Relocation in conditions of uncertainty: the Spanish automobile components industry during the economic crisis (2008-2012)

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Abstract: This paper analyses production relocation patterns in conditions of uncertainty. Analysis of the Spanish automobile components industry during the recent economic global crisis shows that the number of relocations was comparatively lower than in the period before the crisis. Uncertainty weighs more than the advantages derived from the operational flexibility of multinationals in relocation decisions. The main drivers of relocation in the sector are the search for lower labour costs and corporate restructuring. When there is uncertainty, these are conditioned by relocation costs and the risks inherent in such processes. The main implication of the research is that it helps identify the vulnerability of a region in relocation processes. This is key for defining public policies to prevent relocation and avoid its impact on regions that have traditionally suffered such processes.

Keywords: Production relocation; location theory; automotive industry; economic crisis; uncertainty.

1. Introduction

Production geography and in particular the analysis of relocation decisions is a relevant subject for different companies, industries and the regions linked to them (Laamanen et al., 2012; Lampón & Lago-Peñas, 2013). The literature has stressed the special role played by multinationals (MNEs) in the distribution of production decisions (Mucchielli & Saucier, 1997; Barba et al., 2001; Belderbos & Zou, 2006; Konings & Murphy, 2006). This is largely due to their operational flexibility for transferring resources internationally (Kogut & Kulatilaka, 1994; Huchzermeier & Cohen, 1996; Allen & Pantzalis, 1996). Such flexibility allows them to adapt to changes in the environment, especially in a situation of uncertainty, while maintaining an efficient production network configuration (Huchzermeier & Cohen, 1996; Kogut & Chang, 1996; Chung et al., 2010).

An interesting case is the automobile industry; internationalisation by automobile manufacturers has turned a global presence into an essential requirement for components firms (Chanaron, 2004). The result is the presence of globalised MNEs with many production plants in different countries that dominate production and technological activity in the sector (Sutherland, 2005; Frigant, 2009).This industry has experienced several intense changes in spatial distribution of production activities, among both automobile manufacturers and components suppliers (Bilbao & Camino, 2008; Layan & Lung, 2008; Jürgens & Krzywdzinski, 2009; Pavlínek et al., 2009; Domański et al., 2013; Lampón et al., 2015; Pavlínek, 2015). Production geography in the components sector has been transformed by rapid internationalisation processes (Frigant & Layan, 2009). The main processes adopted by firms were relocation to cut back labour costs, intra-corporate reorganisations and follow sourcing (Lung, 2004; Frigant, 2009; Sturgeon et al., 2008; Lampón et al., 2016).

The automobile industry's value chain is very dynamic and in constant transformation, which means attention must be paid to how new international scenarios affect production geography in the sector (Domański et al., 2013; Lampón & Lago-Peñas, 2013; Pavlínek, 2015). The recent global economic crisis of 2008 involved a change in the socio-political and economic environment that was of particular interest in terms of relocation processes (Kinkel, 2012; Domański et al., 2013; Pavlínek, 2015). This was mainly because the key element characterising the crisis was uncertainty, which conditioned the decisions that managers made (Nelson & Katzenstein, 2014; Byrne et al., 2016).

The purpose of this paper is to determine the trends in production relocation patterns in conditions of uncertainty. It makes two main contributions. First, it stresses that uncertainty affects the factors included in traditional models for international relocation based on location theory. Uncertainty increases the relevance of location theory approaches that base their explanations of relocation on limited information and the complexity of the assessment and decision-making process involved in choosing from among the different location alternatives. Second, while the literature has stressed the importance of the operational flexibility of MNEs for relocating resources internationally in conditions of uncertainty, this research shows that the relocation costs and the risks inherent in relocation

processes are key. It stresses that uncertainty has a negative impact on the use of relocation by firms. These findings also have important implications from a regional perspective, because the research points to factors that define the vulnerability of a region in relocation processes under conditions of uncertainty.

The paper is organised in three sections. The first one, based on location theory, identifies the relevant factors potentially leading to international production relocation, in particular in the automobile components sector. The second one analyses a comparison of the relocation patterns in the sector in Spain over two periods: before the global crisis (2003-2007) and during the global crisis (2008-2012). The last section provides the conclusions and the implications from a regional perspective.

