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The role of networking in the competitiveness profile of Spanish firms

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Abstract

Two main forces coincide nowadays in the characterisation of productive systems. On the one hand, the internationalisation of markets and economic activities has resulted in an increasing competition worldwide and a new and more global division of labour. On the other, the greater complexity of technology makes innovation a key factor in manufacturing firms' competitiveness. Cooperative network relationships seem to be important in both processes. This paper aims to explore this aspect in the competitiveness behaviour of four Spanish manufacturing industries: food, chemicals, electronics and vehicles. Data has been obtained from a survey conducted specifically for this purpose at the firm level. Findings from the empirical analysis, based on the application of the *Polytomus Logit Universal Model (PLUM),* confirm the positive effects of the ability to network on company performance, particularly, intra-firm cooperation, cooperation between competitors and user-producer relationships.

Keywords

Co-operation, Networking, Innovation, Competitiveness.

Resumen

La internacionalización de mercados, de actividades económicas y la creciente competencia global son algunos de los factores que caracterizan los sistemas productivos actuales. A ello se suma una intensa complejidad tecnológica que afecta tanto a productos como a procesos productivos, concediéndole a la innovación un papel clave en la competitividad de las empresas manufactureras. En ambos procesos, las relaciones de cooperación empresarial se erigen como forma organizativa de creciente importancia. En este documento se explora la relación entre cooperación y comportamiento competitivo en cuatro industrias manufactureras: alimentación, química, electrónica y automóviles. La información estadística se ha obtenido a partir de una encuesta realizada a nivel microeconómico y diseñada específicamente con este fin en España. Los resultados que se derivan del análisis empírico, basados en la aplicación de un modelo Logit Universal (PLUM), confirman los efectos positivos de las relaciones cooperativas en los resultados empresariales, concretamente las relaciones intra-empresa, la cooperación entre competidores y las relaciones usuario-proveedor.

Palabras clave

Relaciones cooperativas, Innovación, Competitividad.

JEL: D24, D85, O32

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Índice

1. Introduction[1]

The role of cooperative networks in the improvement of company competitiveness has been an issue of increasing interest that has been extensively explored in the economic literature of recent decades. The main reasons for that interest lie in the intensity and increasing competition worldwide due to globalisation trends. Adaptation to that new economic reality requires from firms to develop new organisational forms to be able to survive (Hamel and Prahalad, 1989). Although, explanations about the nature of that transformations are not completely new. Companies' internal resources are seen to be insufficient to achieve greater economies of scale, to reduce the levels of uncertainty involved in access to new markets and to exploit new business opportunities. It is largely accepted that the reduction of transaction costs, such as those related to negotiations and the establishment of contracts between firms, is behind the emergence of a new architecture of relationships (Coase, 1937). While vertical integration deals with the coordination problem of production factors, the entrepreneur capability to integrate complementary external knowledge assets derives on the emergence of more permanent ties. For these reasons, collaborative networks are considered a plausible solution to improving individual performance levels in the case of small and medium firms or SME (Rosenfeld, 1996). On the other hand, the increasing internationalisation of companies explains why local productive systems are characterised by contexts of competition between domestic and foreign-owned firms which are geographically close and which, in many cases, operate in the same segment of international markets; this mainly affects larger firms. Access to new information and knowledge is one of the most powerful motivations behind cooperation between firms. If we assume innovation is a social process, it generally involves more than two actors and for this reason, the role of external actors acquires a higher importance. Then, it is largely accepted that both competing and cooperating relationships involve key factors in the enhancement of firms' competitiveness levels (Belderbos, 2004; Freel, 2003; Lundvall, 1995).

Pioneering contributions on this topic in the literature of industrial organisation and innovation were focused on the importance of geographical proximity in explaining the dynamics of company performance and innovation. This was the aim of the literature on industrial districts which went on to look at clusters of firms and their determinant factors. The main idea extracted from the available evidence is that networking may increase firms' competitiveness, chiefly favouring SME (Humphrey and Schimitz, 1996). Although it is agreed that the Italian case has been paradigmatic, others experiences are reported for other European cases, as well as for North American and Japanese (Saxenian, 1994, Scott, 1992; Storper, 1989). In addition, economic analysis has tried to explain how locations affect a firm's decisions to cooperate with other agents. A growing interest in the flow of knowledge conditioned by geographical proximity has led to one important explanation about industrial and research activity agglomeration (Krugman, 1991). Nonetheless, spatial proximity is an issue not necessarily bounded by space but which could be also discussed from a cognitive point of view. As well as the importance of spatial proximity as a favouring factor in the interaction between actors, a common pool of shared knowledge, organisation and institutional elements also contribute to define the benefits from cooperation (Freel, 1996). Technology -or more broadly knowledge-, is accepted to be one of the key determinants for firms' competitiveness. Attending the behaviour of any particular industry, the general question is whether knowledge, not fully appropriable by the agent who generates it, may reach other firms nearby or whether it spreads on an international level (Jaffe, 1993). Two main trends are crucial in relation to this complex issue: the growing internationalised research and development (R&D) activities (Archibugi and Michie, 1995) and the strength of innovation systems as frame for local ties (Howells, 1999). The consideration of these two forces enriches the analysis of cooperation as a factor for the enhancement of competitiveness.

The existence of market inefficiencies in assigning intangible assets such as technology have

[1] This paper forms part of the outputs obtained by the Spanish partner, at the ICEI, in the European Research Project called *Competitiveness*, under the 5th Framework Programme of the EU. This paper refers to the results of a Survey conducted at the firm level in Spain carried out under that Project. According to a common methodological framework, the Survey has also been developed in mostly of the countries involved in the Project: Poland, Hungary and the Czech Republic. The authors are solely responsible for the views expressed herein and it does not represent the opinion of the European Community, and the European Community is not responsible for any use that might be made of data appearing here in.

led to several explanations about the internationalisation of companies based on market imperfections. While the eclectic theory recurs to ownership, location and internalisation -OLI- advantages to account for the strategies of multinational corporations (Dunning, 1973, 1980), the transaction costs theory exalts the advantages of vertical integration to avoid or reduce uncertainty (Williamson, 1975, 1981). Moreover, a particular structure of incentives to FDI is that constructed on industrial and intellectual property rights (Hortsman and Markusen, 1996). On the other hand, the evolutionary perspective takes innovation and technology development as core elements of market failures and it underlines the importance of companies' hierarchies and routines as the basis for the comprehension of the internationalisation process (Teece, 1977; Pavitt, 1984, 2001, Dosi, Teece and Chytry, 1998).

It has also been demonstrated that the changing strategies of large multinational corporations have developed into an increasing internationalisation of core activities such as R&D (Pearce, 1999; Archibugi and Ianmarino, 2000; Cantwell and Molero, 2003). Although R&D is still a process mainly concentrated in some regions and scarcely globalised (Patel and Pavitt, 2000), the question is how firms gradually become more internationalised in their innovation activities and capabilities (Duysters and Hagerdoon, 1996). R&D internationalisation would concede higher autonomy and independence levels to affiliate companies established abroad. This is an aspect with inherent effects on host locations. The global strategies of large firms and the increasing relationship between science and technology are making proximity an issue of higher importance and highlight the relevance of local capabilities (Cantwell and Mudambi, 2001; Cantwell and Piscitello, 2001). This is why proximity to public research centres, local infrastructures, education systems and a local scientific base are notably valuable for firms. For foreign companies, these aspects regard the dynamics of intra-firm networks and are conditioned by the independence of R&D activities carried out by the affiliates abroad, which could deal to the opportunity of becoming competence creating units (Cantwell and Mudambi, 2001).

