phases in order to obtain the most efficient producer and location for each product or component. It is devised mainly by developed-countries' enterprises, which face a very competitive market where, on the one hand, domestic customers demand high quality products and, on the other hand, products coming from developing countries are highly competitive due to lower labour and production costs. The main aim of adopting this strategy is to take advantage of specialization and scale economies in components or production tasks by external suppliers. In this way, firms specialize in those activities or phases where they have a competitive edge seeking to improve production efficiency, and consequently, their competitiveness.

One of the most important features of this innovative form of production organization is that segmentation of the value added chain is carried out more and more often with independent firms. The fragmentation of production that is not based on equity linkages is called outsourcing[1]. It is important to note that even though there is no direct shareholder control over the segmented phases, it does not mean that there is not any control over them at all. Transactions cannot be considered completely independent market transactions for two reasons: firstly, because the relationship between companies has a long-term nature, and secondly, because of the great quantity of information, such as detailed instructions and specifications, which the external provider receives. As Curzon Price (2001) points out, outsourcing lies somewhere in between total ownership and complete arm's length transactions. Moreover, the externalized production can be outsourced to suppliers located abroad (international or foreign outsourcing) or to domestic providers (national o domestic outsourcing). See Figure 1.

[1] Nevertheless, fragmentation of production and outsourcing are often treated as synonymous. The term outsourcing comes from the compound expression "outside resource using".

Outsourcing of production is thus understood as a process of vertical disintegration of the value chain where some phases or even the whole production process are now contracting out to outside firms instead of performing in house. Understanding what factors determine the intensity of outsourcing production using panel data is the object of the present paper.

In spite of the increasingly use of outsourcing of production activities according to business press[2] and academic literature, empirical research about its determinants remains very limited: Kimura (2001) and Tomiura (2004) for Japanese manufacturing industry, Görg and Hanley (2004) for Irish electronics industry, Girma and Görg (2004) for some UK manufacturing industries and Holl (2004) for Spanish manufacturing industry. Of these, only the last three are panel data instead of cross-section analysis and exclusively Görg and Hanley (2004) and Girma and Görg (2004) try to infer the factors that may affect the level of outsourcing, whereas Holl (2004) focuses on the determinants of the probability that a firm does take the decision of outsourcing using a probit model.

Hence, as far as the author knows, our study is the first on the determinants of outsourcing intensity using panel data for the Spanish manufacturing industry. The estimation includes the GMM approach proposed by Blundell and Bond (1999) especially suitable to deal with models for moderately persistent series from short panels. Furthermore, this paper contributes to the empirical literature by employing a direct and more adequate indicator for outsourcing of internal production. This type of outsourcing is often measured by the ratio of material intermediate inputs to output. But this is a broad measure because it includes raw materials purchases and arms-length purchases of standardized components in the market. A specific characteristic of outsourcing is that the relationship between the firm which contracts out production and outside provider is long-term and it usually implies sharing information about the product. That is, purchases of intermediate inputs through an usual marketing channel have not to be regarded as outsourcing. As Grossman and Helpman (2002b, pg. 2) notes “outsourcing

means more than just the purchases of raw materials and standardized intermediate goods". At the same time, it is a narrow indicator because it does not capture the outsourcing of the final production stage, the assembly or specific production tasks.

For these reasons, we use an indicator that fulfils these required conditions. This is *Production works done by other firms* which refers to tasks which being a part of the own production process are carried out by other firms. It involves contracting out manufacturing and also any stage of the production process such as product design or specific tasks (for instance, in the textile industry, tailoring or press ironing) or even the final assembly. That is, and external services such as maintenance of fixed assets, accounting, consulting, cleaning, transportation, etc., as well as purchases of raw materials and supplies such as office materials or fuel are not included. Girma and Görg (2004) use a bit wider measure, the industrial services receive, which includes activities such as processing of inputs but also certain services as maintenance of production machinery or engineering services[3].

The paper is structured as follows. In the next section, we briefly review previous literature on the determinants of outsourcing. In section III we describe the data set used for the empirical analysis and then we present some descriptive statistics as well as the econometric model. The results of the empirical estimation are showed in section IV. Lastly, in section V, some conclusions are made.

II. DETERMINANTS OF OURTSOURCING OF INTERNAL PRODUCTION.

Companies will opt for outsourcing when externalisation of certain value chain phases allows them to reduce costs, i.e., when de-internalizing has more advantages than in-house production. The technological revolution that has taken place in last decades has allowed for a

[2] *The Economist* has recently published a survey of outsourcing, in which is pointed that "manufacturing has already gone a long way down the road of outsourcing" (The Economist, November 13th 2004).
[3] Tomiura (2004) and Holl (2004) employ a similar indicator but, as pointed out above, the first one uses cross-section data and the second one does not investigate the outsourcing level but the probability of outsourcing.

significant drop in the costs associated with finding information, transport communication and business coordination, lowering the transaction costs and augmenting the possibilities for outsourcing.

