Factors behind international relocation and changes in production geography in the European automobile components industry

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ABSTRACT

This article analyses business strategies in the automobile sector to determine the key factors behind production relocation processes in automobile components suppliers. These factors help explain changes in production geography in the sector not only in terms of location advantages but also from a perspective of corporate strategies and decision-making mechanisms within firms. The results obtained from an empirical study in Spain during the period 2001-2008 show how the components sector has used relocation to meet the requirements for efficiency imposed by automobile manufacturers. The search for lower labour costs, production concentration and specialisation in order to obtain economies of scale and improved productivity are found to be the main factors determining relocation in the sector. These processes are facilitated by the operational flexibility of the multinational firms that dominate the sector which allows them to transfer resources internationally. Lean supply, technological requirements for production processes and the integration of production plants in the institutional environment are the main barriers to such processes of mobility, and may also determine the geographical destination of migrated production.

KEY WORDS: Production relocation, automobile components sector, geography, Spain, Europe.

1. INTRODUCTION

In recent years in Europe, relocation processes have mostly taken place in the automobile industry, in both automobile manufacturers and components suppliers (Bilbao and Camino, 2008; Layan and Lung, 2008; Jürgens and Krzywdzinski, 2009). The economic and social effects of this phenomenon have found a place on the political agenda of many European countries, especially in view of the weakness of the sector after consecutive six years of falling sales and a wave of plant shutdowns and relocations. The European Commission has drawn up a specific plan –Cars 2020– to prevent the destruction of some of the 12 million jobs in this sector throughout Europe (European Commission, 2012).

In the case of automobile components suppliers, the geography of the sector has been transformed by the fast process of internationalisation taking place over the last decade (Frigant and Layan, 2009). Relocation to cut back labour costs, together with specialisation and follow sourcing, has been the main internationalisation strategy adopted by firms in this sector (Frigant, 2009).

Although many analyses have linked production mobility to the search for locations with lower labour costs, there are additional factors mainly linked to firms' internal decisions that explain many of the most recent cases of relocation and transformation of the production geography. Such factors can only be identified on the basis of thorough knowledge of the complex relations governing the different agents in the automobile sector's value chain and by focusing on manufacturers' strategies and the knock-on effect these have on the components sector. This dependency of auto components suppliers means that any initiatives introduced by manufacturers in their purchasing policies, logistics systems, product development or production strategies can transform customer-supplier relations, conditioning location and spatial reorganisation decisions in firms in the components industry.

The purpose of this article is to cast new light on these issues. It comprises three sections. In the first, the main strategies in the components sector are analysed and the resulting factors leading to relocation are determined. In the second, relocation in this sector in Spain is analysed over the period 2001-2008, and the factors proposed in the previous section are empirically tested. Finally, some conclusions are drawn and implications proposed.

2. THE AUTOMOBILE COMPONENTS SECTOR AND FACTORS BEHIND RELOCATION

The automobile sector groups together all firms related to the production of the end product, that is, automobiles. The firms responsible for actual vehicle production are the manufacturers. Other firms that produce components to be incorporated into the end products belong to the components sector.

One of the most important characteristics of components suppliers is their dependency on the strategies adopted by the manufacturers. Relations between components supplier and manufacturer in the sector have changed significantly in recent years and today are largely based on cooperation, joint technological development, shared information and support for obtaining improved results. However, supply terms, development times and quality standards are firmly set, with no room for negotiation, by the automobile manufacturers.

2.1. Fragmentation of the value chain

One of the main results of globalisation has been the international breakdown of production processes and business functions (Mouhoud, 2006). In the automobile sector, this process has led to marked fragmentation of the value chain. The production of an automobile is the end result of a set of coordinated activities performed by different firms located at different levels of the chain according to their participation in the end product, the technological level and complexity of the product and the production process, and their supply functions (Lamming, 1993, Lambert, 2001). This fragmentation has led to specialisation and the concentration of activities in different geographical locations with the aim of taking up competitive advantages (Klier and Rubenstein, 2006). But there has also been standardisation of many products and processes for which the technology is not demanding so the location requirements are not particularly relevant.

