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**THE ITALIAN MACHINE TOOL INDUSTRY**

Secondo Rolfo



CONSIGLIO NAZIONALE DELLE RICERCHE



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The Italian machine-tool industry has witnessed a long period of relative stability, regardless of the fluctuations of demand. During the 80's, its production has increased, as well as its position of second largest European producer, second largest in the world. However, various symptoms of a progressive loss of competitiveness can be seen, mainly due to a productive structure that has been inherited from the past, but not adequately responded to the challenges of the 90's, in the light of technological innovation and internationalization.

L'industria italiana delle macchine utensili è entrata in un fase strutturale delicata al di là della congiuntura negativa del mercato. Durante gli anni 80 il livello qualitativo della produzione italiana è aumentato come dimostrato dalla posizione di paese esportatore in Europa dopo la Germania, e quarto nel mondo. Nonostante si possano osservare vari sintomi di una progressiva perdita di competitività, in gran parte attribuibile alla struttura produttiva che benché migliorata rispetto al passato non è in grado di rispondere adeguatamente alle sfide degli anni 90, rappresentate dall'innovazione tecnologica e dall'internazionalizzazione.





## THE ITALIAN MACHINE TOOL INDUSTRY

Secondo Rolfo

### **Abstract**

The Italian machine-tool industry has entered into an extremely delicate phase, regardless of the cyclical trend of demand. During the 80's the qualitative level of Italian production has increased, as demonstrated by the position of second largest European exporter, after Germany, and fourth largest in the world. However various symptoms of a progressive loss of competitiveness can be seen, largely due to a productive structure that has been improved with respect to the past, but not adequately to respond to the challenges of the 90's, in the form of technological innovation and internationalization.

L'industria italiana delle macchine utensili è entrata in una fase estremamente delicata al di là della congiuntura negativa del mercato. Durante gli anni '80 il livello qualitativo della produzione italiana è aumentata come dimostrato dalla posizione di paese esportatore in Europa dopo la Germania, e quarto nel mondo. Ciononostante si possono osservare vari sintomi di una progressiva perdita di competitività, in larga misura attribuibili alla struttura produttiva che benché migliorata rispetto al passato non è in grado di rispondere adeguatamente alla sfida degli anni '90, rappresentata dall'innovazione tecnologica e dall'internazionalizzazione.



## 1. Introduction

The birth of the Italian machine tool industry dates back to the end of the 1800's, concurrently with the industrial revolution which took place late in Italy with respect to other European countries.

For this reason the new industry grew up in the northwestern area of the country, where the iron and steel and machine industry has been concentrated for a long time. In this area there was a pre-industrial machine industry, linked essentially to the production of military arsenals.

For a long time, alongside firms specialized in market-oriented machine tool manufacturing, the more important mechanical companies tended to internally build the machine tools they needed and to sell only part of them to outside users. This situation remained for a long time in all the industrialized countries, while in Italy it is now limited to Comau (Fiat) and a few other companies (e.g., MI-VAL, controlled by Beretta). In both cases the prevailing productive model was that of vertical integration, from the foundry to the finished product, which in some cases survived until the 1970's.

From technical-productive point of view the Italian machine tool industry remained in a modest position until the end of the 50's. In fact, only with the economic boom of the 60's was there a sharp increase in domestic demand which stimulated the growth of this industry and the entry of new entrepreneurs.

In the following decade the sector consolidated its position by affirming itself on the international market as well. With a structure consisting of mostly small, and very flexible companies, the Italian competitive model appeared to be, in an analysis by the m.t. manufacturer association (Taranto, Franchini, Maglia 1979), linked to low-priced production and an intermediate quality level, but very customized according to customer needs.

In that same analysis, however, some weak points were revealed: the companies were too small to allow for the standardization of components, a continuous process of technological innovation, and an adequate presence on international markets. Moreover, a heavy dependence on foreign suppliers of components (e.g., numerical controls and other electronic devices) and some types of machines with a high technological content remained.

Today, although Italy has become the fourth largest machine tool manufacturer and exporter in the world, many of the above argumentations are still valid, as will be seen in the following sections.

## 2. Market Structure

### A. *Size and Regional Distribution of Firms*

The current structure of this sector results from a reorganization process implemented by the sector firms during the crisis developed in the first half of the eighties and in the years immediately after. This crisis affected Italy only to a limited degree in comparison with France and England and the number of Italian firms which left the





market or were subjected to heavy reorganization is definitely lower. Transfers of property were also limited and most of the companies remained in the hands of their founders. Therefore, the second half of the eighties brought about intense technological innovation and a constant search for new markets abroad. However, under a structural point of view, changes were very small and basically made to stabilize the existing situation.

The consolidation process is difficult to detect because it occurred in the period between two censuses (1981 and 1991), the last of which has not yet been terminated, and also because the census data were traditionally of little use for examining this specific sector. In fact, the machine tool production category for the manufacturing of metal and metal parts also included a variety of mechanical manufacturing firms not clearly defined. The result was that the machine tool sector was overestimated in 1981 with over 50,000 employees on 2,611 local units against a report produced by the sector association (Ucimu) mentioning 436 firms and 36,000 employees (Rolfo 1985).

In 1986, Ucimu carried out a new survey which counted about 450 m.t. manufacturing firms. This paper analyses 303 firms covering 72% of the whole sector production. Table 1 shows the prevalence of smaller firms with less than 50 employees which are 2/3 of the total number. Only 13 firms had more than 200 employees, although they covered 36% of the production of our sample.

Medium-sized firms (50 to 199 employees) employed 40% of the personnel and sold 41.7% of the total sales volume of machine tools. Due to their high productive specialization (92% of the turnover comes from the sale of machine tools), medium-sized firms represent the sector's hard base. Productivity indicators (deliveries per employee) and performance indicators (export/deliveries) are higher than those of the smaller firms and achieve almost the same values as those of larger companies.

Unfortunately, a similar survey was never repeated and the sector's structural development in time is hard to trace. However, we shall base our study on the list of the first 200 major firms of the sector yearly reported since 1986 by the "Tecnologie Meccaniche" magazine.

By comparing the 1986 data with those of 1991, it is clear that a structural strengthening of the sector took place: over a period of 5 years, firms employing under 50 people decreased while medium-sized companies employing 50 to 200 people increased. Although the data are not fully comparable because the current list includes some groups that did not exist in 1986, or else were mentioned as individual companies, the trend of Italian companies can be clearly detected. During the second half of the eighties, Italian companies exploited a favourable economic situation in order to grow in size and acquire sounder and more articulated organizational structures. This is an even more remarkable tendency when we consider that a large number of firms opting for a productive decentralization line during the crisis maintained their strategy. However they attempted to achieve a greater control over their sub-contractors by acquiring even just the minority share of small mechanical and electrical business or software houses. These small companies kept their production lines and customers but nonetheless should be considered as an integral part of the controlling companies to whom they contribute considerable production shares.

As a result of the sector's structural strengthening, the actual growth of the Italian



industry is larger than what is shown by statistical reports although still very far from the optimum and from that observed in Germany and Japan. As explained in the following paragraph, such a lag is mainly due to a lack of an external growth as happened in other European countries.

From the point of view of regional location, most of the companies can be found in the industrialized areas of northern Italy, with the larger concentration in the region of Lombardy: with 60% of the firms and 42% of the employees. Each one of the other three main northern regions houses just above 10% of all the firms while it is noteworthy that of these regions, Piedmont has the highest number of large firms, totalling 30% of the entire number of employees in the Italian sector. This is due mostly to the presence of the most important firm, Comau, controlled by Fiat.

### *B. Concentration*

The large number of small and very small firms in Italy -together with the substantial lack of acquisition and merging activities as observed in Germany - would suggest a low degree of concentration. In actual fact, the presence of a company of the size of Comau and the growth of Mandelli have a considerable impact on this situation since the first 3 major companies make up about 30% of total production. However, since the gap existing between these companies and all the others is so wide, the increase in the concentration rate becomes smaller as long as we include more firms in our survey.