According to transaction cost theory (Coase, 1937; Williamson, 1975), outsourcing would entail a variety of coordination costs associated with various aspects of inter-firm transactions. Search costs to find the right supplier, negotiation costs, costs to design the contract and the incomplete contracts problem, coordination costs, technology transfer risks, etc. have to be considered. At the same time, firms which outsource production search to obtain two types of advantages: first, an increase of flexibility for adapting to changes in demand and technological conditions and, second, a reduction in production costs[4].

If firms outsource in order to reduce costs relative to in-house production and, therefore, to increase efficiency, we would expect that those firms and sectors where the labour costs are higher were more active in outsourcing strategy. To test the relevance of the labour cost-saving motive for outsourcing, Girma and Görg (2004) include the wage rates for skilled and unskilled workers. However, they do not obtain conclusive results. The sign of the coefficient changes depending on the manufacturing industry and on the estimation technique and frequently the variable is statistically insignificant. Görg and Hanley (2004) introduce the average wage per employee when they investigate outsourcing determinants. They also find that the effect of wages is statistically insignificant and not robust to different estimation techniques. Holl (2004) does obtain a positive and significant coefficient of the wages on the probability of subcontracting products, parts and components

In our opinion, a variable more relevant than wage is unit labour cost, that is, the remuneration of labour to produce one unit of output. This indicator of cost pressures in the

[4] Grossman and Helpman (2002a) examine theoretically the decision between outsourcing or vertical integration of intermediate inputs (*make or buy decision*) taking into account the costs that arise from search frictions and imperfect contracting and the costs of running a larger and less specialized organization. By other hand, Antras and Helpman (2003) develop a theoretical framework in which, based on productivity and sectoral characteristics, firms

labour market is computed as the ratio of labour cost to output. It is computed as well as the ratio of labour cost per worker (or per hour worked) divided by labour productivity (output per worker o per hour worked). By this way, changes in unit labour cost are the result of two forces: changes in wage rate and changes in productivity. It has been assumed that high wage firms do more outsourcing because the cost cutting motive will be more important. But those high wages could respond to higher efficiency due to high skills, resulting in lower unit labour costs. That is, it would be the wage, once productivity differences are taken into account, one of the key drivers of outsourcing. Hence, we expect that high unit labour cost manufacturing industries tended to contract out more production works than the rest. This result would confirm the initial hypothesis that fragmentation of internal production is an strategy carried out by developed-country firms in order to improve their efficiency in a context of strong competitiveness coming from cheaper labour regions.

As Abraham and Taylor (1996) suggest, the cost savings derived from outsourcing can be obtained by two ways: first, exploiting the economies of scale in producing these specialized components or phases which are being contracted out (outsourcing for specialization) and, second, turning fixed costs in variable costs and gaining flexibility if there are frequents fluctuations in the product demand (outsourcing for capacity).

The specialization motive for outsourcing introduces firm size as a determinant of this strategy. There may be economies of scale in the production of specific inputs and, in this sense, size variable have to be considered to control for this scale economies effect. Since small and medium enterprises will have more difficulties to reap the minimum efficient scale, they will opt more intensively for outsourcing.

Nevertheless, we also argue that outsourcing is an strategy for gaining flexibility that allows large firms to reduce their rigidity. In a very strong competence environment, a high

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decide whether to integrate into the production of intermediate inputs or outsource them and firms also choose the location of inputs production (at home or abroad).

grade of product differentiation is increasingly required. Consumers demand more and more specific product characteristics. In this context, large firms have to achieve flexibility to adapt to changes of consumer wishes. Contracting out the manufacturing of these specific components or tasks is one of the alternatives to obtain it. That is, firms would tend to back to the basics focussing on those activities where they are more efficient and outsourcing the rest. In this sense, large firms have more incentives to carried out this process of vertically de-integration of production structures. Another reason to expect a positive relationship between size and outsourcing intensity is proposed by Tomiura (2004), who suggests that smaller firms could face to higher search costs, that is, due to stronger market power large firms might find contracting partners more easily.

The sign of firm size is, therefore, ambiguous. Whereas empirical works such as Girma and Görg (2004), Holl (2004) and Kimura (2001) have obtained positive coefficients, in Görg and Hanley (2004) the sign is negative. The last study, however, excludes small firms because it uses a Survey that provides information only for firms with thirty or more employees.

Additionally, Görg and Hanley (2003) point that export propensity may have a positive effect on outsourcing. It could be argued that the more a company exports, the more the possibilities there are in finding foreign low wage suppliers.

