

Instituto de Estudios Sociales Avanzados (CSIC)
Working Paper 98-13

Inter-firm product development in Spain

[Luis Sanz-Menéndez](#)

Clara Eugenia García

Instituto de Estudios Sociales Avanzados
CSIC

Business Administration Department
University Carlos III of Madrid

With the assistance and collaboration of Isabel Álvarez

Draft notes of the Spanish report for the focus group on Inter-Firm Collaboration of the OECD project on National Innovation Systems (phase 2). April 1998.

Data file [dat9813](#) must be also downloaded for complete printing.

This paper attempts to explore the extent in which inter-firm co-operation has emerged for the development of new products in Spain. The basic building block of recent theorizing on technological change is that innovation is a firm-based process. In spite of the central role business organizations play, innovation does not take place in isolation; firms themselves form extensive and intense networks of different types, through their interaction with different economic and institutional actors. We aim to examine the set of factors that shape inter-firm co-operation, including a set of internal technological and managerial capabilities as well as external and institutional factors fostering or inhibiting co-operation. Basically, we are interested in the phenomena that is the result of the firm's behavior in specific contexts related to product development. We shall refer to the empirical evidence provided by firms that have been engaged in product development through co-operation. In this first draft we shall focus on the preliminary findings emerging from a specific questionnaire set up for international comparative purposes.

The basic research questions addressed through an empirical analysis are: to what extent co-operation for the development of new products is a dominant pattern?; (within a population of Spanish firms that may be characterized as "innovative" or "technology-based" -see Technical Annex), and to what extent innovation may be considered as a collective process of knowledge production and learning coordination?.

There are several theoretical reasons provided by current literature and supported by empirical data concerning the general idea that product innovation is increasingly driven by co-operation between firms, and between firms and other major actors such as public agencies, government institutions and universities. Firms diversify their technological sources mainly due to scale, scope and cost of technological development, and also as a way of dealing with the uncertainty emerging from the rapid technical change. From the set of data used in this document we may conclude that co-operation for product development is a basic and dominant trend, though firms have also reported an increasing tendency for collaboration concerning other areas of activity -i.e. more than 60 % of the firms report a significant increase of cooperation with national and foreign partners in the last three years.

However, despite this dominant vision of product development as the outcome from inter-firm co-operation, co-operation and the willingness to co-operate are seen as elements related to the firm's internal set of technological competencies and complementarities between firms relating to their technological core and/or knowledge base. This is

fundamentally attributed to the following assumptions. First, it is currently assumed that cooperative firms will have at least a specific, and partially, common knowledge base represented by the generic technological knowledge which is shared by all these firms and organizations. Secondly, it is often assumed that efficient cooperation will increase as a function of the firm's technological specialization. Third, there are different forms of inter-firm co-operation and such differences will be a function of the firm's coordination capabilities as well as their learning processes. Hence, we shall expect an active co-operation between firms to increase as their level of either technological similarities or complementarities increases.

In spite of these general assumptions concerning inter-firm cooperation and new product development, some remarks were brought to our attention at this stage and will require further elaboration. First, it should be pointed out that firms have a deep understanding of what is meant by product development. Product *development* is seen basically as an active learning coordination process involving knowledge production in a broader sense. Meanwhile, product *innovation* understood as new marketed products represents a less active pattern of learning; product innovation may be simply the result of defining commercial areas of common interests, and does not imply an active learning coordination process. In this respect, and using such distinction, our preliminary results show some relevant characteristics and basic differences between two types of cooperation: (a) active interchange of knowledge and collective learning, and (b) sharing of experiences and knowledge that reduces costs or increases the benefits of internal learning activities (e.g. licensing, and cross-licensing agreements).

The survey's main questions addressed the "development of new products in the last three years" as opposed to the "introduction of new or improved products into the market" as innovation surveys derived from the Oslo Manual have been suggesting. From such distinction it is important to notice that such definition is more strict and less inclusive than the one contained by the Oslo Manual. The basic point of reference for such assertion is that while 78 % of the surveyed firms, reported that they did developed a new product in the last three years, 91% of the firms reports that they have introduced into the market a new product or improved in the last three years. Significantly, there is a 15% of the total sample that reported "not having developed a new product" but "having introduced into the market a new or improved product". There is a subtle but significant difference between these two statements which infers some potential explanations. First, there is may be a time lag between new product development and market introduction which has to be taken into account; secondly, that the new products marketed are not necessarily developed by the firm engaged in distribution and commercialization; and finally that some of the firms may have reported just technical improvement in their products.

