

SPANISH MACHINE TOOL INDUSTRY

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Abstract

The Spanish case offers a particularly interesting opportunity to consider the innovative policies of a country that, after great difficulties, is becoming competitive in the machine tool world market. Firms in the Basque Country, and Spanish companies as a whole, are facing the actual economic internationalization process in a situation of inferiority: small size, weakness of external commercial networks, low R&D, and so on. Within such a national and local situation, Spanish machine tool shows some peculiar characteristics in the international contest of this industry that are worthwhile mentioning.

Il caso spagnolo offre una interessante opportunità per considerare le politiche innovative di un paese che, dopo grandi difficoltà, ha incominciato a divenire competitivo nel mercato mondiale delle macchine utensili. Le aziende nei Paesi Baschi, e nel loro insieme, le aziende spagnole, stanno affrontando l'attuale processo di internazionalizzazione economica in una situazione di inferiorità: dimensioni ridotte, debolezza nel penetrare nelle reti commerciali estere, investimenti in Ricerca & Sviluppo particolarmente carenti, ecc.

All'interno di tale situazione nazionale e locale la macchina utensile spagnola mostra alcune caratteristiche peculiari nel contesto internazionale di tale settore che vale la pena sottolineare.

1. Introduction

The Spanish case offers a particularly interesting opportunity to consider the innovative policies of a country that, after great difficulties, is becoming competitive in the machine tool world market.

The change of the political system from the totalitarian regime to democracy has caused profound changes, which have allowed Spain to overcome its economic isolation.

After the Civil War, the Spanish economy endured a long period of autarchy (1945-58) which prevented the Country from facing the problem of constructing an economic infrastructure and of consolidating a basic industry which was in the meanwhile developing all over Western Europe [Escorsa, 1986]. The ensuing slow opening favoured the acquisition of intermediate inputs and of capital assets (1958-70). This process was helped by the continuous influx of foreign capital and by the Government's hegemonic socio-political system under Franco's regime (Plan de Estabilizacion).

Despite the introduction of these improvements, and the advantage of the Spanish non-involvement in the Second World War, which was to their advantage, they still could not cope with the economic crisis of the 70s [Martinez Mendez, 1982].

This resulted in an increased rate of unemployment and an increased technological gap compared with other industrialized countries. Investment funds flowed to projects requiring a great amount of capital and aimed at restructuring the industrial processes (labour substitution and energy saving); but only a small amount of the capital was used to increase productivity. This behaviour made Spanish industry weaker and more dependent on the international division of labour. The transformations in manufacturing industries became dependent on technological transfers and investments by foreign firms. This can be explained by several factors: the important role played by technical progress, an increased concentration of capital, the presence of large translational industries and the continuous restructuring of both productive system and production processes [Petitbo, 1988].

The Spanish economic recovery was mainly due to Spain entering the European Community in 1986: the Gross National Product rose at an average rate of 5% per year and investments at a rate of 12%.

The Spanish machine tool industry, which benefited from the national economic development, originated at the beginning of this century during a period of high industrialization involving all of Europe. The first machine tool activities began in 1912 in Guipuzcoa, one of the three Basque Regions. Among the early firms, Estarta y Ecenarro must be mentioned, as it is one of the oldest firms of this sector still working today. It turned out to be a real technical training school from which many employees moved away to create other machine tool manufacturing firms. From the beginning, the transfer of technical know-how has been considered one of the most crucial factors supporting the sector. This is confirmed by the foundation of the Armeria School which, since 1913 has made a lasting contribution to the learning and the use (afterwards also to the manufacturing) of machine tools in Spain.

A strong steel industry tradition in that area and a national policy meant to reduce the high level of imports, were other factors that greatly helped the machine tool sector at the beginning of its activity. Today, these factors are still present. Most producers of accessories and components for machine tool manufacturing industries are located in the Basque Region [Belza-Perez, 1991]; in recent years both Central Government and the Basque Autonomous Administration drafted a number of support plans for this sector.

Later on, other factors contributed to the development of this industry. At the end of the Civil War Spanish industries were forced to build plants internally due to a shortage of machinery and imported products. Afterwards, the Second World War allowed the exploitation of new markets for the exports of Spanish production surplus. The opening towards the international economy under Franco's regime led, albeit cautiously, to the formation of a new entrepreneurial class which had the ability to develop and to present itself positively on the international markets. However, the customs tariffs that greatly helped the Spanish industry in that period, did not allow the import of new technology coming from the more advanced countries such as the United States. Thus, from the 50's onwards, the tariffs favoured the deterioration of the technological level of the entire Spanish production system. In the mid 60's many Spanish producers were not able to develop in-house the new products required by the market and abandoned their activities under the pressure of the new technological developments and of the new entrepreneurial class formed in that period.

With the gradual opening of national borders, figures changed considerably. In the last five years the customs duty reduction which on average (depending on the type of machine) decreased from 36% to 6%, has been one of the main causes that led to large increase in real terms of both consumption and machine tool imports.

Besides the progressive abandoning of protectionist policies that from 1993 will no longer have reason to exist towards the European Community countries, another factor that reduced the competitiveness of Spanish products is represented by the Central Government monetary policy that led to an over valuation of the Peseta of about 20-25%.

These socio-economic changes together with the technological advances forced the Spanish machine tool sector to face a complete reorganization. Most employees were retrained or were replaced by younger technicians, better prepared to cope with the new situations. Factories, machinery and plants were renewed by producers who invested more than 300 million dollars. Research and development activity expanded, as the amount of money assigned to it increased year after year.

For a correct evaluation of this sector it is important to consider the existence of those groups that, according to their different degrees of co-operation, are able to develop together production, research and development and the marketing and sales activities.

Finally, one of the most significant peculiarities of the Spanish supply of machine tools is the attention that manufacturers pay to their customers so as to give them highly customized products at equally competitive prices.

2. Market structure

The production of machine tools is one of the activities which has influenced and still influences the industrial development of the whole of Spain, helping undoubtedly the modernization of her productive system. The geographical concentration of the sector in the Basque region, home to 75% of the firms (figure 1), clearly shows the specific weight and the strategic importance of this sector within the industrial structure of this Self-governing Community ^[1]. The machine tool sector takes advantage of this particular situation because

1. Basque regions account for 25% of the national consumption of machine tools.

it benefits from the presence and help of an administrative system which has great legislative independence in the field of industrial policy.

Nowadays the machine tool industry is composed of 140 firms employing almost 8,000 people. In the last thirty years the number of machine tool firms has drastically decreased, but this phenomenon took place above all outside the Basque region. Overall, the number of machine tool manufacturers has been reduced to a half, while in Catalonia, Logroño and Castile it has shrunk to a quarter.

The average number of employees per firm (58) is similar to that of other European countries like Italy and France, but the number of medium-sized firms is higher. In Spain we find a high concentration of firms with 50 to 100 employees (54.7%), while the number of firms with more than 100 employees represents only 9.5% of the total. Only one firm has a little more than 500 employees and only two firms employ between 250 and 500 people (diagram 1). This distribution of firms results in a low productive concentration. Sixty firms cover 80% of the machine tool production, whereas the 10 largest firms' turnover reached only 30% of the total production.

One of the most important peculiarities of the Spanish machine tool industry is that share holders' equity is almost completely of domestic ownership ^[2].

Nowadays only two firms of this sector are active in the capital market through the Stock Exchange: Nicolas Correa and Zayer. Both had at the beginning a family-type organization structure. Capital was then composed of a limited number of associated members: thus, the financial needs of growth and expansion required an increase in the number of shareholders. Usually, the Spanish machine tool firms were founded by a family nucleus or by technicians who chose a co-operative structure. These two types of ownership have two effects in common: on the one hand they favour the transfer of technical know-how within the factory and from father to son; on the other hand, the direct involvement in all the operational aspects by the ownership and by the employees leads to a high reinvestment in the firm of the income obtained. The traditional way of expanding the firm, through organic growth rather than by acquisition, is actually favoured. This is one of the reasons why large industrial groups interested in this sector or majority take-overs by foreign operators are non-existent in Spain. The only groups existing among the machine tool manufacturers are the results of personal involvement by their administrators. The Danobat Group (ex Debako), Fatronik and MIL were only recently founded and their formation has shown a bottom-up process. Their main goal is to become more competitive in all aspects in order to overcome the limits deriving from their small-size.

In order to evaluate the organizational structure of the Spanish machine tool sector, many other aspects should be considered.

First of all the high degree of decentralization of production. Following the Japanese model [Vitali, 1990], in which the subsuppliers have achieved great reliability, Spanish firms tend to increase the amount of production ceded to external manufacturers, especially for parts with low added value; on the other hand they are developing an in-house automated system for the processing of critical semi-finished products [Metalworking, 1991]. None of the Spanish machine tool firms in-house manufacturers cast iron parts. The manufacture of these components is carried out by some very skilled steel firms mainly located in the Basque

2. Only one enterprise is of foreign ownership.

region, where the majority of machine tool manufacturers are situated. The same is true for other parts and basic components, such as gears and ball-bearings. In this way firms specialized in these products can increase the quality of their product and achieve economies of scale which could not be otherwise obtained by the single machine tool manufacturers.

In the same way, simple parts which do not require high precision are assigned to subsuppliers. This method is chosen by the major firms which tend to concentrate their attention on the following activities: design, assembly, trade, research and development, after-sale maintenance and internal production of only some strategic components.

This organizational configuration can actually provide a structural flexibility able to meet the ever changing market requirements as regards demand quantity levels and technology contents [Carlsson, 1990].

3. Strengths and weaknesses

The first competitive advantage is linked to a long tradition of Spanish manufacturers in the machine tool sector (figure 2). This historical evolution, partially discussed in the introduction, is unequivocally tied to the economic development of one of the main Spanish industrial districts, the Basque region.

Seventy-five percent of machine tool manufacturers, together with their subsuppliers, and 80% of total turnover are concentrated in this region (second advantage). The Basque machine tool industry represents 2% of the industrial work-force in the region. The firms in Guipuzcoa alone, numbering more than 60, account for more than 50% of total machine-tool activity in Spain. Within the province of Guipuzcoa, a town of special importance is Elgoibar, where more than twenty machine-tool firms are located, employing approximately 1,800 people.

This favourable situation facilitates the relationship between different firms inside or outside the sector, allowing agreements to achieve common targets while at the same time improving technology transfer together with the relevant know-how.

Furthermore the concentration of machine tool manufacturers in one region aids the comprehension of the new trends of production developing among the nations [Vizcaino, 1987].

The third point of strength of the Spanish machine tool sector is labour costs. Even if labour costs in Spain have increased on average more than in the rest of Europe during these last few years their level can still be considered highly competitive. The figures in table 1 allow a quick comparison of the hourly labour rates in the manufacturing industry.

Finally, the last point of strength of the Spanish machine tool manufacturers consists in their capability to adapt products to the customers' requirements, one of the factors which most influences a customer's decision to buy one product rather than another when acquiring a new plant. The nature of the machine tool demand is heterogeneous: the spectrum of metalworking processing is very wide and a great deal of different types of competencies and know-how determine the sector segmentation. In spite of many technological changes, the machine tool industry is still a specialized sector, where the identification of the manufacturer with his customers is what counts most. As far as this range of products (designed and manufactured to give the best solutions) is concerned, Spanish manufacturers can offer

experience, tradition and creativity, factors of great importance in global competition.

On the side of weaknesses, the average size of the firms in this sector represents one of the worst disadvantages for Spanish producers, compared to the rest of European and Japanese competitors (figure 3). Although it is known that the average number of employees per firm is not an accurate measure of the real situation ^[3], the lack of other structural indicators shows a basic deficiency which could deprive the Spanish machine tool sector of the necessary instruments to face foreign competition. Diagram 2 shows the average values concerning the most important countries producing machine tools in 1988. These values include the number of employees per firm, the turnover per firm and per employee. Leaving aside this last value, for which Spain has an intermediate position, in the other two Spain holds the lowest positions. The average number of employees per firm is 54, which is the absolutely lowest value, the average turnover per firm is 4.9 million dollars, which is only above the United States. Moreover, the annual turnover per employee is just less than a hundred thousand dollars, higher than Germany, Great Britain and the United States, but lower than Japan, Switzerland, Italy and France.

In order to be competitive, many Spanish firms have chosen specialization while others have made agreements to co-operate with different firms. The second solution is not widespread due to the atypical management style of the Spanish machine tool sector. Most of these firms are family run or co-operative societies ^[4]. But both are characterized by a strong independence and a legal configuration which makes it difficult to establish any kind of co-operation.

The technological improvements in product development and manufacturing processes represent a serious threat to small and medium-sized firms which face the risk of bankruptcy. The change of competitive terms creates three potential difficulties:

- In this situation firms have to plan long term business strategies. The lack of the so-called "minimum efficient size" for the small Spanish firms results, on the contrary, in short term planning. When all protective barriers, such as customs duties and national type approvals, are eliminated the technological level of Spanish products will directly compete with foreign products. As the Spanish manufacturers tend to introduce technological improvements with a certain delay compared to the market leaders, it is very likely that foreign competitors gain some share of the domestic market - either for

3. The index can be easily altered by firms policies, which can pursue strategies of production decentralization or external growth with the creation of integrated groups. In both cases the firm increases its actual ability to control the market, even if its size remains substantially the same.

4. The Basque region has numerous co-operative firms because of socio-economic conditions and as a result of a well-defined historical period. This phenomenon is not restricted to the machine tool sector but is common to the whole Basque economy, as the co-operative form is present in many business activities. The co-operative movement originated in the period immediately following the Spanish civil war and was promoted by a priest, Father Arizmediarrieta, in the district of Alto Deba in Guipuzcoa. The first experience was running an isolated farm located in an area with poor transport and communications. The basic idea was to pass, through the common use of the proceeds, from a rural economy to an industrial one, with the subsequent creation of new jobs, taking into consideration the importance of training young people.

special machine tools, for which German, Swiss and Italian products are considered of a higher quality, or for standard machine tools, coming from Asia at lower unit prices and of advanced technology.