Finally, previews works usually control for ownership nationality. According to Görg and Hanley (2004) and Girma and Görg (2004), since foreign firms are part of an international network competing in a global market, the potential to contract out to more efficient producers abroad increases. Hence, it could be assumed that they do more outsourcing than domestic firms. However, if foreign affiliates are located in a country just for doing production tasks for the parent company, the possibility from these manufacturing plants for using subcontractors could decrease. The sign of national ownership variable is, as well as firm size, ambiguous and will be an empirical matter. Previews works have obtained positive signs (Girma and Görg, 2004) but also negative signs (Holl, 2004; Görg and Hanley, 2004).

III. DATA AND METHODOLOGY DESCRIPTION.

In order to investigate the determinants of outsourcing of internal production we use industry level data for manufacturing in Spain. The data are derived from the Industrial Companies Survey (*Encuesta Industrial de Empresas*) published by the Spanish National Statistics Institute. The Survey, which follows Eurostat recommendations, is undertaken annually since 1993. It provides information on employed persons, wages, hours worked, sales, intermediate inputs, external services and some more variables for 93 manufacturing industries. The sectors correspond mostly to the 3-digit level of NACE Rev.1 (Table 1). The Survey basic unit is industrial company with one or more remunerated employed persons. Approximately 43,000 firms compose the sample in 2002.

The inclusion of the variable *Production works done by other firms*, as defined in the introduction section, makes the Survey particularly interesting for our analysis of outsourcing of internal production. Subcontracts are included within this concept. Subcontracts correspond to the relationship between two companies (the subcontractor and the main contractor), where the subcontractor company participates in the design and production process of a particular product, which belongs to the contractor company. The subcontract conditions may include the main contractor providing a diagram and precise technical specifications for the manufacture of the product, as well as the supply of its main raw materials. In our opinion, this variable is best suited for researching about outsourcing of internal production. We measure it as the ratio of these production tasks carried out by other firms to gross output. If the ratio goes up, we interpret that manufacturing firms are replacing in-house production for outside contract production.

Figure 2 plots the extent of outsourcing for Spanish manufacturing industries in 2002. We observe the heterogeneity in the outsourcing intensity among sectors. Outsourcing level is higher for Textile Industries, Wearing Apparel, Footwear, Publishing and Printing, Fabricated Metal Products and Shipbuilding and Aerospace Industry. All of them show fragmentation levels well above 10% of gross production, and 20% for the last two sectors. According to this indicator, for

the average Spanish manufacturing industry around 5% of output are production works contracted out to outside producers. Moreover, our data show that fragmentation of production has increased steadily (average rise of 40% from 1993 to 2002)[5]. Therefore, we find evidence of the growing disintegration of the production process and rising of outsourcing production activities in Spain.

To analyse the determinants of outsourcing of internal production we consider the following regression equation which relates outsourcing intensity to a broad range of industry's characteristics:

$$OUTS_{it} = \beta_0 + \beta_1 OUTS_{i,t-1} + \beta_2 ULC_{it} + \beta_3 \%Small\text{-}Firms_{it} + \beta_4 National\text{-}own._{it} + \beta_5 Export\text{-}prop._{it} + \beta_6 DSKILLS_{it} + \beta_7 D_t + u_{it} \quad (1)$$

Where i represent the 92 manufacturing sectors[6], t is the time period 1993-2002, OUTS is the outsourcing level measured as production works carried out by other firms per unit of output, UCL are the unit labour costs measured as defined above and %Small-Firms variable is the percentage of small firms (less than 20 employees) in a sector. We include a variable of ownership nationality (National-own.) which reflects the percentage of domestic firms (those with one hundred percent of national capital). Export-prop. is the export propensity ratio measured as exports to output. If firms use outsourcing as a cost-cutting strategy, we would expect that high skill sectors gave stronger support to fragmentation based on contracting out production phases to specialized producers than the rest of the industries, mainly those production tasks more intensive in low skilled labour[7]. For this reason, the model also includes a

[5] This increase is higher than the average scored by German manufacturing enterprises, which has placed in 27% for the period 1992-2000 according to Görzig and Stephan (2002). However, it should be noted that the fragmentation processes in German industry had most probably taken place before the 1990s. A very detailed analysis of the trends, types and geographical dimension of outsourcing for Spanish manufacturing industries is provided by Díaz-Mora and Gandoy (2004).

[6] The sector "Manufacture of office machiney and computers" has been removed from the econometric analysis. The data in 2002 show a sharp decrease of output which is not present in employment or number of enterprises suggesting a measure error for that year. Since the indicador of outsourcing used is calculated related to output, the level of fragmentation will be overestimated.

[7] Although some American and British firms have already begun to outsource some of their business services abroad (so far mostly to India), the outsourcing of white-collar work is still only emerging (*The Economist*, November 13th 2004).

dummy variable to control for high skill requirements (DSKILLS), which takes on value 1 for sectors with high skill requirements and 0 for the rest using the Peneder (1999) classification. This classification is based on the OECD's occupational data, which distinguish between white and blue-collar workers, on the one hand, and between high and low skilled labour on the other. At last, 10 time dummies are introduced to control for period-specific effects.