In the next sections we are concerned only with firms that have been actively involved in the knowledge creation and learning coordination. The analysis and raw data provided draw on a Spanish survey implemented though CATI (See Technical Annex) from which we shall derive a preliminary set of relevant characteristics. The following analysis is mainly descriptive, it uses indicators and information in progress to address the general issue of inter-firm cooperation for product development in the Spanish economy. It address issues related to the forms of the innovative networks, the relevance on the different collaborators for product development and other issues associated to performance and management tools of the collaborative arrangement. Yet, although some of the data will require further elaboration, this first draft document will try to cover some of the most relevant findings.

1. New product development in context and the outcome of collaboration

Results provided by the survey conducted in Spain confirm the general assumption that

innovation is becoming strongly associated with inter-firm collaboration and inter-organizational cooperation. Most firms which have developed, within the last three years, new products have been engaged in collaborative arrangements (82,5%). The extension to which firms become involved in cooperation is related to the number of new products that the firm has developed. Widespread inter-firm collaboration has been taken often as a proxy for the limited technological capabilities and financial resources the firms devote to product development. However, the trend exhibited by Spanish firms points out that multi-product companies, and highly diversified companies increase the probability of developing new products through cooperation. Such relationship between the horizontal scope of the firm and its cooperative behavior will be further developed. In contrast, firms that have developed one single product show a lower level of cooperative behavior and involvement. 85% of "multi-product development" companies have been involved in collaborative agreements while only 74% of "single product development" firms have developed collaborative ties in the last three years. Raw data in this subject may be pointing out that the collaborative behavior may be correlated to innovative performance measured by the number of new products developed.

In our analysis we have considered, from within the group of firms that have developed at least one product in the last three years, the subset of firms involved in product development collaboration, that is those firms which have manifested to have had at least one collaborator in product development.

Taken at an aggregate level these firms have more and closer relationships with other types of firms than with non-firm organizations. However, the diversity in the type of inter-firm relations is higher. As a main aggregate result we found that 79 % of the firms have collaborative links with "technological services organizations" (centers for test, control or certification; public technological institutes or private engineering firms for technological support or associated laboratories), 60 % have links with customers (public or private), and 60 % with universities or public research centers. In the lower range only 15 % of the firms have cooperation relations in the product development with competitors.

One very interesting fact that emerges when examining the sample by employment size is that there are almost no relation between the size of the firm and the propensity to have a collaborative relationship. There is only one clear exception, as it could be expect, that is the collaborations with subsidiaries or associated firms, tend to increase with the size of the firms, because these firms with associates or subsidiaries are larger.

There is a second relevant conclusion that comes from the survey is that there is low correlation between the size of the firm and the total number of type of collaborators. That is, the total number of type of collaborators (11 were defined in the questionnaire) does not increase significantly with the size of the firms.

Firms involved in cooperation exhibit high levels of variety collaboration arrangements, ranging from those firms that have developed new products out of collaboration with one single partner to those complex networks of collaboration. Overall, the average number of actors cooperating with firms in product development is about 5 out of the 11 types defined in the questionnaire. The explanatory significance and relative value of such number of ties will be conditioned when establishing of international comparisons. However, taken in isolation it represents a measure of innovative networks in Spain. Besides any other consideration concerning the structure and nature of innovative networks it is worth noticing the idea that inter-firm collaboration is not a new phenomenon; however the number of cooperative ties and the intensity of knowledge transfer and learning coordination has increased in the last years. It has been emphasized that cooperative behavior does not emerge automatically suggesting that past experiences and history are determinants in

such process. Nevertheless, cooperative behavior has emerged in the last years within companies that do not have a history in cooperation. A clear indication of this tendency is that almost 30% of the partners of the companies were first time collaborators. As previously suggested, we may approach new cooperative behaviors by focusing on such distribution. Hence, new product development, and the building of an innovative network is not based only in past experiences. New players are entering in a dynamic environment, and cooperation enables them to capture the set of new opportunities by means of sharing risks and benefits. Finally, in such a dynamic environment aimed at improving cooperation and innovation, public research centers and universities as well as testing and quality control institutes have emerged as the most relevant new comers.