- The greater needs leading to investments in research and development involve enormous costs for smaller firms. On this subject it is very important to be able to rely on some sources of financing to cover the ever increasing costs of the development of new products and processes. Most Spanish machine tool firms, owing to their small size, have many difficulties in covering financially important projects, requiring large investments, most of which cannot be financed internally. The high concentration of the machine tool manufacturers in a strong autonomous state, the Basque region, makes it possible to partially overcome this problem. In this region the Basque Government has undertaken many supporting activities for these firms, both structural (creation of consortia and establishment of scientific parks) and financial (development plans and economic aid).
- In many market sectors, it is difficult to recover the operating costs and the investments made due to the impossibility of creating economies of scale in the production and distribution activities. With the opening of the Common Market, in order to be competitive, it will be necessary to organize effective distribution systems at every level. Sixty percent of the Spanish machine tool manufacturers sell products directly only in the domestic market and less than 30% of these firms intend to adopt the same technique in the future for selling abroad. At present only 30% of the firms have agents abroad, only 10% depend upon a single sales representative and another 10% have branch sales offices abroad. The remaining 50% of these firms employ wholesalers for their sales abroad.

The market globalization, particularly favoured in Europe during 1993 owing to the elimination of customs barriers, will also involve small sized firms, which in the past only served domestic market. These will then be forced to internationalize their outlet market. For these firms the reduced amount of turnover makes it impossible to support groups of employees and agents in other regions of the country or abroad. The only possible solution is to establish agreements with other non-competing manufacturers, even if this choice will hinder the possibility of growth through product diversification ^[5].

4. Product diversification

The product diversification of Spanish machine tools presents some interesting features compared to the international situation. In Spain, actually, there is a considerable specialization in some market niches which is not found in any other country. Spanish manufacturers applied themselves to milling machine manufacturing for many years and more recently to spark erosion machines. Compared to the total turnover of the industry (diagram 3), the milling machine production is higher than 23.4% (the world milling production is 8%

5. The first experience of this type is the formation of MIL group. For further details see chapter 6.

of the sector) and the spark erosion machine production covers more than 3.7% (in many countries this type of production is insignificant) ^[6].

The particular interest in milling machines is further strengthened by the great number of machine tool manufacturers specialized in this sector (diagram 4) and by the time comparison. During the last five years, although important changes occurred in machine tool demand world-wide, the milling machine production percentage is unchanged in relation to the total production. Furthermore, NC machine tool production has increased, reaching, only for this product, the same level of the major manufacturing countries (diagram 5).

The joint analysis of diagrams 3 and 5 shows the great efforts made by the Spanish manufacturers with regard to distribution and technological upgrade. The competitive strategy is, nevertheless, concentrated only on some market segments, with the aim of protecting the more favourable productive sectors (milling machines and spark erosion machines) and of increasing interest in machining centres and metalforming machines in general. This sector policy has led to a decreased interest in the other metal cutting machine tools and in particular in the lathes, which in 1986 covered 18% of the total production and in 1991 only 11%.

Comparing the competitive indexes, the propensity to import and the degree of specialization ^[7] for each type of machine tool during the period 1986-90, it is possible to highlight the essential changes which occurred in the market. In diagram 6, each product ^[8] has been represented with an arrow whose base identifies the values for 1986 and whose head represents the values for 1990. If the degree of specialization is declining, the arrow leans towards the bottom, while if there is an increase of the propensity to import it leans to the left. As we can see, the propensity to import has decreased for every product, except for grinding machines without NC, and in some cases the decline has been considerable (NC lathes and presses). The degree of specialization has varied favourably only for machining centres, boring machines and transfer lines. It is important to point out that in 1986 many of

6. The high quality level reached by the four spark erosion machine tool manufacturers is strengthened by their ability to supply their products with NC. Located in the town of Durango, in Vizcaya, Ona Electroerosion is the Spanish leader in spark erosion and one of the most important in Europe. Ona exports nearly 70 percent of its production, uses advanced manufacturing technology and devotes more than 5 percent of turnover to research.

7. The propensity to import indicates the importance that purchasing from foreign countries has on national machine tool consumption (import/consumption). This point is particularly important for a time series analysis. The increased values of the indicator show a greater dependency upon the rival nations. On the other hand the degree of specialization is the ratio $(E - I)/(E + I)$ where E is the export and I is the import of the products taken into consideration, the numerator will be the relevant trade balance and the nominator the total value of commercial flows. This indicator shows the possible non specialization or the relevant specialization, according to its variation between -1 and +1. Results higher than zero state, first of all, that the sector balance of trade is positive and secondly that its tendency towards 1 determines a propensity to dominate markets rather than to be subject to the strategies of rival countries.

8. The initials in the diagram correspond to the following products, further subdivided by the presence or absence of NC: L=lathes, M=milling machines, B=boring machines, G=grinding machines, D=drilling machines, MC=machining centres, TL=transfer lines, P=presses, S=shearing and notching machines.

the products were highly competitive (high values for the degree of specialization and low values for the propensity to import) because of the high customs duties.

The gradual opening of the frontiers has led the Spanish machine tool sector to a long process of adaptation and assimilation of the actual competitive situation in the world. The major countries tend to a diffused non-specialization in all market sectors [Gros Pietro, 1991], this is also spreading across Spain, though gradually and with great difficulty. The persistent tendency to privilege only some market sectors is confirmed both by the products most affected by the introduction of NC ^[9] and by the strategies adopted by the firms.

Spanish firms tend to specialize in only a few products. Fifty-six percent of firms cover only one segment of the machine tool sector ^[10] while only 10% are concerned with more than 2 production segments (table 2 and diagram 7). This phenomenon is related to the whole machine tool industry and can not be restricted to a specific group of firms. By examining the 30 most important manufacturing firms we cannot see any relationship between their respective turnover and their level of product diversification and we notice that most of the main Spanish manufacturers are highly specialized. The four firms dealing with at least five types of products have different turnovers (from a minimum of 7 to a maximum of 54 million dollars). The same holds true for the three firms with a medium product diversification (from 1.5 to 26 million dollars), and for the 23 firms dealing with a maximum of two product types (from 1.1 to 59 million dollars).

The concentration of industries is emphasized when we consider the production of NC machines. Forty-one percent of Spanish manufacturers do not produce any NC machine. Of the remaining 59%, the majority (40% of the whole) fall in only one segment, while only one firm reaches the highest values, manufacturing four different types of machine tools.

5. Competitive capability

Observing more in detail the overall evolution of product diversification as far as the Spanish machine tool sector (diagram 3 and 5) is concerned, we notice that most of the products are still in the market segment composed by traditional products with low technology (grinding machines, some lathes, universal milling machines, shearing, bending machines, cutting machines and drilling machines without NC). These products require a

9. Diagram 5 shows that from 1986 to 1991 only NC milling and grinding machine production showed an important increase. Lathes, which are still considered a basic product for metal transformation did not suffer from remarkable changes, though all manufacturers can supply their products with NC (diagram 4).

10. The different types of machine tools have been grouped according to their similar composition: milling machines with boring machines, drilling machines with thread-cutting machines, grinding machines with lapping machines and tool and cutter grinding machines, working units with transfer lines, broaching machines with shaping machines. All machine tools for metalforming, except for bending machines, belong to the group for sheet metal processing. Lathes, machining centres, gear cutting machines, sawing and cutting off machines, spark erosion and bending machines have no similarities with other machines.

competitive strategy based on prices and on their related terms of trade. Most Spanish manufacturers belong to this production segment (as stated in the paragraph on market structure) since it does not require large firm size, research and development costs are modest, and selling does not need special distribution channels. Marketing is mainly based on the publication of catalogues and the only added costs (which are only minimum) relate to the after-sale service. Moreover, in this sector, the reduced profit margins due to the large quantity of labour required, the cost of which varies frequently, and due to the scarce development prospects (only for Eastern European countries an increase in demand is expected) have caused the most technologically advanced manufacturers to leave, lowering the barrier to entry and favouring the countries (among which Spain) with lower labour costs. The price-quality ratio favours Spanish manufacturers, especially as far as milling machines are concerned.

The special structure of this market segment and its renewed competitive repositioning have until now allowed national demand to address itself almost entirely to Spanish manufacturers. However, future reductions in customs tariffs could increase the number of competitors interested in the Spanish market with the subsequent rise of the imports from countries with a similar productive structure (Asian developing countries).

During the last few years some of these products have undergone continuous technological improvements, considerably modifying competitive strategies. The technological level embedded in the different types of machine tools becomes another relevant factor in addition to the traditional product classification based on the degree of customization. Simplifying the two strategic factors according to their level of content (more or less high), four distinct market segments result, the first of which - standard production at low technological level - has already been described.

An increase of technological content of the standard machine tool leads into a market segment where competitive advantages derive from a greater availability of funds for the inevitable investments in high technology, from the necessity of carrying out frequent marketing analyses and from the capacity to offer after-sale services. In this segment we find certain types of NC lathes, milling machines and grinding machines for which the demand has increased, requiring more customisation. The efforts of Spanish manufacturers were concentrated towards the above-mentioned tools, except for lathes, in order to improve the respective margins of competitiveness (diagram 3 and 5). This is mainly due to two factors: a strong internal increase in demand and a wider opportunity to overcome the technological gap with the other manufacturing countries. It is a market segment where international competition is particularly sharp and, in order to face it, many characteristics are required which are seldom found in this Spanish sector. Many Spanish firms present problems in the management of the distribution and of service network; they are scarcely known abroad, they are small and slow and they lack flexibility in conforming to the new demand trends.

One segment in which Spain has a long tradition is that characterized by a highly customized product coupled with a low technological content. This is the case of most metalforming machine tools without NC and of transfer lines. Competitive strategy is mainly based - apart from prices - upon the ability of a firm to adapt a product to the clients requirements and upon the control the firm has on its wage system. Even though Spanish labour costs are particularly competitive in Europe, Spanish products show a definite loss of competitiveness. The comparison of the standard indexes (diagram 6) points out the

transition from a situation of high specialization to one of despecialization for presses and shearing, while transfer lines still depend strongly on domestic demand and are hardly present on international markets. This is due to inefficient distribution channels and to the lack of capability to develop adequate marketing policies. Product complexity and the small size of firms force Spanish firms of this sector to strongly depend upon their suppliers, reducing in this way their chances of growth.

Finally we would like to note that improvements in Spain occurred in the sector which shows the largest increase of demand on the international scene and therefore the largest international competitive level, the sector of highly customized and technological products. Machining centres, though an increase in the propensity to import has occurred (diagram 6), have been the only type of product which, between 1986 and 1990, positively reversed its competitive position compared to foreign countries. Moreover, a few Spanish firms invested capital in research and development in order to create and install flexible manufacturing systems for national and international customers. However, these firms were prevented from growing steadily because of a lack in the Spanish economy of strong national groups known world-wide and capable of stimulating and supporting demand ^[11]. A well-timed introduction in this highly technological market characterized by high entry barriers, if followed by carefully planned firm policies aimed at overcoming the same problems existing in other production areas (distribution, availability of funds, service, staff training) will necessarily lead to the transfer of the acquired know-how to all the other industrial activities. This will improve the competitive position of the entire Spanish machine tool industry.

6. External growth strategies

In the past, Spanish machine tool firms depended entirely on foreign patents for learning and mastering the technology involved. Today the sector spends large sums on researching and developing its own technology.

With the aid and support of research centres set up by the Basque Government, firms have developed technologies that enable them to compete aggressively on the market. In order to improve their competitiveness and overcome the negative effects deriving from their small size, Spanish firms have preferred to develop joint projects rather than to buy other firms or to cease activities, as has happened in other nations [Rolfo, 1990]. Spanish machine tool manufacturers long ago began intense co-operation within the industry on the basis of production and commercial agreements and mainly for the development of common research plans. The results obtained and the large number of firms involved lead to believe that this is one of the most remarkable and peculiar organizational transformations at the European level. In no other country was such an extensive inter-company action ever undertaken; it actually generated profitable synergies among the different participants and activated corporate functions which could not have been achieved otherwise by the single firms. The

11. The automobile industry and the office machine and data processor manufacturing industry, which represent the main outlet sectors for the production of cells and flexible systems, are inadequate. In Italy they covered 54.7% and 11.5% respectively of the global demand in 1989.

factors which stimulated this initiative are geographic location (all firms are located in the Basque region), the size of firms (most of them are small) and, in some cases, production specialization.

This co-operation, developed in the 80's, has led to the creation of some distinct groupings of companies interacting with one another. Among these, we shall analyse

Danobat Group, Fatronik and MIL whose global turnover represents almost 50% of the national production. Only Danobat can be considered an industrial group according to the economic literature and similar to those found in other machine tool manufacturing countries [Gros-Pietro, Rolfo, 1989]. As to Fatronik and MIL, although presented under the same category, they are a series of specific joint ventures which are not only limited to two contractors, but involve a non-predefined number of enterprises. Ibarria, a firm which belongs to both groups, can be considered as an example of their associative nature. Among these groups there are no significant relations.

MIL GROUP

MIL Group unites four medium-small sized producers^[12] (CME, Ibarria, Metosa and Sierras Sabi) which have entered into mutual agreements exclusively for the marketing and promotion of their own products. The co-operation was favoured first of all by the type of production of each firm, which is not in competition with that of the other partners, secondly by a production specialization focused only on metal cutting machines, and finally by the small size of the firms, which is close to the average national values by number of employees and total turnover. These firms are highly specialized in one or at the most two production segments^[13] and they can all supply NC to their respective machine tools.

FATRONIK GROUP

The grouping of enterprises called Fatronik has included, since 1986, a great number of firms which are interested in accomplishing important quality improvements as far as research and development are concerned. Nevertheless the activity of the enterprises which have supported this initiative is not aimed purely at manufacturing. Most of them (16 firms) are obviously machine tool manufacturers, but an export firm and an applied research association are also involved in the group.

The influence of manufacturing firms, some of national and international importance (Anayak, Exte-tar, Juaristi, Ona Electroerosion, Zayer), is remarkable if compared with the national sector. The total turnover is more than 30% of that of the whole Spanish sector. The

12. The turnovers combined do not reach 5% of domestic production.

13. The product diversification is as follows: CME for milling machines, Ibarria for drilling machines and machining centres, Metosa for lathes and Sierras Sabi for cutting off machines.

Fatronik Group employs about 2000 people (20% of the sector) and shows a greater propensity to export (55% of total sales compared with 45% for the sector). This is a planning organization, and has no pretensions of harmonizing the various productions. After a six year co-operation, the 16 manufacturing enterprises are not present in all production segments of the market. None of them manufactures bending machines, cutting off machines or gear cutting machines. The presence in the metalforming industry is modest, while the concentration in the milling machine (9 firms) and machining centre (7 firms) segments is high.