Therefore, to analyse how cooperative relationships are linked to the competitiveness improvement of firms is an interesting issue which requires taking into account which are the most preferable actors for them. A twofold objective is followed in this paper. On the one hand, the observation of whether there are differentiated elements across industries leading the strength of local ties to foster firms' competitiveness. On the other, a discussion of the behaviour of foreign-owned firms which form part of international networks. These aspects are explored here in relation to the competitiveness behaviour of four manufacturing industries: food, chemicals, electronics and vehicles. Micro data has been obtained from a survey on competitiveness conducted specifically for this purpose at firm level in Spain.

To accomplish these objectives, the paper is structured as follows: In the second section, a data description of competitiveness and technology related variables from the Spanish survey results is made, according to both industries and ownership of the firms. The third is devoted to the characterisation of the kind of cooperation relationships the companies develop either with other companies or with other agents. In the fourth section the empirical model is presented in two steps. First, an explanation of both the competitive profile of firms as well as its potential determinants is made; analysis of them is based on a set of indicators which were specifically constructed as a result of a principal components analysis. Second, the results obtained from the econometric estimation are presented and confirm the role played by networking and innovation abilities in the firms' competitiveness level. Finally, some concluding remarks can be found in section sixth.

2. Company performance and technology: Data description

Research has been conducted at firm level into four manufacturing industries: food, chemicals, electronics and vehicles. The selection of these industries was designed to guarantee an international comparative study as well as ensuring the assessment of different technological content in a variety of industries. Information was gathered from company managers and collated at two specific periods of time: 1998 and 2003. The purpose of the survey was to obtain data on competitiveness measures, the impact of innovation and networking links. The companies included in the sample were selected with a view to guaranteeing representative results and to have a balanced

presence of firms from different industries[2]: The smallest proportion of companies came from the vehicle industry, which made up 19%, and the highest proportion were from the food industry, making up 30%. In terms of the ownership of the capital, the survey included domestic firms, foreign-owned firms and companies without controllers. However, since all the firms without controllers are domestic, only the first two groups are considered here. Among the companies in the sample, 20% are foreign-owned, although some differences across industries exist[3]: Only 5% of the food firms included in the sample are foreign-owned while among chemical firms this proportion is over 37%. In terms of company size, measured by the number of employees, the results of the survey were mostly representative of medium and large firms: the average size is close to 200 employees (186 employees). Again, differences across industries are noticeable, the largest firms belonging to the motor vehicles industry and the smallest being found in the food industry, where the average size is 73 employees.

2.1. COMPETITIVE PERFORMANCE

The market share of a company in relation to its main product has been the homogeneous measure of competitiveness taken in the survey and the results obtained reveal the lack of a clear profile[4]. The competitive structure prevails in a quarter of the firms in which their sales capture less than 10% of the market. On the other hand, another quarter of the sample show quasi monopolistic behaviour, that is, dominating between 90 and 100% of the market. This last statement is most notable in the food and vehicles industries where in both, more than 34% of domestic and foreign firms have reported a near complete domination of the market by their main product[5] - see Álvarez, Fonfría and Marín (2004) for more precise details on this issue.

When it comes to shares in the domestic market, the majority of companies in the four selected industries are mainly operating under competitive conditions –Table 1. Nonetheless, something more than one third of the firms in the vehicles and food industries are near-monopolist (38% and 36%, respectively), this latter being a character less common among more R&D-intensive industries. Some differences in the results corresponding to 1998 and 2003 are detected. In particular, the proportion of firms falling between the 10th and 90th percentiles has increased in the four industries and most notably in the chemical branch, due to the process of market concentration operated in recent years.

On the other hand, company managers were asked to answer two questions related to their competitiveness profile in the international market: the strength in both the main products and the production technologies[6]. With regard to products, the majority of firms have declared a moderate competitiveness level. Nonetheless, almost 50% of firms in the chemical branch declare themselves to be strongly competitive –Table 2. Considering the differences between foreign and domestic firms, although most of them are placed in the segment of moderate competitiveness, the level is notably higher among the former ones; a weak competitiveness profile is declared by more than 16% of domestic firms.

Finally, competitiveness in production technology is also considered as moderate by most firms and differences across industries persist - Table 3. In fact, for nearly half of the chemical companies their international competitiveness is strong; in contrast, nearly 28% of firms in the food branch declare their competitiveness weak. Regarding ownership, a notable 43.5% of foreign-owned firms rate themselves strongly competitive, while domestic firms prevail in a moderate level of competitiveness. This result coincides with other available evidence on Spanish manufacturing industries (Bajo and López, 1996).

[2] The number of responses obtained was 134 over a sample of 554 firms; then, the rate of response has been 29 per cent. The sample includes firms with more than 50 employees with productive activities in Spain –and not only commercial. The database *Fomento de la Producción 2002* that includes more than 30.000 firms in Spain provided the information to conform the universe of firms included in the survey.

[3] This is coincident with the figures corresponding to the presence of foreign firms in the Spanish manufacturing industries: foreign firms represent 22% of the manufacturing employment (Álvarez, 2003).

[4] Competitiveness is measured according to the categorization of firm market share in percentiles.

[5] According to data referred to all the manufacturing industries in Spain, the highest market concentration corresponds to vehicles and office machinery industries, where the C4 index achieves values of 73% and 75% respectively (Alvarez, 2003).

[6] These answers are based on the subjective assessment made by firms' managers.

Table 1
Domestic Market Share by Industry (percentages)

	Under competitiveness		In between		Near-Monopolist	
	1998	2003	1998	2003	1998	2003
Food	32,14	25,81	32,14	38,71	35,71	35,48
Chemical	36,84	20,83	52,63	70,83	10,53	8,33
Electronic	17,86	15,63	67,86	68,75	14,29	15,63
Vehicles	9,52	8,70	52,38	65,22	38,10	26,09
Total	23,96	18,18	51,04	60,00	25,00	21,82

n = 110

Table 2
International Competitiveness in Products by Industry and Ownership (1)

		Strongly competitive	Moderately competitive	Weak
Industry	Food	23,81	57,14	19,05
	Chemical	47,83	47,83	4,35
	Electronic	7,69	73,08	19,23
	Vehicles	21,05	73,68	5,26
	Total	24,72	62,92	12,36
Owner	Domestic	18,80	64,50	16,10
	Foreign	37,50	62,50	—
	Total	24,42	63,95	11,63

(1) Data correspond to year 2003 since no significant differences exist between 1998 and 2003
n = 89

Table 3
International Competitiveness in Production Technology by Industry and Ownership (1)

		Strongly competitive	Moderately competitive	Weak
Industry	Food	11,11	61,11	27,78
	Chemical	47,83	43,48	8,70
	Electronic	17,39	65,22	17,39
	Vehicles	23,53	70,59	5,88
	Total	25,93	59,26	14,81
Owner	Domestic	19,60	64,20	16,00
	Foreign	43,48	47,83	8,70
	Total	26,58	59,49	13,92

(1) Data correspond to year 2003 since no significant differences exist between 1998 and 2003.
n = 81

2.2. TECHNOLOGY - RELATED ACTIVITY OF MANUFACTURING FIRMS

It is accepted that technology-related activity is a factor which drives company competitiveness (Dosi, Pavitt, Soete, 1990; Soete and Verspagen, 1994; Verspagen and Wakelin, 1997). For this reason, exploring aspects related to technology can provide a better understanding of companies' competitiveness profiles. Firstly, we can note that in terms of the most formalised knowledge-generation activity, the institutionalisation of an R&D lab has been carried out in the majority of companies (65% out of 128 answered affirmatively to this question) –Table 4. That said, differences do exist between industries. In the chemical industry it is noticeable that all the foreign firms have an R&D or design unit and nearly 90% of the domestic ones too. However, in the food branch R&D is less institutionalised, and is more likely to be institutionalised in the foreign-owned firms in this industry. This is of particular interest for the four industries because when only foreign subsidiaries are taken into account, the percentage of companies with an R&D or design unit is clearly higher than those foreigners without one, a result which is also reported in other analyses of Spanish manufacturing firms (Fonfría, 1999). On the other hand, when the existence of quality control laboratories inside firms was considered, again a majority of firms replied affirmatively - all the foreign firms in the sample account with this kind of lab and in the chemical industry all the domestic firms too. In the other three industries, domestic firms which have no labs for the control of quality represent a notable 36% in the food and 33% in the vehicles branch –see Table 4.