The equation (1) represents a standard dynamic model, where lagged dependent variable is included among the regressors. It seems reasonable that the decision about the outsourcing intensity in period t is related to the level of outsourcing in previous period t-1. The lagged dependent variable is included to account for this persistence in the outsourcing decision (Girma and Görg, 2004).

Furthermore, we will treat the unit labour cost variable as endogenous, since it is conceivable that changes in outsourcing level lead to changes in future unit labour cost. For similar reasons, we consider the share of small firms and the export propensity ratio as endogenous and we also include these variables lagged.

We calculate the outsourcing intensity, the unit labour costs and the percentage of small firms from data of the Industrial Companies Survey. Data for the ownership are drawn from the firm level panel survey, the Survey of Firm Strategies (*Encuesta sobre Estrategias Empresariales, ESEE*) of the Spanish Ministry of Science and Technology which offers data for 20 manufacturing industries.

All variables are expressed in logarithms and therefore the estimated coefficients represent elasticities. We use a one-way error component model for the disturbance term, $u_{it} = \alpha_i + \nu_{it}$, where α_i denotes the unobservable individual specific effects that are independent and identically distributed (iid) over the sectors with variance σ_α^2 and ν_{it} denotes the remainder disturbance that are iid over the whole sample with variance σ_ν^2. The time invariant variables are often difficult to measure or hard to obtain. For example, a sector-specific production technology may allow the dispersion of phases of production process better in that sector than in another

sector. This production technology varies across sectors but it is not expected to change very much in a short time period.

Taking into account these three aspects (potential industry unobserved heterogeneity, dynamic nature of the model and endogeneity of some explanatory variables), the appropriate estimator is the Generalized Method of Moments (GMM) developed by Arellano y Bond (1991). They suggest first differencing the model to get rid of the industry specific effects and then using valid instruments (lagged values of the instrumented variables) to deal with the problem that by construction the new error term is correlated with the lagged dependent variable. The use of instruments is also required to control for the potential endogeneity of other explanatory variables. We use at least three lagged values of unit labour cost as instruments for the equations in first differences to control for the potential influence of current outsourcing level on current unit labour cost. The same lagged values are chosen for the percentage of small firms and the export propensity ratio. Since national ownership is assumed to be strictly exogenous, it is instrumented with itself.

A draw back of the difference GMM estimator of Arellano and Bond (1991) is that when first differences are taken, time invariant variables are wiped out. So, the estimator does not use cross sectional information reflected in the differences between industries. Another disadvantage is that lagged levels are often poor instruments for the equation in differences, especially in the case of panel with a small number of time periods with highly persistent data. It can cause large finite-sample biased and poor precision in the estimators. To reduce this problem associated with the difference GMM estimator, we use a new estimator, the system GMM, developed by Arellano and Bover (1995) and Blundell and Bond (1998). This estimator is based on an augmented system that includes the regression in differences in addition to the regression in levels with lagged differences as instruments. The second part of the system requires the additional assumption of no correlation between the variables in differences and the unobserved

industry effects, although there may be correlation between the levels of the explanatory variables and the fixed effects.

Some summary statistics for the variables used are provided in Table 2. We observe that, in manufacturing industry labour cost are about 20 percent of the output value and about 30 percent of the output is sold to foreign markets. In addition to, small firms as well as firms without foreign participation are clearly predominant. Table 3 presents the simple correlations between pairs of variables. Since the correlations between the independent variables are small (except between the shares of small firms and national firms), we interpret there are not multicollinearity problem in the regressions. In addition, we see that outsourcing is positively correlated with all the independent variables, mainly with levels of the unit labour costs, the proportion of domestic firms and the high skill requirements. Nevertheless, the outsourcing intensity is determined jointly with these variables and other factors which have to be controlled. For these reasons, an econometric analysis is applied.

IV. ECONOMETRIC RESULTS.

The results of the econometric analysis are reported in Table 4. The first two columns present the results from the estimation of equation (1) using GMM estimation methods. The GMM-differenced estimations (column 1A) indicate a high degree of persistence, with a coefficient on the lagged dependent variable significant at 5% level. This finding can be related with the existence of important transaction costs. They are a key difficulty in the decision of outsourcing internal production according to the theoretical model by Grossman and Helpman (2002a). These costs will be higher in the first moments, when the outsourcing strategy is becoming to be used. In following years, transaction costs probably will be decreasing and they will be compensated by the advantages of farming out parts of the production process.