The data mentioned in this paper result from a record of the contrasting actions observed during the eighties. In the first half of the decade, the crisis caused grave difficulties to several firms, particularly small-size firms, and favoured the growth of larger and more organized companies: consequently, in 1986 (the first years for which data are available) the sector's degree of concentration was quite high (see table 3). In the second half of the decade, on the other hand, a lively demand spurred the productive growth of small and medium-size firms that rose at a faster rate than it did for leading companies, some of which were put into a critical position (like Ocn-Ppl or Berardi). Therefore, the concentration rate decreased and recovered only in 1990, basically due to the acquisitions made by Mandelli, whose consolidated turnover grew by 84% from 1989 to 1990. A further increase in the concentration rate has been observed in 1991 <sup>(1)</sup> following the acquisition strategy undertaken by Mandelli.

In the last few years, the rest of sector remained on the sidelines waiting and, with the exception of Mandelli, only a few other companies (Comau, Berardi, Parpas, and Castel) carried out some very small limited acquisition operations but not very frequently, nor were the acquisitions made by groups operating in the wider field of mechanical engineering and automation substantial (OCN acquired by the ANFINA group, Cima by GD and Secmu, Utita, TMA and Tesak consolidated into the FAS group).

From a general point of view, this situation resulted in the consolidation of Comau and the strengthening of Mandelli without however leading to the establishment of an

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1. The 1991 data are not comparable to those of previous years since the classification in "Tecnologie Meccaniche" does not report data concerning those firms which were in serious financial difficulties (Berardi, OCN, FAS).



oligopolistic system. Proof of this can be seen by applying the calculations of oligopolistic equilibrium ratios of Linda<sup>[2]</sup> which do not allow us to define a group of dominant companies or to quantify the extent of their power. As a matter of fact, indexes calculated for 1990 and 1991 (with or without Comau)<sup>[3]</sup> show a downward trend (see table 4).

On the other hand, a certain interest in the acquisition of Italian firms was shown by German and Swiss companies: after Maho entered Graziano, the latest operations of Schiess (Pensotti), Traub (Gloria), Mikron (Cima) and Pfanter (Pai-Demm) seem to prelude a disengagement of some undertakers of the sector, aware of their inability to withstand the present competitive effort.

As far as the segment is concerned, except for FMS systems and transfer lines which are the concern of the first three firms, the concentration is lower.

As a result, most of the companies operate below the minimum optimum size. A paper of recent date (Canesi 1990) showed that in the production of milling machines, boring machines and machining centres, the minimum indivisible plant should work 17,000 chip hours/year with a turnover of 63 billion liras for totally closed machines and 82 billion liras for open machines. The minimum optimum size is lower for larger machines and corresponds to a turnover of 22.5 billion with 5,000 chip hours/year. The paper showed that only 5 Italian firms out of fifty have turnovers up to or above those mentioned above. Furthermore, critical situations and very low profits were pointed out in particular for companies having turnovers of 20-30 billion liras. As a matter of fact, these companies have difficulty turning to automation while their production volumes do not allow the use of flexible manufacturing cells, which are suitable starting from yearly requirements of 8,000 chip hours. Moreover, this level requires a more structured internal organization with qualified personnel in key-positions.

### C. Barriers to entry

There are few barriers that prevent the entry into the sector because new firms can be set up with relatively small capital and little technological know-how. Therefore, new entries are recorded even recently, especially in those areas with strong traditions in the mechanical industry: experienced engineers and technicians employed in companies of

2. The index is given by:

$$EO_i = \frac{\frac{A_i}{i}}{\frac{A_n - A_i}{n - i}}$$

where  $A_i$  = cumulative share of the leading companies

$n$  = 10 major companies of the sector

see Linda (1976).

3. The diversified production of Comau makes it difficult to separate from the total sales volume the share relevant to machine tool which are most of the time sold as an integral part of automated systems.



the sector or collateral sectors (robotics, mechanical engineering) are often tempted to leap into the undertaker's world. This was a typical process in the Italian mechanical industry which characterized the history of the machine tool sector till the end of the seventies.

In some cases, qualified engineers and skilled workers were scattered over the territory due to the critical situation of a given company. An example is that of Secmu, in the area of Piacenza, in the mid-seventies. Secmu's former employees were able to set up flourishing firms such as MCM or to substantially contribute to the technological patrimony of other firms already operating in the area (Mandelli, Jobs, Norma). Other cases, by the end of the seventies, were those of already existing firms operating in different fields of mechanics which entered the machine tool sector (e.g., Sigma).

In the eighties, the growth rate remarkably slackened, because of the crisis, and slightly recovered only in the second half of the decade due to the favourable economic situation.

Today new firms are still entering the sector (e.g. Linea in 1991), although a concurrent opposite situation occurs as small-size firms cannot find a sufficient space within a highly competitive framework. Small mechanical firms often enter in the sector by launching a new machine and remaining in the market just as long as they can commercially exploit the new item without actually abandoning their former activities. Once the boost is exhausted, or if the new item proves unsuccessful, these industries leave the sector to turn up again some years later, often under a new business name and with a new project.

As we said before, such a situation is made possible by the lack of barriers to new entries and the existence of market niches in which are determinant the ability to solve a customer's specific problem, as well as the personal relationship between customer and supplier, rather than the supplier's technical or commercial reliability.

It is self-evident that, with a more qualified demand, the barriers tend to become stricter under both a technological (more sophisticated machines) and commercial point of view (reliability, servicing, spare parts availability, and so on). For this reason, the new firms are operating within a wide environment of small and very small production units with specific features more typical of custom-made oriented artisan undertakings than of the industrial business.

#### D. Strategic Groups

The varied pictured of Italian supply of machine tools shows sharp internal differences in terms of position in the market, technology, size, growth rate, export, strategies. The lack of analytic data for a large number of companies prevent us from using methodologies such as the *cluster analysis* while the wide variety of different situations and behaviours tends to multiply the number of clusters and their meaning.

Therefore, we shall rather attempt to distinguish within the Italian industry some strategic groups as defined by Porter (1980) as "a group of firms following the same or similar strategy along the strategic dimensions". According to this definition we tried to create a taxonomy of the firms based on variables that played a major role in the last few years. First of all, we shall consider the technological development of machinery towards





full automation and integration into systems. In the second place, the company size will be taken into account as a fundamental factor that allows for suitable strategies for innovation and a commercial attack on foreign markets.

Based on the above considerations , we are in a position to divide the Italian offer into four strategic groups according to company technological capacities and successful results on international markets.

At the top, we shall place a small number of large leading companies capable of setting up FMS and automated systems with a high degree of complexity. Their production range is generally wide enough to meet the requirements of different customers. The markets they are operating in are of a worldwide level with competitors basically consisting of the large German, American and Japanese groups. Although they change year by year, exports make up large share. The worldwide oriented strategies of these companies as well as their size generally require the structure of a group with subsidiaries and joint-ventures in Italy and abroad.

At a lower level we shall place a restricted number of medium-sized firms specialized in the production of machining centres and moving fast towards systems. Due to their specialization and technological capacity these companies are successful suppliers of 2- or 3-machine cells on the Italian and European markets, even though a few FMS were also developed. Their direct competitors are the large Japanese and German groups offering similar products and solutions, the former also quoting lower prices on account of their high production volumes. Although a large part of their efforts were directed towards the foreign markets with branches opened and cooperation agreements concluded, these companies still need to improve their internationalization.