Inter-firm collaboration, as the literature points out, presents several advantages but also some serious shortcomings. Sharing risks and costs is almost one of the most acknowledged advantages while the lack of success and high level of conflicts between partners may erode the advantages achieved through cooperation. In this preliminary report we have adopted the creation of a prototype as an indicator for product development success, and the basic outcome of collaboration, since we were concerned with cooperative patterns and firms behavior rather than by commercial success. Departing from such consideration, 75% of the Spanish firms engaged in collaboration developed prototypes at the first stage. Movement and circulation of prototypes between different organizational and production settings has been a common feature through the process of product development as well as the exchange of employees involved in the product development project, as reported by 70% of the respondents. Movement of people and artifacts have to be taken as a basic approach and indication of the process of knowledge production and exchange through what is embodied in people and artifacts, as well as of the learning process within innovation. The standard distinction between tacit and codified knowledge may be useful here as the differentiation of the different stages in the knowledge spiral including socialization.

Even if we take into consideration that the prototype may represent the first measurable outcome of innovative cooperation it is just the first and preliminary stage of a complex, competitive and difficult path. Nevertheless, 40% of the firms interviewed have reported that the final outcome of collaboration of the most important product has been subject to patents, utility models or other types of legal protection of the intellectual property rights. Such findings are quite relevant for different reasons. First, this highlights the relevance of appropriability issues and regimes within technological development. And, second, it serves as the final rate of success or final indicator that can be used to measure technological performance in the knowledge production by learning coordination.

Finally, our empirical data confirms that inter-firm development collaboration does not rest upon informal relationships; friendship, partnership, and personal relations do count, but confidence and trust are not substitutes for formal agreements and contractual relationships. On the lack of relevance as explanatory variable played by trust, and the implications of firms' behavior for the so-called economics of trust we shall focus in next steps of our research agenda. However the first results showed us that 77% of the firms reported that collaboration was managed by formal contracts.

Product development is not only the result of the interaction between firms and RTD organizations; such interaction is shaped by government and intermediary funding agencies. Traditionally and departing from an economic point of view it has been pointed out that cooperation is a matter of incentives and incentives' alignment. Nevertheless, the role played by institutions is not exclusively restricted to funding issues and the set up of economic incentives through different policy instruments. For firms describing their most important project in collaboration a small but significant 16 % reported that the original

motivation for the collaboration was related to public economic support and funding policies. Apart from the driving force fostering cooperative behavior also 67 % of the firms have acknowledged that their most important collaborative project received public support.

Innovation related to new product development as well as the organization of cooperative networks have been the major theme and phenomena under investigation. However, it has been often suggested that product innovation is strongly related to service innovations. From our survey we may conclude that the relationship between new products and the development of new services is not as direct and strong as this seems to be. The relationship between products and related services may be quite complex ranging from those firms that have been innovative in services associated to their products while they do not report any product innovation (20%), to those in which new products and new related services have been developed almost simultaneously (30%). We also have found firms that have developed the product in collaboration while the services have been developed in isolation, however 50% of the firms that have developed services associated to their products have collaborated with other firms and organizations in its development. Product innovations are not a good predictor of service innovations, nor of the collaborative networks and further elaboration on the relatedness of both aspects is also required. Besides this tendency and low rates of collaboration between manufacturers and service providers in new product development it is worth noticing that it can be found an increasing amount of services used as intermediate inputs along the product development process; because some of the most relevant collaborators of the firms in the process of development of new products are companies or organizations which major function is to provide a set of specific business services in strong connection with the innovation process.

2. Inter-firm co-operation: Active exchange of technological knowledge and coordinated learning

In recent years a growing amount of literature has discussed the emergence of international and domestic-based groups of firms engaged in collaboration. Large firms, in central countries and operating within specific industries are characterized by the increasingly international scale of their innovation activities developed through international joint ventures, strategic alliances and any other form of formal and informal inter-firm collaboration. International collaboration for new product development is related to business and corporate technological policies that support international co-operation in order to avoid time compression diseconomies. Secondly, the increasing globalization of markets and widespread patterns of consumption will support international cooperation in some particular technological areas. Joint product development has contributed greatly to standardization of products; country-specific characteristics are becoming in some market niches less relevant as there are more similar market structures in which these companies compete. International collaboration in product development will help firms to define more accurately potential consumer needs, and consumption patterns, behaviors and expectations.