Moreover, in line with our prior expectations, higher unit labour costs are related to higher level of outsourcing. We can interpret that sectors tend to use fragmentation of production

as a defensive strategy trying to improve their competitiveness. With respect to firm size, sectors where the share of small firms is lower, outsource more internal production than the rest, pointing the existence of less difficulties in searching specialized outside producers for large firms. Contracting out production works is more intensive when the percentage of national firms and the export propensity increase as indicated by the positive signs of the respective coefficients. Although the variables show the expected signs, only lagged dependent variable and export propensity variable are statistically significant.

The outcomes using GMM-system estimator are displayed in column 1B. The sign of the coefficients of all the right-hand variables is robust to the different estimation technique. But their statistical significance improve in the case of the lagged outsourcing intensity, the unit labour cost and the share of national firms. Particularly, when regressions in levels are added to regressions in first differences using appropriate instruments for each of them, the effect of unit labour cost and national ownership on outsourcing turns significant at 1% level. The positive and significant coefficient of unit labour cost is an important result because it provides empirical evidence of the cost-cutting motive for outsourcing. Additionally, according to the positive link between the share of domestic firms and the outsourcing level, as the percentage of foreign firms increases, so do outsourcing activities. This result would contradict that foreign firms were more prone to contract out internal production. In our opinion, this is because the last have been located in Spain as production affiliates carrying out parts of the production process for the parent firm. Moreover, the dummy variable high skill requirements exhibits a positive and significant sign showing that industries intensive in high skilled-labour tend to farm out internal production more intensively. By contrast, export propensity remains positive but turns not significant.

Another disparity between difference GMM results and system GMM results is that the magnitude of the marginal effect of those three variables (lagged dependent variable, unit labour cost and share of national firms) on outsourcing is considerably larger in the system GMM.

These outcomes confirm that that first-differenced coefficients are biased downwards if the available instruments are weak.

Most of the time dummy variables are highly significant although, in order to spare space, the coefficients are ommited from the results table.

Consistence of the GMM estimators depends on the validity of instruments which is examined by four specifications tests. The first is the Sargan test of overidentifying restriction. For both difference and system GMM, the Sargan test does not reject the validity of the instruments employed in the estimation process. Since system GMM used additional moment conditions over the difference GMM, a Sargan Difference test can be employed to examine the validity of these additional instruments obtained from the equation in levels. The Sargan difference test does not rejected the validity of them ($\chi^2[8]=10.53$). The other tests examine the absence of first and second order serial correlation. Again, for both estimators, the null hypothesis of no second order correlation cannot be rejected.

We test the robustness of the regressions by removing those variables which do not have a significant impact on the outcome variable. The columns 2A and 2B of Table 4 present the results from the estimation of equation (1) excluding the share of small firms whereas we have removed the export propensity in the columns 3A and 3B. According to the System GMM estimations, the positive coefficients for previous outsourcing intensity, unit labour cost, national ownership and skill requirements remain robust and the negative coefficient of the share of small firms turns out significant when export propensity is not included.

V. CONCLUSIONS.

In this paper we have investigated the determinants of outsourcing of internal production using industry level data for Spanish economy. Our study covers 93 manufacturing sectors and the period 1993-2002. We observe that manufacturing industries are fragmenting the value chain and they are opting increasingly for contracting out production works to outside providers.

We test a model where the outsourcing intensity at industry-level depends on lagged level of outsourcing, unit labour cost, share of domestic firms, proportion of small firms, export propensity and skill requirements. We employ the system estimator proposed by Blundell and Bond (1999) that provides better instruments when right-hand variables are persistent over time.

We find that current level of outsourcing is highly related to previous outsourcing intensity. The market transaction costs associated to contracting out production are probably higher when firms make the decision of outsourcing. In due course, some of these costs will be reduced and so the advantages of in-house production will be dropped. Therefore, if firms are achieving their objectives of gaining flexibility and decreasing costs, the outsourcing will be used more and more intensively allowing firms to concentrate on their innermost core competence.

Furthermore, our results show that the unit labour costs affect positively the ratio of production works that are contracted out to outside providers related to output. The pressure of low-cost competitors could be more intensive in manufacturing industries with higher unit labour costs and, therefore, they would be mostly encouraged to outsource production works to cheap and specialized contract manufacturers. Finally, in the GMM system regression we find significant evidence for the positive link between the share of domestic firms as well as the high skill requirements and the outsourcing intensity.