A certain number of firms (about twenty) make up what we shall call the intermediate group in terms of size, production range and technology. These firms employ an average of a hundred people but can reach up to 300-400, and are mainly specialized in 1 or 2 types of machines for which they can usually offer a certain range of models. As far as technology is concerned, these companies have always closely followed technical development and now offer top quality levels. Their machines are normally designed in modules allowing customization and a high degree of automation (piece or tool loading/unloading robots, Cad/Cam connections, etc.) and are capable of working as autonomous modules as well as within lines and systems supplied by other companies. Many intermediate level companies have direct control over a network of suppliers and some have concluded agreements with foreign partners and set up commercial subsidiaries. The impact of competition is hard both in Italy and abroad - where sales however represent a large share of their turnover - since these companies are constrained within the competition of large companies from the market top layers and the attack of small firms from the base where the price is still a determining factor. The success of intermediate level companies results from a mixture of technology, customization and price.

Finally, the lower level is made up of the majority of the small firms (about 50 employees), mainly operating only on the Italian market or with sporadic exports of a limited range of machines. To fight competition, small firms exploit price policy and customization possibilities. In many cases these firms work on *ad hoc* projects for each customer. The efforts they make to keep up with technological development and to envisage special solutions for certain applications are remarkable. The impact of



numerical control on technology is not so strong because it does not involve very advanced solutions. Controls and other components are to a large extent purchased from local independent suppliers who quote lower prices.

### **3. Conduct**

#### *A. Product Diversification*

The structural features described above provide an outline of the Italian industry of machine tools as characterised by a high degree of specialization. Diversification of products that are different from machine tools concerns only a few firms: an isolated case is Comau's acquisition of a manufacturer of presses for plastic and a die manufacturer. Both firms are functional to Comau's strategy to supply complete systems for the automotive industry. All other cases of industries involved in different activities are due to specific corporative situations rather than to actual diversification strategies. For companies such as MI-VAL, Oleodinamica Donzelli, Streparava, the production of machine tools is diversification with respect to their main activity. Therefore, the production mix tends to change in accordance with the trend of each individual market.

Other examples of "reversed" diversification are those concerning the entry of groups not belonging to the machine tool sector. Three similar cases of groups operating in the automation field were recorded in the eighties. They entered the machine tool field responding to strategies of integration and exchange of specific know-how among different companies, with a much broader vision of automation as a process involving items which are basically the same for the different fields of application. As the automation process started early for mechanical machining, gaining control over companies operating in this sector would enable the transfer of know how and the use of fruitful synergies. For example, large-scale economies can be implemented in mechanical machining and in the production of electrical components by entrusting a specialized unit with the production on behalf of the different group companies. As a matter of fact, these strategies are more difficult to pursue than what they appear to be.

When considering the diversification within the sector itself, we shall firstly point out a shift of several firms towards the production of cells and FMS systems. This mainly concerned transfer machine manufacturers that slowly turned to flexible transfer lines suppliers and then FMS suppliers, and boring/milling machines manufacturers who moved to the production of machining centres and towards progressive automation and integration in cells and flexible systems (see Figure 1).

Actually this process also involved some firms - operating in lathes, grinding machines and forming machines - that were aiming at improving their machines by such means of automation that would transform them into autonomous cells or cells to be integrated into existing lines.

As such a development involved the acquisition of electronic and software know-how as well as the need to integrate equipment produced by outside sources (e.g. automated handling systems), several companies had to confront the make-or-buy problem. At an early stage, the "make" solution was preferred for software components,



while the mechanical and electronic parts were bought from external suppliers. Later on, the need of a stricter monitoring on technology and products led to the internal production of mechanical parts, or the direct control of suppliers.

This development also affected a few manufacturers of milling machines for diesinkers. These manufacturers entered the market as suppliers of an inclusive solution covering the whole process, from CAD work-station to the machine tool itself. This evolution required a software know-how acquisition and a change from mere machine tools manufacturer to CAD workstation distributor.

The diversification operations we just described, aimed at widening the product range, could only be carried out by a relatively small share of medium-sized and large companies, capable of mobilizing human, technical and financial resources. The majority of the small firms was left aside, or tried to take some isolated steps. The same occurred to an even larger extent when dealing with product expansion to other market segments. In this case, diversification only really affected Mandelli which followed progressive acquisition steps to add grinding machines, lathes and large machining centres, and milling machines to their traditional production of machining centres and FMS systems.

On the whole, the sector is therefore characterized by a low rate of diversification. As shown in table 5, out of the first 25 firms, only 5 (including the first 3 leaders) show a high degree of diversification with production ranges covering robotics and numerical controls. The number of firms having a part in three or four groups or families of machines is also quite restricted, while the majority of the firms, regardless of the strategies undertaken towards technological development and integration capacity, did not expand their traditional specialized production.

### *B. External growth*

The external growth process within the Italian machine tool industry took place with a certain amount of lag and many limits with respect to other branches of mechanical engineering and with respect to European competitors. As a matter of fact, in the first half of the eighties, considerable external growth through M & A operations had already occurred in other branches of mechanical engineering such as textile machines and wood working machines - growth which brought about the setting up of large groups (Gros-Pietro and Rolfo 1988).

Although the structural and competitive conditions were basically the same as those characterizing the rest of mechanical engineering, the machine tool sector marked time. By the mid-eighties, the ever-increasing strength of the Japanese penetration - identified by BCG (1985) as the result of large-scale economies - was quite clear. Nevertheless, the external growth process was relatively slow and affected only a small number of firms. Acquisitions and other equity operations (e.g. joint-venture, consortia) were performed only by Mandelli and, to a lesser extent, by Comau and Salvagnini.

As was stated in the paragraph dealing with concentration, most medium-sized companies opted for a policy of direct control over suppliers. In some respects, this tendency is opposed to the production decentralization typical of the seventies, when machine tool manufacturers would rather entrust sub-suppliers with various minor activities in order to concentrate themselves on what they reputed to be critical aspects



such as designing, some mechanical machining, assembly, marketing, servicing.

Lately, the increasing importance of non-price-factors - and in particular of quality, delivery terms, compatibility and integrability - led industries towards a direct monitoring of the whole production cycle. This was implemented by acquiring the controlling interest, or a minority share, of various other firms which, although strictly bound to the machine tool manufacturing holding company, would still operate individually on the market and maintain their customers.

As this process concerned small firms, the acquisitions made were mostly unnoticed arousing little comment from either the economical or technical press of the sector. However, this led to the setting up of small vertical groups having even three or four times the size of the holding company. Managing strategical functions were at any rate always performed by the holding company while subsidiaries mostly played a service role (Lorenzoni 1990).

In situations where the supplier maintains a high degree of autonomy in the market and the buying and selling relationship within the group is not very binding, this vertical integration process could be interpreted as a horizontal development of the holding company towards parallel or complementary technologies and markets. More likely, we should consider it as very changeable hybrid forms of organization *à la Williamson*, with some features of the "constellations of firms" studied by Lorenzoni (1990) and some of the characteristics that emerged from the survey carried out by Irer (1988). Although centralized management prevails - as is typical of the small groups where the undertaker directly performs different functions - this sector also includes technologically complementary groups especially where the controlled firms are still partly managed by the former owners and maintain a certain amount of independence as far as technology and market are concerned.

Specific group typologies do not lend themselves easily to a description of this phenomenon in which there are remarkable differences. The only unifying item detected within the recent development of Italian firms in this sector is the control on the production units operating in the machine tool *filière*. Regardless of any market relationship already existing with the holdings, this process is mainly originated from the need to obviate relationships which had become too onerous for the machine tool manufacturer. A problem which not only depended on the actual costs of the components but also on other transaction costs derived from delivery terms, flexibility to changes, capacity of active interaction, capacity to grant quality and reliability of finished products. Based on these assumptions, the development that has taken place in Italy in the last few years could be defined as a concentration in *filière*, as that recently described by Poncet and Prades (1989). In particular, this reorganization occurred in a period when competition was growing fast, even within the national market and required an intense and defensive reaction.