Besides the basic argumentation for international inter-firm collaboration there are several contingent aspects that might influence how Spanish firms behave at the end of the XX Century. International co-operation remains a function associated to old business practices to get in and gain access to foreign markets. In spite of the attention paid on international inter-firm collaborative agreements, still one of the basic features of Spanish firms that engage in co-operation for product development is their domestic character. Hence, international co-operation for new product development as part of a broader picture grounded in the internationalization of technologies, markets and related issues in this case does not apply. Of course, it should be related to what the firm is searching for and where that knowledge or competencies could be obtained minimizing the cost, the efforts

and the risks. To illustrate this point it is worth noticing that only 14% of the total links or ties established between firms included exclusively a foreign partner while such number slightly increase when firms have multiple partners including both domestic and foreign business firms and institutions. And additional data is that 20% of our total sample does not collaborate with foreigners.

These data confirm that for active collective learning coordination for research and development, international co-operation may be constrained by several factors such as cultural differences, the traditional market scope of domestic firms, the required technological base, or the type of managerial capabilities needed to deal with complex international cooperative agreements. It is worth noticing that from our perspective international cooperative agreements for product development are complex to manage in comparison to domestic cooperative structures.

Business history may be useful to understand the type of technological co-operation that occurred in Spain; the most substantive collaborations were distinguished by traditional technological exchange that did not include learning coordination. Apart from the above mentioned lack in process and business culture differences, the division of markets and technological competencies as well as differences in firm's technological potential and reputation may play a relevant role too.

In spite of the fact that international active co-operation does not represent a relevant characteristic, the analysis of which are the foreign companies/actors tied to the process of product development is highly representative. In this broad characterization, one basic feature emerges: the most relevant foreign partners are customers and suppliers of both capital goods and materials or intermediate goods/inputs. This trend confirms the relevance of users/producers interactions while at the same time it sheds light on some of the regularities that emerged from previous analysis on the country's technological dependence and basic technological structure. Collaborative links between firms exhibit, first, history dependence and, second, they have to be controlled by industry; though, the users/suppliers "chain" has expanded internationally, as result of the increasing technological inter-relatedness.

While international cooperation in product development is not a dominant process, not even a common pattern of Spanish firms, some elements concerning the subjective perception on the valuable contribution of foreign partners may help our understanding of the type of international innovation in which firms located in Spain are involved. First, the network of international ties for Spanish firms, often branches of a multinational corporation, is mainly dominated by customers and suppliers of capital goods and intermediate goods. Second, and behind what may be termed as an extreme necessity -to cooperate with your suppliers and users, a quite interesting picture emerges from the following data. The contribution of affiliated companies and technological centers have been considered of the major relevance, immediately followed by suppliers and customers. In further analysis we shall provide a more elaborate information concerning such subject, but at this stage it is worth noticing to point out that such relevance is pointing in different directions. First, that the structure of multinational corporations matters, as indicated by the relevance of the contribution of the technological center, and secondly that international networks of cooperation for product development may be biased by multinational corporations operating from Spain and involving foreign companies that are tied by different means of previous and complex arrangements to the company. The major role attributed to the affiliated companies may be also an indication of the role played still by the head quarters, and the strategic control of R&D facilities.

When considering the relevance of the collaborators contribution (domestic vs. foreign) it is

interesting to mention that the size of the firm is a relevant factor. The small firms have a much higher average consideration for the contribution of the domestic partners, while medium and big firms have a much more average positive assessment of the contribution of the foreign partners than the national partners.

3. Co-operating within the national boundaries

Inter-firm collaboration involving active learning is characterized by the dominance of domestic/internal links or ties among innovative firms. Hence, knowledge production and knowledge transfer is mainly grounded in domestic firms and local organizations . Therefore, the nature and structure of the national network of collaborative ties represent critical issues to be addressed in this study. In such context, our results confirm the different set of capabilities and the different nature of learning that take place within domestic networks of firms vs. international networks of firms.