Table 4
Percentage of firms with a R&D or design unit and quality control laboratory

		R&D Unit	Quality Lab
Food	Domestic	38,89	63,89
	Foreign	50,00	100,0
	Total	39,47	65,79
Chemical	Domestic	89,47	100
	Foreign	100,00	100
	Total	93,55	100
Electronic	Domestic	72,41	82,76
	Foreign	85,71	100
	Total	75,00	86,11
Vehicles	Domestic	50,00	66,67
	Foreign	60,00	100
	Total	52,17	75,00
Total		64,84	81,40

n = 128

With regard to R&D intensity, proxy by the amount of sales revenues that firms devote to R&D expenditures, 5% is the average value for the whole sample in 1998 and it reaches 6% in 2003 –see Table 5. The R&D intensity of domestic vehicle and chemical firms is exceptionally high in 1998 -8% and 7%, respectively-; domestic firms in the chemical sector retain this high intensity in 2003. Another R&D intensive industry is the electronics one: a value of 5.76% of sales in 1998 and 6% in 2003. At the other side of the scale, the lowest value of this indicator corresponds to foreign-owned firms operating in the food industry. Across periods, it is well noted that R&D carried out by foreign firms rose in the other three industries; particularly in the vehicles industry where it multiplied by up to 3.5. In

general terms, it can be said that domestic firms devote more resources to R&D than do foreign companies. Nonetheless, the latter have more labs, making formal innovation activities more likely than in the other group of firms.

Table 5
R&D intensity -percentage over sales-, 1998 and 2003

		1998		2003		Growth 1998-2003
		Average	St. Dev.	Average	St. Dev.	
Food	Domestic	3,67	6,14	4,36	7,52	18,83
	Foreign	1,00	—	—	—	na
	Total	3,40	5,85	4,36	7,52	28,15
Chemical	Domestic	6,89	5,88	7,08	6,12	2,73
	Foreign	2,00	1,10	3,43	1,72	71,43
	Total	4,65	4,90	5,64	5,05	21,29
Electronic	Domestic	6,00	4,87	7,63	6,46	27,08
	Foreign	4,67	3,51	5,67	2,52	21,43
	Total	5,76	4,59	7,32	6,00	26,91
Vehicles	Domestic	8,20	8,35	5,57	6,55	-32,06
	Foreign	2,00	1,15	7,00	6,06	250,00
	Total	5,44	6,78	6,09	6,11	11,87
Total		5,00	5,33	5,92	6,03	18,48

The uncertainty of innovation explains why very often firms need to recur to external sources of knowledge (Von Hippel, 1988). In-house R&D is not always enough to accomplish complex projects of technological development and in some cases other agents complement companies' in-house abilities. This is why the decision to cooperate with external agents depends on how their contribution is assessed by companies. Consultations about this topic in the survey provide a picture about the types of institutions favoured by cooperation or by the subcontracting of R&D activities. As shown in Table 6, the relation with domestic universities, as well as with both materials and machinery suppliers are the most habitual cooperative agreements. Public and private research organisations, as well as foreign universities, are the least involved. When it comes to subcontracting, Spanish universities and private research institutes are notably involved in cooperative R&D with firms. Individual researchers are also intensively subcontracted by firms. The role played by research organisations is also limited. On the other hand, in terms of what kind of activities is done by companies' in-house or subcontracting, scientific research and design are the most likely activities to be subcontracted. However, there is a predominance of R&D in-house in relation to product and process innovation and quality control (Álvarez et al, 2004).

Table 6
Cooperation and Subcontracting R&D activities by type of Institution

Type of institution	Cooperation	Subcontracting
Private domestic research institutes	7,91	16,03
Public domestic research institutes	12,43	9,92
Domestic universities	20,90	16,03
Private foreign research organizations	2,26	6,11
Public foreign research organizations	1,69	3,05
Foreign universities	2,82	3,05
Raw material suppliers	20,34	11,45
Machinery and equipment suppliers	15,82	12,21
Independent researchers	5,08	15,27
Other firms with which yours has capital ties	8,47	5,34
Other	2,26	1,53

n = 89

Although patents are a formal mechanism for knowledge appropriation, the number of patents granted by firms is generally used in the innovation literature as one indicator of technological performance. It is plausible to accept that the propensity to patent differs according to different industries and also according to other structural characteristics of firms, such as their ownership (Howells, 1990; Fonfría, 1999). In general terms, firms included in the sample do not declare a high number of patents in the last five years. Nonetheless, international patents are more representative for these industries than the patents granted in Spain[7].

In terms of industries, it is noticeable that chemical firms present a higher propensity to patent in both markets –Table 7. Nonetheless, the value of the two kind of patents for domestic firms in the vehicles industry is especially important, more notable those of the international type. On the other hand, domestic firms in the rest of the highlighted industries are more active in applying for patents than their foreign counterparts.

Finally, according to the literature, the introduction of new products in the market is one of the most outstanding indicators of innovation (OECD, 1996). On average, nearly a quarter of the companies' sales are due to new products (21% of sales in 1998 and 25% in 2003). In the vehicles industry the innovative capacity is even higher: more than 30% of its sales, having decreased the gap between other branches between 1998 and 2003. Among the firms in this industry, domestic companies seem to be the most innovative in products: 45% in 1998 and 40% in 2003. The distribution between domestic and foreign-owned firms in the other three branches seems to be more similar, with the noticeable exception of the evolution of the national chemical industry in the period –Table 8.

[7] According to the results of the Survey, firms have obtained in average 134 international patents while only 75 in Spain (Álvarez et al, 2004). Nonetheless, this is also a shared general trend in the Spanish manufacturing industry.

Table 7
Distribution of domestic and international patents in the last 5 years (percentage of firms)

		Domestic Patents	International Patents
Food	Domestic	13,16	0,00
	Foreign	0,00	0,00
	Total	12,50	0,00
Chemical	Domestic	20,00	25,00
	Foreign	16,67	16,67
	Total	18,75	21,88
Electronic	Domestic	10,34	10,34
	Foreign	14,29	0,00
	Total	11,11	8,33
Vehicles	Domestic	5,00	5,00
	Foreign	16,67	0,00
	Total	7,69	3,85
Total		12,69	8,21

n = 209 patents

Table 8
Share of sales due to new products, 1998 and 2003

		1998		2003		Growth
		Average	St. Dev.	Average	St. Dev.	1998-2003
Food	Domestic	17,40	15,59	17,83	9,06	2,49
	Foreign	—	—	20,00	—	na
	Total	17,40	15,59	17,95	8,82	3,15
Chemical	Domestic	17,44	14,32	27,25	19,17	56,21
	Foreign	10,40	7,30	13,67	9,31	31,41
	Total	14,93	11,99	22,32	17,11	49,44
Electronic	Domestic	16,94	20,95	22,83	21,86	34,81
	Foreign	11,67	7,64	17,75	8,58	52,14
	Total	16,11	19,40	21,91	20,04	36,04
Vehicles	Domestic	45,00	32,40	38,89	27,13	-13,58
	Foreign	29,50	38,67	30,40	32,55	3,05
	Total	37,71	33,63	34,47	27,73	-8,61
Total		21,30	22,99	23,52	19,57	10,45

3. The cooperative relationships of manufacturing firms

The reasons why firms decide to cooperate with other agents are diverse. Access to new opportunities and markets, as well as efficiency gains, are some of the most important (Howells, 1990; Kleinknecht and Reijnen, 1992). The idea is that firms do not operate in an isolated way in the market but face competition recurring more and more to either other companies or other agents too. In other words, companies' relationships can be horizontal –with competitors- as well as vertical –mainly with customers and suppliers-; the type of complementary assets these other firms would provide defines the relationship most preferable for them, conditioning the firm's choice of partners. In an increasingly internationalised world, an additional issue to the type of activities firms decide to do in cooperation is whether they prefer to cooperate with foreign or domestic partners.