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Table 1: Sectoral disaggregation of Industrial Companies Survey 2002

Manufactures of food products, beverages and tobacco
151 Production, processing, preserving of meat, meat products
152 Processing and preserving of fish and fish products
153 Processing and preserving of fruit and vegetables
154 Manufacture of vegetable and animal oils and fats
155 Manufacture of dairy products
156 Manufacture of grain mill products, starches and starch products
157 Manufacture of prepared animal feeds
1581-2 Manufacture of bread, biscuits and bakery products
1583-4 Manufacture of sugar, cocoa and chocolate
1585-9 Manufacture of other food products
1591-7 Manufacture of alcoholic beverages
1598 Production of mineral waters and soft drinks
160 Tobacco products
Manufacture of textiles, wearing apparel, leather and footwear
171 Preparation and spinning of textile fibres
172 Textile weaving
173 Finishing of textiles
174 Manufacture of made-up textile articles, except apparel
175 Manufacture of other textiles
176 Manufacture of knitted and crocheted fabrics
177 Manufacture of knitted and crocheted articles
181-2 Manufacture of leather clothes and other wearing apparel
183 Dressing and dyeing of fur; manufacture of articles of fur
191 Tanning and dressing of leather
192 Manufacture of luggage, handbags and the like, saddler
193 Manufacture of footwear
Manufactures of paper, paper products, publishing and printing
211 Manufacture of pulp, paper and paperboard
212 Manufacture of articles of paper and paperboard
221 Publishing
222-3 Printing and service activities related to printing
Manufacture of chemical
241 Manufacture of basic chemicals
242 Manufacture of pesticides and other agro-chemical products
243 Manufacture of paints, varnishes and similar coatings
244 Manufacture of pharmaceuticals, medicinal and botanical products
245 Manufacture of soap, detergents, cleaning, polishing
246 Manufacture of other chemical products
247 Manufacture of man-made fibres
Manufacture of rubber and plastic products
251 Manufacture of rubber products
252 Manufacture of plastic products
Manufacture of other non-metallic mineral products
261 Manufacture of glass and glass products
262 Manufacture of ceramic goods
263-4 Manufacture of construction products
265 Manufacture of cement, lime and plaster
266 Manufacture of articles of concrete, plaster, cement
267 Cutting, shaping and finishing of stone
268 Manufacture of other non-metallic mineral products
Manufacture of basic metals
271 Manufacture of basic iron and steel and of ferro-alloys (ECSC)
272 Manufacture of tubes
273 Other first processing of iron and steel
274 Manufacture of basic precious and non-ferrous metals

Manufacture of fabricated metal products
2811 Manufacture of metal structures and parts of structures
2812 Manufacture of builders' carpentry and joinery of metal
282 Manufacture of tanks, central heating radiators and boilers
283 Manufacture of steam generators
284 Forging, pressing, stamping and roll forming of metal
2851 Treatment and coating of metals
2852 General mechanical engineering
286 Manufacture of cutlery, tools and general hardware
287 Manufacture of other fabricated metal products
Manufacture of machinery and equipment
291 Manufacture of machinery for the production of mechanical power
292 Manufacture of other general purpose machinery
293 Manufacture of agricultural and forestry machinery
294 Manufacture of machine-tools
295-6 Manufacture of other special purpose machinery and weapons
297 Manufacture of domestic appliances n.e.c.
Manufacture of office machinery, computers and precision equipment
300 Manufacture of office machinery and computers
331 Manufacture of medical and surgical equipment
332-5 Manufacture of instruments for measuring and optical instruments
Manufacture of electrical equipment
311 Manufacture of electric motors, generators and transformers
312 Manufacture of electricity distribution and control apparatus
313 Manufacture of insulated wire and cable
315 Manufacture of lighting equipment and electric lamps
314/316 Manufacture of accumulators and electrical equipment n.e.c.
321 Manufacture of electronic valves and other electronic components
322 Manufacture of television, radio transmitters, apparatus for line telephony
323 Manufacture of television and radio receivers, sound or video recording
Manufacture of transport equipment
341 Manufacture of motor vehicles
342 Manufacture of bodies for motor vehicles, trailers and semi-trailers
343 Manufacture of parts, accessories for motor vehicles
351 Building and repairing of ships and boats
352 Manufacture of railway, tramway locomotives, rolling stock
353 Manufacture of aircraft and spacecraft
354-5 Manufacture of motorcycles and other transport equipment n.e.c.
Manufacture of wood, furniture; manufacturing n.e.c.
201 Sawmilling and planning of wood, impregnation of wood
202 Manufacture of veneer sheets and other panels and boards
203 Manufacture of builders' carpentry and joinery
204 Manufacture of wooden containers
2051 Manufacture of other products of wood
2052 Manufacture of articles of cork, straw and plaiting materials
361 Manufacture of furniture
362 Manufacture of jewellery and related articles
364-5 Manufacture of sports goods and games and toys
363/366 Miscellaneous manufacturing n.e.c.

275 Casting of metals

Table 2: Summary Statistics

	1993		2002		1993-2002	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Outsourcing	3,83	3,59	5,11	4,71	4,49	4,17
Unit Labour Cost	24,27	7,68	18,26	5,98	19,55	6,78
% Small Firms	79,21	12,18	74,91	13,21	77,55	13,20
Export Propensity	28,01	20,07	31,16	19,46	29,76	19,28
National Ownership	77,53	12,14	77,41	13,10	77,14	12,37
Skills (dummy)	0,12	0,33	0,12	0,33	0,09	0,28

Source: Industrial Companies Survey, Comext, Survey of Firm Strategies and Peneder (1999).
Note: All the variables are before taking logarithms.