Collaboration in new product development within domestic networks is based mainly in a sort of ties that imply universities and public research centers as providers of a scientific base for the process. The second tier of innovative partners within the domestic network is formed by testing and quality control institutes whose role has to be carefully analyzed. Collaboration with suppliers of materials and components is also relevant in the building of the domestic network of collaborative innovation.

The crucial role played by universities and public research centers has been theorized, and acknowledged for a long time, though as the dynamics of innovation and of public/private cooperation have evolved such relationships are subject to an intense debate. Major questions arise on the efficient results of cooperation between two different organizational settings that operate in highly differentiated environments and are coordinated by different incentive structures. Nevertheless, transfer from public centers -mainly universities and research centers- to private business units is not the subject matter here but the structuring of formal and informal ties aimed at developing new products, and how public institutions emerge as central actors within the domestic structure of cooperation.

Universities and public research centers have a dual role within the network of inter-firm cooperation for product development: they provide basic/scientific knowledge, mainly embodied in human resources incorporated as partners within specific projects, and they provide institutional legitimacy concerning the quality and excellence of the knowledge at use. Such view of universities as socially relevant and legitimate actors in research is rooted in social and cultural values which are country-specific. The relevance of universities and public research centers as central actors within this innovative networks has to be also controlled by the levels of institutionalization of research and development in the country. In an environment dominated by public policies aimed at fostering and subsidizing or supporting cooperation between public institutions and business organizations is not surprising to find that public centers are the most likely collaborators. Such strong policy orientation, as it was mentioned, has been confirmed by the fact that around 67% of the firms involved in product development have received public support for what they have identify as the most relevant project within the company. However, and due to the original composition of the data set used for the sampling of our empirical analysis such percentage is highly surprising and it is lower than expected (See technical Annex on the general characterization of the sample).

Firms have also pointed out the relevance of testing and control institutes as major actors in the process of product development in collaboration. These centers are providers of specialized business services including technological assessment, technology risk evaluation and quality certification. On the other hand, within the development process

these "actors" are located, and they intervene, in what can be called "advanced stages" of the process; hence their relevance can be an indirect measure of success in product development. Success meaning here that the transformation of initial ideas and concepts into a prototype or parts of the technological architecture has occurred, and they may be subject to test and control.

The role of testing and quality control institutes has to be emphasized; their contribution has been considered as important by business firms involved in the project. It is our claim that such organizations play a decisive role but they act serving different purposes not entirely independent. Testing and control institutes are characterized by a set of complementary skills and capabilities as well as experiential knowledge firms lack. From that point of view they are perfectly complementary to the firm's own competencies. Moreover, they are external providers of services that could be developed within firms by creating specific facilities. Hence, these institutions may be interpreted as external providers of technological services that firms have come to externalize; in other words technological services that rely on market transactions. However, there is a second role that clearly influences the perception of firms in the contribution of such type of actors; by acting as external to the firm they are providers of legitimacy concerning the technological and innovative activities of firms. Thus, technological skills and legitimacy on technological actions and initiatives place these organizations as major players, and new comers, within the development process.

Together with universities and testing and quality control centers, many of them supported by public bodies or regional governments, Spanish firms rely on customers and suppliers. Such data may be useful to confirm that users/producers relationships are becoming dominant as far as the technological characteristics and the technological dimensions are becoming more interrelated and complex. Technological complexity is at the basis of such strong collaboration between users and suppliers.

In the opposite side of this broad picture, Spanish firms do not see cooperation with competitors as a relevant variable for the development of new products, and mainly based on their past experiences. About 15% of the surveyed companies have developed new products in collaboration with competitors; the lower rate of participation in joint products is reflected also in the subjective perception of the potential contribution of competitors to the overall process. Spanish firms lack confidence in the contribution of competitors to the development of new products (17%). Issues concerning market structure and the characteristics of competition in final markets have to be explored to understand the low rate of competitors as relevant partners and major sources of innovation.

Concluding remarks

From the Spanish data on product development collaboration what clearly emerges supports the argument that innovation is a collective process.

Also some evidence on the lack of explanatory relevance of the traditional industrial economy variables (as size, industry) come out. These traditional variables give us almost no insight into the explanation or mapping the collaborations forms in product development.