Graph 1 provides an illustration of the results from the survey combining the type of activities carried out in cooperation by firms and the type of partners, that is, between competitors, customers and suppliers, and their origin[8]. Subcontracting, technical assistance and acquisitions have been the most cited types of cooperation; although, the differences between others types of cooperation are not huge. With competitors, the pattern is similar for both cases, domestic and foreign, and the preferable operations are those related to acquisitions and strategic alliances[9]. These are also the most likely forms of cooperation with domestic and foreign customers, and with these agents the activities of technological assistance gain in relevance.

Taking into account the relative importance of the type of cooperation, measured as the percentage over the whole sample of firms, by the type of agent and its nationality, the most relevant cooperative activity between foreign partners are the operations of acquisitions, strategic alliances and cooperation with competitors. More than 20% of firms cooperate through these three cases. On the other hand, around 18% of firms cooperate with both customers in OEM[10], and also with suppliers through acquisitions, subcontracting and strategic alliances.

Geographical proximity is in general an important issue since cooperation with domestic organisations seems to be more significant than with foreign firms. In fact, the highest values correspond to the cooperation with domestic suppliers, while around a quarter of the companies said they subcontracted and cooperated in technical assistance with them. Strategic alliances are the most relevant type of cooperation when it comes to domestic competitors, also being important the percentage of firms which have made acquisitions of domestic competitors. Finally, technical assistance is the type of cooperation with customers in which the highest portion of firms in the sample has stated involvement in; this last result is probably due to the relatively lower level of transaction costs and the commitment of resources involved by companies (Alonso, 1995).

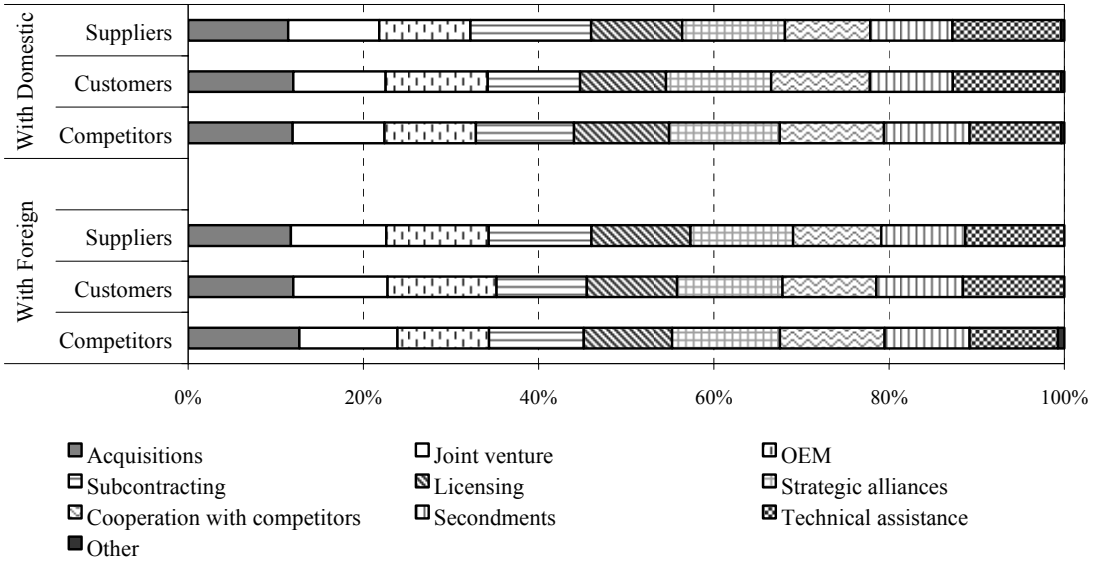
Additionally, an interesting topic in the innovation literature is the role played by different organisations with which firms cooperate in R&D activities. The higher costs and complexity levels of these activities make this kind of cooperation necessary. According to the results of the survey, the majority of Spanish firms do not cooperate. Meanwhile, the role of domestic universities and research institutes seems to be crucial for the companies' R&D: between 14 and 20 per cent of firms have reported this (Álvarez et al, 2004). Although to a lesser extent, the importance of industrial and end-product customers, as well as material suppliers, is also observed. These results partially confirm what the literature on systems of innovation stresses about the role played by user-producer relationships as basic external sources to improve firms' internal innovation abilities (i.e. Lundvall, 1992; Edquist, 1997). By contrast, the role of foreign partners, universities, research labs and consulting firms is limited.

[8] Be noted that the number of firms answered to this question was 69. Due to the existence of different options, one firm could provide several possible answers in each case.

[9] For a broad analysis of mergers and acquisitions in Spain, see Marin (2004).

[10] OEM: Original Equipment Manufacturer.

Graph 1
Type of Cooperation and type of partners (% over total sample)



Finally, whether firms look for cooperation with finalist or instrumental ends can be seen in Table 9. In fact, two main objectives of firms' R&D activities are the development and improvement of product and process, while scientific and applied research is less often prioritised. Design and quality control are in an intermediate position, declared by near half of the firms in the sample. Regarding capital ownership, domestic firms are more likely than foreign ones to devote their R&D efforts to product innovation. This difference is less clear in the chemical industry where more firms perform R&D oriented to research: 14 chemical firms out of the 26 declared scientific research as an objective, and 18 out of 37 applied research.

Table 9
Objectives of the R&D activities (% of firms)

		Food		Chemical		Electronic		Vehicles		Total
		Dom	For	Dom	For	Dom	For	Dom	For	
Development & improvement of products	Yes	52,94	100	78,95	72,73	75,00	83,33	47,06	83,33	66,39
	No	47,06	0	21,05	27,27	25,00	16,67	52,94	16,67	33,61
Development and improvement of process	Yes	55,88	100	72,22	63,64	61,54	50,00	35,29	83,33	58,82
	No	44,12	0	27,78	36,36	38,46	50,00	64,71	16,67	41,18
Scientific Research	Yes	8,82	100	52,63	36,36	23,08	0	5,88	16,67	21,67
	No	91,18	0	47,37	63,64	76,92	100	94,12	83,33	78,33
Applied Research	Yes	11,76	0	68,42	45,45	37,04	33,33	11,76	16,67	30,58
	No	88,24	100	31,58	54,55	62,96	66,67	88,24	83,33	69,42
Design	Yes	23,53	100	15,79	54,55	62,96	66,67	35,29	66,67	40,50
	No	76,47	0	84,21	45,45	37,04	33,33	64,71	33,33	59,50
Quality Control	Yes	57,58	100	52,63	54,55	52,17	66,67	29,41	66,67	52,59
	No	42,42	0	47,37	45,45	47,83	33,33	70,59	33,33	47,41

4. Empirical model and estimation results

The aim of this section is to analyse whether firms' competitiveness profile can be explained by their networking ability. A statistical analysis based on the *Polytomus Logit Universal Model* (PLUM) has been carried out. The main advantage of this kind of estimation in relation to the traditional *logit* regression is that it permits the analysis of the categorical dependent variable, showing several outcomes which can be ordered (McCullagh and Nelder, 1989; Nagelkerke, 1991). That is to say, our dependent variable measures a company's competitiveness level in the euclidean space – as explained below. Then, the value calculated for each firm indicates its better or worse position in relation to the others. In our case, the PLUM analysis will show what variables affect the relative probability in achieving a better competetive position.