Today, we are far from a geographical set-up in the sector such as that that existed in the 1970s in Europe, when design activities were polarised in the centre and the production of standard products took place in countries in the periphery with the transfer of simple production technologies (Lung, 2004). Nevertheless, there is evidence that fragmentation of the value chain in the sector is, to some extent, retaining certain characteristics of the former structure. In fact, the literature today notes that unnecessary location in terms of demanding technology has facilitated the relocation of assembly activities and of the production of standard components in the sector (Camuffo et al., 2006; Dicken, 2007). It also indicates that it is difficult for firms to transfer

technologically complex processes, because of a lack of technological capabilities among local suppliers in other potential locations (Brown, 2000).

In summary, vertical disintegration in the sector has led to clear segmentation of processes and products in the value chain with regard to technological requirements, know-how or capabilities. From the point of view of relocation, the greater technological requirements of complex products or processes in comparison with other less complex or standard ones amount to a barrier for transferring them to locations that are not able to meet such requirements. In contrast, products and processes that are not complex, most of which fall within the lower levels of the value chain, can be easily replicated and transferred anywhere.

2.2. Competition based on process efficiency and cost reduction

Over recent decades, automobile manufacturers have undertaken a process of vertical disintegration of production. It has been estimated that 75% of the total cost of producing a vehicle comes from components (Frigant and Layan, 2009). This outsourcing creates advantages in terms of flexibility for adapting to frequent changes in demand and to cost reduction requirements, mainly concerning labour. This cost reduction strategy has become consolidated as a requirement in the sector and is hardly questioned because it has allowed manufacturers to reduce direct production costs by keeping down headcounts and investments in production resources. Under these circumstances, with much of the activity in the hands of their suppliers, the search for lower costs for manufacturers inevitably entails the reduction of prices for components. This, together with the power of manufacturers in manufacturer-supplier relations, explains the great competition on a global scale based on cost reduction to which the components sector is subject (Freyssenet et al., 2003).

This constant demand of vehicle assemblers for lower prices is included in bargaining with components suppliers in the form of a commitment to reduce prices annually throughout the duration of the supply contract. Hence efficiency and productivity ratios become a prime objective for components suppliers and a measure of their capacity to meet their customers' demands.

All this means that inefficiency in a plant may lead to it being closed down and transferred because of pressure from the owners to maintain competitiveness within the sector (Sleuwaegen and Pennings, 2006). Not surprisingly, this sector is characterised by the presence in many firms' capital of large holdings, for which investment projects are based on the single criterion of profitability and high levels of returns (Bilbao and Camino, 2008).

In parallel, the fact that there are many multinationals has led to a new way of seeing competition in the sector. Other conditions permitting –especially logistics– several plants of a multinational may choose to produce the same product, sometimes sharing out production and sometimes reserving exclusive production for a specific plant from which products are then distributed worldwide. In this context of internal competition among the plants of a single multinational, lower efficiency in one plant in comparison with others may place it at risk of shutdown or transfer if the parent company management decides on a production restructuring process in order to guarantee its competitive position in the sector.

2.3. Integration of low labour cost countries in the international supply network

The integration of low-cost countries in the production strategy of automobile manufacturers has been one of the most significant changes for the location of production in the components sector (Humphrey and Memedovic, 2003). In recent years, globalisation has led to expansion into new geographical areas, mainly the 'emerging' countries (China, India, Latin America and Eastern Europe). In view of manufacturers' preference to work with the same suppliers in their different production locations, many components producers have followed manufacturers in this international expansion.

Several studies have noted this feature of the automobile industry in Europe. Van Tulder (2004) points to the strategy whereby manufacturers have included Eastern and Central European countries in their international supply networks. Layan and Lung (2007) note marked growth in the production of components in countries in North Africa as foreign multinationals are able to find cheaper wage conditions there and, from there, send their products to assembly plants in Europe.

The result of this strategy has therefore led to the inclusion of countries with low wage costs in the production set-up of the components production sector. Such countries offer alternative locations for certain activities, especially those that are labour-intensive. Over recent years, plants have been relocated to North Africa (Layan and Lung, 2008) and Central and Eastern Europe (Pavlínek and Janák, 2007; Jürgens and Krzywdzinski, 2009). It should, however, be pointed out that for firms whose strategy is not based on labour, these low wage cost countries are not particularly attractive as relocation destinations.