2. Literature review

2.1. Relocation factors in conditions of uncertainty

The literature offers different approaches to, and interpretations of, uncertainty (Milliken, 1987; Beckman et al., 2004). In this research, the concept of uncertainty refers to what the literature calls environmental uncertainty (Milliken, 1987; Miller, 1993; Werner, 1996). This has been conceptualised using a range of definitions such as lack of the information needed to assess cause-effect relations in order to make decisions (Carpenter & Fredrickson, 2001), or changes in the economic conditions faced by an organisation that are outside its control and hard to anticipate (Krishnan et al., 2006) and including dynamism and controllability, all of which made interpretations of results and generalisations difficult (Buchko, 1994). In this research, uncertainty is defined as the environmental conditions that make it impossible to predict the future state of that environment, the impact on organisations and the possible outcomes of actions (Milliken, 1987; Buchko, 1994; McIver et al., 2009).

Studies on relocation are usually based on the neoclassical, behavioural and institutional approaches of location theory (Lloyd & Dicken, 1992; Hayter, 1997; Van Dijk & Pellenbarg, 2000; Brower et al., 2004; Holl, 2004; Knoben & Oerlemans, 2008). From an international perspective, the literature has shown that MNEs have a prominent role in international relocation processes (Buckley & Mucchielli, 1997; Belderbos & Zou, 2006; Konings & Murphy, 2006). MNEs' operational capabilities have been identified as a key driver for achieving higher levels of performance (Tan et al., 2007); managers thus allocate resources and capabilities to the areas that can contribute most to improving the company's outcomes. Operational flexibility therefore becomes a strategic tool, as it allows MNEs to coordinate and transfer resources internationally (Kogut & Kulatilaka, 1994; Huchzermeier & Cohen, 1996; Dasu & Li, 1997). Such flexibility explains MNEs' production configurations efficiently because it allows for international transfers and better adaptation to environmental conditions (Kogut & Chang, 1996; Chung et al., 2010).

For MNEs characterised by complex internal organisation and decision-making processes, the behavioural approach to location theory is very appropriate for the analysis of international relocation (Brons & Pellenbarg, 2003). Basically, the approach regards the firms as having limited information and being subject to uncertainty when it comes to decision-making, and when the aim of relocating is not to maximise profits but to seek a satisfactory result from the complex process of assessing the relocation alternatives (McCann, 2001). In this approach the firm's internal factors are considered as factors that explain relocation; not just those that are purely economic but also those that are more related to the firm's capabilities and the management's perception. Moreover, the costs linked to relocation such as dismantling, transport, implanting new facilities or training of the workforce at the new site, as well as the sunk cost, are included in the decision-making process (Rosenbaum & Lamort, 1992; Motta & Thisse, 1994; Clark & Wrigley, 1997). In terms of the economic capacity of the firm to finance relocation costs (Caves, 1996; Pennings & Sleuwaegen, 2000), such costs take on significant importance in the decision to change location in an environment of limited information and uncertainty. Thus, the first research hypothesis is:

H1: *In conditions of uncertainty, relocation costs are key when taking the decision to relocate production.*

At the same time, the behavioural approach focuses on the processes of estimating, searching, evaluating and information-processing, which may lead to relocation, and also takes path dependency into account (Van Dijk & Pellenbarg, 2000). From this perspective, the potential risks linked to international relocation are relevant factors in the process of evaluating location decisions (Schoenherr et al., 2008; Liu & Nagurney, 2011). These risks may be related, among other factors, to guaranteeing the transfer of knowledge and technological skills and quality to the new location or to the ability to deliver on time from the new location (Mucchielli & Saucier, 1997; Schoenherr et al., 2008; Danese & Vinelli, 2009).

From a neoclassical approach, location advantages of labour costs in low-wage countries are one of the main forces driving firm relocation (Fujita et al., 1999) and several studies show the relevance of relocating production activities to low-wage countries (Mucchielli & Saucier, 1997; Pennings & Sleuwaegen, 2000; Barba et al., 2001). In the automobile industry, the integration of low-cost labour countries, mainly Central and Eastern European and North African countries, in the supply strategy of automobile manufacturers has been one of the most significant changes for the location of production in the components sector (Lavan & Lung, 2008; Jürgens & Krzywdzinski, 2009; Pavlínek et al., 2009; Domański et al., 2013).