The joining of forces involved in the Fatronik project initially created a shared research and development unit (Fatronik I+D). Afterwards an industrial company was created, in order to make the studies developed by the research centre operational (Fatronik System).

Fatronik I+D develops technological innovation projects which will be applied to those enterprises of the group lacking adequate technical and human resources. The activities of the centre do not only dwell upon applied research (electronics, industrial computer systems, mechanics, metrology, production technologies), but they also take into consideration professional training and the study of new entrepreneurial projects.

This analytical field has generated the idea of creating a pilot enterprise with the main objective of carefully examining the technical and economic advantages of flexible manufacturing systems. The main purpose is the transformation of the demonstrative project developed by the research centre into an operational manufacturing system. Fatronik System must produce, in a flexible way, semi-finished goods and components for the enterprises belonging to the group and for the other industrial sectors. This will allow the firms of the group to acquire the necessary know-how in order to adjust their products to the characteristics of flexible manufacturing systems and it will allow them to gain a better understanding of their true capabilities and their possible applications.

DANOBAT GROUP (ex DEBAKO)

Danobat machine tool industrial group, national leader for the manufacture of technologically advanced systems and machine tools, was established at the beginning of 1980 by five firms: Danobat (the Spanish machine tool firm with the highest number of employees and product diversification which gave its name to the group), Izarratiz (specialized in the production of cutting machines), Goiti (specialized in metal forming), Soraluze (the fourth most important Spanish firm) and TSC (specialized in spark erosion machines). In 1992 the composition of the Danobat Group underwent a rearrangement process. Izarratiz was absorbed by Danobat and TSC was merged into Soraluze, while Goiti was substituted by Lealde (specialized in lathes). The total turnover of this industrial group represents 10% of the national one and exports are 50% of total production. Although composed of a smaller number of firms, the Danobat Group is significantly active in almost all market segments thanks to a more advantageous combination of the Group firms (compared to Fatronik Group). The production does not include bending, broaching and gear cutting machines.

All firms have the same co-operative legal form and are members of the Mondragon Co-operative Group, which includes other machine tool manufacturers (Fagor Arrasate, Egurko, Goiti, Ona-Pres and Ortza) and which deals with other economic sectors (investment

goods, intermediate and consumer durable goods, banking services) able to create useful mutual synergies.

The activities of the Mondragon Co-operative Group are now structured and organized according to homogeneous productive sectors with a common series of services [Gonzales, 1987]. Within the industrial sectors, the co-operatives belonging to Danobat Group are assembled according to their productive specialization, linked to the production of machine tools metalcutting, while the other machine tool manufacturers of the Mondragon Co-operative Group are specialized in metalforming. In 1992 a merger process within Arrasate, Ona-Pres and Goiti began. The resulting firm will be the largest Spanish machine tool firm with 450 employees and a turnover of 90 million dollars.

The main purpose of the Danobat Group is to achieve a balanced development of its firms through the co-ordination and planning its various businesses and industrial and financial activities. Certain joint initiatives and services have been arranged to this end.

- As far as production is concerned, the most important is surely the joining of the Danobat and the Soraluze brand names for the design and manufacturing of special machines, transfer lines and flexible transfer systems. This initiative generated a new corporate structure (D+S).
- In order to improve the competitive ability, in 1988 the Group realized an important three year investment plan to update the means of production totalling 15 million dollars.
- In the same period, with an investment of about 4 million dollars, they created a research and development centre (IDEKO) specialized in machine tools, supported also by the other Mondragon Group co-operatives belonging to the same sector. The research centre has been realized thanks to the financial aid given by Guipuzcoa Province, the Basque Government, the Central Administration and by the Mondragon Co-operative Group's Banks. IDEKO co-operates with other Basque research centres mainly for the development of mechanical technology, industrial information technology, production systems, electronics and automatism. In order to reduce production costs and improve the integration among the partners, one of the main targets of the centre is the standardization, through CAD procedures, of the great number of components used by the partner co-operatives in their production. For example the Danobat Group alone uses more than 7000 different components.
- The co-operation agreements are not restricted to the group alone. In recent years Danobat started to co-operate with both national and foreign firms. The most important agreement is with Renault Automation (France) for the commercialization of Danobat products in France and for the manufacturing of the French firm's Acma Robot in Spain. The agreement with Fagor Automation, a partner of Mondragon Co-operative Group, is technologically important for the development of laser systems to be used for shearing, nibbling, punching and cutting. Moreover, Danobat has drawn up an agreement with Matrix Churchill (Great Britain) for the mutual commercialization of their products.

7. Technology research policy and institutional support

An aspect worth noting when analysing the Spanish machine tool sector is the attention paid by the firms and national organizations to technological development policies. These are pursued by favouring the introduction of innovation through the substitution of means of production and by creating the conditions which allow firms to be innovation promoters themselves [Escorsa, 1986]. In the early 80's, principally in the Basque region, where the majority of machine tool manufacturers are situated, a vast project was begun to encourage and support technological innovation in all industrial sectors [Arrieta, 1987]. The main result of this initiative has been the considerable improvement of the ratio between research and development expenses and the gross national product. For this autonomous region the ratio (about 1%) is the highest in Spain, even if it is still far from those of the most technologically advanced European countries (an average of 2.5%).

The technological level has changed profoundly in a few years; as for machine tools, it has been possible to gradually incorporate the essential elements typical of the electronic and information technology sections, changing the properties of the goods produced from being exclusively mechanical to incorporating a set of different technologies.

The limited financial resources of these firms, due to their small size, to their family-type or co-operative management, favoured the creation of common research centres (see chapter 6) and persuaded the Central Government and the regional administrations to set up different methods of intervention. The machine tool producers benefited from direct aid (funds to stimulate the demand and support to research centres) and indirect aid (funds for the increase of the demand and use of services and infrastructures).

7.1 The regional research centres

One of the instruments adopted especially by the Basque Government has been the support it offered to the research centres of its region (CEIT, INASMET, LABEIN, IKERLAN and TEKNIKER); their joint activity covers all the main innovative areas that local authorities consider essential from a strategic point of view (automation, new materials, electronics, chemistry, environment, energy). The IKERLAN and TEKNIKER Institutes are particularly interested in the technological development of the machine tool sector and they are both involved in projects financed by the EEC.

IKERLAN belongs to Mondragon Co-operative Group and follows with particular interest industrial process control systems, CAD/CAM/CAE, robotics, automatic transport, artificial vision, local area networks and the integration of technologies. It is worth mentioning its co-operation with Danobat Group that led to the implementation of a flexible cell for manufacturing prismatic pieces.

TEKNIKER, although it was only founded in 1981, aspires to becoming the most important Spanish machine tool research centre thanks to its co-operation with the Fatronik group. It is particularly interested in some peculiar and intrinsic characteristics of the machine tool such as: remote fault diagnosis, tool management, the analysis and evaluation of machine noise and the manufacturing of high speed heads. Furthermore the projects for the automation of processes such as the Fatronik System (discussed in the previous chapter) are

essential.

The co-operative attitude which characterizes the machine tool sector, is to be found also among several research centres, and between these and various manufacturers. As a matter of fact, before adopting certain product or process innovations, they are supposed to carry out a common effort to solve problems adequately and to join efforts and resources.

The technological centre ROBOTIKER, for the diffusion of robotics and automation, is in an intermediate position between the research centres already mentioned and the co-operative groups of firms (Fatronik and Danobat Group). It is a non-profit association supported by the Vizcaya Province Council and by 55 firms belonging to different industrial sectors. The main areas of interest are: research, firm service and training through constant promotion aimed at favouring the introduction of automation and at underlining the advantages it brings in terms of flexibility. The purpose is that of persuading Spanish firms to implement and adopt entirely computerized production systems (CIM). For this reason Robotiker is active in many programs of the European Community such as: Esprit, Drive, Famos-Eureka and Comett.

7.2 Firms for industrial promotion and reconversion

In order to facilitate the progress of firms towards the continuous technological changes, agencies for industrial promotion have been founded in almost every Spanish region (SOPREA in Andalusia, IFR in Asturias, CIRIT and CIDEM in Catalonia, IMPIVA and IPI in the Valenciana Community, SPRI in the Basque Region, SPI in the other regions). These agencies, created as a consequence of special local legislation, aim at defending and creating new jobs and at favouring development and growth of industrial activities.

The types of intervention can be very different and offer many opportunities to firms. For this reason the firms for industrial promotion and reconversion adopted a policy which requires the intervention of the Ministry of Industry and Commerce. The efforts are meant to support the industrial development strategies at financial, technological and training levels, to promote Spanish firms on an international scale and to create essential industrial infrastructures. Among the latter the most important is the creation of scientific and technological parks (the Technological Park of Zamudio in the Basque Region, the Technological Park of Valles in Catalonia, the Technological Park of Madrid, the Technological Park of Valencia and the Technological Park of San Ciprian de Viñas in Galicia).

7.3 Public investment

The Spanish legislation provides many opportunities for financial aid for a machine tool firm. Subsidies mostly depend on the characteristics of the scheduled intervention and on the type of firm to which they are assigned.

In general, considering the industrial nature of these firms, they can benefit from incentives in order to adopt new technologies or increase their research and development activities. On the supply side, machine tool manufacturers benefit from specific industry support plans. As for the other financing methods, their main purpose is to increase the demand for and the diffusion of specific industrial goods in order to improve deal terms. In

this case the manufacturer benefits indirectly from the Government's action. Another point of distinction comes from the promoting body. The adoption of an administrative structure characterized by a strong decentralization makes it possible for the different autonomous regions to perform different intervention in the field of industrial policy. Such interventions are integrated with the national measures and, in some cases, they anticipate the Central Government's actions.

7.3.1. The overall interventions

The industrial policy activity in Spain is assigned to the Spanish Ministry of Industry, Commerce and Tourism (ex MINER) by its various bodies.

For the period 1989-1992 8,071 million Pesetas have been appropriated for the public investment plan of this Ministry.

The Ministry includes the CAICYT (Joint Commission for Scientific and Technical Research) and the CICYT (Interdepartmental Commission for Science and Technology). The CAICYT's duty is to finance basic and applied research developed in Spain, concerning the projects approved by the Interdepartmental Commission.

The CICYT carries out the operations of financial nature. This Commission can only provide the funds for particular projects and in case of commercial success these funds must be refunded at least partially to the Commission.

The CDTI (Centre for the industrial-technological development), which promotes innovative techniques, processes and products for Spain, and the IMPI (Institute for small and medium industrial firms) which seeks to increase the co-operation among the firms for the establishment of common research projects and for the improvement of their commercial network, work in the same environment but are independent from the Ministry of Industry, Commerce and Tourism.

Another form of financial aid provided to the firms is that of tax breaks for technological innovation. Besides, the firm can benefit from a particular depreciation scheme for a period of five years for intangible expenditures and fixed assets needed for research and development, and for a period of seven years for buildings utilized in research and development activities.

7.3.2 Aids supporting supply

The best known Spanish methods to finance projects on technological innovation are the following:

- a) Plans of national relevance
The national plan for scientific research and technological development (PLANYCIT). Its purpose is that of promoting, planning and co-ordinating the funds managed by the different national bodies. This plan intends to put together all research promoting efforts undertaken by the different administrations, universities and firms through the participation of the Autonomous Communities, the Ministerial Departments and more than 400 researchers. There is a planned funding of 262,223 million Pesetas for the

period 1988-1991 that, added to the EEC funds (111,372 million Pesetas) and to the Ministerial resources (260,576 million Pesetas) form a total amount of 670,171 million Pesetas of which 14,433 million Pesetas have been assigned to research in the Robotics and Advanced Automation field.

b) Plans of regional relevance

The Extraordinary Plan for the Promotion of industrial development (PRE) is specifically addressed to the machine tool sector. This plan was approved by the Basque Government in 1985 and allocated in total more than 8,000 million Pesetas to 64 firms of this sector as subsidies and credit guarantees. The main objectives of the plan have been to maintain employment levels and to increase the competitiveness of the sector.

7.3.3 Aids supporting demand

a) Plans of national relevance

The PEIN II plan (the second part of the National Plan for electronics and information technology) allocated about 48,000 million Pesetas in the period 1988-90: to develop the high- technology field, to promote its international expansion of the same field, to develop the exploitation of the large institutional markets and finally, in order to help implement the three preceding points, to develop the infrastructures.

The PAUTA (Plan for the advanced industrial automation), which is now in its third edition, provides grants for the automation of production systems. In the previous edition, out of a total of 48 projects approved, 11 concerned flexible manufacturing systems and 5 the introduction of robotics. For the PAUTA II plan the State intervention covered 40% of the investment costs while for the PAUTA III plan it will only cover 25%.

b) Plans of regional relevance

- In 1983 and in 1985 two plans to help the acquisition of NC machine tools (CN-110) were approved in the Basque Region. The funding assigned to both plans was meant to be of 100 million Pesetas but the investment reached 2,400 million Pesetas. The great success obtained by this regional plan has led the Central Government to extend the plan to the whole country, including the Basque Region, for a total amount of 1,000 million Pesetas (CN-1000).
- Both the Catalan and Basque Regions have promoted financial aid plans for the diffusion of flexible automation in their territories. In Catalonia, through the CIRIT, the FORMENTO plan (for the period 1989-1992) will provide money to finance projects for the development of flexible manufacturing systems for a total sum of 3,625 million Pesetas. The CIDEM, also located in Catalonia, has arranged a plan (AUTOMAT) to help firms make preliminary studies and analysis of the necessary conditions for the introduction of automation. In the Basque Region, the SPRI has formulated a

permanent plan for financing the introduction of technologically advanced production systems in the firms (ECTA). In 1988, 160 requests were approved for a total of 307 million Pesetas, while the investments undertaken were for a total of 1,844 million Pesetas.

8. Performance

World machine tool production has developed on average at a higher growth rate compared to various other industrial sectors; it increased by a factor of seven, at current prices, going from 6,500 million dollars in 1968 to 41,000 in 1991. This long period of growth lasted until 1980, but an uninterrupted phase of development started again in 1984, showing some signs of slowing down only in 1991. This favourable development is due to positive economic growth and especially to the investments made by the major industrial countries to restructure the production phases[Calabrese, 1990].