Table 3: Simple Correlations between variables

	Outsourcing	ULC	% Small	Export Prop.	National Own.	Skills
Outsourcing	1,000					
Unit Labour Cost	0,440	1,000				
% Small Firms	0,155	0,176	1,000			
Export Propensity	0,184	0,153	-0,320	1,000		
National Ownership	0,385	0,159	0,421	-0,183	1,000	
Skills	0,321	0,281	-0,080	0,249	-0,109	1,000

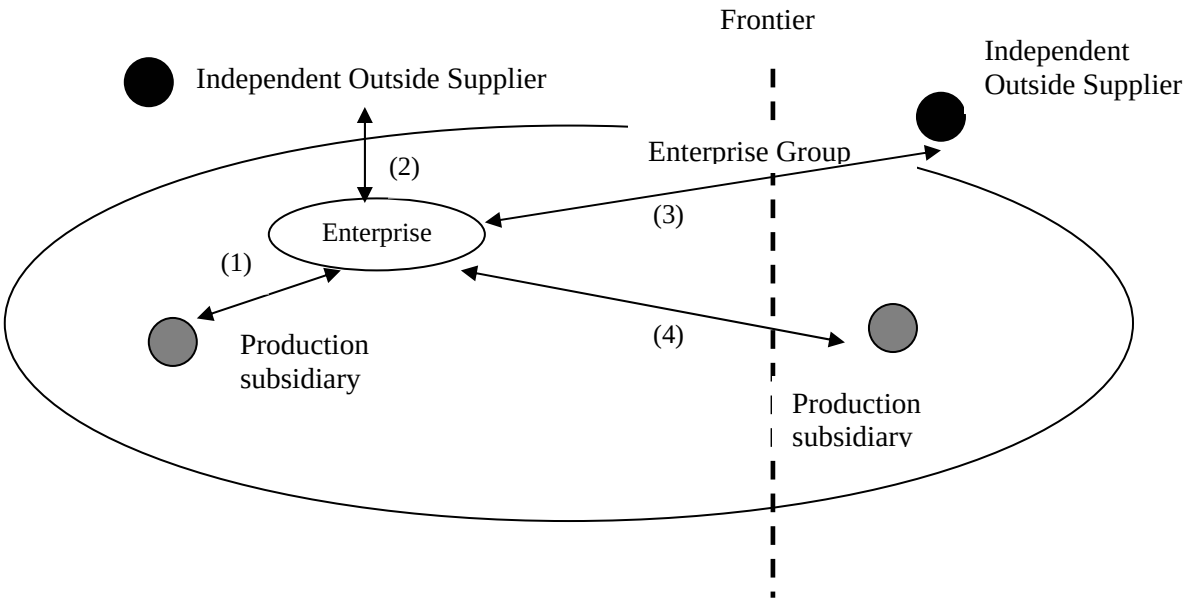
Source: Industrial Companies Survey, Comext, Survey of Firm Strategies and Peneder (1999).
Note: All the variables are before taking logarithms. The number of observations is 870.

Table 4: Determinants of Outsourcing (Regression Results).

Parameters	GMM-differ. (1A)	GMM-system (1B)	GMM-differ. (2A)	GMM-system (2B)	GMM-differ. (3A)	GMM-system (3B)
Outsourcing $_{t-1}$	0.152**	0.815***	0.226***	0.785***	0.172***	0.781***
	(0.071)	(0.029)	(0.083)	(0.038)	(0.079)	(0.039)
ULC	0.005	0.315***	0.048	0.288**	0.035	0.318***
	(0.144)	(0.086)	(0.141)	(0.114)	(0.136)	(0.113)
%Small-firms	-0.410	-0.087			-0.330	-0.340**
	(0.278)	(0.099)			(0.271)	(0.151)
National-ownership	0.056	0.314**	-0.195	0.369**	0.009	0.497***
	(0.286)	(0.138)	(0.342)	(0.142)	(0.310)	(0.173)
Export-prop.	0.089*	0.003	0.053	0.015		
	(0.054)	(0.028)	(0.053)	(0.021)		
High Skills	Dropped	0.040**	Dropped	0.056**	Dropped	0.051*
		(0.019)		(0.023)		(0.028)
Constant	0.002	-0.718**	0.001	-0.955***	0.003	-0.572**
	(0.004)	(0.271)	(0.004)	(0.288)	(0.003)	(0.327)*
Observations	522	783	522	783	552	828
Sectors	87	87	87	87	92	92
Test (p-values)						
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.506	0.313	0.815	0.326	0.764	0.337
Sargan test	1.000	1.000	0.387	0.592	0.981	0.987

Notes: One-step robust standard errors in brackets; statistically significant * at 10%, ** at 5*, *** at 1%.
All equations include year dummies.
AR(1) and AR(2) are tests of first and second order serial correlation.
Sargan is a test of the over-identifiying restrictions (two-step estimations). P-values below 0.05 suggest a rejection of the validity of the instruments at the 5% critical level.