4.1. VARIABLES AND INDICATORS

To obtain the competitiveness profile of manufacturing firms, a set of indicators has been designed specifically for this purpose with micro data obtained from the Spanish survey in four manufacturing industries in Spain, as previously explained. Several variables related to both product and market characteristics, as well as performance and financial items, have been considered as company competitiveness indicators. A factorial analysis –*principal components*- was carried out for each group of variables in order to obtain the inputs for building it -a relation of the variables included as well as the components of the factorial analysis are found in Annex I and II, respectively-. The competitiveness indicator CED was then used to denote the distance of every firm to the frontier, defined as the maximum value of each factor, and according to the next formula:

$$CED_j = \sqrt{\sum_i \left(1 - x_{ij}\right)^2} \qquad (1a)$$

where:

$$x_{ij} = \frac{y_{ij}}{\max_k y_{ik}}$$

and where y_{ij} is a value of the i^{th} competitiveness variable in the j^{th} firm.

Therefore, indicator CED_j measures firm's competitiveness in Euclidean space and then, the lower the value of the indicator, the more competitive the firm is.

Several indicators corresponding to competitiveness determinants have also been calculated making use of the same method. These include not only the networking variables but also the human capital and innovation characteristics of companies. The indicator CDED groups human capital and innovation aspects, and another six indicators concerning networking variables were obtained –from NED1 to NED6[11].

The aim of the analysis is regress CED indicator against those determinants. The generated indicators provide a rank of the competitiveness position of firms. This is why PLUM seems to be the most suitable estimation technique. As will be shown below, the CED indicator obtained for every firm has a continuous nature, adopting values from 0 to 3, although in the estimation method selected it is necessary to consider it a categorical variable. Accordingly to the values obtained, the following criterion has been adopted:

$$CED = \begin{cases} 0 & \text{if} \quad 0 \le CED \le 1 \\ 1 & \text{if} \quad 1 < CED \le 2 \\ 2 & \text{if} \quad 2 < CED \end{cases}$$

where the zero value indicates the better competitive position, the 1 value an intermediate profile and the 2 value a less competitive company.

It has also been demonstrated that a company's competitiveness profile differs according to the ownership. Consequently, the nationality of the companies has been incorporated as a control variable in the regression.

A closer breakdown of the indicator of competitiveness by industries and by ownership is shown in Table 10. The values of the CED *Indicator* reveal that there are no significant differences between industries. The vehicle sector shows a slightly higher competitive behaviour compared to the others, revealed by the lowest mean and median values. The food

[11] These indicators are further described.

industry presents the highest CED values, denoting its worse competitive position in relation to other sectors; this industry also shows the highest dispersion (although the standard deviation is similar to that of the chemical industry, this branch presents the greatest value: 0,83).

In terms of ownership in each sector, the differences are so easily detected, foreign-owned firms being more competitive than domestic ones in the four industries when the median is considered. However, when we take mean values, domestic firms perform slightly better in the vehicle and chemical industries. In general terms, according to the values of the CED competitiveness indicator by ownership, foreign firms perform better, being more competitive than domestic firms and being the dispersion shorter.

Table 10
CED Competitiveness Indicator by Industry and Ownership (1)

		Maximum	Mean	Median	Minimum	St.Dev.
Food	Domestic	2,93	2,32	2,49	0,00	0,63
	Foreign	2,69	2,11	2,11	1,52	0,83
	Total	2,93	2,16	2,48	0,00	0,83
Chemical	Domestic	2,78	2,28	2,53	0,00	0,64
	Foreign	2,80	2,35	2,44	1,20	0,42
	Total	2,80	2,13	2,46	0,00	0,81
Electronic	Domestic	2,76	2,37	2,48	1,22	0,37
	Foreign	2,81	2,17	2,46	1,03	0,62
	Total	2,81	2,34	2,46	1,03	0,42
Vehicles	Domestic	2,87	2,25	2,34	1,39	0,41
	Foreign	2,47	2,26	2,26	2,08	0,16
	Total	2,87	2,12	2,28	0,00	0,53
Total	Domestic	2,93	2,32	2,48	0,00	0,53
	Foreign	2,81	2,26	2,38	1,03	0,45

(1) See Annex I for the definition of variables included in Factorial analysis

Regarding the other determinants, a brief description will be made here (a detailed one can be found in Álvarez et al., 2004). According to *human capital and innovation as competitiveness determinants*, the best results in CDED indicator are achieved by the chemical and vehicle industries -denoting the importance of both aspects in those sectors. The most heterogeneous is the food. When it comes to company ownership, there are not great differences between the two groups. In general terms, foreign firms concede greater importance to aspects such as workforce training levels and technological innovation than do domestic-owned firms[12] -the former presents the lowest dispersion.

One of the strengths is that the survey questionnaire was designed in accordance to the importance firms attribute to the kind of activities in which they cooperate and to the organisations with which they establish linkages. Consequently, six indicators were calculated: R&D cooperation (NED 1), cooperation with sister companies and subsidiaries (NED 2), cooperation with suppliers (NED 3), cooperation with customers and competitors (NED 4), benefits from cooperation for customers and suppliers (NED 5), and areas of benefits from

[12] This affirmation is based on both average and median values.

cooperation (NED 6)[13]. The main results of these indicators are the following:

- The values of NED1 *indicator of R&D cooperation* show that this is an aspect of less importance for foreign firms. Considering the results across industries, the food sector presents the best result and the highest heterogeneity with regard to this issue. In comparison, the importance of this issue to the electronic and vehicle industries is limited. That is, in science-based branches and specialised suppliers, own R&D activity seems to gain importance.

- In terms of *cooperation with sister companies and subsidiaries,* the NED2 indicator reveals no relevant differences between industries. Nonetheless, the vehicles sector presents the lowest average value which is indicative of the greater importance of this kind of cooperation for these firms. The highest cooperation corresponds to the most R&D intensive industries: chemical and electronics. On the other hand, although domestic and foreign firms differ on this issue, it is difficult to find a clear pattern but the former seems to achieve better results.

- The lowest technological content industries concede the highest importance to upstream relationships. Outsourcing and cost reduction are some of the main motivations and food companies show the most cooperative behaviour in the NED3 *indicator of cooperation with suppliers*. These firms are also notable for their highest heterogeneity. Taking into account the capital ownership breakdown in these four industries, foreign firms are the group in which the cooperation with suppliers is the most relevant; even though, domestic firms prevail in the vehicle industry. In addition, the least cooperative behaviour corresponds to domestic-owned firms in the four industries considered.

- Regarding downstream cooperation and the horizontal type, NED4, that is, the *cooperation with customers and competitors*, the results do not offer a clear profile. On average, the highest importance given to this kind of cooperation is conceded by the chemical sector. However, the NED4 values show again a quite similar behaviour across industries. By capital ownership, no notable differences are detected in this indicator.

- A look at the NED5 indicator regarding the *benefits obtained by customers and suppliers from the cooperation activities* reveals no special differences between the industries. The highest obtaintion of benefits has been achieved in the most traditional industry. However, the chemical industry is the most disperse and in terms of company ownership, domestic firms are those for which these benefits are higher.

- Finally, in the network indicator concerning the *areas of benefits from cooperation*, there is a great similarity among industries as well as among companies' capital owners. The indicator NED6 seems to be quite homogeneous across the manufacturing industries and independent of the ownership of the companies, with no clear differences emerging with regard to this issue.