2.4. Size and global presence of firms

The process of internationalisation in the automobile sector has made global presence an essential requirement if firms are to step up their efficiency. In this context dominated by globalised firms with production locations in several countries, efficiency requires that suppliers must be able to supply to each of the locations. This has led to globalisation of the components sector and a fast process of restructuring based on mergers and acquisitions (Wells and Rawlinson, 1994; Chanaron, 2004). This, in turn, has led to the appearance of several giant firms that dominate the production of systems to be supplied to end manufacturers. Size and global presence have thus become critical factors at certain levels of the chain.

An example of this situation is that of a small group of suppliers that have grown to a large size in order to meet the requirements of the manufacturers they supply ('mega-suppliers')[1]. Concentration of the sector among this small number of leading producers, some of which had grown even larger than the automobile assemblers, was pointed out by Sadler (1998). Ten years later, these firms had grown in both production and size, gaining a larger percentage of total sales in the sector[2]. Although these globalisation processes have mainly affected first-tier suppliers, many firms at lower levels have grown in parallel. For many firms, the need to have an international production network has become part of their strategy.

The presence in the sector of these globalised firms, with subsidiaries in different countries, has facilitated international relocation processes. For instance, if we focus on cases of relocation in the sector in Spain over recent years (Cuervo and Guillén, 2005; Bilbao and Camino, 2008), we find those of Delphi, Lear Corporation and Valeo, all of which are 'mega-suppliers' (Delphi has 172 plants in 42 countries and 186,000 employees; Lear Corporation has 207 plants and 100,000 employees; and Valeo has 129 plants and 68,000 employees).

In sum, a flexible production set-up in these multinational firms allowing them to coordinate and transfer resources internationally allows them to take the lead in relocation processes. If they have alternative locations they can transfer production without incurring sunk costs, which have been identified as the main barrier to international relocation (Motta and Thisse, 1994).

2.5. Manufacturers' strategies to promote economies of scale in suppliers

Manufacturers are increasingly, and quickly, introducing new models that offer new features or improvements on the model they are replacing. This commercial objective is only possible if strategies are adopted to combine flexibility in the products

made with balance in the production costs that result from such constant change. This strategy covers:

1) The reduction and standardisation of platforms[3], that is, the use of a shared platform for different models so that a large number of components and systems are common to several vehicles all assembled on the same platform. This also makes it easier to interchange the production of such models among the firm's different plants (Patchong et al., 2003; García et al., 2005); and
2) Assignation by a manufacturer of the production and supply of a system or component to a single supplier ('single sourcing'*).* This is advantageous because there are fewer suppliers to deal with and increased outsourcing, both of which are key for maintaining efficiency in this sector (Richardson, 1993; Matthyssens and Van den Builte, 1994).

These two strategies have allowed firms in the components sector not only to save by specialising in the production of a specific component but also to face high product development costs because the minimum threshold of units produced to make such investments profitable is guaranteed by the exclusive supply of the component for one or more models on a single platform.

In order to reach these economies of scale, components producers restructure and rationalise their production capacity globally, intensifying intra-corporate flows among plants. On the one hand, they are able to concentrate production capacity by transferring part or all the activity to other plants in which production is finally concentrated. On the other, they can specialise by product or activity, and such specialisation is often linked to comparative advantages in location. This process leads to the relocation of activities from plants that initially manufactured a product but were not chosen to continue producing it within the new production set-up. In this sector, this has sometimes led multinationals to give up some of their divisions in a country or even in a continent.

2.6. Lean supply as a model

Lean manufacturing has become a standard in the automobile sector. Flexibility and quality in a mature, saturated market have been two of the most important objectives in the choice of the production model finally adopted. Clearly, there are differences among the production systems developed by each firm, but these lie above all in the extent to which the systems are adopted (Bélis-Bergouignan et al., 2000). Extension of this philosophy to purchasing policy and supplies has been considered key for successful adoption of the model (Mehra and Inman, 1992). It has led to the concept of 'Lean supply' or 'JIT purchasing', the term used for the characteristic supply

activities of a ‘Just in time’ environment. It entails a set of activities involved in a global approach to relations between manufacturers and suppliers that has been widely adopted throughout the sector (Alonso et al., 2006). Amongst them, of special interest are operating practices relating to the physical flow of products, which determine the location of firms under this model of supply chain management (small and frequent batches for delivery, use of kanban and synchronisation, minimum stocks and geographical concentration using plants or warehouses).