Figure 1: Dimensions of Fragmentation of Production.



(1) Intra-firm national fragmentation

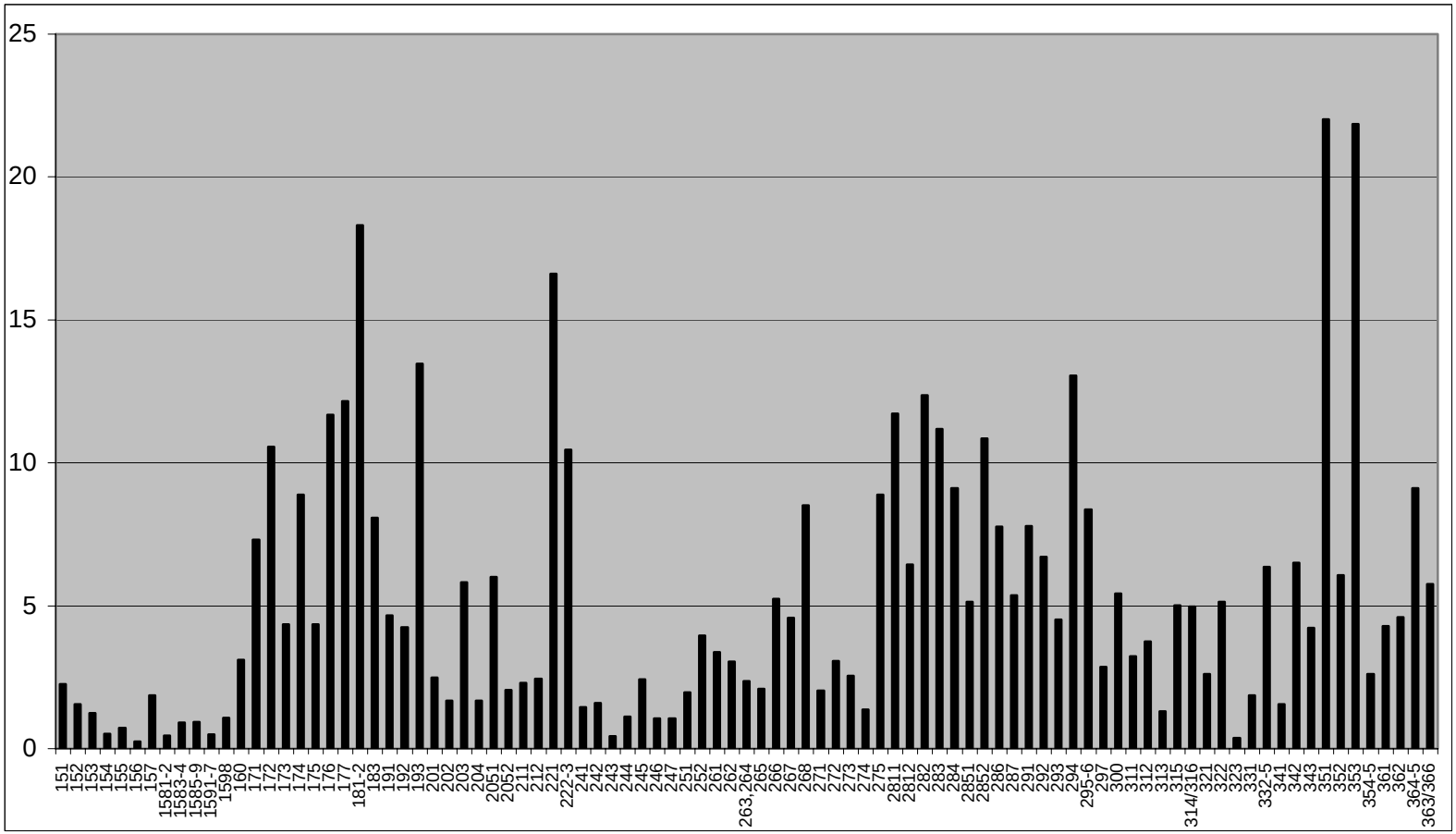
(2) Inter-firm national fragmentation (national outsourcing)

(3) Inter-firm international fragmentation (international outsourcing)

(4) Intra-firm international fragmentation (FDI is required).

Source: Own elaboration from Kimura (2001) and Curzon Price (2001).

Figure 2: Level of Outsourcing of Internal Production in 2002
(Production works carried out by other companies / Gross production, in percentage)



Source: Industrial Companies Survey 2002 (National Statistical Institute of Spain.