The last issue that clearly emerges is that the "location" (domestic vs. foreign) of the collaborator is still a very significant factor for many firms. The domestic networks are in general much more relevant than the international ones.

Last but not least, formal contract between partners are the basic tool for managing the collaborative relationship in the product development.

However what has been presented as the first very preliminary results from the survey deserves more deep and careful analysis.

Annex 1. Industry classification used in the data from Innovation Survey

NACE Divisions	Sectores Industriales	Industries
10,11,12,13,14	Extractivas	Mining and extractive
15	Alimentación, bebidas	Food and beverage
16	Tabaco	Tobacco industries
17	Textiles	Textiles
18	Prendas de vestir y peletería	Wearing apparel and fur
19	Cuero y calzado	Leather and footwear
20	Madera y corcho (excepto muebles)	Wood and Cork (not formitures)
21	Cartón y papel	Pulp & paper
22	Edición, impresión y reproducción	Publ., print & repro. Of rec. Media
23	Coque, refinado de petróleo y combust.	Coke, ref petrol prod & nucl.fuel
24 (less 24.4)	Química (excepto farmacia)	Chemicals (less Pharmaceuticals)
24.4	Farmacia	Pharmaceuticals
25	Caucho y plástico	Rubber and Plastic
26	Minerales no metálicos	Non-metallic mineral product
27 (less 27.4)	Metales férreos	Ferrous metals
27.4	Metales no férreos	Non-ferrous metals
28	Manufacturas metálicas	Fabricated metal products
29	Maquinaria (n.c.o.p.)	Machinery n.e.c
30	Máquinas de oficina, cálculo y ordenadores	Office machinery & computers
31	Máquinas eléctricas	Electrical Machinery
32.1	Componentes electrónicos	Electronic components
32.2, 32.3	Aparatos de radio, tv y comunicación	Radio, TV and Communication equipment
33	Instrumentos óptica y relojería	Instruments
34	Automóviles	Motor vehicles
35.1	Naval	Ships construction
35.3	Aeroespacial	Aerospace
35.2, 35.4, 35.5	Otro material de transporte	Other transport equipment
36.1	Muebles	Furniture
36 (less 36.1)	Otras manufacturas	Other manufacturing industries
37	Reciclaje	Recycling
40	Electricidad, gas y agua	Electricity, gas and water supply

Annex 2. Spanish Survey on Product Development Collaboration ECODEPE (*Encuesta sobre Colaboración en el Desarrollo de Productos en España*)

The main purpose of ECODEPE is to detect the collaborative patterns in manufacturing firms and to identify both foreign and national partners. This survey has been developed through telephone interviews with industrial firms and the tool used for implementation was a Computer Assistant Telephone Interview (CATI).

The survey focuses on product development collaboration. Product development is understood as the "development of a tangible product which in its design, its construction, its productive capacity or in any other way is *new* for the company". The time reference was within the "last three years".

We employed this interpretation which refers to "product develop process" in order to permit international comparability with Danish and Austrian surveys which have also used this concept.

The conceptual approach taken is slightly different from the concept of product innovation defined in the Oslo Manual, that clearly refers to it as "the introduction into the market of a new or technically modified product by the company" The justification of using this approach can be found in Sanz Menéndez, L; Schibany, A; Naes, S.O; Poulsen, C.S.(1997) "Proposal for the common set of core questions in the pan-European collaboration survey" (http://www.oecd.org/dsti/sti/s_t/inte/nis/membersonly/pdf/Eurodisk.pdf) . However, a control variable was included into the Spanish Survey in order to appreciate the relevance and the differences with the Oslo Manual definition.

In the Spanish Survey, the questionnaire which has been used comes basically from the DISKO project, with some particular adaptations made by the Spanish team and mostly set in the context of the document mentioned above. Specifically, the Spanish Survey contains: a) questions about the relative importance of the partners for the firm's product development, b) questions related to the most important product development project, which include a brief description, patents application, weight of this project in comparison with the amount of resources devoted by the firm to the development of new products, etc. Some questions about the public support of the most important project –if any- were also included, c) finally, we asked about the methods used to manage the collaboration relations or the partner agreements. Other questions, found in the DISKO questionnaire, were kept out from the Spanish one, which include environmental issues in collaborative practices, services' development and the development of services in collaboration.