These practices have been applied unevenly, with greater adoption among first-tier suppliers and less among levels that are further away from the assembler. Irrespective of this fact, Lean supply has led to great importance being placed on the link between production location and market location (González-Benito and Spring, 2000). Under this type of supply, the distance between manufacturer and supplier may not be a barrier to adoption (Wafa et al., 1996; Das and Handfield, 1997) but does imply an increase in the cost of logistics, especially transport.

Under Lean supply, supplier-customer proximity is a requirement for certain components and systems that are synchronised with vehicle assembly (front-end, cockpit, seat, back axle, exhaust system, etc.), so the plants producing them are unlikely to be relocated. Moreover, the lack of proximity between supplier and manufacturer can only be mitigated by solutions that increase logistics costs, with cargo consolidation or the use of buffer warehouses (Handfield, 1993; Miemczyk and Holweg, 2004). This amounts to a barrier for relocation.

2.7. Influence of the institutional environment on decisions in the sector

The automobile sector affords many examples of networks governed by a large firm that organises and coordinates a group of suppliers. This coordination and organisation is influenced not only by the automobile manufacturer’s strategies in each region and market, but also by the specific socio-political and institutional environment in which they work (Coe et al., 2004; Dicken, 2007).

Undoubtedly, for many countries the importance of the sector in terms of jobs and GDP has given the automobile industry a key role from the institutional viewpoint. Proof of this can be seen in the influence exerted by governments in development of the sector. This takes the form of tax incentives and promotion of investment to encourage automobile and components manufacturers to establish operations in their territories (Pavlínek and Janák, 2007; Chu, 2011; Ibusuki et al., 2012).

From this institutional viewpoint, the degree of integration in the environment is considered one of the main reasons for resisting a change of location (Amburgey et al., 1993). Such integration results from the generation and spreading of relations of trust in the long term with different institutions based, above all, on proximity (Putnam, 1993; Becattini and Rullani, 1995). In the automobile sector, ownership of a firm's capital plays an important role in the extent to which a plant is integrated in its institutional environment (Aláez and Barneto, 2008).

The sector is characterised by the presence of many multinationals whose head offices coordinate and control the operations of their subsidiaries (Andreff, 1996). This means that the decision-making centre of many firms is outside the territory where activities take place. For such production plants belonging to foreign-owned firms, there is a separation between the economic activity and the management on the one hand, and between the people involved in the activity and the society around them on the other. Such firms therefore have plenty of leeway for deciding on the shutdown and transfer of plants because political and social costs fade for them. Conversely, for national-owned firms that are more integrated in their institutional environment, the political and social costs associated with relocation processes amount to a barrier for moving the activity.

Table 1 summarises this analysis of strategies in the sector, implications for location and relocation and factors that determine relocation.

Table **1**: Strategies, trends, and relocation factors

Strategies and trends in the sector	**Implications for location and relocation of production**	**Firm relocation factors**
Fragmentation of the value chain	Spatial division of labour based mainly on technological requirements in production processes	Technological complexity
Competition based on process efficiency and cost reduction	The relative efficiency of production plants in comparison with their subsidiary plants becomes a key criterion in relocation decisions	Productivity
Integration of low labour cost countries in the international supply network	Low labour cost locations attracts labour-intensive activities	Labour intensity

Size and global presence of firms	Sector dominated by large multinationals with many locations and great flexibility for transferring resources internationally	Alternative plants
Manufacturers' strategies to promote economies of scale in suppliers	Constant processes of concentration, specialisation and rationalisation of capacities to obtain economies of scale involving intra-corporate production flows	Corporate restructuring
Lean supply as a model	Relevance of manufacturer-supplier proximity. Distance increases logistics costs and makes moving the activity difficult	Lean supply requirements
Influence of the institutional environment in decisions in the sector	Importance of political and social costs as determined by integration of the plant in the institutional environment, for relocation decisions	Capital ownership

Source: Drawn up by the authors

3. EMPIRICAL EVIDENCE FOR THE CASE OF SPAIN

In Spain the automobile industry (including both manufacturers and components producers) accounts for 6% of GDP and 18% of total exports. Several vehicle manufacturers are present in Spain, with a total of seventeen production plants. These produced 2.36 million units in 2011, placing Spain in ninth position for volume of units produced, that is, 2.9% of worldwide production. Of every 100 workers in the automobile sector, 78 were employed by components production firms (190,000 people in 2011). Equally important is the value of production which amounted to 29.5 billion euros that same year, placing Spain in sixth position worldwide and third in Europe for components production, only preceded by Germany and France.