The machine tool sector in Spain, as in the rest of the world, has shown a great recovery starting in 1984 but with higher average increases than in any other country. Spain has, in fact, gained the largest share of the world market, both in terms of production and of exports, than any other country in the last seven years. The percentage covered by Spanish machine tools has actually doubled, as far as production is concerned, going from 1.1% in 1984 (this value is very similar to that of 1980) to 1.9% in 1990, while the Spanish share of the world export market has risen by 60%, 1.3 in 1984 and 2.0 in 1991. The average yearly development has exceeded the BIPE (Bureau d'informations et de Prévisions Economiques) forecasts, that attributed an average yearly increase at current prices of 5% to the Spanish manufacturers for the period 1988-93 while up to 1990 the average growth rate was 13.4% and only in 1991 a change of trend occurred due to the economic crisis brought by the Gulf War.

The large increase in national consumption is one of the main reasons for these results. According to Cecchini's report, in the near future this trend should continue, since 62% of the Spanish firms intend to invest in machinery and plants.

The progressive recovery from the recessive crisis, during which investments were scarce, and the need to replace obsolete machinery have favoured all capital goods producers. Nevertheless, all the changes described, coupled with the even more important political transformations and the adhesion to the European Community, have been so significant that Spanish machine tool manufacturers have not been able to meet the new demand of production goods in terms of both quantity and quality. Although Spain has increased its domestic supply, with great efforts and considerable help from the Government, which allowed it to gain a large portion of the world market, it slowly transformed itself from a self-sufficient country into a nation dependent on foreign countries. As shown in diagram 8, starting from 1987 the consumption of machine tools became higher than the quantity actually produced by Spain ^[14], furthermore the sector interchange indicators, the export/import ratio and the propensity to import worsened considerably in the last few years. In the

14. Among the nations taken into consideration in this book, only France has been facing the same situation for a long time.

first half of 80's, exports of Spanish machine tools have always been higher than imports, sometimes more than twice as much, while in the last few years exports are slightly lower. The import/export ratio has decreased to a value smaller than 1, showing a deficit in the balance of trade with foreign countries. Foreign competition has assumed an ever-growing importance for national demand. The index which shows the propensity to import at the moment of the Spanish adhesion to the European Community has considerably increased: from less than one-third in 1986 to nearly one-half in 1991.

Similarly for the NC machine tools, the most technologically advanced sector, a worsening of the indicators of interchange with foreign countries has been noted. During the same years the export-import ratio, for these products only, has decreased from 1.6 to 0.9, while the index which shows the tendency to import has increased by 0.25 to 0.42. Considering more closely both commercial trade indicators of NC machine tools, we find better values as compared to the global ones. This might indicate that the negative trend is mainly due to machine tools without NC and therefore the development of more technologically advanced products is less critical. However, it is important to remember that the spread of NC machine tools in Spain started later than in the other countries ^[15] [Malero, 1986], thus, for an accurate time evaluation, it is better to consider the trend variation than to simply make a comparison with general data. In doing so, we find that, in the last few years, the indicators relevant to these products have become seriously worse compared to the traditional machine tool indicators.

The deterioration of the competitive level is mainly linked to two factors. First of all the commercial opening towards the international markets has led to a progressive and unavoidable abandonment of protectionist policies. As a consequence, it was impossible to artificially hide the wide technological gap between national and foreign firms. Secondly, the Spanish machine price index (diagram 9) has remained steadily higher than that of other countries, partly reducing the competitive advantage deriving from the availability, keeping technological level constant, of one of the least expensive labour forces in Europe. In spite of this situation it is necessary to emphasize the important progress made by the machine tool industry in Spain. Diagram 10 shows that, among the most advanced countries in the machine tool sector, Spain is the country which increased the most its domestic production in the last decade, at constant prices. If we take 1980 ^[16] as our base year, equal to 100, we can distinguish two different development phases in Spain. In the first half of the 80's, it had the same recessive trend as the most important countries ^[17], while, from 1985, the actual production has been constantly increasing, reaching a value of 194 in 1990, nearly twice the

15. The first Spanish NC machine tool was manufactured by Danobat in 1976, while in Italy the first machines were manufactured by FIAT in 1961.

16. The choice of 1980 as basic year is not fortuitous, but rises from the fact that a brief recessive phase began soon afterwards and ended in 1984.

17. The only exception is Japan, which only in 1983 recorded values lower than 1980.

value of 1980, in contrast to many other countries. It can be noted that, by observing the other nations, Great Britain, France and the United States now all have a machine tool production level lower than that of 1980, while Germany has slightly increased this value.

The efforts to improve technological positioning have been remarkable ^[18]. The NC machine tool production rose by 40% in 1986, by 62% in 1991 and exports improved from 25% to 47% compared to the total amount, while the machine centres, which are the most technologically sophisticated machine tools, increased their importance in the metal cutting sector. At the beginning of the 80's this branch was almost non-existent, while in 1990 it constituted 6.3% of the total production^[19]. Also in this case, the BIPE (Bureau d'informations et de Prévisions Economiques) forecasts for the period 1988-1993 have so far been greatly exceeded.

All of these variations have caused an important change in the trade with other countries but above all they have inverted the commercial balance from positive into negative. Next, the opening of frontiers has changed the main type of customers and suppliers of the Iberian country. Comparing data of 1986, the year during which Spain joined the European Community, with those of 1990, we notice that Spanish machine tools have been exported to the most economically advanced countries, especially to France (diagram 11). After all, the importance of the South American Countries, with which Spain has always kept a preferential relationship, and that of countries with minor strategic importance ^[20] has decreased. As far as imports are concerned, a growing concentration can be seen coming from the European countries, leaders in the machine tool sector: Germany, which covers more than 30% of imports and Italy (diagram 12). The different relative importance of the other countries dealing with Spain, as countries of origin and destination for machine tool exchanges, has influenced the values in the bilateral balance of trade. As shown in diagram 13, the sign of the balance of trade has changed only for Great Britain while as regards to the other countries the existing gap increased. Considering as possible the hypothesis that the comparison between imports and exports in a certain period can be used as a comparative indicator of the internal capabilities of a national sector with regard to a competitor country, it may be inferred that the negative gap has increased with respect to the leading European countries, Germany and Italy. On the other hand, we notice an increase of the positive gap with respect to France and the United States, countries with an old tradition in machine tools, but with a lower rate of increase in technological level.

18. Eighty-five percent of NC used by Spanish manufacturers is produced in Spain (Aurki Fagor Automation).

19. However, the percentage is lower than that of other countries with the same technological level.

20. It is worth mentioning the decrease in value for the aggregate which groups the countries called "others".

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Table 1: Labour cost in manufacturing industry (1993)
(Germany = 100)

Germany	100
Switzerland	89
Norway	83
Belgium	82
Holland	78
Denmark	76
Sweden	75
Japan	75
Austria	75
U.S.A.	65
France	63
Italy	62
Finland	59
Great Britain	51
Ireland	47
Spain	45
Greece	25
Portugal	19

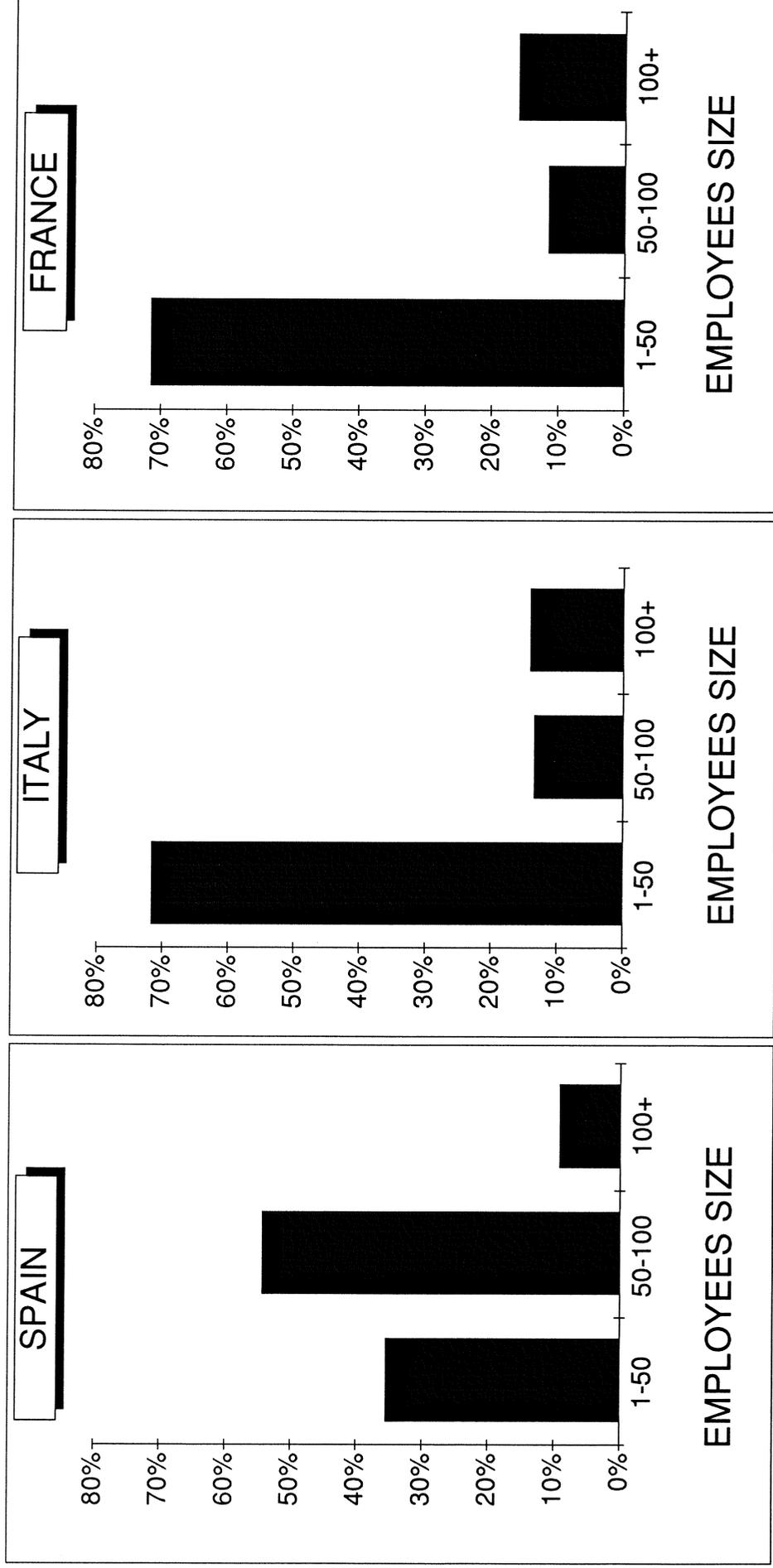
Fonte: EIU

Table 2: PERCENTUAL RATES OF COMPANIES IN DIFFERENT SEGMENTS OF THE MARKET

NUMBER OF PRODUCTS	WITHOUT N.C.	WITH N.C.
0	0.0%	41.4%
1	55.9%	39.6%
2	27.0%	16.2%
3	7.2%	1.8%
4	3.6%	0.9%
5	4.5%	
6	0.9%	
7	0.9%	

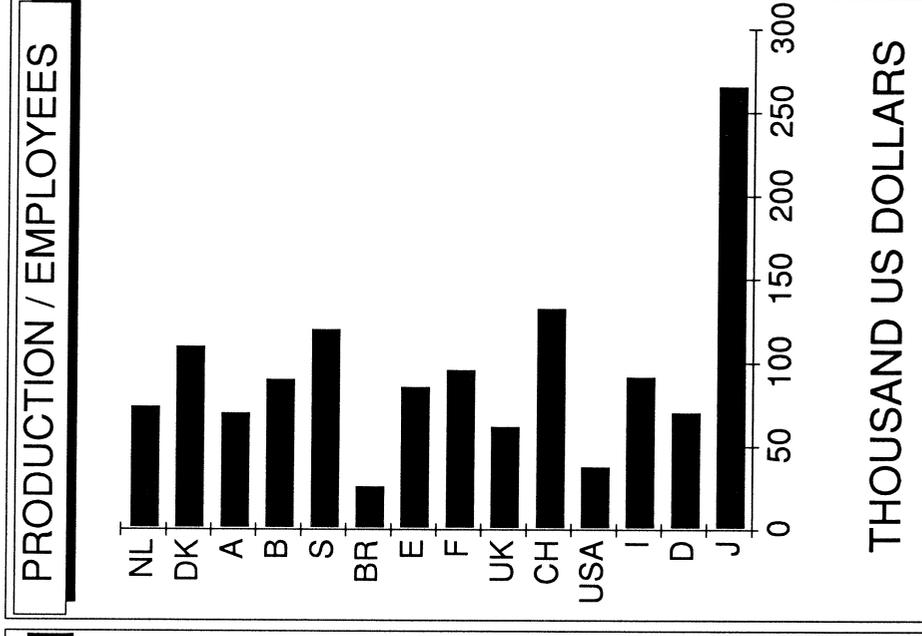
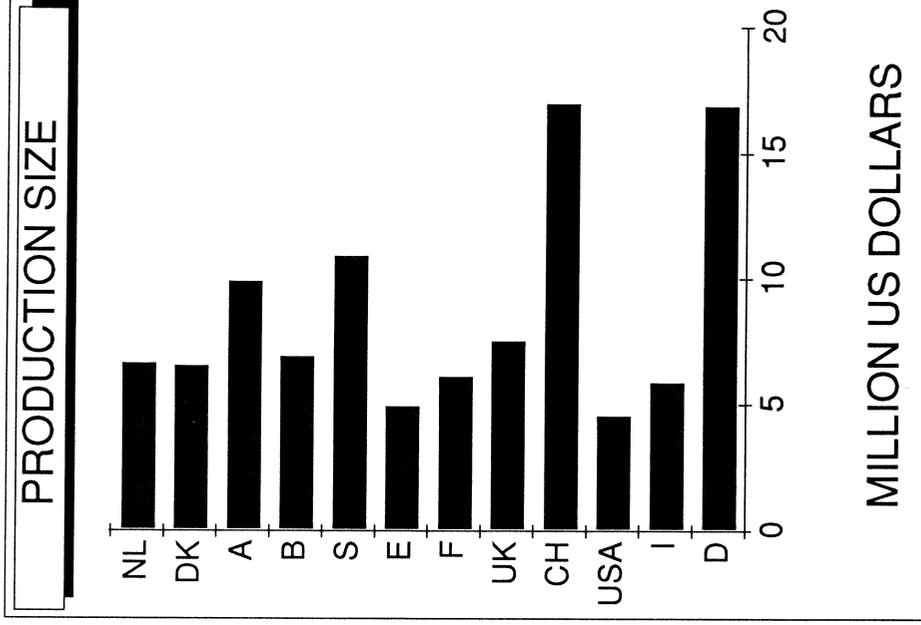
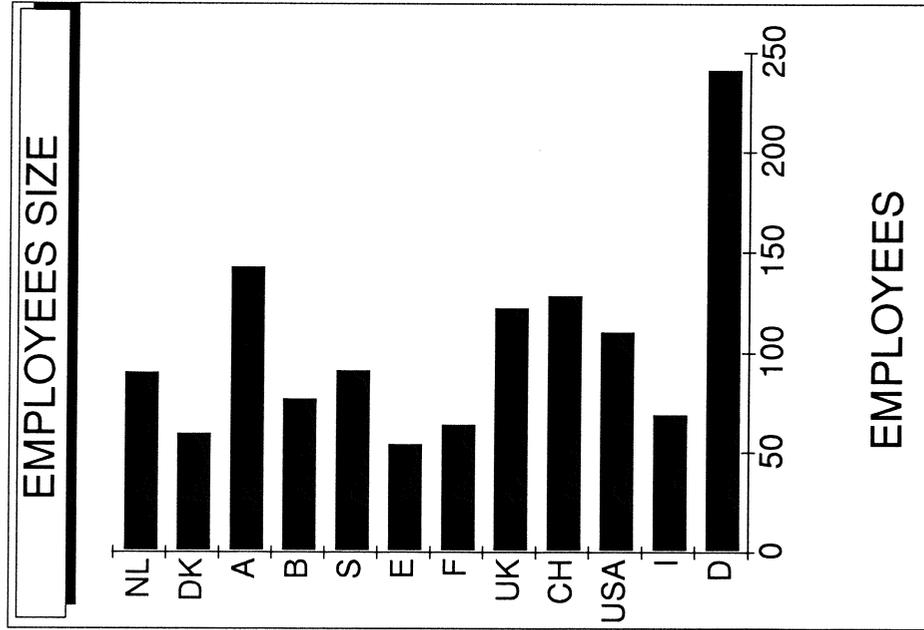
Source: Ceris elaboration on AFM data