Although useful in strengthening the sector framework, this development could under no circumstances be compared with the external growth of the major Japanese, German and Swiss companies which acquired majority and minority shares and set up joint-ventures in different European countries. The gap already existing in the previous decade is not at all narrowing; on the contrary, it is increasing to the extent that Italian companies seem to be unable to keep up with their competitors along certain fundamental strategic lines.





In particular, while the internationalization rate of this sector is increasing, with the direct presence on foreign markets of commercial subsidiaries and production units, Italian companies have only recently started to move towards that direction, while their prevalent interest has seemed to be setting up reliable commercial networks. The number of subsidiaries is still very low and concentrated in France and the United States (see table 6). On the contrary, the examples of Italian companies which installed their own production structures abroad can be counted on the fingers of one hand.

The explanation normally given is that the average size of Italian companies is too small to allow the undertaking of such strategies. As a matter of fact, even the more affordable non-equity agreements did not arouse much enthusiasm.

The data base created by UCIMU to record the trend of agreements in the industrial automation field, underlines only 41 cases of agreements concluded by Italian manufacturers of machine tools in the period between 1980 and 1991. As shown in table 7, most of the agreements made were trade agreements and concern only 33 companies, among which only one signed a remarkable number of agreements (7), while the others played a minor part.

As we are well-aware, the total number of non-equity agreements might be underestimated since small and medium-size companies are quite reluctant to disclose any agreements made and the attention of media is not focused on this kind of information. Nevertheless, it is remarkable how the Italian industry - though second in Europe after Germany - stands out for its long-lived individualistic attitude.

### *C. Product Innovation and Research Activity*

The eighties were characterized by constant growth of the technological content of machine tools, in particular, the diffusion of numerical control to machine types still unprovided (e.g. many types of forming machines) and a continual improvement of performances by adopting the latest versions of numerical controls, and applying of brushless motors and teflon guides. These are typical incremental innovations brought about by follower strategies that exploited the results of research carried out in different sectors and countries. This solution seems inevitable due to the predominance of the medium and small-size of Italian firms and by the lack of large groups in the electronic sector specialized in industrial automation. Unable to develop basic innovation, Italian manufacturers were forced to adopt new components and technologies as soon as they were available on the market.

On the other hand, Italian firms aimed essentially at enriching the operating capability of their machines in terms of automation and integrability. An innovation effort which entailed the applications of automatisms of different kinds (tool change, pallet change, wear detectors, etc.) enabling machine tools to work without the assistance of operators, as well as the adoption of suitable control software.

A certain number of companies also engaged in the attempt to manufacture machines which could be integrated into larger productive plants. This required considerable commitment in terms of both designing and working out of adequate application programs.

It is evident that only a restricted number of large and medium-large companies see



the success of their attempts but several others undoubtedly tried original technical solutions.

The innovative process occurred almost entirely within private firms. In fact, although the research carried out by the Faculties of Engineering and National Council for Research (CNR) has high standards, Italy cannot yet rely on a tradition of cooperation between the sphere of research and that of private industry. Very few companies, mostly large ones, deal with institutes or conclude research agreements with them.

The Finalized Project "Tecnologie Meccaniche" was launched by CNR in 1984 and finished in 1989 with an expense of 30 billion liras, but did not succeed in changing this situation. The companies involved in the project were 58 and receive 47.8% of the budget.

As said before, the innovative effort was mostly made within private companies, though with the aid of public financing as provided for by the Law 46/82. Over the period from 1982 to 1988, the machine tool manufacturers who implemented projects relevant to their sector (excluding any financing of other activities) received borrowing facilities up to 115 billion liras and grants to research up to forty billion.

These aids were allocated from two funds provided for by the law with a slight prevalence of the Fondo Innovazione Tecnologica (Fund for Technological Innovation). Over the period we are considering, the machine tool sector took over about 2% of the total credits allocated by IMI and by the Ministry of Industry and up to 43 firms, among the most important ones, were involved. The prevailing role of large companies in exploiting the funds should be pointed out, and in particular the Fondo Ricerca Applicata (Fund for Applied Research) dedicated to research projects: 4 large companies took over 84.8% of the borrowing facilities and about 60% of the grants allocated to the sector. On the other hand, a larger share of small firms benefited from the Fondo Innovazione Tecnologica: large companies received less than 20% of the credit and the 38 firms using this fund received an average of 1.682 billion at an subsidized rate.

Despite the difficulties in identifying the project contents by their titles, it seems that almost all the projects submitted to the Fondo Ricerca Applicata concerned the study, design and construction of flexible systems and lines, while the Fondo Innovazione Tecnologica was mostly used for projects concerning newly-conceived individual automated machines, sometime integrated into flexible systems.

#### 4. Performance

##### A. Production and Sales

During the 80's machine tool manufacturing went through two phases in Italy: the first was a particularly severe crisis in 1982-83, and the second was a growth phase that lasted until 1989. In actual fact the data of table 9 show how the recovery was extremely slow and the productive levels of 1980 were reached and surpassed (at constant prices) only in 1987. Though the comparison was made with a year that was particularly favourable, as was 1980, it is undeniable that the recovery of domestic and international demand, starting in 1984, took a great deal of time to reach the previous levels.



This recovery was determined by the improved international economic climate, but it was helped along internally, in particular by two legislative provisions (Laws 696/83 and 399/86) that stimulated Italian demand through a mechanism of contributions (25% of investment) to small and medium-sized companies that invested in advanced technology machinery (mostly CNC machines). This government action also helped to spur the innovative process in manufacturers.

As illustrated in table 12 the favourable trend of demand was much more pronounced and foreign competitors took advantage of it, as we will see in the following paragraph, by increasing their exports to Italy. The year of the domestic consumption boom was 1987 (+ 47.4%) which marked a turning point, because in the following years there was a progressive decline in demand and, consequently, in production.

In 1985-1989 there was a sudden halt because domestic demand increased to the current values of 12%, but in constant terms only 2.1%, while production showed traces of the decline in the international economic climate (especially in Europe) and in 1990 rose by a modest 1.9% to constant values.

The drop in orders continued up to 1991 and its effects were felt as late as 1992. According to the provisory results supplied by the UCIMU, in 1991 production decreased by 5.0% to constant values with a reduction in deliveries both at home and abroad. Only in the second half of 1992 were the positive effects of the new law in favour of small and medium-sized enterprises felt, although without overturning the downward trend because of the scarcity of finances.

From the point of view of commodities the 80's marked the prevalence of metalcutting machines that cover over 70% of production. Numerically controlled machines make up over 60% of metalcutting machine tool production, but only 28% of metalforming machine tools.

In the division into categories lathes and boring machines lost weight in favour of an increase in milling machines and gear cutting and finishing machines, but above all in favour of machining centres, which at the beginning of the 80's were not even considered as a category of their own. Among the metalforming machines there was a slight increase in shearing and punching machines to the detriment of presses.

Another survey made by the UCIMU on the configuration of machines produced allows us to follow the growing importance of cells and integrated systems. The share of stand-alone machines is slowly, but clearly decreasing: over a period of four years it went from 81.6% to 79.8%. And this is a positive sign of the technological evolution of the sector that is shifting to high segments of the market through a choice for integration of its own machines, without altering basic production choices. The Italian industry in fact did not show any particular tendencies toward specialization in one or more families of machines during these years (unlike Japan), but it maintained a widespread presence in all the segments, although progressively abandoning, within each machine segment the types that were less qualified or more subject to international competition. What is more important to point out, however, is that, notwithstanding this undoubtedly positive internal modification, there was a lack of production in innovative non-conventional machining segments, like laser, water jet, EDM, etc. where the market spaces were occupied by the Germans, Swiss, Japanese but also by the Spanish.



B. *Foreign Trade*

During the 1980's Italy's position in international trade came increasingly closer to that of the major industrialized European countries.