4.2. ESTIMATION RESULTS

According to the aim of the analysis, the *CED Competitiveness indicator* has been regressed against the different independent variables – CDED and NED indicators- previously described. Before commenting on the regression results, it is necessary to clarify the meaning of the coefficients that could be obtained. In accordance with the interpretation of these kinds of models, negative coefficients indicate an inverse relationship between the dependent and the independent variable. Similarly, positive signs show a positive relationship between the predictor and the outcome.

Moreover, it is important to bear in mind that higher values on indicators reveal a worse competitive profile. That is to say, lower CED values mean a higher degree of competitiveness, and lower NED and CDED values mean a better ability to network and stronger non-network determinants of competitiveness, respectively. Consequently, positive signs on in-

[13] These last two indicators (NED5 and NED6) includes the benefits obtained from the cooperation regarding mainly production and technological improvements as well as access to new markets and to financing among other variables. The differences are that the first one (NED5) is referred to benefits for customers and suppliers, whilst the last one (NED6) is related to benefits for the firm derived from the cooperation with customers, suppliers and investors.

dicator coefficients would reflect that as values of NED and CDED indicators reflect a better networking and innovation activities (lower values), it is more likely to observe better competitiveness profile.

In terms of the variable of company ownership -introduced in the analysis too-, the interpretation is different; negative signs are those that improve the competitiveness profile of firms. The reason for this is that this variable accounts for the nationality of the firm and the dependent variable (CED) accounts for its competitiveness. So, the lower the value of the CED indicator, the higher a firm's competitiveness is. Therefore, a negative sign in the firms' nationality would indicate that foreign firms are likely to be in the lower CED categories, and in consequence performing better.

Estimated results show that two networking indicators tend to increase the probability of firms' competitiveness, in Table 11: the one related to cooperation with sister companies and subsidiaries (NED2), and the NED4 indicator of downstream and horizontal cooperation (NED4). The indicator corresponding to human capital and innovation (CDED) is also significant. Their positive coefficients show that a better position in these indicators implies a higher likelihood of obtaining a better firm's competitive profile.

Table 11
Results of the regression of Competitiveness in products and markets Indicator

		Estimate	Std. Error	Wald	Df	Sig.
Threshold	[CED = 0]	4,52	2,60	3,03	1	0,082
	[CED = 1]	7,55	2,74	7,62	1	0,006
	[CED = 2]	28,81	6,06	22,64	1	0,000
Location	NED1	0,77	0,72	1,14	1	0,287
	NED2	4,90	1,53	10,32	1	0,001
	NED3	0,78	1,33	0,34	1	0,559
	NED4	2,67	1,08	6,06	1	0,014
	NED5	0,66	0,61	1,20	1	0,274
	NED6	-0,66	0,78	0,71	1	0,401
	CDED	2,64	1,37	3,68	1	0,055
	Foreign	-1,23	0,57	4,68	1	0,031
	Domestic	0(a)	.	.	0	.

Link Function: Logit.
a This parameter is set to zero because it is redundant.

The findings confirm the importance acquired by internal networks existing in large business groups where firms belonging to them share complementary competences. The character of the sample, integrated mainly for medium and large firms (average size was 186 employees) may be conditioning of the coefficient achieved by NED2. Therefore, it may be plausible to think that these results would differ if the analysis were repeated only for SME. The explanation of this result is confirmed by the presence of multinational companies (MNC) in Spain in the four industries analysed here. This result is influenced by both the role played by the headquarters of Spanish companies and the relationships of these with their subsidiaries abroad, and the international networks to which the foreign subsidiaries belong (Cantwell and Molero, 2003).

The parameter of significance for the NED4 coefficient is quite interesting. It clearly reveals the importance of inter-firm cooperation to improve company position in the market. On one hand, the relationships that firms establish with their customers seem to be positive in terms of their competitiveness. It confirms that better information about the interests and requirements from the market side provides inputs for a better firm performance. This would contribute, for instance, to the reduction of risks associated with the introduction of a new product into the market (Von Hippel, 1988), On the other hand, the formal relationships

with their competitors also affect Spanish firms' performance. In these cases, it can be understood that the complexity of products and process as well as the necessity to combine efforts are crucial elements behind these kinds of company strategies. The positive effects that cooperation with competitors have on productivity levels is an issue confirmed also by recent empirical evidence existing for Dutch firms (Belderbos, 2004).

The indicator of human capital and innovation (CDED) has also been significant. The coefficient is positive, showing again that better values of this indicator imply a higher likelihood of improving firms' competitiveness. These findings denote that beyond the traditional cost determinants, the importance of qualitative aspects is of concern. The improvement of market positions requires some effort from firms in order to hire qualified personnel and be highly innovative. Moreover, this result coincides with the idea that cooperating firms are generally engaged in higher levels of innovation activities (Rosenfeld, 1996; Belderbos, 2004). This behaviour is especially important in those industries where technological changes are frequent –such as electronics and chemical-, but also in those characterised by high economies of scale, such as the vehicles sector.

When it comes to the industry in which a firm operates, the descriptive analysis of indicators reveals the existence of different company competitiveness profiles across industries. In consequence, this same analysis was run considering the four sectors but the results did not differ from those obtained above. In fact, neither of the industries showed a significant coefficient[14].

Finally, considering the ownership of capital assets, foreign firms present a better competitiveness profile than do domestic ones. This is reflected in the negative sign, which implies that foreign firms are likely to present lower CED values. This is fully coincident with other analyses carried out into manufacturing industries in Spain. Foreign firms present, in general, better productivity levels than Spanish firms (Merino and Salas, 1995; 1996; Bajo and López, 1996; Álvarez, 2003). This would confirm the assumption generally made about the superior performance of foreign firms in host economies and it still justifies questioning the possibilities of positive spillover effects in local companies.

5. Concluding remarks

The findings of this paper have shown the importance of cooperative relationships for the competitiveness levels of manufacturing firms. The strength of the global chain value and the increase in international competition in current economic activities are some aspects which have been shown to be interesting in the analysis done in this paper. Moreover, this trend goes together with the increasing presence and influence of foreign firms in local host economies and the lack of an indisputable internationalisation pattern of innovation.

One important element which should be underlined is how competitiveness is approached and analysed at the firm level. In fact, findings and further implications may substantially vary when performance and finance indicators are used with regard to products and market results (Álvarez et al., 2004). When companies' capital ownership is introduced as control variable in the analysis of competitiveness, foreign firms achieve better results in terms of performance and finance, which reveals their better position with regard to the ability to collaborate. In contrast, when a firm's competitiveness is measured by its product and market position, differences between foreign and domestic firms disappear. This result confirms that domestic firms are making greater efforts to remain and to improve their market position, being able to compete with foreign firms. In this sense, among the factors enhancing the competitiveness profile of firms we found the amount of resources devoted to R&D activities, to hire and to train a qualified workforce, as well as the efforts made to establish cooperation with other organisations to speed up and to obtain better innovative results.

The empirical analysis carried out in this paper allows us to explain firms' competitiveness upgrading in terms of networking abilities. Particularly, user-producer relationships have been largely underlined in the literature on systems of innovation and its importance for the four industries analysed here has been satisfactorily confirmed. Another crucial aspect is the level of human capital and innovation achieved by firms, giving a higher value to tho-

[14] Detailed results can be provided by the authors on request.

se determinants of competitiveness of a qualitative nature. Moreover, the importance of intra-company networks has been revealed, denoted by the significant role of cooperation that firms established with both sister and subsidiaries companies in order to improve their competitiveness levels.