From a perspective of the risks that are inherent in relocation processes, locating in low-cost labour countries is more complex. The lack of readily-available qualified workers or the difficulty in attaining required levels of quality or productivity are issues that the literature includes among the risks of failure when relocating to these countries (Carrincazeaux & Berrou, 2005; Bilbao & Camino, 2008). Some risks are particularly unacceptable in conditions of uncertainty as failed relocation processes may not only have repercussions on the company's results but also, in the short-term, cause supply problems. Thus, the second research hypothesis is:

H2: *In conditions of uncertainty, the risks inherent in the relocation process reduce the relative importance of the search for low labour costs as a driver of relocation.*

The main internationalisation processes adopted by firms in this sector, apart from relocation to cut back labour costs and follow sourcing, were intra-corporate reorganisations (Lung, 2004; Frigant, 2009; Sturgeon et al., 2008; Lampón et al., 2016). In order to reach production efficiency, particularly economies of scale, components producers have traditionally restructured and rationalised their production capacity globally (Lampón & lago-Peñas, 2013). Operational flexibility allowed MNEs to implement corporate production restructuring strategies and thus optimise their production network. Such strategies, which forced firms to change their organisational and spatial structure, intensifying intra-corporate flows between plants, have explained some cases of relocation processes in the sector (Lampón et al., 2015).

These restructuring processes can be used by MNEs when faced by changes in the environment, not with the aim of obtaining economies of scale *per se*, but rather as a response to fluctuations in demand (Chung et al., 2010). There is evidence indicating that in economically tense times of decreasing global growth and sales, companies tend towards re-concentrating their production capacities at their parent site and serving some foreign markets via export modes (Kinkel, 2012).

In Europe, the loss of production of 3 million vehicles and a reduction in demand for components destined for European vehicle plants occurred during the first two years of the crisis period (2008 and 2009) (Pavlínek & Ženka, 2010). This caused many firms to consider the possibility of restructuring their production networks and rationalising their production capacities (Lampón & Lago-Peñas, 2013). Although these plants need *Lean Supply* of certain components from nearby sources, which makes it impossible to relocate production of such parts, other components can be served at a distance under these conditions (Das et al., 1997; Miemczyk & Holweg, 2004). Thus, the third research hypothesis is:

H3: *In conditions of uncertainty, corporate restructuring gains in relative importance as a driver of relocation.*

2.2. Relocation intensity in conditions of uncertainty

Against the background of the 2008 economic crisis, the question arose: is the intensity of relocation in the automobile components sector going to continue, or has it significantly decreased? Some empirical studies have shown that uncertainty has had an impact on the probability of relocation among MNEs and point out that operational flexibility has a higher value in uncertain times (Li & Ruman, 2007; Belderbos & Zou, 2009). MNEs have the option to relocate their activity among plants within their production networks, seeking the advantages of being able to transfer resources which firms without such an international production network do not have (Kogut & Kulatilaka, 1994). The automobile components sector is characterised by the presence of large MNEs that dominate production activity (Sutherland, 2005; Frigant, 2009) and their operational flexibility can favour their relocation processes in conditions of uncertainty. Furthermore, production relocation is becoming an increasingly interesting option as a form of foreign direct investment (FDI) (Pennings and Sleuwaegen, 2000; Kinkel, 2012). In particular, this aspect is relevant when considering the clear reduction in FDI flows during the first years of the economic crisis (UNCTAD, 2009).

However, although operational flexibility in MNEs improves their efficiency, particularly in situations of uncertainty, the relevance of relocation costs and the risks inherent in such processes can condition and limit the use of such flexibility for transferring resources internationally (Rosenbaum & Lamort, 1992; Clark & Wrigley, 1997; Schoenherr et al., 2008; Danese & Vinelli, 2009).