Diagram 1: SUBDIVISION OF FIRMS BY EMPLOYEES SIZE



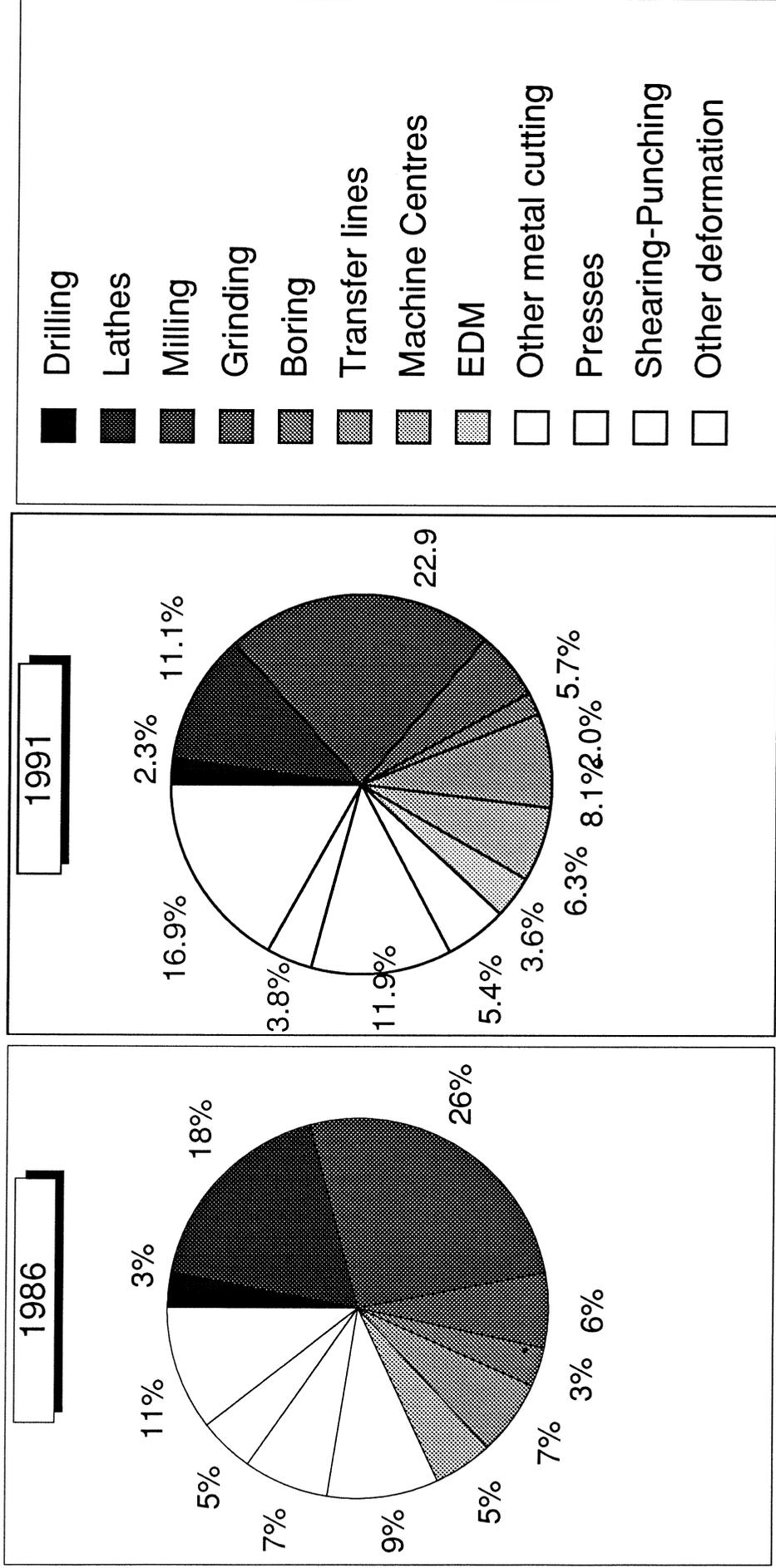
Source: CERIS elaboration on AFM, SYMU and UCIMU data.

Diagram 2: MAIN SIZE INDICATORS



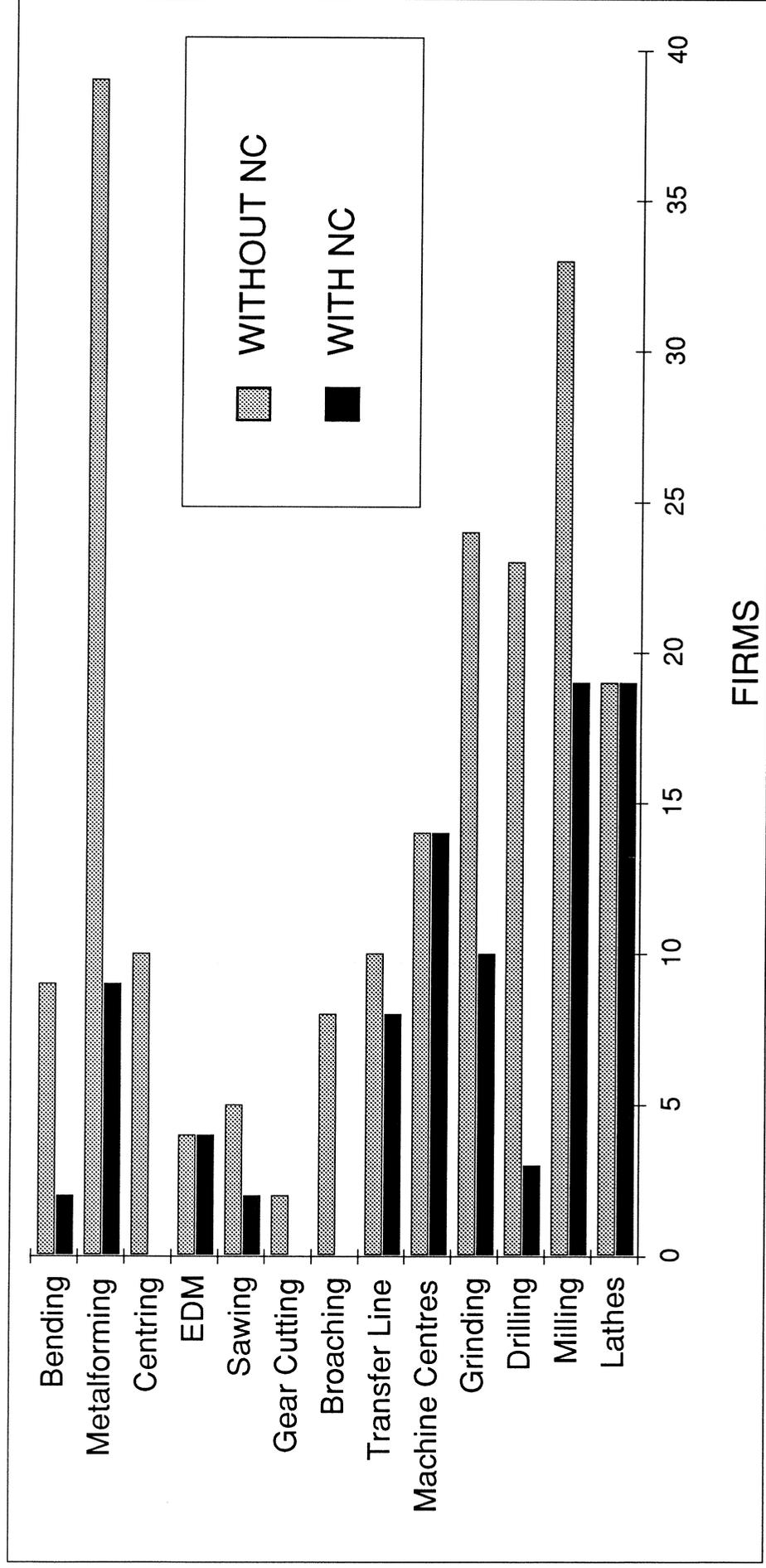
Source: CERIS elaboration on national data.

Diagram 3: SPANISH PRODUCTION BY TYPE



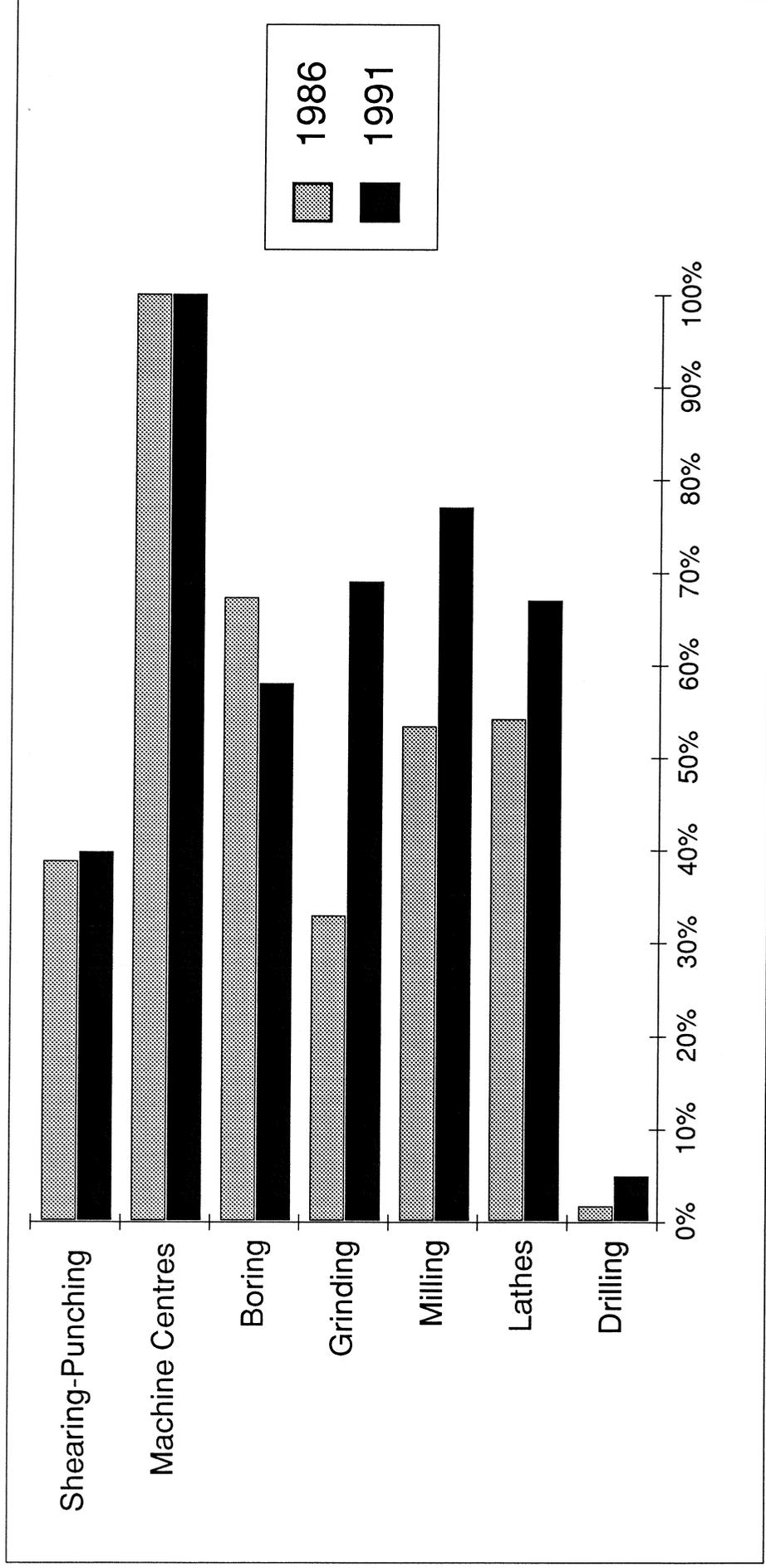
Source: CERIS elaboration on AFM data.