In fact it became consolidated in the role of second largest European exporter, after Germany and fourth largest in the world, with a total weight on world exports that went from 7.6% to 9.2%. This means that the function of exportation assumed extremely important structural characteristics, by then unconnected to the trend of domestic demand, as noticed in the previous decade (Gros-Pietro and Gaibisso 1980).

From a cyclical point of view exportation followed the conjuncture trend of the international market with the crisis of 1982-83, the subsequent recovery and another downturn in 1986-87, concomitantly with the economic decline of the major European countries. In the two-year period of 1988-89 there was another recovery of Italian exports: at constant prices of 1980 the index reached a maximum value of 145 in 1989, then decreased again the following year, and probably also in '91.

Italian exports, in comparison with production, rapidly rose from initially low values to 50% halfway through the 70's. This weight increased even more in the beginning of the 80's until it reached a maximum of 63.4% in 1985. It subsequently fell to 47% in the years 1987-90.

This temporal evolution can be seen also in the export/import ratio that, after having reached a maximum value of 3.6 in 1985, stabilized, with some fluctuations, around 2. Analogously, the normalized foreign trade balance went from 0.41 in 1980 to 0.57 in 1985, then fell to 0.29 in 1990.

The decline in terms of trade in the second half of the 80's was largely connected to the increase in imports. In fact while Italy imported half of its machine tool demand in the 50's, it reduced its dependency on foreign suppliers to 30% in the 70's, which demonstrates a considerable amount of qualitative technological growth. This level of imports was maintained until halfway through the 80's, then gradually rose just short of 35% of domestic consumption. Considering, however, the increase in domestic demand, this greater penetration of foreign machine tools had remarkable effects, placing Italy among the major importers in the world: our country went from seventh place with a 3.7% share in 1980 to fifth place in 1990 with a 6.1% share. In monetary terms, Italy imports more machinery than Great Britain and around half that of the United States.

This result seems to be caused - at least partially - by the growing Japanese penetration, which, after having involved other European countries, it finally directed itself to Italy: in 1980 only 1.7% of Italian imports came from Japan, whereas in 1990 that share rose to 14.4% with a negative balance of 156 billion liras for Italy.

In actual fact in the face of this pressure from competition, there was an evolution in all the industrialized countries which saw the increase of intersectorial trade as a result of productive specializations that were modified over time along with the technological content of the machines and prices.

This fact is better observed from a geographic point of view, since Italian exports were directed essentially toward European countries, who were also our principal machine tool suppliers: the most striking example is Germany, which absorbed 18% of Italian exports and covered 35% of the machine tool imports to our country (with a deficit of about 70 billion liras for Italy in 1990). In comparison with imports, which were





largely concentrated in three countries, Germany, Switzerland and Japan, exports are more articulated and are significantly present not only in Europe but in the United States, in Russia (and CSI) and, recently, in China.

## 5. Conclusions

This analysis has allowed us to evaluate how the Italian machine tool industry has entered into an extremely delicate phase, regardless of the cyclical trend of demand. On the one hand, in fact, the qualitative level of Italian production has increased, as demonstrated by the position it has assumed on the international market and the increase in its exchanges with other industrialized countries. From this point of view the increase in imports and the decline in terms of trade would not be alarming, but the logical consequence of a progressive shift to more qualified segments and the abandonment of poorer products in which the high cost of labour has inevitably caught Italian production off guard.

On the other hand, however, various symptoms of a progressive loss of competitiveness can be seen, largely due to a productive structure that has been improved with respect to the past, but not adequately to respond to the challenges of the 90's, in the form of technological innovation and internationalization. In fact the reinforcement of companies both in the way of size, and through control over suppliers, has not yet significantly impinged on a structure which on an international level is still too fragmented. If we add to this the delay in undertaking strategies of external growth in Italy and abroad, it is clear how the gap in relation to its major competitors, the Germans and Japanese, instead of narrowing is probably widening. Moreover, this reinforcement of companies in terms of size exposes them to substantial risks, since many of them are in a difficult period and in a delicate position. Often, in fact, the old strategies of product customization and organizational flexibility are no longer applicable in the presence of larger, and therefore more rigid and costly, company organizations. On the other hand, there are almost never production volumes that are adequate for the MES, and therefore able to make investments in automation that would make it possible to curb production costs.

Italian companies thus risk seeing the innovative effort, which they carried out with determination in the last decade, thwarted and losing ground in the innovative process due to lack of resources. The solution could be the one adopted by many English and French companies in the 80's: to fall back on traditional niche strategies, of customization, and give up a qualified and extended international presence. This would bring about a streamlining of the sector, only partially compensated by the entry of foreign investors interested in buying the best firms.

In the face of this scenario, made more gloomy by the difficult economic situation, there seems to be only one way out that will preserve the sector as a whole and the independence of the companies. This would involve courageous choices of cooperation both commercially and technologically. Only through forms of aggregation that allow the associated companies to realize economies of scale will it be possible to resist challenge brought forth by a throng of aggressive competitors. These strategies are far from the mentality of the entrepreneur used to managing his enterprise directly, but they



are not impossible to carry out: in other segments of mechanical engineering (farm machinery and food-processing machines) there have been cases in which small entrepreneurs have entrusted their companies to a holding company with which they have become partners and at the same time managers. In the machine tool sector there have been projects in common carried out, like the Leonardia for the promotion of the technological park of Piacenza and the Asia consortium to sell in Southeast Asia. Moreover, the recent law regarding small enterprises expressly provides for - among the various actions planned - financing through contributions in capital account of consortium companies for the supply of services for technological innovation and commercial promotion. These are relatively new forms of intervention for Italy, that nonetheless enter into a line of industrial policy that in other countries has been followed for some time now and, in spite of the exiguity of the financing envisaged by the new law, is the only type of initiative capable of affecting the qualitative level of minor enterprises.

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Figure 1 - Technological evolution within the machine-tool industry