The sample was obtained by a randomised automatic computer selection from the population of 1519 Spanish industrial firms, with NACE codes 15-37. The database is from the CDTI (Centro para el Desarrollo Tecnológico Industrial), an organisation belonging to the Spanish Ministry of Industry, which is in charge of promoting technological development in firms.

The random selection guaranteed an even sector distribution of the sample. Assuming that CDTI database is integrated by mainly high tech firms, for the Survey sample no bias has been found. On the contrary, compared with the national industry structure data, the sample is bias to the overrepresentation of the NACE codes 6 (chemical and man made fibres), 10 (machinery and equipment), 11 (office machinery, computers, electrical machinery, radio, TV, optical instruments..) and to the under-representation of the NACE codes 2(textiles, wearing and leather), 9 (basic metals), 13 (furniture and other

manufacturing) –table 1 below-

A total of 2250 telephone calls were made. A total of 594 firms were contacted -a mean of four telephone calls for contacted firm - and 400 firms agreed to participate. This represents 67% from the contacted firms. For the rest number of firms (194) only ten refused to participate and the others postponed the interview to a date which was later than the end of the Survey's time frame (33% of contacted firms).

Exceptionally, firms requested to read the questionnaire before answering to it by telephone. A total of 164 faxes were sent and 34 firms sent back the written questionnaire (instead of phone interview) which represents 8,5% of the total number of valid interviews.

The Spanish Survey on firms' collaboration was conducted during a 7 week period between February the 17th and April the 7th, 1998. It took 35 work days at the Institute for Advanced Social Studies (IESA-CSIC). At first, there was only one interviewer, but since March the 3rd the database was divided into two interview points (two computers) with the aim of taking less time to achieve the planned number of results. This partition was done maintaining the randomised selection of firms from the database applying the criteria of firms' number order (even/odd). Total time of valid interviews was 113 hours, with an average time for a valid interviews of 17 minutes.

Table A1. Sector Distribution of the Population, the Sample and the Spanish Industrial Firms

Agregation Groups	Population firms (%)	Sample Firms (%)	Spanish Industrial Firms (%)
	n=1519	n=400	n=163.267
1	15,34	14,5	18,26
2	4,27	4,75	14,63
3	1,57	1,50	9,42
4	3,55	2,50	8,40
5	0,26	0,00	0,01
6	16,12	17,25	2,18
7	4,87	5,00	2,96
8	3,81	4,50	5,87
9	8,62	8,25	16,67
10	14,61	15,25	6,08
11	19,03	18,75	3,29
12	5,53	5,00	1,57
13	2,37	2,00	10,64
NACE 15-37	99,95	99,25	100

Table A2. NACE groups aggregation used in ECODEPE

Agregation	NACE CODES
1	Food (15), tobacco (16)
2	Textiles (17), wearing apparel (18), leather (19)
3	Wood and wood products (20)
4	Pulp, paper (21), publishing, printing (22)
5	refined petroleum (23)
6	chemicals and made fibres (24)
7	rubber and plastic products (25)
8	non-metallic mineral products (26)

9	basic metals (27), fabricated metal products (28)
10	machinery and equipment (29)
11	office machinery and computers (30), electrical machinery and apparatus (31), radio, tv, communication (32), optical instruments, watches, clocks (33)
12	motor vehicles (34), other transport equipment (35)
13	furniture, manufacturing n.e.c. (36) recycling (37)

Luis Sanz-Menéndez, CSIC Institute for Social Advanced Studies, Madrid. C/ Albasanz, 26-28, 3ª planta, Módulo D (E-28037 Madrid). E-mail: lsanz@iesam.csic.es. **Clara Eugenia García**, Business Administration Department, University Carlos III of Madrid. C/ Madrid 126 (E-28903 Getafe -Madrid). E-mail: claragar@emp.uc3m.es.

We thank the financial support for the project received from the CICYT (Spanish Interministerial Commission for Science and Technology). We also acknowledge the help provided by the CDTI and the Ministerio de Industria y Energía.

◀ [\[CSIC\]](#) [\[IESA Madrid\]](#) [\[Working Papers\]](#) ▲