The world's main producers of components are present in Spain, alongside a large number of Spanish firms, some of which are highly international. Components production supplies not only Spanish industry (41% of the total goes to the domestic market) but also plants in Europe (48% of total production). In addition, the Spanish industry imports large quantities of components, especially from European countries. In 2011, the value of such imports from Europe was 20.3 billion euros. All these figures indicate the importance of Spanish auto components in the geography of the sector in Europe and the strong spatial links between components production and the market for them.

3.1. Relocations from 2001 to 2008

33 production plants fully or partially relocated their activity during the period 2001-2008. In employment terms, this amounted to the loss of 9,300 jobs from plants belonging to multinational groups, most of them foreign-owned (91% of the total). This migrated production accounted for 1.4 billion euros a year in sales.

Regarding the relocated products and activities (Table 2), wire harnesses amounted to over 33% of cases covered in our empirical work, followed by textiles (fabrics, seat covers and airbags) with 18%, rubber and plastic products (pipes, rubber parts and external decorative elements) and small metal, mechanical elements (bearings, valves, shock absorber parts, etc.) 12% each, and the rest were electrical motors assembly, lighting and signalling elements, safety belts, steering columns, locks and other metal elements.

Table **2**: Relocated products and activities

Product	**No. of plants**	**Product**	**No. of plants**
Wire harnesses	11	Headlamps and signalling elements	2
Small metal elements (bearings, valves...)	4	Electric motors (windscreen wipers, fans, ...)	2
Airbags	3	Door locks	1
Fabrics and seat covers	3	Steering columns	1
Pipes and rubber parts	2	Safety belts	1
Plastic parts	2	Metal frames for seats	1

Source: Drawn up by the authors

The geographical destinations of relocated production (Table 3) mainly followed criteria of proximity and low labour costs. The main destinations were in Central and Eastern Europe (Poland, Czech Republic, Romania, Slovenia and others) which received 48% of relocated jobs, and North Africa (Tunisia and Morocco) which received 28%. Western Europe (France, Germany, Italy and Portugal) received 15% and Asia (China and India) and Latin America (Mexico) received 6% and 3% respectively.

Table **3**: Geographical destination of relocation (% of the 9,300 jobs lost)

NEARBY COUNTRIES (90.2%)				REMOTE COUNTRIES (9.8%)	
EUROPE CORE (6.8%)	EUROPE PERIPHERY (8.1%)	EUROPE CENTRAL & EAST (47.7%)	NORTH AFRICA (27.6%)	LATIN AMERICA (3.2%)	ASIA (6.6%)
France (4.8%)	Portugal (7.3%)	Poland (20.4%)	Morocco (22.9%)	Mexico (3.2%)	China (4.4%)
Germany (2.0%)	Italy (0.8%)	Czech Republic (10.8%)	Tunisia (4.7%)		India (2.2%)
		Romania (10.2%)			
		Slovenia (3.0%)			
		Turkey (1.3%)			
		Slovakia (1.1%)			
		Belarus (0.9%)			

Source: Drawn up by the authors

3.2. Data and variables

In order to test the key factors behind relocation, the data on relocated plants were compared with those of plants that had not undergone relocation during the same period (active plants). For the universe of active plants, the AMADEUS data base was used, from which plants in Spain classified under Vehicle Parts and Accessories (SIC 3714) having over 75 employees were taken, leaving a total of 254 plants.

The variables used to measure each of the relocation factors are given in Table 4, separating those for production plants and those for parent companies, and indicating the source.