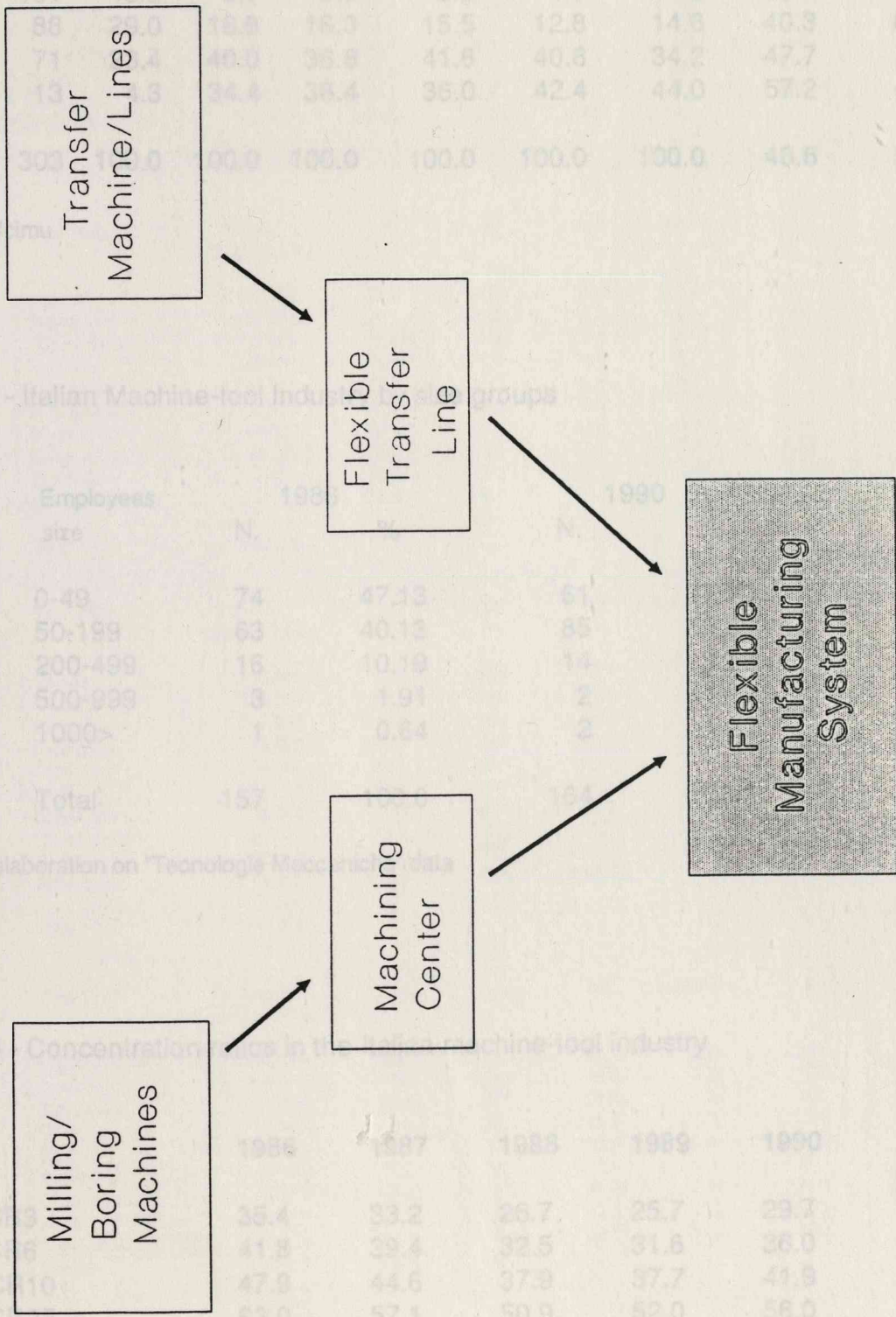


Table 1 - Italian Machine-tool industry by size groups as 1986

Employees size	Companies n.	Companies %	Employees M.T. Total	M.T. sales	M.T. export	Total sales	M.T. exports/ M.T. sales	M.T. sales/ Total sales
0-19	131	43.3	8.7	8.5	6.9	7.2	23.2	56.6
20-49	86	27.0	19.8	18.5	15.5	14.6	40.3	62.5
50-199	71	22.4	49.0	36.8	41.6	34.2	47.7	71.9
>200	13	4.3	34.4	38.4	35.0	44.0	57.2	48.5
Total	301	100.0	100.0	100.0	100.0	100.0	48.6	59.1

Table 2 - Italian Machine-tool Industry by size groups

Employees size	1986 N.	1986 %	1990 N.	1990 %
0-49	74	47.18	61	41.3
50-199	63	40.13	56	36.9
200-499	16	10.10	14	9.3
500-999	3	1.91	3	2.0
1000>	1	0.64	2	1.3
Total	157	100.0	146	100.0

Source: elaboration on "Tecnologie Meccaniche" data

Table 3 - Concentration of sales in the machine-tool industry

Employees size	1986	1987	1988	1989	1990
0-9	26.4	33.2	26.7	25.7	29.3
10-9	41.8	39.4	32.5	31.6	36.0
10-99	47.9	44.6	37.8	37.7	41.9
100-999	63.0	57.1	50.9	52.0	56.0

Source: elaboration on "Tecnologie Meccaniche" data

Source: Ceris-Cnr





## LINDA CONCENTRATION RATIOS

Table 1 - Italian Machine-tool Industry by size groups as 1986

Employees size	Companies		Employees		M.T. sales	M.T. export	Total sales	M.T.export/ M.T. sales	M.T.sales/ Total sales
	n.	%	M.T.	Total					
0-19	131	43.3	8.7	8.5	6.9	4.0	7.2	28.2	56.6
20-49	88	29.0	16.9	16.3	15.5	12.8	14.6	40.3	62.5
50-199	71	23.4	40.0	36.8	41.6	40.8	34.2	47.7	71.9
>200	13	4.3	34.4	38.4	36.0	42.4	44.0	57.2	48.5
Total	303	100.0	100.0	100.0	100.0	100.0	100.0	48.6	59.1

Source: Ucima

Table 2 - Italian Machine-tool Industry by size groups

Employees size	1986		1990	
	N.	%	N.	%
0-49	74	47.13	61	37.20
50-199	63	40.13	85	51.83
200-499	16	10.19	14	8.53
500-999	3	1.91	2	1.22
1000>	1	0.64	2	1.22
Total	157	100.0	164	100.0

Source: elaboration on "Tecnologie Meccaniche" data

Table 3 - Concentration ratios in the Italian machine-tool industry

	1986	1987	1988	1989	1990
CR3	35.4	33.2	26.7	25.7	29.7
CR6	41.8	39.4	32.5	31.6	36.0
CR10	47.9	44.6	37.9	37.7	41.9
CR25	63.0	57.1	50.9	52.0	56.0

Source: elaboration on "Tecnologie Meccaniche" data



TABLE 4

## LINDA CONCENTRATION RATIOS

Year 1991	Sales (Million Lires)	Ai	An-Ai	Ai/i	An-Ai/n-i	Eo
1 Comau	780 200	47.7	52.3	47.7	5.81	8.21
2 Mandelli	320 000	67.3	32.7	33.6	4.09	8.23
3 Salvagnini	134 500	75.5	24.5	25.2	3.50	7.20
4 Gildemeister	70 500	79.8	20.2	20.0	3.36	5.94
5 Rambaudi	65 000	83.8	16.2	16.8	3.24	5.17
6 Maho Italia	64 325	87.7	12.3	14.6	3.07	4.77
7 Parpas Group	57 000	91.2	8.8	13.0	2.92	4.46
8 Biglia	49 900	94.3	5.7	11.8	2.86	4.12
9 Ficep	48 000	97.2	2.8	10.8	2.79	3.88
10 Tacchella	45 560	100.0	0.0	10.0		
Total	1 634 985					
Year 1991	Sales (Million Lires)	Ai	An-Ai	Ai/i	An-Ai/n-i	Eo
1 Mandelli	320 000	35.6	64.4	35.6	7.16	4.97
2 Salvagnini	134 500	50.5	49.5	25.3	6.18	4.09
3 Gildemeister	70 500	58.4	41.6	19.5	5.95	3.27
4 Rambaudi	65 000	65.6	34.4	16.4	5.73	2.86
5 Maho Italia	64 325	72.8	27.2	14.6	5.45	2.67
6 Parpas Group	57 000	79.1	20.9	13.2	5.23	2.52
7 Biglia	49 900	84.6	15.4	12.1	5.12	2.36
8 Ficep	48 000	90.0	10.0	11.2	5.01	2.24
9 Tacchella	45560	95.0	5.0	10.6	4.96	2.13
10 Mecof	44601	100.0	0.0	10.0		
Total	899386					
Year 1990	Sales (Million Lires)	Ai	An-Ai	Ai/i	An-Ai/n-i	Eo
1 Comau	890 000	47.8	52.2	47.8	5.80	8.23
2 Mandelli	296 200	63.7	36.3	31.8	4.54	7.01
3 Berardi	135 000	70.9	29.1	23.6	4.16	5.69
4 Salvagnini	113 676	77.0	23.0	19.3	3.83	5.02
5 OCN	94 300	82.1	17.9	16.4	3.59	4.58
6 FAS	73 000	86.0	14.0	14.3	3.50	4.09
7 Rambaudi	70 000	89.7	10.3	12.8	3.42	3.75
8 Gildemeister	67 000	93.3	6.7	11.7	3.33	3.50
9 Biglia	63 000	96.7	3.3	10.7	3.28	3.27
10 Maho Italia	61 200	100.0	0.0	10.0		
Total	1 863 376					
Year 1990	Sales (Million Lires)	Ai	An-Ai	Ai/i	An-Ai/n-i	Eo
1 Mandelli	296 200	28.7	71.3	28.7	7.92	3.63
2 Berardi	135 000	41.8	58.2	20.9	7.27	2.87
3 Salvagnini	113 676	52.8	47.2	17.6	6.74	2.61
4 OCN	94 300	62.0	38.0	15.5	6.34	2.44
5 FAS	73 000	69.1	30.9	13.8	6.19	2.23
6 Rambaudi	70 000	75.8	24.2	12.6	6.04	2.09
7 Gildemeister	67 000	82.3	17.7	11.8	5.89	2.00
8 Biglia	63 000	88.4	11.6	11.1	5.78	1.91
9 Maho Italia	61200	94.4	5.6	10.5	5.62	1.86
10 Mecof	58000	100.0	0.0	10.0		
Total	1031376					