From these findings, some interesting questions emerge with implications for the policy debate. Firstly, the presence of foreign capital in manufacturing industries leads to aspects such as what factors define the existence of the different expected competitiveness behaviour between local firms and foreign affiliates. Local industrial systems are then conditioned by this dual presence. Foreign-owned firms still have a predominant role in industries in which the technological complexity is higher and this is a crucial aspect in the definition of policies aimed at raising competitiveness in manufacturing industries. In this context, policy action designed to enhance local production facilities, those promoting entrepreneurship and the improvement of local absorption capacities could be considered. This would encourage the exploitation of spillover effects from the potential better competitiveness results of foreign companies.

Secondly, it can be accepted that cooperative relationships of firms constitute in many cases a crucial element to innovate. Different stages for policy action can be described. On the one hand, policy instruments which promote an increase in the quality of basic and applied research capabilities are crucial. On the other hand, policies directed at establishing a greater level of interactions between firms and other agents through, for instance, the establishment or reinforcement of interface instruments, should be considered. To sum up, public interventions aimed at strengthening the links which favour technological upgrading inside the local systems of innovation can be highlighted. Moreover, the role of user-producer relationships leads us to underline the importance of collaborative industrial associations as well as the provision of services designed to facilitate inter-firms contacts.

Therefore, the improvement of local capabilities for the generation and diffusion of knowledge still seems to be a relevant element to be included in the definition of public policies addressed at the industrial and technological fields. In this sense, an aspect that can be underlined is the importance of the interrelation among the different policy fields. In general terms, it can be said that successful competitiveness policy actions must take into account a range of aspects, such as the qualifications of the labour force or the advertising campaigns to promote local products in foreign markets.

References

Alonso, J. A. (1995), "International Process and Forms of Market Penetration: A Dynamic Proposal" in J. Molero (ed.), *Technological Innovation, Multinational Corporations and New International Competitiveness The Case of Intermediate Countries,* Harwood Academic Publishers, Reading.

Álvarez, I. (2003), *Empresas extranjeras y efectos de derrame tecnológico o spillovers: Una aplicación a las manufacturas españolas,* Tesis Doctoral, Universidad Autónoma de Madrid.

Álvarez, I., Fonfría, A., Marín, R. (2004), *Results from a Competitiveness Survey to the manufacturing Spanish firms,* COMPETITIVENESS European Project, WP 6, Del. 4, (available at www.case.pl).

Archibugi, D., Michie, J. (1995), "La Internacionalización de la Tecnología: Mito y Realidad", *Información Comercial Española*, núm. 726, febrero, 23-42.

Archibugi, D., Ianmarino, S. (2000), "Innovación y globalización: evidencia e implicaciones", in J. Molero, *Competencia global y cambio tecnológico*, 103-137, Pirámide, Madrid.

Belderbos, R., Carree, M., Lokshin, B. (2004), "Cooperative R&D and firm performance", *Research Policy,* 33, pp. 1477-1492.

Bajo, O., López, C. (1996), "La Inversión Extranjera Directa en la Industria Manufacturera Española, 1986-1993", *Papeles de Economía Española*, vol. 66, 176-190.

Cantwell, J., Molero, J. (2003), *Multinational Enterprises, Innovative Strategies and Systems of Innovation*, Edward Elgar.

Cantwell, J., Mudambi, R. (2001), "MNE competence-creating subsidiary mandates: an empirical investigation", *ICEI Working Paper*, DT 06/2001.

Cantwell, J., Piscitello, L. (2001), "The location of technological activities of MNCs in European Regions", *Fifth Seminar of the MESIAS Network, Proceedings,* Reading.

Coase, R. H. (1937), "The Nature of the Firm", *Economica*, vol. 4, num. 16, nov. 1937, 386-405.

Dosi, G., Pavitt, K., Soete, L. (1990), *The economics of technical change and international trade*, Harvester Wheatsheaf, London.

Dosi, G., Teece, D. J., Chytry, J. (1998), *Technology, organisation and competitiveness,* Oxford University Press, Oxford.

Dunning J. H., (1973), "The determinants of international production", *Oxford Economic Papers,* January 1973.

Dunning, J. H, (1980), "Toward an eclectic theory of international production: Some empirical test", *Journal of International Business Studies*, 11(1), 9-31.

Duysters, G., Hagerdoon, J. (1996), "Internationalisation of corporate technology through strategic partnering: an empirical investigation", *Research Policy* 25, 1-12.

Edquist, C. (ed.) (1997), *Systems of Innovation. Technologies, Institutions and Organizations,* Pinter Publishers, London.

Fonfría, A. (1999), "Patrones de innovación en la empresa española: un dato para la política tecnológica", *Papeles de Economía Española*, vol. 81, 182-195.

Freel, M. S. (2003), "Sectoral patterns of small firm innovation, networking and proximity", *Research Policy,* 32, 751-770.

Hamel, G., Prahalad, C. K. (1989), "Strategic Intent", *Harvard Business Review*, may-june 1989.

Hortsmann, I. J., Markusen, J. R. (1996),"Exploring new markets: Direct investment, contractual relations and the multinational enterprise", *International Economic Review*, 37(1), 1-19.

Howells, J. (1990), "The Internationalization of R&D and the Development of Global Research Networks", *Regional Studies*, vol. 24, 495-512.

Howells, J. (1999), "Regional Systems of Innovation?", in D. Archibugi, J. Howells and J. Michie (eds.), *Innovation Policy in a Global Economy,* Cambridge University Press.

Humphrey, J., Schimitz, H. (1996), "The triple C approach to local industrial policy", *World Development*, vol. 24(12), pp. 1859-1877.

Jaffe, A. B. (1993), "Geographic localisation of knowledge spillovers as evidenced by patent citations", *Quarterly Journal of Economics*, 577-598.

Kleinknecht, A., Reijnen, J. (1992), "Why do Firms Cooperate on R&D? An Empirical Study", *Research Policy*, vol. 21, 347-360.

Krugman, P. (1991), "Increasing returns and economic geography", *Journal of Political Economy*, 99(3), 483-492.

Lundvall, B. A. (ed.). (1992), *National Systems of Innovation,* Pinter Publishers, London.

McCullagh, P., Nelder J. A. (1989), *Generalized Linear Models,* Chapman & may, London.

Marín, R. (2004), El impacto de las Fusiones y Adquisiciones Transfronterizas en la capacidad tecnológica de las empresas. Diploma de Estudios Avanzados. Universidad Complutense de Madrid.

Merino, F., Salas, V. (1995), "Empresa extranjera y manufactura española: efectos directos e indirectos", *Revista de Economía Aplicada*, 9(3), 105-131.

Merino, F., Salas, V. (1996), "Diferencias de eficiencia entre empresas nacionales y extranjeras en el sector manufacturero español", *Papeles de Economía Española*, 66, 191-208.

Nagelkerke, N. J. D. (1991),"A note on the general definition of the coefficient of determination", *Biometrika,* 78(3), 691-692.

OECD (1996), *The Oslo Manual*, OECD, Paris.

Patel, P., Pavitt, K. (2000), "National System of innovation under strain: the internationalisation of corporate R&D", in R. Barrell, G. Mason, O'Mahoney (eds.), *Productivity, Innovation and Economic Performance*, Cambridge University Press.

Pavitt, K. (1984), "Sectoral patterns of technical change: Towards a taxonomy and a theory", *Research Policy*, 13, 343-373.

Pavitt, K. (2001), "Public Policies to Support Basic Research: What Can the Rest of the World Learn from US Theory and Practice? (And What They Should Not Learn)", *Industrial & Corporate Change*, 10, 761-779.

Pearce, R. D. (1999), "Decentralised R&D and strategic competitiveness: globalised approaches to generation and use of technology in multinational enterprises", *Research Policy*, 28, 157-78.