MNE managers must take decisions regarding the location of manufacturing network production capacities by considering the advantages of operational flexibility, the use of relocation as a form of FDI, and the costs and the risks inherent in the relocation process. A period of economic crisis adds not only limited information to the decision-making process, but also uncertainty about how the environment will evolve. Therefore, aspects regarding relocation costs and risks take on greater weight in such decisions compared to aspects regarding the expected results of such production mobility processes. Thus, the fourth research hypothesis is:

H4: *In conditions of uncertainty, production relocation processes are reduced.*

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 2.73 million units in 2015, placing Spain in eighth position worldwide for volume of units produced. In Europe it is in second place, after Germany, and is the leader in the industrial vehicle segment (OICA, 2015). The components industry (SIC 3714: Vehicle Parts and Accessories) is an essential part of the Spanish automobile sector, especially in terms of employment. Of every 100 workers in the automobile sector in 2015, 76 were employed by components production firms (a total of 205,000 people in 2015) (SERNAUTO, 2015). Equally important is the value of production which amounted to 32.0 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 components sector in Spain is characterised by a strong industrial fabric linked to automobile assembly plants located in the country, highly-skilled and experienced labour and firm institutional support. The world's main producers of components are present in Spain, alongside a large number of Spanish firms, some of which are highly international (SERNAUTO, 2015). Over the last decade, firms have seen a far-reaching change in their size and their situation within the sector's value chain. Today, plants belonging to MNEs are operating at the first and second levels of supply, and dominate production activity in the Spanish sector.

Finally, production relocation processes in Spain were particularly intensive in the automobile components industry during the last decade 2000-2010 (Bilbao & Camino, 2008; Lampón & lago-Peñas, 2013), accounting for 18.1% of totally relocated plants and 20.3% of jobs relocated in Europe (EU 27 and Norway), according to data from the European Restructuring Monitor (ERM).

3.1. Data

Taking into account the subject of the research, we chose to use three samples of automobile components production plants belonging to MNEs: one sample comprised plants which, during the period before the economic crisis 2003-2007, had relocated their production, a second sample was of plants relocated during the period of economic crisis 2008-2012, and the other comprised plants that had not undergone this relocation process during the two periods 2003-2012.

a) Relocated plants before the economic crisis from 2003 to 2007

The process of obtaining the sample of relocated plants started out with an analysis of several sources of information (scientific literature, sector reports and studies, public and private surveys on relocation and databases on European restructurings). Subsequently, the cases were verified through direct contact established with managers in the companies involved. The final number of plants relocated during this period for which information was available for the analysis was 26. In employment terms, this amounted to the loss of 8,040 jobs. This migrated production accounted for 1.1 billion euros a year in sales.

The relocated products were wire harnesses in over 42% of the cases covered in our empirical study, followed by textiles (fabrics, airbags, etc.) at 24%, plastic products (pipes and external decorative elements) at 13%, and other products at 21%.

b) Relocated plants in the period of economic crisis from 2008 to 2012

Using the same process described above to identify the relocated plants, the final number of relocations during this period for which information was available for the analysis was 15. In employment terms, this amounted to the loss of 2,610 jobs. This migrated production accounted for 0.7 billion euros a year in sales.

The relocated products during this period were more heterogeneous: mechanical steering and transmission elements accounted for 18%, components belonging to modules (seat, cockpit, etc.) 18%, small metal elements (bearings, valves, etc.) 12%, rubber parts 12%, wire harnesses 12%, and other products 16%. Table 1 summarises the geographical destination of the relocated production.

c) Non-relocated plants from 2003 to 2012

The AMADEUS database was used to determine the universe of non-relocated plants. The selection was drawn from plants located in Spain, classified as Motor Vehicle Parts and Accessories (SIC 3714) and belonging to MNEs, which had not relocated in the two periods from 2003-2012. A total of 219 plants met these criteria.

The value of annual production by these 219 plants amounted to 24.7 billion euros. Plants belonging to some of the world's main producers of components are present in this sample as well as a large number of plants belonging to Spanish multinationals.

3.2. Variables

Three variables were employed in the empirical analysis to test the hypotheses.

- *Relocation costs*: This variable refers to the cost related to the production assets (Pennings & Sleuwaegen, 2000; Sleuwaegen & Pennings, 2006) and is a measure of the value of the plant's machinery and equipment.
- *Labour intensity*. According to the perspective that labour-intensive firms are more likely to move their production towards low-cost labour locations (Antras & Helpman, 2004), this variable is defined as the labour costs in relation to the total cost of the plant.
- *Corporate restructuring*. In the literature, this variable appears as a dummy that indicates whether a firm implements this strategy or not (Liao, 2004; Higuchi & Matsuura, 2004). In our research, the variable measures the intensity of the restructuring strategies implemented by the firm. This is defined as the number of European plants the firm has involved in a process of concentration or rationalisation of capacities over the total number of its European plants.