Table **4**: Independent variables, definition and data sources

Variable	Definition	Source
Parent company variables		
Corporate restructuring	Quotient, expressed as %, for the number of plants closed by production restructuring processes in the last 3 years in Europe over the total number of the firm's plants in Europe	ERM
Alternative plants	Number of plants owned by the firm located in other countries that produce the same product as the plant	Survey
Capital ownership	Dummy variable: value 1 if the plant belongs to a mostly foreign-owned firm; 0 if Spanish-owned	AMADEUS
Production plant variables		
Lean supply requirements	Dummy variable: value 1 if the plant operates under a lean supply system (kanban or synchronous and multi-day delivery frequency); 0 otherwise	Survey
Technological complexity	[Number of production process technologies] * [Senior engineers and graduates among the total plant staff] * [Employees in quality functions among the total plant staff]	Survey
Productivity	Dummy variable: value 1 if the plant productivity (average value over the last 5 years of [Operating Revenue / Costs of Employees]) is below the average for subsidiary plants in Europe; 0 if it is the same or greater	AMADEUS
Labour intensity	Total assets / Number of employees (*)	AMADEUS

(*) Capital intensity (variable obtained directly from the source of information). Since this is complementary with labour intensity and to facilitate understanding of the results in the model, the final variable used results from applying the following algorithm to the data set: $X_n=-X+(X_{min}+X_{max})$, where X_n is the new value of the variable, X is the current value, X_{min} is the minimum value of X, and X_{max} the maximum value. With this transformation, the maximum value becomes the minimum value, the second highest value the second lowest value, etc.

The variables for active plants were obtained from a survey carried out during the first four months of 2009 using a sequential methodology based on three systems (by post, by telephone and from face-to-face interviews) and with the support of the TNS-Demoscopia research company for the field work. 153 valid questionnaires were received (sample error of $\pm$5.01%, for a confidence level of 95% considering equal population proportions of the characteristics being studied).

For relocated plants, the variables and qualitative information on relocation were obtained by means of in-depth interviews with members of the firms that participated in these processes of production mobility during the period 2005-2009[4].

The AMADEUS data base also included data to define both the *Labour intensity* and the *Capital ownership* variables. From this same data base, the value of productivity for each of the 186 plants (33 active plants and 153 relocated) was obtained, as well as that of their subsidiary plants located in Europe and producing the same product. The total number of European production plants used to compare productivity levels was 1,116. Finally, the *Corporate restructuring* variable was obtained from the European Restructuring Monitor (ERM).

3.3. Econometric analysis

Since in our study the endogenous variable shows a binary response (0/1; active plant / relocated plant), logistic regression models were used. Basic descriptive statistics of all variables and linear correlations between independent variables are reported in Table 5. *Capital ownership* is the only regressor with simple correlations over 0.25. Its moderate correlation with the *Alternative plants* and *Corporate restructuring* variables can be explained by the existence of large foreign-owned groups in the sector, with a global presence that is much greater than that of Spanish-owned companies.

We fit several logit models using a maximum-likelihood estimator. Iterative computations are performed using the software STATA 12. Results are reported in Table 6. Model 1 includes *Corporate restructuring* as the relocation motivator factor and all the variables identified as the facilitator and barriers in the relocation decision. Model 2 also includes the effect of the *Productivity* variable. In model 3 all the independent variables are included. Multicollinearity between regressors is not a serious concern. We checked that econometric results hold when *Capital ownership* was excluded from the models.

All variables are significant. Model 3 performs significantly better than model 2 and model 1 in terms of goodness of fit (Pseudo-R^2). In figure 1 we compare observed choices on relocation with probabilities derived from model 3. The model is particularly accurate for firms with estimated probabilities below 0.2 (137 observations) and over 0.6 (16 observations).

Table **5**: Descriptive statistics and correlations between independent variables

Variable	**Mean**	**S.D.**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Relocation	0.18	0.383							
(1) *Corporative restructuring*	3.03	6.632	1						
(2) *Alternative plants*	13.89	14.77	0.123	1					
(3) *Capital ownership*	0.65	0.480	0.516**	0.552**	1				
(4) *Lean supply requirements*	0.35	0.478	-0.161*	0.086	0.072	1			
(5) *Technological complexity*	0.017	0.043	-0.027	-0.068	-0.039	0.099	1		
(6) *Productivity*	0.41	0.493	0.036	0.213**	0.114	-0.082	-0.088	1	
(7) *Labour intensity*	829.9	125.5	0.118	0.091	0.117	-0.248**	-0.192*	0.194*	1