Diagram 4: SPECIALIZATION BY PRODUCT



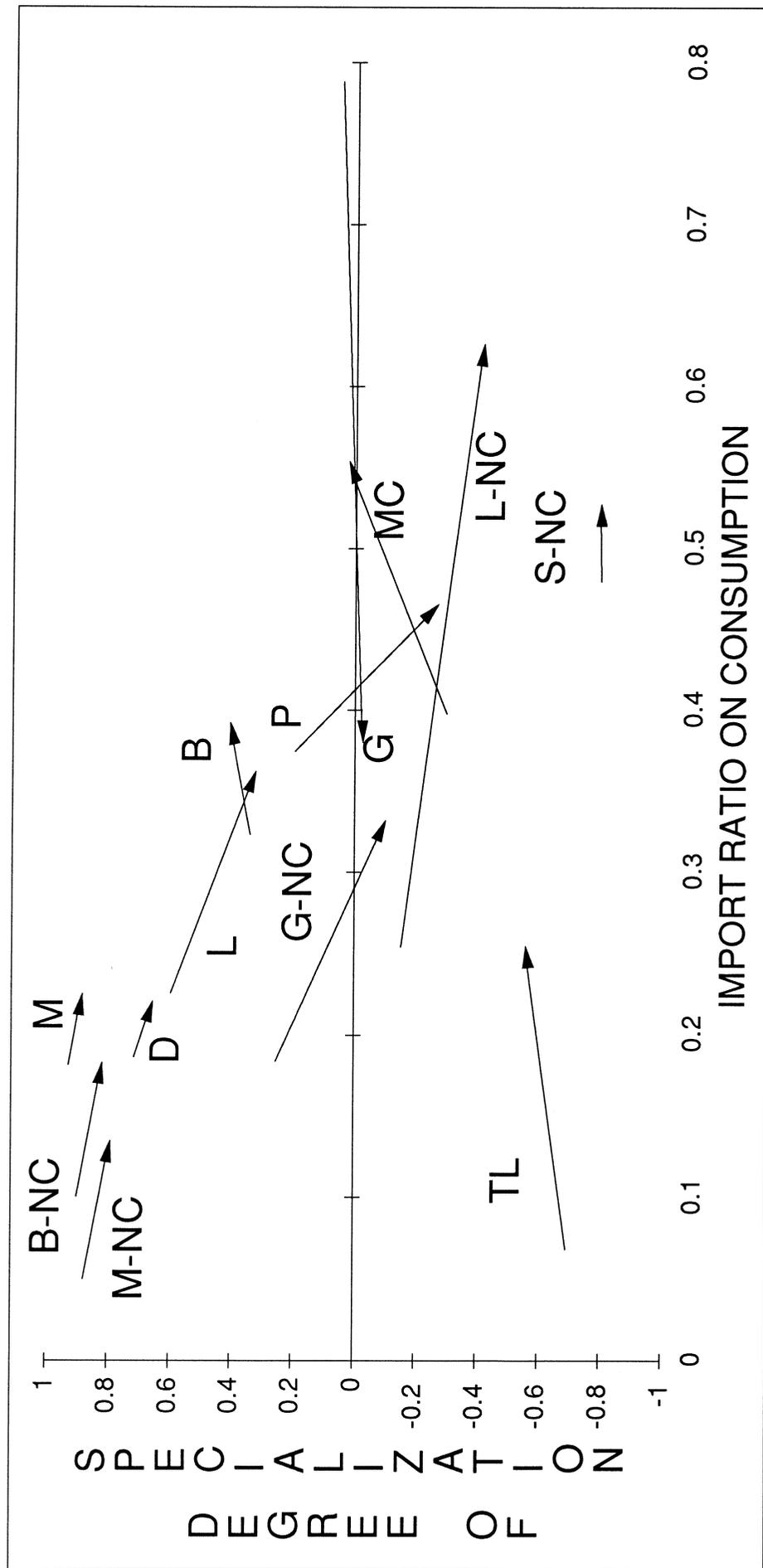
Source: CERIS elaboration on AFM data.

Diagram 5: SHARE OF NC PRODUCTION BY TYPE



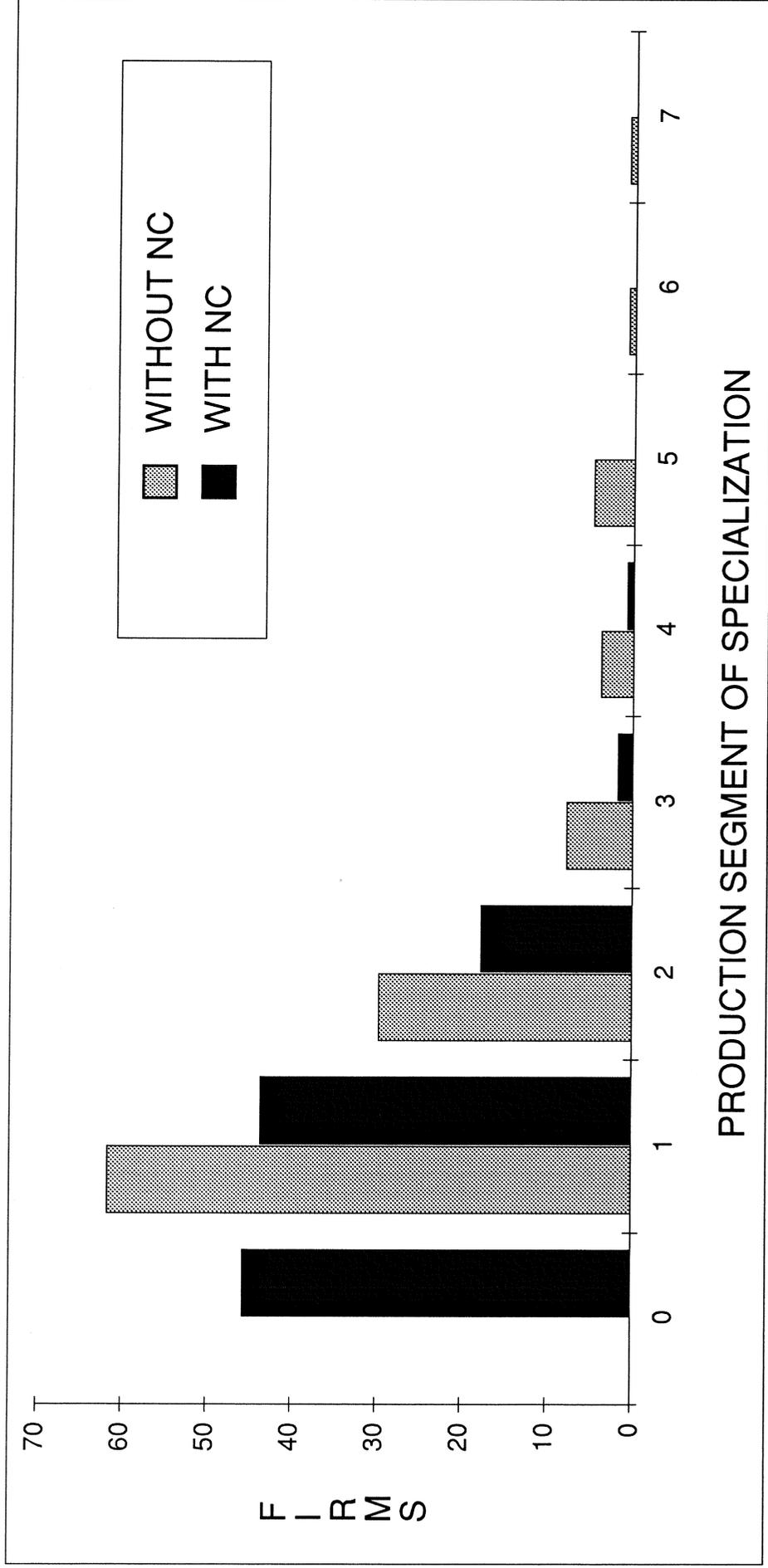
Source: CERIS elaboration on AFM data.

Diagram 6: COMPETITIVE INDEXES (1986-1990)



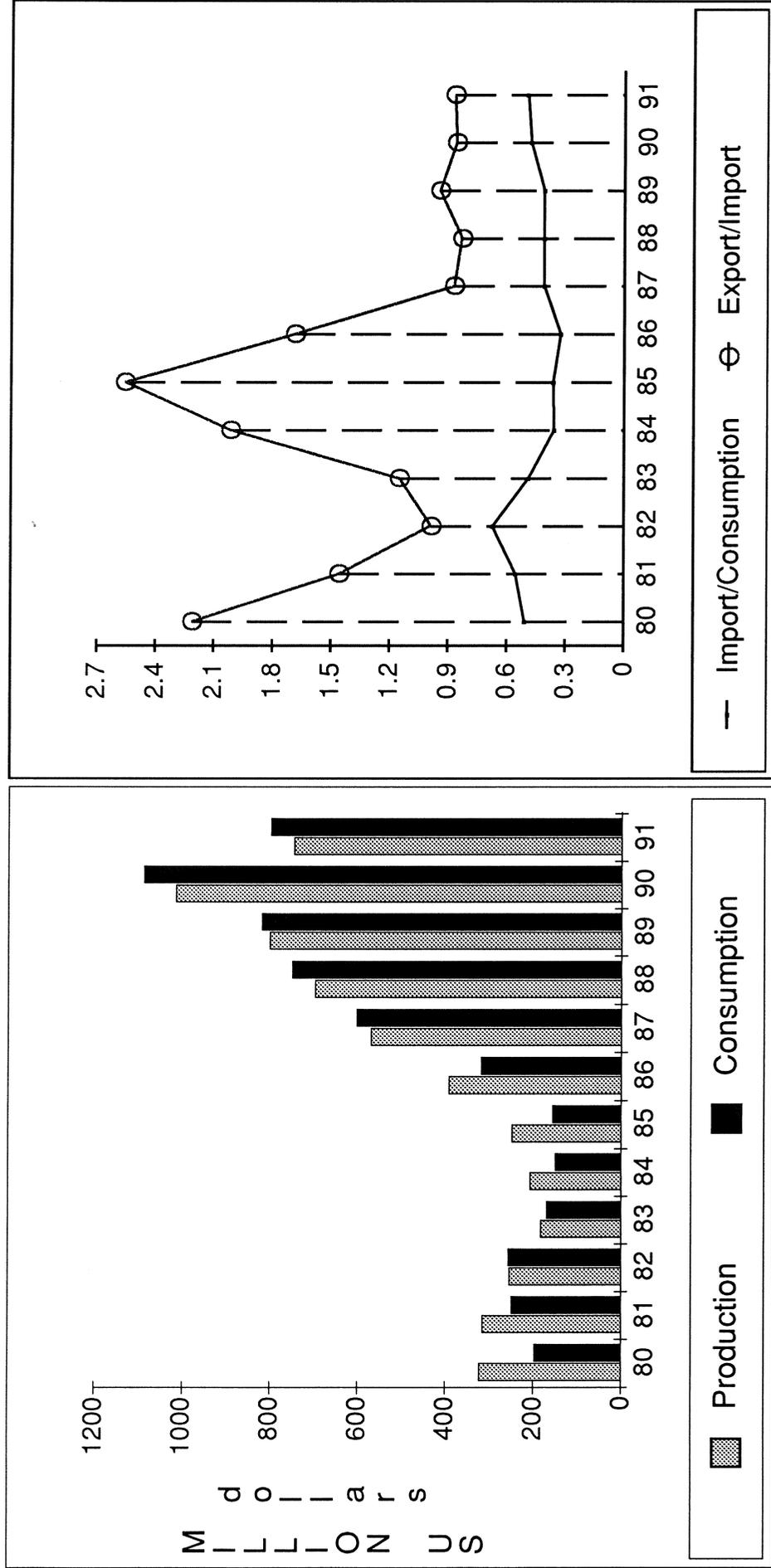
Source: CERIS elaboration on AFM data.

Diagram 7: SPECIALIZATION BY PRODUCT



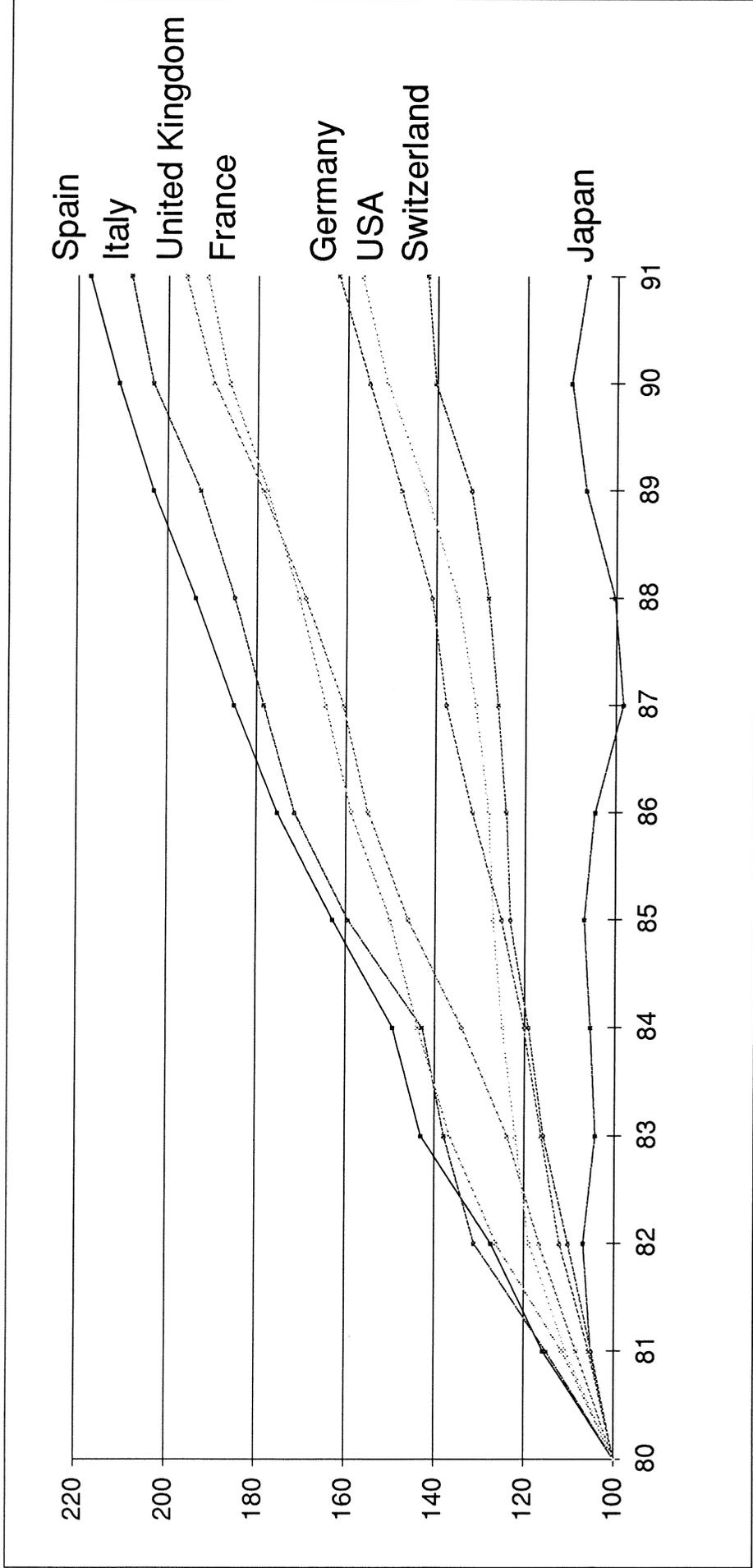
Source: CERIS elaboration on AFM data.