A further three control variables were considered which, according to the literature (Brower, 2000; Pennings & Sleuwaegen, 2000; Van Wissen, 2000; Brower et al., 2004; Lee, 2006; Sleuwaegen & Pennings, 2006; Lampón & Lago-Peñas, 2013), are relevant in relocation decisions:

- *Operational flexibility*. A firm's production network configuration (their size or presence in a large number of countries) can increase its operational flexibility (Allen & Pantzalis, 1996; Pennings & Sleuwaegen, 2000; Tong & Reuer, 2007). The variable is measured as the number of plants the firm has (Lee, 2006).
- *Foreign ownership.* This variable indicates that the plant belongs to a foreign firm (Brower et al. 2004; Lampón & Lago-Peñas, 2013). The variable is defined as a dummy, which is 1 if the plant belongs to a firm that is foreign-owned, or 0 if the capital is Spanish.
- *Plant age*. This variable indicates the years that the plant has been operating (Brower, 2000; Van Wissen, 2000). In our case, for relocated plants it is the difference between the year of relocation and the year of establishment. For non-relocated plants, it is the difference between 2012 and the year of establishment (if the variable is analysed for the crisis period), or the difference between 2007 and the year of establishment (if the variable is analysed for the pre-crisis period).

Different sources were used to obtain the variables. The *operational flexibility* variable expressed as the total number of plants was collected from the corporate information of the respective MNE. The *corporate restructuring* variable was calculated using information gathered from the European Restructuring Monitor (ERM). This database covers cases of production restructuring that involve an increase or loss of at least 100 jobs, or affect at least 10% of the workers in plants having more than 250 employees. *Relocation costs, labour intensity, foreign ownership* and *plant age* variables were collected from the AMADEUS database.

Table 2 summarises the variables, distinguishing between those relating to the production plant and those relating to the parent company (firm), and indicating data sources.

Table 1. Relocation key figures

	Period before economic crisis (pre-crisis) 2003-2007	**Period of economic crisis 2008-2012**
Number of relocated plants	26	15
Employees relocated	8,040	2,610
Relocation rate (Number of relocated plants / Number of non-relocated plants)	11.9%	6.8%
Geographical destination (expressed as % of the relocated jobs)		
Remote countries	11.3	0.0
Latin America (Mexico)	3.7	0.0
Asia (India, China)	7.6	0.0
Nearby countries	88.7	100.0
Western Europe (France, Germany)	4.7	35.8
Southern Europe (Italy, Portugal)	9.5	30.2
Central and Eastern Europe (Poland, Romania, Czech Rep., Slovakia, Slovenia, Turkey)	47.6	16.6
North Africa (Morocco, Tunisia)	26.9	17.4

Table 2. Variables, definition, level of the analysis and data sources

Variable	Definition	Level of analysis	Source
Relocation cost	Value of production fixed assets (machinery and equipment)	Production plant	AMADEUS
Labour intensity	[Labour costs] / [Total costs]	Production plant	AMADEUS
Corporate restructuring	[Number of European plants of the firm involved in process of concentration or rationalization of capacities] / [Number of the European plants the firm has]	Firm	ERM
Operational flexibility	Number of plants owned by the firm located in other countries that produce the same product as the plant	Firm	Corporate Information
Foreign ownership	Dummy variable: value 1 if the plant belongs to a foreign-owned firm; 0 if Spanish-owned	Firm	AMADEUS
Plant age	Age of the plant in number of years	Production plant	AMADEUS

3.3. Analysis

Two statistical analyses were carried out using the samples and variables described. The first aimed to detect significant differences between the mean values of the variables for plants relocated in the 2003-2007 period and those relocated in the 2008-2012 period. Given the characteristics of the samples, a conventional t test for two independent samples was used to check the null hypothesis of no significant differences between the means of both samples (table 3). In order to interpret the t test results, the results from the Levene test must be taken into account. This test of the homogeneity of variance indicates whether the variability is statistically similar between the variables of the two samples. Depending on whether the variability is different or not, the pertinent t test result is chosen. Computations are performed with STATA 13.1.