Source: elaboration on "Tecnologie Meccaniche" data



**Table 5 - Product Diversification of 25 first Companies**

Firm	Sales 1990 (million Lire)	Employees	Major Products Groups	Degree of diversification
Comau	890,000	3,185	10	High
Mandelli	296,200	1,657	9	
Berardi	135,000	639	7	
Fas	73,000	266	5	
Pedrazzoli	38,000	210	7	
Salvagnini	113,676	680	4	Medium
Ocn-Ppl	94,300	300	4	
Mecof	58,000	350	3	
Vigel	39,000	165	3	
Rambaudi	70,000	400	2	Low
Gildemeister It.	67,000	363	1	
Biglia	63,000	124	1	
Maho-Graziano	61,200	306	1	
Sigma	55,000	275	2	
Parpas	54,000	395	2	
Ficep	48,000	301	2	
Sacma	45,280	144	2	
Cima	42,576	308	1	
Tacchella	40,343	245	1	
C.B.Ferrari	38,371	97	2	
Mcm	35,000	125	2	
Rovetta	35,000	161	2	
Colgar	33,500	208	2	
Mec. Nova	31,782	182	1	
Safop	29,358	100	2	

Source: Elaboration on "Tecnologie Meccaniche" data.

**Table 6 - Direct commercial network of the Italian machine-tool industry**

Year	Firms	Commercial subsidiaries						Total subsidiaries
		France	Germany	UK	USA	Sweden	Other	
1988	13	8	4	1	4	2	2	21
1990	20	12	7	3	10	2	3	37
1992	31	12	7	4	20	3	8	42*

(\*) In USA and Singapore there are two joint subsidiaries owned by a number of Italian machine-tools builders.

Source: Ceris-Cnr



Table 7 - International agreements signed by 24 Italian firms with foreign machine-tool builders' (1980-1991)

Total	Licence Acquisition	Licence Selling	Technical Agreements	Commercial Agreement	Mixed Agreement
N.	N.	N.	N.	N.	N.
%	%	%	%	%	%
35	1	12	6	11	5
100.0	2.9	34.3	17.4	31.4	14.3

(\*) The agreements with other firms (customers, suppliers, dealers) have been excluded.

Source: Ceris-CNR





**Table 8 - Aids to Research and Innovation 1982-88, Law 46/82**  
(Billion lire)

	Applied Research Fund		Technological Innovation Fund	
	Borrowing facilities	Grants to Research %	Borrowing facilities	Grants to Research %
Machine-tools	52,931	2.1	63,928	1.8
Mechanical Engineering	275,669	11.0	560,710	16.3
Total	2,503,126	100.0	3,443,455	100.0

Source: Elaboration on Official data

**Table 9 - Production of machine-tool in Italy**  
(Billion lire)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Production in current terms	1,480	1,720	1,540	1,575	1,750	2,130	2,422	2,897	3,635	4,123	4,440	4,305
Var.% Prod.	-	16.2	-10.5	2.3	11.1	21.7	13.7	19.6	25.5	13.4	7.7	-3.0
Production in 1980 prices	1,478	1,518	1,174	1,141	1,224	1,336	1,405	1,650	1,860	2,140	2,180	2,071
Var.% Prod.	-	2.7	-22.6	-2.8	7.3	9.1	5.2	17.4	12.7	15.1	1.9	-5.0
Production Index (100=1980)	100	103	79	77	83	90	95	112	126	145	148	140

Source: Ucimu, Istat



**Table 10 - Production by categories of machines**  
(Billion lire)

	1981	1982	1984	1986	1988	1990	1991
	%	%	%	%	%	%	%
Boring M.	111	89	47	65	104	137	76
	6.4	5.8	2.7	5.2	2.9	3.1	1.8
Drilling M.	49	36	37	38	69	105	67
	2.8	2.3	2.1	3.1	1.9	2.4	1.6
Gear Cutting & Finishing M.	15	12	10	34	43	72	72
	0.9	0.8	0.6	2.7	1.2	1.6	1.7
Grinding & Polishing M.	134	108	104	150	256	291	294
	7.8	7.0	5.9	12.1	7.0	6.5	6.8
Lathes	268	211	170	297	476	519	438
	15.6	13.7	9.7	24.0	13.1	11.7	10.1
Milling M.	116	133	146	223	277	446	302
	6.7	8.6	8.3	18.0	7.6	10.0	7.0
M.C.	-	-	-	262	857	932	954
	-	-	-	21.2	23.6	21.0	22.2
Other	480	504	736	-	559	688	716
	27.8	32.7	42.1	-	15.4	15.5	16.6
<b>Total Metalcutting</b>	<b>1,170</b>	<b>1,093</b>	<b>1,250</b>	<b>1,070</b>	<b>2,642</b>	<b>3,190</b>	<b>2,919</b>
	<b>68.0</b>	<b>71.0</b>	<b>71.4</b>	<b>86.3</b>	<b>72.7</b>	<b>71.8</b>	<b>67.8</b>
Punching & Shearing M.	52	47	67	70	145	180	200
	3.0	3.0	3.8	5.6	4.0	4.2	4.6
Presses	163	165	128	100	282	314	381
	9.5	10.7	7.2	8.1	7.8	7.0	8.9
Other	335	235	309	-	566	756	805
	19.5	15.3	17.6	-	15.5	17.0	18.7
<b>Total Metalforming</b>	<b>550</b>	<b>447</b>	<b>500</b>	<b>170</b>	<b>993</b>	<b>1,250</b>	<b>1,386</b>
	<b>32.0</b>	<b>29.0</b>	<b>28.6</b>	<b>13.7</b>	<b>27.3</b>	<b>28.2</b>	<b>32.2</b>
<b>Total</b>	<b>1,720</b>	<b>1,540</b>	<b>1,750</b>	<b>1,240</b>	<b>3,635</b>	<b>4,440</b>	<b>4,305</b>
	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Source: Cecimo



**Table 11 - Production by level of integration**  
(Billion lire)

	1987	1988	1989	1990	1991
Stand-alone machines	2,364	2,805	3,213	3,545	3,435
Cells	180	220	305	325	340
FMS	353	610	605	570	530
Total	2,897	3,635	4,123	4,440	4,305
	%	%	%	%	%
	81.6	77.2	77.9	79.9	79.8
	6.2	6.0	7.4	7.3	7.9
	12.2	16.8	14.7	12.8	12.3
	100.0	100.0	100.0	100.0	100.0

Source: Ucimu

**Table 12 - Consumption of machine-tools in Italy**

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Consumption in current terms	1,059	1,158	957	951	1,090	1,155	1,493	2,201	2,850	3,193	3,618	3,372
Var. % Consumption		9.3	-17.4	-0.6	14.6	6.0	29.3	47.4	29.5	12.0	13.3	-6.8
Consumption in 1980 prices	1,057	1,030	729	678	762	723	866	1,294	1,435	1,464	1,776	1,637
Var. % Consumption		-2.6	-29.1	-7.1	12.4	-5.0	19.7	49.4	10.9	2.1	21.3	-7.8
Consumption index 1980=100	100	97	69	64	72	68	82	122	136	139	168	155