Diagram 8: EVOLUTION OF THE MACHINE TOOL SECTOR IN SPAIN



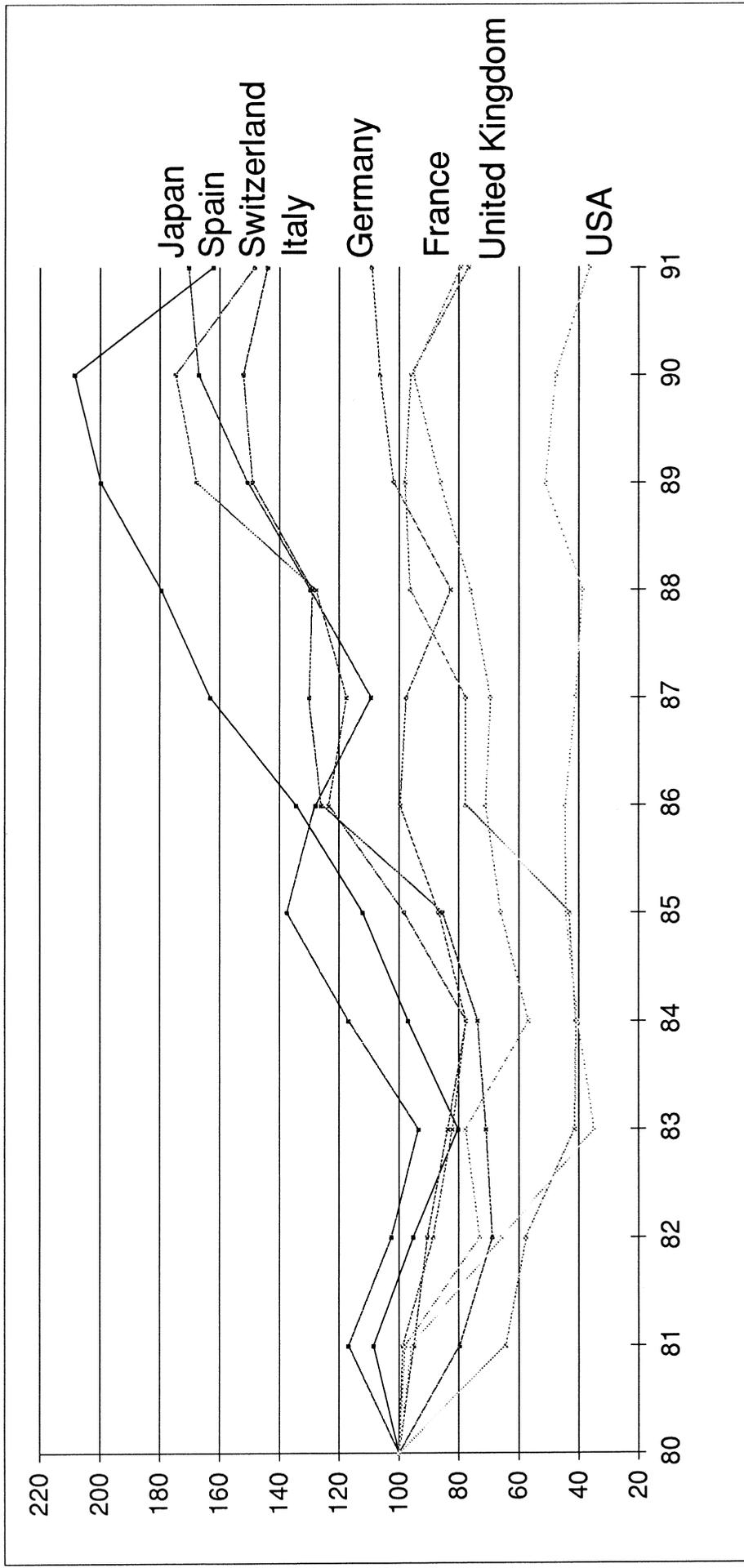
Source: CERIS elaboration on AFM data.

Diagram 9: EVOLUTION OF MACHINE TOOL PRICE INDEX



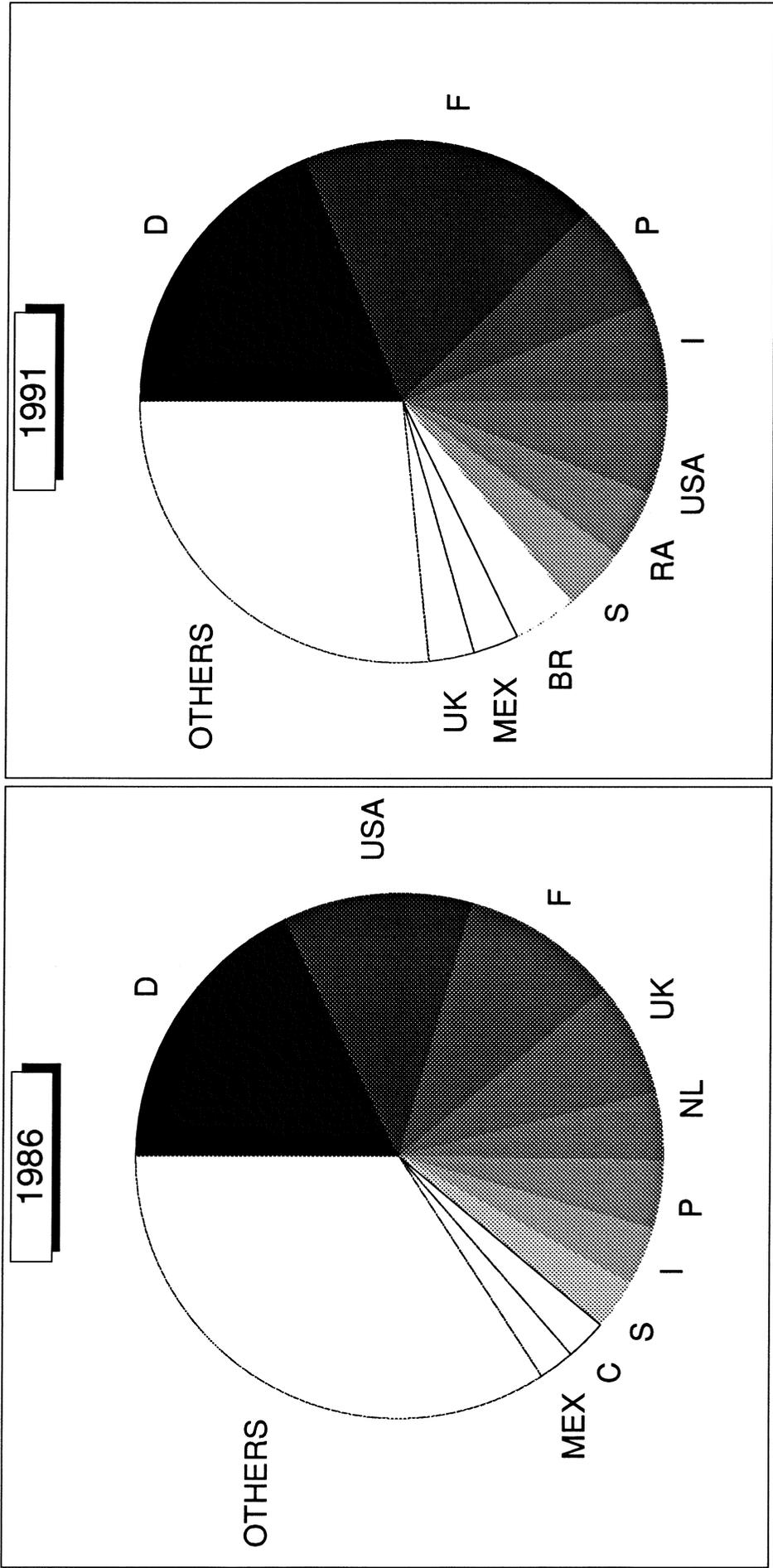
Source: CERIS elaboration on CECIMO data.

Diagram 10: MACHINE TOOL PRODUCTION IN REAL TERMS



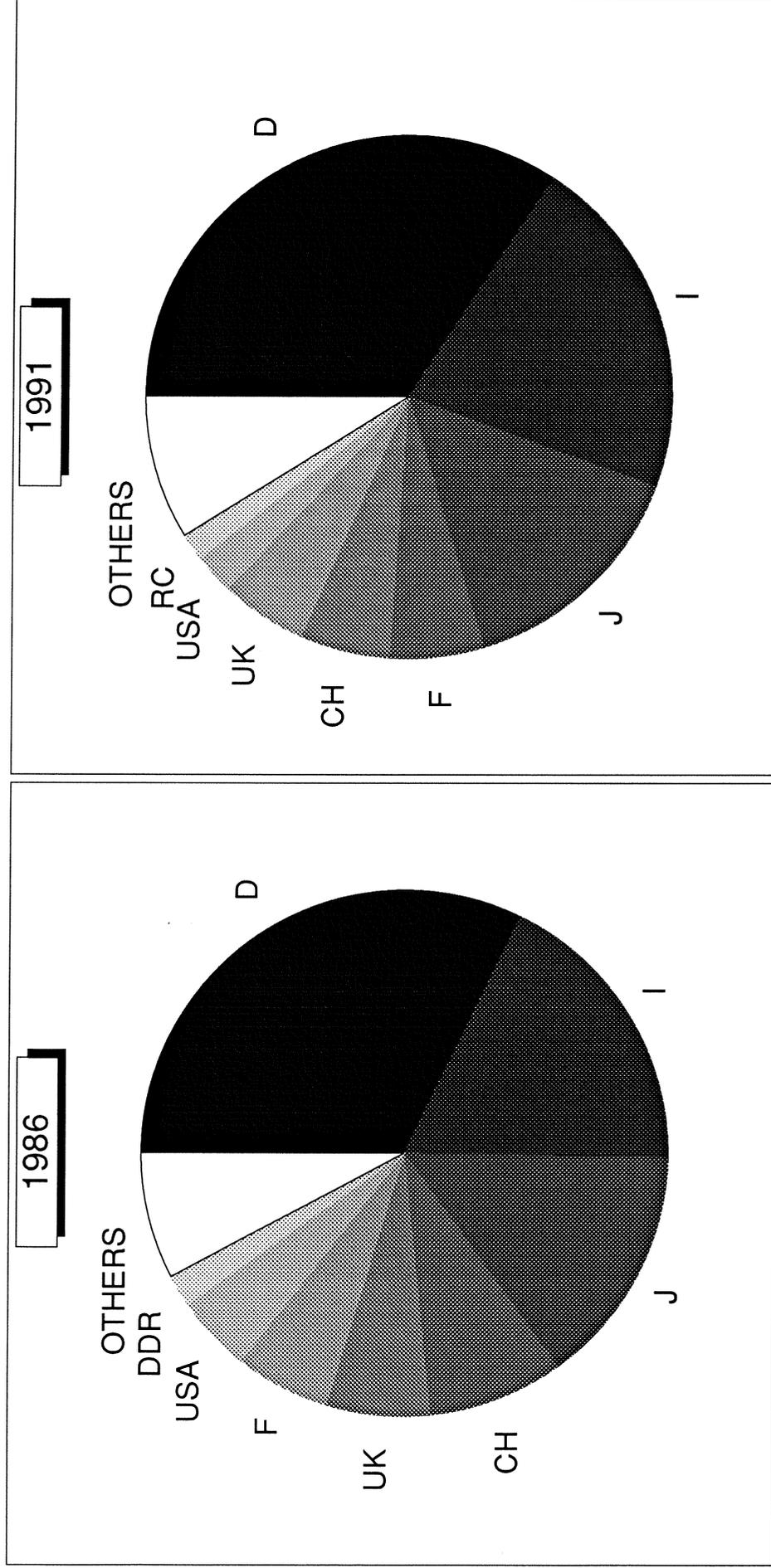
Source: CERIS elaboration on CECIMO data.