Table 3. t contrast between plants relocated in the 2003-2007 period and plants relocated in the 2008-2012 period

		Levene's test for equality of variances		T test for equality of means	
		F	Sig.	t	Sig. (bilateral)
Relocation costs	Assuming equal variances	4.219	0.047	1.573	0.124
	Not assuming equal variances			2.069	0.049
Labour Intensity	Assuming equal variances	6.115	0.102	2.401	0.022
	Not assuming equal variances			2.177	0.044
Corporate restructuring	Assuming equal variances	0.019	0.892	-3.073	0.004
	Not assuming equal variances			-3.071	0.005
Operational flexibility	Assuming equal variances	3.743	0.060	1.273	0.211
	Not assuming equal variances			1.427	0.162
Foreign ownership	Assuming equal variances	1.307	0.315	-0.495	0.623
	Not assuming equal variances			-0.528	0.601
Plant age	Assuming equal variances	6.408	0.016	1.412	0.166
	Not assuming equal variances			1.673	0.103

The results from the analysis show, for the plants relocated in each period, significant differences in means for the three variables used to test the hypotheses. The *corporate restructuring* variable is

significant at a confidence level of 99%, whereas this is the case for *relocation costs* and *labour intensity* at 95%. The t coefficient's negative sign for the *corporate restructuring* variable indicates that it is the only one in which the mean for the variable for the sample of plants relocated from 2003 to 2007 is lower than that for those relocated in the 2008-2012 period. The results show no significant differences in means for all the control variables.

The second analysis determined the explanatory capacity of the variables in relocation for each period. The econometric model to be estimated was the following:

$$Relocation_i = b_0 + b_1\, x\ relocation\ costs_i + b_2\, x\ labour\ intensity_i + b_3\, x\ corporate\ restructuring_i + b_4\, x\ operational\ flexibility_i + b_5\, x\ foreign\ ownership_i + b_6\, x\ plant\ age_i + \varepsilon_i$$

The specification makes it possible to observe and compare the explanatory capacity of each variable in international relocation processes. The dependent variable, *Relocation*, shows a binary response (0/1; non-relocated plant / relocated plant). The corresponding logit model is estimated by using a maximum-likelihood estimator. Computations are performed with STATA 13.1. In order to avoid scale issues in the variables, all of them were standardised. The results found are reported in table 4. The linear correlations between variables are shown in table 5. Multicollinearity between regressors is not a serious concern.

The two models (table 4) show a good performance in terms of goodness of fit (Pseudo-R^2 = 0.497 and 0.664) and predictive capacity (91.8% and 94.4%). In column 1 (model 1) of table 4, the *labour intensity* variable is highly significant at a confidence level of 99% ($p<0.01$), while the *corporate restructuring, operational flexibility, foreign ownership* and *plant age* variables are significant at 95% ($p<0.05$). Finally, the *relocation costs* variable is not significant. As expected, the sign of the coefficients confirms the effect of each variable on relocation.

In column 2 (model 2) of table 4, the *corporate restructuring* variable is highly significant at a confidence level of 99%, while the *relocation costs, operational flexibility, foreign ownership* and *plant age* variables are significant at a confidence level of 95% and *labour intensity* at 90% ($p<0.1$). As expected, the sign of the coefficients confirms the effect of each variable on relocation.

Table 4. Summary of the results of the logistic regression models

	Period before economic crisis 2003-2007	**Period of economic crisis 2008-2012**
Relocation costs	-0.209 (0.285)	-4.977** (2.498)
Labour intensity	3.004*** (0.783)	1.311* (0.715)
Corporate restructuring	0.413** (0.175)	0.751*** (0.296)
Operational flexibility	0.486** (0.234)	1.134** (0.476)
Foreign ownership	1.523** (0.767)	3.510** (2.074)
Plant age	-0.967** (.399)	-2.465** (1.244)
N	245	234
Predictive capacity (%)	91.8	94.4
Pseudo-R^2	0.497	0.664

*** $p<0.01$; ** $p<0.05$; * $p<0.1$. Standard errors in brackets.*

Table 5. Correlations between independent variables

Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1) *Relocation costs*	1					
(2) *Labour intensity*	-0.006	1				
(3) *Corporate restructuring*	-0.001	0.133*	1			
(4) *Operational flexibility*	0.225**	0.027	0.139*	1		
(5) *Foreign ownership*	-0.058	0.060	0.497**	0.399**	1	
(6) *Plant age*	0.081	-0.055	-0.176**	-0.205**	-0.050	1