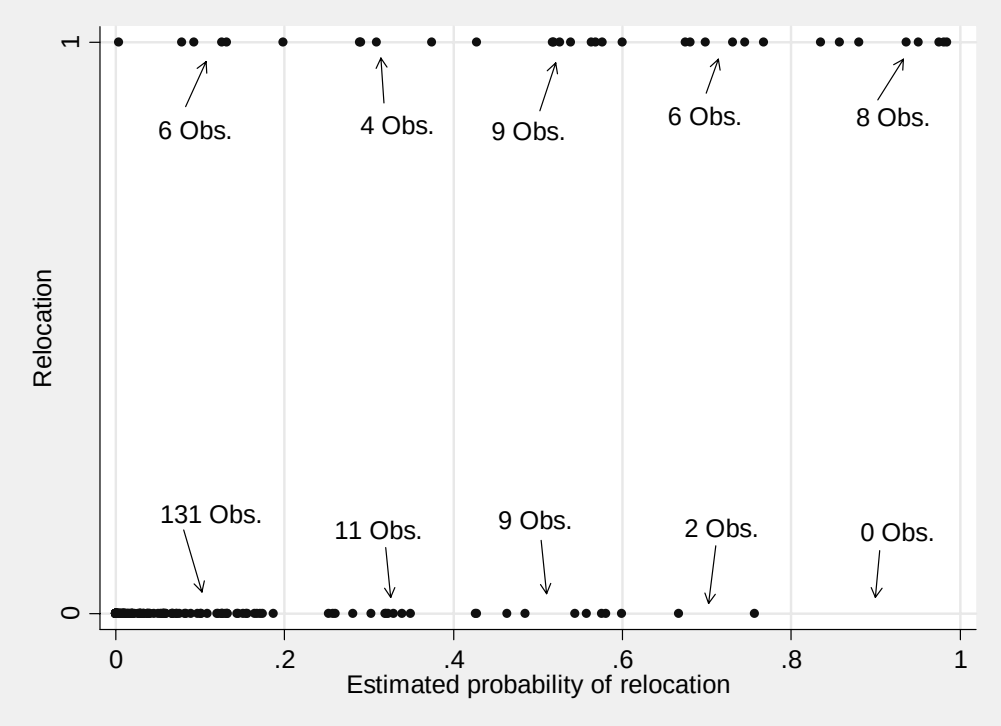
**** p<0.01; ** p<0.05; * p<0.1. Pearson's correlation coefficient between pairs of quantitative variables and Spearman's correlation coefficient between pairs of variables in which one of them is qualitative.*

Table **6**: Summary of the results of the logistic regression models

Variables	**Model 1**	**Model 2**	**Model 3**
Corporative restructuring	0.062**	0.071**	0.070**
	(0.028)	(0.032)	(0.030)
Alternative plants	0.052***	0.050***	0.054***
	(0.016)	(0.017)	(0.018)
Capital ownership	1.496**	1.718**	1.342*
	(0.720)	(0.773)	(0.777)
Lean supply requirements	-2.365***	-2.470***	-2.201***
	(0.725)	(0.760)	(0.829)
Technological complexity	-92.592**	-90.635**	-71.720*
	(40.949)	(40.516)	(40.944)
Productivity		1.487***	1.320**
		(0.518)	(0.541)
Labour intensity			0.016**
			(0.006)
N	186	186	186
Pseudo-R^2	0.340	0.392	0.450

**** p<0.01; ** p<0.05; * p<0.1.*

Figure 1: Comparing probabilities of relocation with observed relocation



Source: Own elaboration based on model 3 in Table 6

3.4 Discussion of results

The econometric results show that the restructuring strategies adopted by multinationals to obtain economies of scale largely explain relocation processes in the sector. These intra-corporate processes for the transfer of production capacities among plants belonging to a single multinational have been intensified because of by the size and global presence required in the sector. The significance of the *Alternative plants* variable suggests that the greater the size of the production locations network in countries apart from that of the multinational, the greater the flexibility for coordinating and transferring resources internationally. In this context of production restructuring in multinationals, internal rivalry or intra-corporate competition measured in terms of productivity plays a determinant role in the relocation decision. The results obtained for the *Productivity* variable show that subsidiaries of a single multinational group amount to the greatest source of competition to be taken into account for maintaining the location of a production plant in the sector, greater than that of external competition.

In line with the need to reduce costs in the sector, the results obtained for the *Labour intensity* variable indicate that labour-intensive firms are under great pressure to relocate their production outside Spain. Firms in the sector using labour-intensive technologies –wiring, textiles or assembly activities– have been forced to relocate their activity in countries with low labour costs, mainly North Africa and Central and Eastern Europe, as well as China, India and Mexico (see Tables 2 and 3).