Sources: Ucimu, Istat



**Table 13 - Values of Italian Machine Tool Production, Imports, Exports and Consumption, in real Terms (Billion lire 1970)**

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Production	344,6	337,8	273,4	260,8	276,5	312,0	332,9	381,2	455,5	486,5	492,3	462,8
Imports	71,1	65,2	47,6	43,6	47,4	50,0	64,1	87,1	103,8	116,4	126,8	105,4
Exports	169,1	167,1	143,9	137,5	145,4	188,0	189,9	171,9	207,3	233,2	236,0	223,7
Consumption	246,6	235,9	177,1	166,9	178,5	174,0	207,1	296,4	352,0	372,1	399,6	358,0

Source: Uciimu, Istat

**Table 14 - Italian Machine Tool Exports in Main Destination Countries (% on total value)**

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Germany F.R.	12.1	12.1	9.5	9.6	10.7	14.6	14.4	15.0	11.9	12.3	18.2	20.3
France	11.2	14.7	14.0	15.4	9.7	9.1	12.2	13.0	12.3	13.1	15.4	15.5
Usa	6.8	5.8	6.7	6.5	10.4	13.3	13.4	8.2	8.2	6.9	5.8	4.9
Ussr	8.1	5.5	10.1	10.7	8.1	6.0	7.5	7.4	9.7	7.8	5.5	4.9
Spain	2.0	2.5	3.1	1.8	1.5	1.5	2.1	5.1	5.5	4.8	5.2	5.1
Polonia	1.8	2.7	0.6	0.7	1.4	0.8	1.1	0.9	0.9	1.0	4.5	1.9
Great Britain	6.0	3.9	5.1	3.1	4.7	4.4	4.4	3.6	4.2	4.1	4.5	3.4
Switzerland	3.3	3.5	3.2	2.4	4.0	3.1	4.3	5.1	3.5	4.2	4.4	3.6
China P.R.	-	0.7	0.2	1.0	1.8	3.7	4.9	2.7	2.7	3.0	3.2	2.8
Belgium-Lux.	1.7	1.2	1.3	1.8	1.7	1.9	2.3	1.8	2.0	2.2	2.2	2.3
Portugal	1.1	1.4	1.1	0.7	0.6	0.6	1.0	0.9	1.3	1.5	1.7	1.5
Jugoslavia	3.7	1.7	1.8	1.7	1.3	0.9	1.4	1.3	0.9	1.6	1.5	0.9
Sweden	1.3	1.7	2.2	1.5	1.8	1.8	2.0	2.6	2.4	5.0	1.5	1.1
Turkey	0.6	2.2	1.7	4.0	5.0	5.0	1.5	1.9	1.9	1.4	1.5	3.6
Netherland	1.5	1.2	1.0	0.9	1.2	1.5	1.6	1.6	1.2	1.1	1.3	1.2
Other Countries	41.2	40.2	38.6	41.4	39.7	33.4	24.4	29.3	31.9	30.2	23.6	27.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Uciimu, Istat





**Table 15 - Italian Machine Tool Imports by Major Countries of Origin**  
(% on total value)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Germany F.R.	38.1	37.6	38.3	36.1	41.4	39.0	36.7	37.9	36.2	38.9	35.6	37.6
Switzerland	15.4	15.9	18.4	23.9	18.9	20.3	21.0	18.3	15.8	12.9	14.6	16.0
Japan	1.7	3.9	2.7	4.1	4.8	5.9	8.1	9.6	11.9	12.8	14.4	10.4
France	7.0	5.6	5.9	8.3	4.7	4.3	4.6	3.7	5.9	5.5	5.5	5.4
Taiwan	0.4	0.7	0.2	0.2	0.3	0.5	0.8	1.8	3.0	4.4	4.1	3.4
Great Britain	8.9	5.2	3.9	3.7	4.2	3.9	5.3	5.1	5.5	4.6	4.0	3.2
Usa	4.7	6.4	9.6	8.4	7.4	6.3	3.7	3.6	3.1	3.9	3.9	3.9
Spain	3.7	3.9	2.9	1.6	1.7	1.7	1.7	2.6	2.5	2.4	2.8	2.6
Belgium-Lux.	1.3	1.0	1.7	1.3	2.8	2.0	4.0	3.2	3.0	2.7	2.3	3.1
Austria	0.6	0.9	1.2	0.9	1.3	0.5	1.9	3.2	1.3	1.5	1.7	2.1
Ddr	3.9	4.2	3.5	1.7	2.2	1.9	2.2	1.9	1.9	2.1	1.7	-
Ussr	2.7	2.9	1.8	2.3	1.5	2.9	1.8	1.4	1.3	1.3	1.3	0.9
Sweden	2.4	1.4	3.4	2.4	2.1	5.0	2.6	1.6	1.3	0.8	0.9	1.0
China P.R.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.6	0.9	1.3
Tchecoslovak.	3.0	2.5	1.1	1.2	1.1	1.1	1.5	1.5	2.2	1.0	0.9	2.0
Other Countries	6.2	7.9	5.4	3.9	5.6	4.7	4.1	4.3	4.6	4.5	5.4	7.1
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Source: Ucimu, Istat



**Table 16 - Machine tool import-export balance between Italy and the first twenty manufacturing countries**  
(million lire)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
France	60,008	113,629	104,358	118,106	79,788	107,352	153,043	149,518	155,457	205,141	252,533	253,082
Ussr	50,376	39,512	82,140	91,691	74,779	70,313	99,453	89,421	153,439	143,398	98,238	89,555
Spain	3,335	9,210	18,336	11,853	8,972	13,751	70,751	34,672	71,286	69,593	72,022	73,793
USA	35,237	30,710	30,487	36,151	77,798	156,045	174,132	84,763	111,540	96,193	72,307	56,284
China P.R.	-	-	479	8,102	17,214	50,309	70,751	34,672	32,573	52,965	54,838	43,434
Great Britain	16,264	17,698	33,542	18,181	32,378	45,601	36,216	11,937	20,537	32,143	42,798	33,412
Corea S.	-	-	742	3,417	2,798	3,691	5,137	11,303	4,214	13,266	7,643	27,319
Brasil	-	-	-	-	-	4,957	9,235	20,920	15,735	21,020	24,011	25,993
Austria	10,424	6,923	5,979	-	-	-	-	2,168	9,239	6,485	5,331	22,629
Canada	-	-	-	-	-	46,082	41,918	19,728	27,262	21,172	8,674	19,630
India	-	-	5,532	8,455	6,737	19,265	12,458	13,436	13,390	17,762	12,677	13,286
Sweden	2,546	10,467	9,213	7,401	10,399	5,241	14,909	23,258	29,714	92,622	18,604	12,211
Jugoslavia	-	-	14,849	14,599	11,756	10,215	18,849	15,366	11,408	24,504	21,133	12,165
Belgium-Lux.	8,481	7,024	6,937	-	-	-	-	1,628	7,783	15,246	17,119	12,146
Germany F.R.	-28,407	-18,666	-25,979	-11,627	-27,691	50,543	18,440	-75,028	-130,628	-175,132	-70,881	1,821
Ddr	-6,639	2,942	-4,650	-615	426	2,152	-9,372	-569	30,662	48,754	-13,873	-
Czechoslovakia	484	-5,191	-585	664	7,867	3,256	-1,767	-951	14,893	4,352	1,467	-13,293
Taiwan	-	-	2,176	9,434	3,586	4,195	-2,823	-7,770	-20,081	-39,873	-42,720	-25,759
Japan	-585	-9,676	-1,273	-1,694	-3,805	-9,332	-28,812	-60,786	-94,125	-116,505	-156,287	-88,552
Switzerland	-23,366	-22,393	-24,306	-44,369	-21,267	-34,479	-46,431	-65,660	-85,217	-55,583	-93,134	-100,476

Source: elaboration on Istat data



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