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

3.4. Discussion of Results and Findings

The results for the control variables show, on the one hand, that there are no significant differences between the crisis and pre-crisis periods and, on the other, that in the econometric models for both periods these variables have a high explanatory power in relocation decisions. The significance of the *operational flexibility* variable confirms that the greater the size of the firm's international production network (the number of plants owned by the multinational), the greater its flexibility for transferring resources internationally and the easier the relocation processes. For the *foreign ownership* variable, the results indicate that this significantly increases the probability of relocation. From the institutional approach, foreign-owned firms have a large margin for action and for deciding on the transfer of their production plants. For such firms, the political and social costs associated with relocation processes are lower than for firms with decision-making centres in the same country as the plant to be relocated (Brower et al., 2004; Lampón & Lago-Peñas, 2013). Along the same lines, the results show that plant mobility decreases with age. The institutional approach of location theory indicates that older plants are more embedded in their spatial environment. They are embedded in networks based on long-term trust-based relations which are likely to be facilitated by spatial proximity (Brower, 2000; Van Wissen, 2000). In summary, the results obtained for the control variables tie in with expectations. The results of the variables that are significant at high confidence levels in the econometric models indicate that the data used for the analysis seem to be valid and reliable.

Regarding *relocation costs* variable, there is a significant difference of means when the two sample periods (table 3) are compared, in that the plants relocated during the time of crisis (2008-2012) show significantly lower relocation costs than the plants relocated during the pre-crisis period (2003-2007). Furthermore, when the results of the econometric models are observed (table 4), while those for model 1 do not explain relocation (pre-crisis), the results for model 2 indicate that the costs linked to dismantling, transport, implanting or procurement of new facilities condition relocation under conditions of uncertainty. So, hypothesis H1 is demonstrated.

In the debate on relocation costs for international production relocation (Rosenbaum & Lamort, 1992; Motta & Thisse, 1994; Caves, 1996; Clark & Wrigley, 1997; Pennings & Sleuwaegen, 2000), our research shows that, in a context of limited information and uncertainty, the location of an activity is a search for satisfactory outcomes and is the result of assessing alternatives in a complex process in which relocation costs have a determining influence.

The results of the conventional t test (table 3) for the *labour intensity* variable indicate that the plants relocated in the pre-crisis period are more labour intensive than those relocated in the crisis period. At the same time, the results from the econometric models (table 4) help to demonstrate the influence of this variable in the explanation for relocation in each period. The model 1 results indicate that labour-intensive firms in the pre-crisis period are under great pressure to relocate their production to low-cost labour locations. However, in model 2, even though some of these relocation processes can be explained by this variable and, therefore, there were labour-intensive firms that relocated production to low-cost labour locations, the low significance indicates that some of the labour-intensive firms opted to stay put. These differences for the two periods become considerable when the geographic destination of the relocated production is observed (table 1). In the pre-crisis period, the

low labour-cost destinations received a total of 85.8% of the relocated jobs (Central and Eastern Europe received 47.6%, North Africa received 26.9%, China and India received 7.6% and Mexico received 3.7%), whereas in the crisis period these low labour-cost destinations received a total of 34.0% of the relocated jobs (Central and Eastern Europe received 16.6% and North Africa received 17.4%). Relocation to countries where labour costs are low was significantly reduced in the crisis period compared to the previous period. Moreover, not one remote country was a destination for relocated production during the crisis period. So, the results obtained confirm hypothesis H2.

Our research highlights that, although previous studies have so far stated that the requirement for constant cost reduction and the inclusion of low labour-cost countries in the sector's production set-up have made relocation a strategic matter for labour-intensive automobile components firms (Van Tulder, 2004; Lavan & Lung, 2008; Jürgens & Krzywdzinski, 2009), in conditions of uncertainty, the risks that are inherent in these processes significantly condition such a strategy.

The results obtained by the t test for the *corporate restructuring* variable (table 3) indicate that plants relocated during the crisis period belong to MNEs that have implemented more intense production restructuring processes –concentration or rationalisation of production capacities– than the MNEs owning plants that were relocated before the crisis. Also, the result of two econometric models for the *corporate restructuring* variable (table 4) shows that the restructuring strategies adopted by MNEs largely explain international relocation of production processes in the sector. The spatial and organisational changes involved in this production restructuring favour intra-corporate flows in MNEs. As shown by the t test, these restructuring processes in the crisis period explain the greater significance of international production mobility, as this strategy is used as an option for rationalising production capacities among plants in the face of changes in demand. Therefore, hypothesis H3 is confirmed.