Considering the significance of the *Technological complexity* variable, the greater requirements of quality and knowledge of technologically complex processes act as a restriction on transfer to a different location. Conversely, the lack of complexity in many processes, caused by fragmentation of the value chain in the sector, has been used by firms to select optimum locations to which such standard processes using simple technology can be transferred.

When barriers to relocation processes in the sector are analysed, the results show that demanding supply logistics –pull order system and multi-day delivery frequency– amount to one of the main restrictions for plant mobility. The high cost of logistics solutions when customers are far away and the supply system involves short lead times and a flexible response to changes in demand reduces the benefits of changing location. The intensification of spatial links between production and market under Lean supply is clear from the fact that it is nearby countries –North Africa and Europe– that are the main destinations of migrated activity.

Finally, econometric estimates show to what extent institutional factors determine relocation decisions in the sector. When decisions and activities take place in the same location, there are many institutional pressures, both political and social, that act as barriers to the transfer of a plant. Conversely, for production plants belonging to foreign-owned firms, political and social costs are much less relevant for relocation choices.

4. CONCLUSIONS

International relocation of production has been one of the main results of production reorganisation in the automobile components sector to implement the efficiency strategies adopted by automobile manufacturers. Analysis of relocation factors shows that the geography of the European automobile components sector has been characterised by expansion of the production space in the search for new peripheries, a reorganisation of spatial division of labour and an intensification of intra-corporate production flows.

The basic determinants in this process are the search for locations with lower labour costs and corporate production restructuring strategies adopted by multinationals. The former is related to the requirement for constant cost reduction together with the inclusion of low labour cost countries in the sector's production set-up, both of which have made relocation a strategic matter for labour-intensive activities. This search for lower labour costs has changed the European periphery in the sector. Countries in North Africa and Central and Eastern Europe have become the main destination for labour intensive activities, especially the production of wire harnesses and textile products and assembly activities to supply automobile manufacturing plants located in Europe. Regarding the strategies adopted by automobile manufacturers to achieve economies of scale in the components sector, these have been accompanied by processes of specialisation, concentration and rationalisation of production capacity within multinationals in the sector. These processes, which are facilitated by the predominance in the sector of large multinationals having a global presence and a large number of alternative plants located in different countries, give them great operational flexibility for coordinating and transferring resources internationally.

This prominence of multinationals has made internal decision-making processes for the allocation of production capacities and intra-corporate production flows among subsidiaries particularly relevant in the spatial distribution of production in the sector. This situation has brought with it a new way of seeing competition. Management tensions associated with the decision-making process in the distribution of production and the resulting allocation of resources to each plant reflect with precision the competition that lies behind plants belonging to a single multinational group. In such a context, the relative differences in productivity among European subsidiaries are determining the location of many of the production activities in this sector in Europe.

The link between requirements in terms of production technology and management of relocation flows indicates how work is divided spatially in this sector. This shows to what extent certain characteristics of the geographical set-up of the sector in Europe are being retained, that is, with polarisation of technologically complex activities in the centre and the production of standard products in peripheral countries with the transfer of the simple technologies they need.

The adoption of Lean supply as the standard process has made logistics costs especially relevant in relocation decisions. This supply system has intensified spatial links between components and automobile production plants in Europe. More distant countries are rarely an alternative for the relocation of plants producing components to be used in automobile assembly plants located in Europe.

Finally, domestic-owned plants are less likely to be relocated than foreign-owned plants as political and social costs are less relevant for the latter. As a result, public policies have had relatively little influence on multinationals' relocation decisions or, therefore, on the geography of the sector. Such decisions are taken on the basis of corporate criteria so are favoured by globalisation and by flexibility for transferring resources internationally.

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Notes

[1] This term refers to suppliers who supply direct to manufacturers and have acquired a large size by managing extensive resources, capital and capabilities (Sutherland, 2005).

[2] Frigant (2009) pointed this out. In 2005, the turnover accrued by the 30 leading firms in the production of components amounted to over 73% of the total for the sector, and the average turnover of these firms was 11.055 billion dollars as opposed to 6.38 billion in 1998.

[3] The platform is the basic support of a vehicle, including the chassis, the engine, the transmission and other elements except those related to personalised style or characteristics.

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