Rosenfeld, S. A. (1996), "Does cooperation enhance competitiveness? Assesing the impacts of inter-firm collaboration", *Research Policy,* 25, 247-263.

Saxenian, A. (1994), *Regional Advantage –Culture and Competition in Silicon Valley and Route 128*, Harvard University Press, Cambridge MA.

Scott, A. J. (1992), "The role of large producers in industrial districts: a case study of high technology systems houses in Southern California", *Regional Studies*, vol. 26(3).

Soete, L., Verspagen, B. (1994), "Competing for Growth: The Dynamics of Technology Gaps", in L. L. Pasinetti, R. M. Solow (eds.), *Economic Growth and the Structure of Long-Term Development*, St. Martin's Press, New York.

Storper, M. (1989), “The transition of flexible specialisation in the US film industry: external economies, the division of labour and the crossing of industrial divide”, *Cambridge Journal of Economics*, vol. 13(2), pp. 273-305.

Teece, D. J. (1977), “Technology transfer by multinational firms: the resource cost of tranfering technological know-how”, *The Economic Journal*, 87, 242-262.

Verspagen, B., Wakelin, K. (1997), “Technology, Employment and Trade: Perspectives on European Integration”, in J. Fagerberg, P. Hansson, L. Lundberg, A. Melchior (eds.), *Technology and International Trade*, Edward Elgar, Aldershot.

Von Hippel, E. (1988), *The Sources of Innovation*, Oxford University Press, Oxford.

Williamson, O. (1975), *Markets and hierarchies*, Free Press, New York.

Williamson, O. (1981), "The modern corporation: origins, evolution, attributes”, *Journal of Economic Literature*, 19, 1537-1568.

ANNEX I

COMPETITIVENESS VARIABLES (variables related to products and markets, performance and finance)

Domestic market share
Percentage of sales on various markets
New products
What markets they were new for the firm
New technology
Relative level of products & technology
Total revenues
Sales revenues
Export revenues
Ratio of export revenues to sales revenues
EU export revenues
Ratio of EU export revenues to sales revenues
Ratio of total costs to total revenues
Ratio (gross wages & salaries to total costs)
Ratio (materials & energy to total costs)
Gross profit (total costs – total revenues)
Gross profitability (GP / total revenues)

COMPETITIVENESS DETERMINANTS (variables regarding human capital & innovation activities)

Employment:
- Growth of total employment
- Work force which is white-collar
- Work force which is technical

Certification quality:
- Number of ISO (and other quality management) certificates andothers certificates not related to quality management (CE, HACCP, etc.)
- Since when (how many years)

Importance of training:
R&D or design unit:
Quality control lab
Ratio (R&D spending/ total revenues):
Patent applications:
Investment spending:
Ratio investment to gross profit in 2003

NETWORKING VARIABLES

1. R&D COOPERATION
Organisations with whom there is R&D cooperation
-Organisations with whom there is R&D cooperation
-Organisations with whom there is R&D subcontracting
Kind of activities for R&D coop
-Kind of activities for R&D subcontracting
-Kind of activities for R&D in-house

2. SISTER COMPANIES AND SUBSIDIARIES
Sister companies
Subsidiaries
Areas of benefits for subsidiaries

3. COOPERATION WITH SUPPLIERS
Outside services costs
Ratio (outside services costs/ total costs)
Sources of supplies
Types of cooperation with suppliers
Benefits from cooperation with suppliers

4. COOPERATION WITH CUSTOMERS AND COMPETITORS
Types of cooperation /types of organisations
- Types of cooperation with customers
- Types of cooperation with competitors

5. BENEFITS FOR CUSTOMERS AND SUPPLIERS
Benefits for customers
Benefits for suppliers

6. AREAS OF BENEFITS FROM COOPERATION
Benefits from cooperation with customers
Benefits from cooperation with suppliers
Benefits from cooperation with investors
Benefits from cooperation with other firms

ANNEX II – Principal Components

CED-Products and Markets, and Financial and Performance Competitiveness

Regarding markets and products Competitiveness:

C1: Market share and sales to domestic market
C2: Sales to international markets
C3: the firm's evaluation of its product and process competitiveness at national and international levels
C4: Sales due to new products and processes in the domestic and international market
C5: Sales of products produced with old technology

Regarding financial- performance Competitiveness

C1: Total costs
C2: Increase in total costs
C3: Increase in sales revenues
C4: Export revenues to EU
C5: Increase in export revenues
C6: Increase in profits

CDED-Human capital and Innovation as Competitiveness determinants

C1: Importance to training and R&D laboratory
C2: Quality measures
C3: Increased in qualified workforce
C4: Patents
C5: Quality control age
C6: Investment spending

NED1-R&D Cooperation

C1: R&D in-house
C2: subcontracting design projects/R&D activities
C3: subcontracting public and private research organisations and foreign universities
C4: R&D cooperation with foreign public and private research organisations
C5: R&D cooperation with independent researchers
C6: establishing R&D contacts with org's outside the firm
C7: subcontracting domestic public org's and universities
C8: subcontracting processes development and improvement and quality controls
C9: R&D cooperation with suppliers of raw materials and machinery and equipment
C10: R&D cooperation with domestic public and private organisations including universities
C11: R&D cooperation with foreign universities

NED2-Cooperation with Sister Companies Subsidiaries

C1: firm has improved product quality, production process and technology and the access to finance, new markets and distribution channels in its subsidiaries
C2: firm has improved the subsidiaries' delivery conditions
C3: foreign subsidiaries distribute to and supply the company
C4: firm acquired industrial domestic companies in order to improve the production process
C5: firm has acquired other industrial foreign firms
C6: the firm has acquired a domestic industrial firm
C7: domestic subsidiaries supply and distribute firm' products
C8: the firm improves product quality in its subsidiaries
C9: the firm supply inputs to sister companies
C10: the firm acquired one main international firm
C11: the firm has acquired a consulting firm
C12: the firm has acquired a trade company

NED3-Cooperation with suppliers

C1: Cooperation with domestic and foreign suppliers
C2: Technology improvements and delivery conditions
C3: Cooperation in accessing to finance, distribution channels and new markets as well as joint participation in trade fairs
C4: Improvements in production
C5: Cooperation with domestic suppliers
C6: Cooperation with suppliers in EU
C7: Cooperation with suppliers in other markets
C8: Outside services costs to obtain new EU suppliers
C9: Other domestic suppliers

NED4-Cooperation with customers - competitors

C1: Cooperation with domestic customers and competitors and foreign customers
C2: Cooperation with foreign competitors
C3: Other types of cooperation with domestic customers and competitors

NED5-Benefits for customers and suppliers

C1: Access to modern technologies, production improvements, modernization and improvements in delivery conditions for suppliers
C2: Access to new markets & distribution channels and marketing improvements for customers
C3: Technological improvements for customers
C4: Access to finance/joint participation in trade fairs for customers
C5: Access to new markets and production opportunities for suppliers
C6: Improvements in production and financing for customers
C7: Joint participation in trade fairs for suppliers
C8: Improved product quality & design for suppliers
C9: Improved inventory management for customers/suppliers
C10: Improvements in terms of marketing and new distribution channels for suppliers

NED6-Areas of benefits from cooperation

C1: Benefits from cooperation with investors
C2: Benefits from cooperation with suppliers
C3: Benefits from cooperation with customers regarding better access to new markets and distribution channels
C4: Benefits from cooperation with customers regarding technology improvements
C5: Benefits from cooperation with customers regarding improvements in delivery conditions
C6: Benefits from cooperation with other companies regarding technology improvements and access to new markets and distribution channels
C7: Benefits from other companies regarding joint participation in trade fairs
C8: Benefits from cooperation with other companies regarding access to finance
C9: Benefits from cooperation with customers regarding improvements in production

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