Finally, observing the key relocation figures for both periods (table 1), it can be seen that there is a reduction in relocation processes in the crisis period compared to the previous period: the number of cases drops to practically half and the number of relocated jobs to a quarter. The relocation ratio in the crisis period is much lower to that for the pre-crisis period studied in this research and other periods found in earlier studies on relocation (Brouwer et al., 2004; Sleuwaegen & Pennings, 2006). These results are especially relevant if one takes into account that the operational flexibility of the MNEs that have relocated plants is similar in both the periods analysed, as there are no significant differences in the t test for the *operational flexibility* variable (table 2) and this variable has the same explanatory capacity for relocation in both econometric models (table 3). Therefore, hypothesis H4 is confirmed.

The literature points out that MNEs use operational flexibility to adapt to changes in the environment while maintaining an efficient production network configuration (Kogut & Kulatilaka, 1994; Huchzermeier & Cohen, 1996; Chung et al., 2010) and this operational flexibility has a higher value in uncertain times (Li & Ruman, 2007; Belderbos & Zou, 2009). Our research shows that despite the operational flexibility of MNEs, the risks and costs inherent in the process of moving their activity means that uncertainty has a negative impact on the use of relocation by firms.

4. Conclusions

From a theoretical perspective, uncertainty conditions the factors included in traditional models for international relocation based on location theory. It increases the relevance of location theory approaches that base their explanations of relocation on limited information and the complexity of the choice from among the different location alternatives. From this perspective, economic factors related to the firm's capabilities (e.g. relocation costs and the financial situation required to meet them) and non-economic factors related to the management's perception of the risks inherent in relocation processes will both condition decisions about changing location and diminish any possible advantages arising from doing so. In fact, despite the importance attached by the literature to the operational flexibility of MNEs in international relocation, it is the above factors that determine the negative impact of uncertainty in the use of relocation by firms.

The research has various implications from the point of view of regions and the relocation of production during periods of uncertainty. On the one hand, regions that have traditionally been affected by these processes suffer less of an impact in terms of relocated activity and jobs, especially

activities related to labour-intensive processes. On the other, the relevance of a firm's internal factors, both economic and non-economic related to the manager's behaviour, make it difficult to detect the vulnerability of these regions in such processes. Risk analysis of relocation by production plants located in these regions is more difficult for public policy-makers because most of the key factors for the analysis are internal to MNEs, and those related to the environment are very uncertain. So defining public policies to prevent relocation in these regions is more complex. However, this research helps to explain the main barriers to relocation and the factors anchoring production plants to these regions. These are key elements for defining vulnerability to relocation and orienting public policies in such uncertain conditions. The research shows that the traditional institutional factors continue to be valid in this context. For domestic-owned firms, there are institutional pressures, both political and social, that act as barriers to relocation. Also, from this institutional perspective, the age of the plant acts as a barrier. Older plants are embedded in regional networks based on long-term, trust-based relations which are likely to be facilitated by spatial proximity. The research also points to a low probability that plants that have made large investments in production assets will relocate. If, in addition, the economic situation of the firms that own the plants is included in the analysis, the public decision-makers have a key element for measuring the region's vulnerability to relocation processes. Finally, in a context defined by corporate production restructuring processes in the face of changes in market demand, plants belonging to MNEs that are characterised by a lower implementation of such strategies are less likely to be relocated. Along these lines, plants with a diversified market in terms of customers, many of whom are located in the same region as the plant, will be less vulnerable to relocation processes.

This paper has limitations that could be considered in future studies. The choice of the Spanish automobile components industry is justified by its great relevance in terms of production and employment, its very heterogeneous production processes and the fact that many plants belong to MNEs. In addition, production relocation processes in this industry were particularly intensive during the last decade, accounting for a very large proportion of total jobs relocated in Europe. In order to generalise the results, it would be of interest to perform an analysis at European level, including more countries. This would make it possible to detect changes in intra-European production relocation flows and to include more factors, providing a broader view of the phenomenon according to the type of region (central, semi-peripheral and peripheral).

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