Diagram 11: SPANISH MACHINE TOOL EXPORT BY MAJOR DESTINATION COUNTRIES



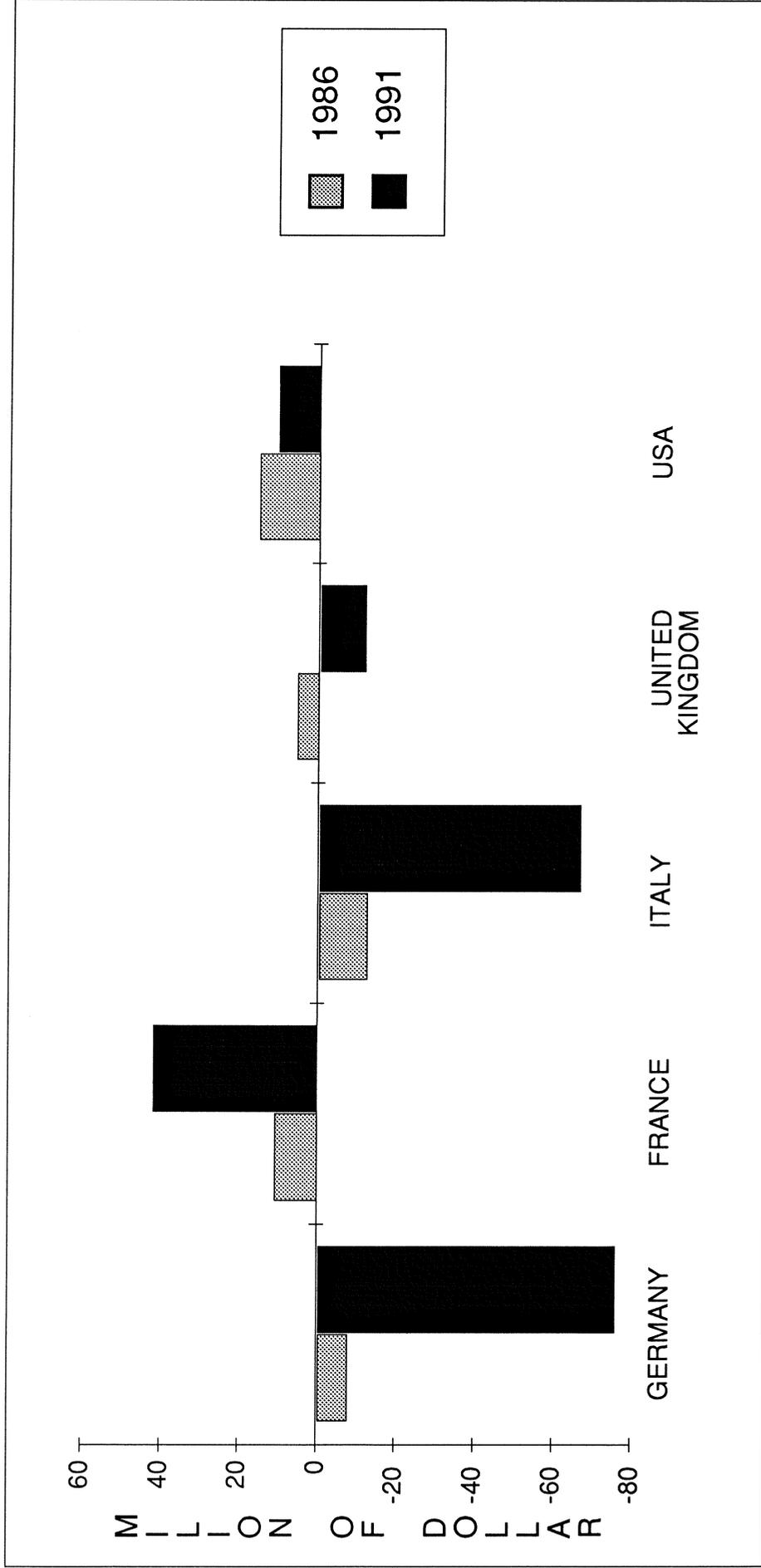
Source: CERIS elaboration on AFM data.

Diagram 12: SPANISH MACHINE TOOL IMPORT BY MAJOR ORIGIN COUNTRIES



Source: CERIS elaboration on AFM data.

Diagram 13: MACHINE TOOL TRADE BALANCE WITH SOME MAJOR COUNTRIES



Source: CERIS elaboration on AFM data.

Figure 1: DISTRIBUTION OF MACHINE TOOL INDUSTRY IN SPAIN

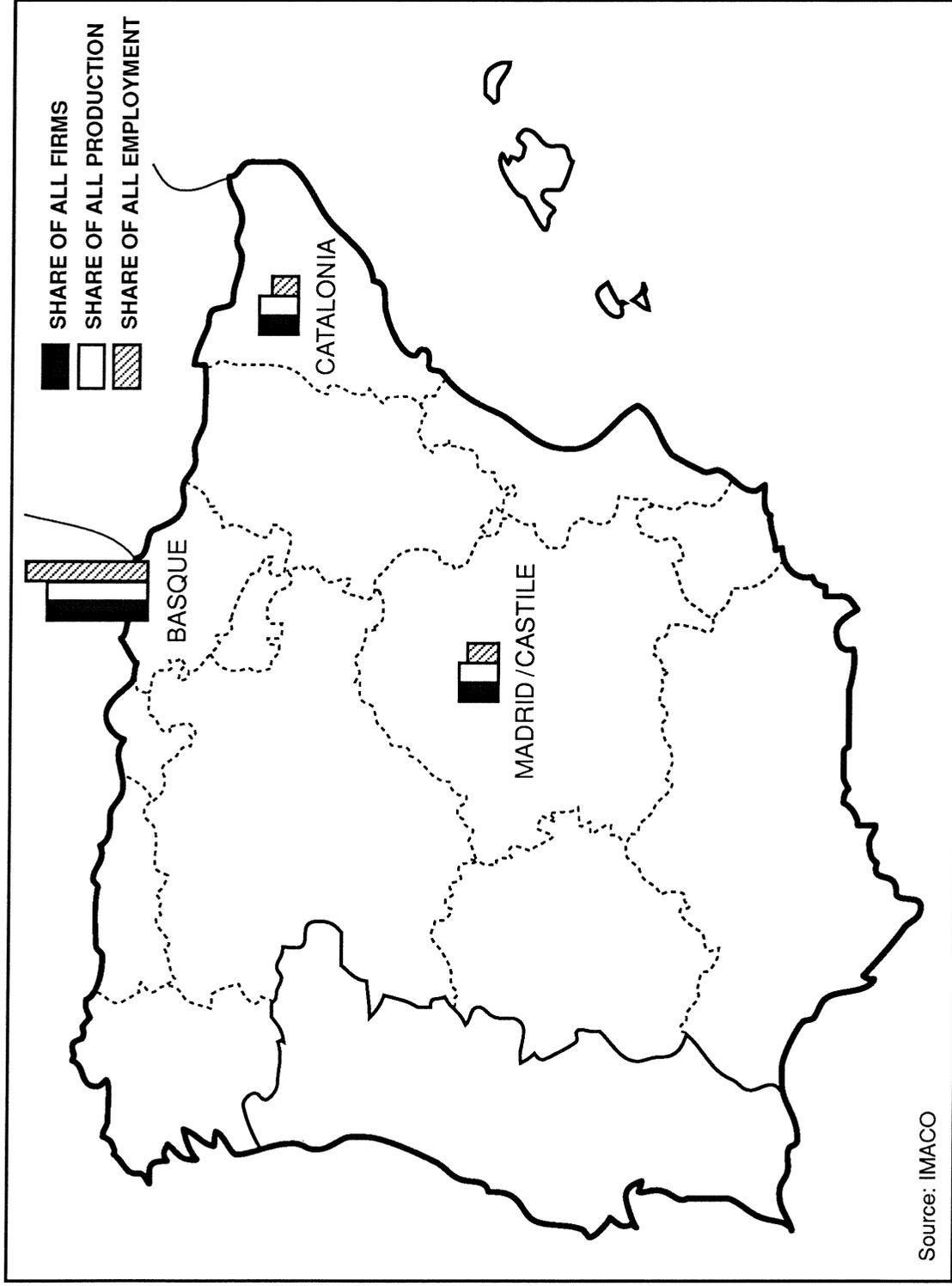


Figure 2:

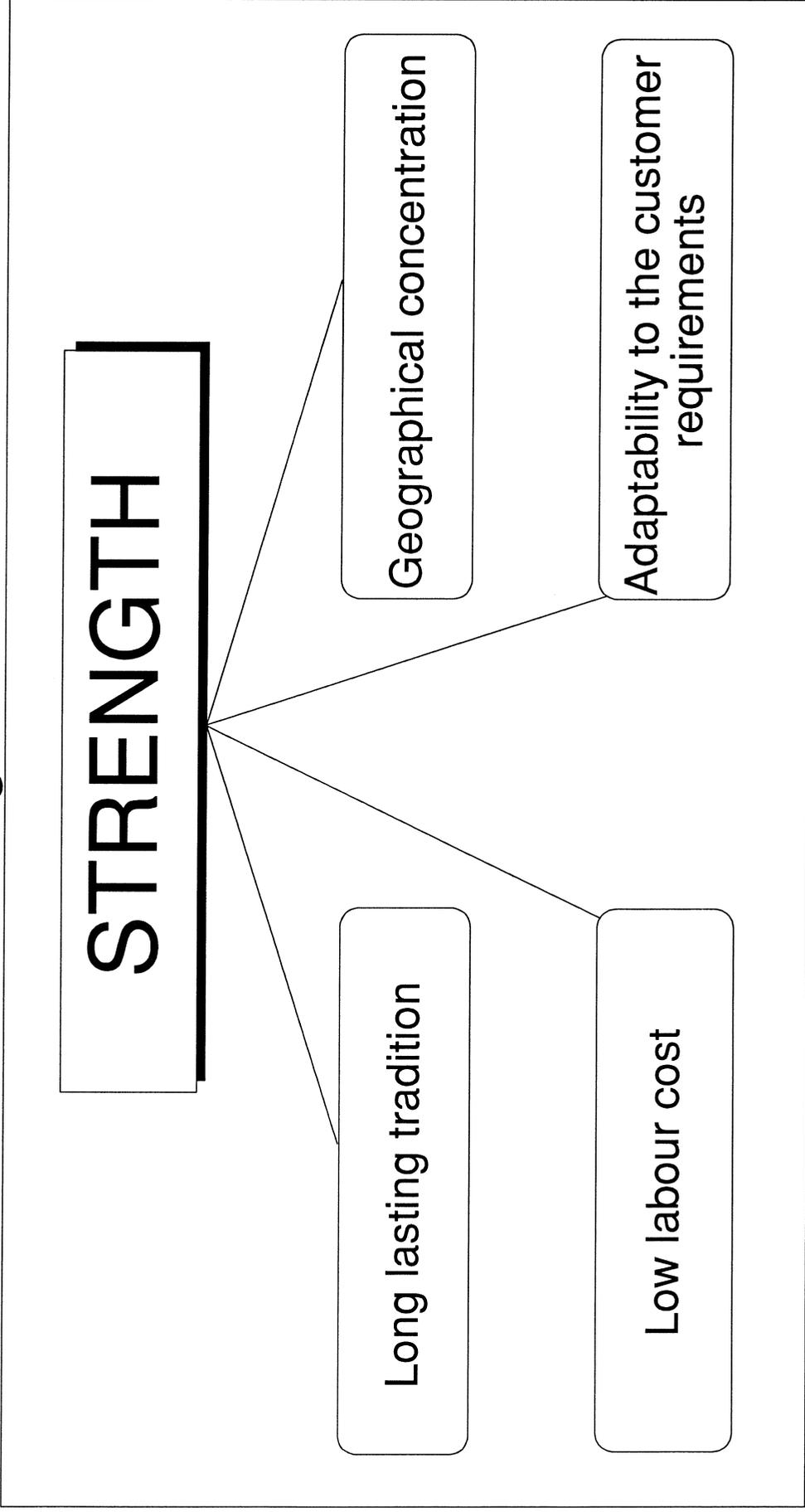
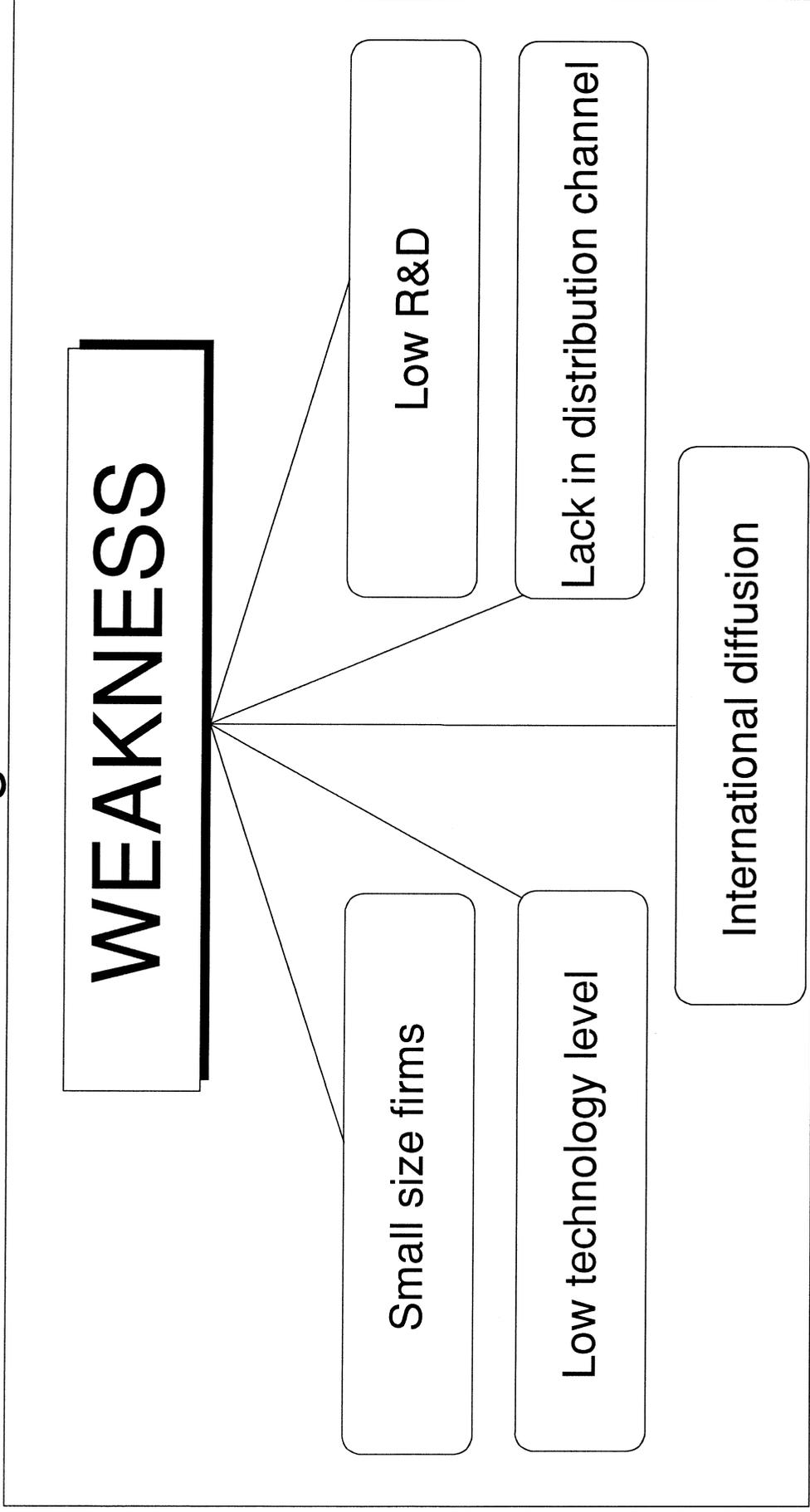


Figure 3:



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