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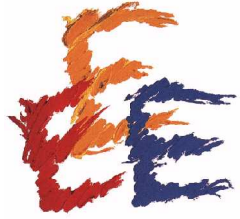
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Fondazione Eni Enrico Mattei

**Italian Policy towards
Cooperation in R&D**

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NOTA DI LAVORO 100.2000

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Italian Policy towards Cooperation in R&D

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1. Introduction*

Italy seems to lack an organic policy to promote cooperative research, in particular when Italian Science and Technology (thereafter S&T) policies are compared to those of other European countries. This is even more evident with regard to

Research Joint Ventures (RJVs). Several weaknesses persist and prevent the Italian industry to become more competitive in high technological sectors: lack of advanced and original technological capabilities, a fragile technological infrastructure supporting innovation processes and unstable links between universities and industry. However, in recent years, a great effort has been done to support and promote innovative activity in general, with some efforts to encourage technological cooperation.

Public policy favoring research was mainly focused on mature technologies and scale intensive sectors (chemical industry, steel-making industry, car makers) until 1980. A major reform was adopted in 1982 (Law 46) which provided new instruments to implement a policy for innovation and research. The new tools were directed either to applied research or to create prototypes at a pre-competitive stage or to promote co-operation in both basic and applied research.

In terms of policy for R&D co-operation, a coherent set of tools to support co-operation and joint ventures among firms and between public research centers and firms has not been set up yet. However, in the last decade Italian firms and research centers/universities have been actively involved in the programs financed by the European Commission, as already emphasized in chapter 2 of this book.

Furthermore, S&T policies are not only related to the promotion of innovative activity, especially at the cooperative level, but also to technological effects on market competition and Intellectual Property Rights (IPR). Therefore we will focus on the characteristics of Italian competition policies and IPR as well as on their links to R&D strategies. Italian Antitrust policy is rather young in Italy, it was implemented in 1990 and it is based on artt.85 and 86 of the Treaty of Rome. Italian legislation on IPR has incorporated European legislation. Both competition policy and intellectual property rights are complementary means of promoting innovation, technical progress and economic growth to the benefit of the consumer and the whole economy. The key question is to establish when the exercise of an intellectual property right ceases to be legitimate

* The “STEP to RJVs” project was co-ordinated by Yannis Caloghirou, National Technical University of Athens/Laboratory of Industrial and Energy Economics. Project participants are. NTUA/LIEE (Greece), SIRN (UK), FEEM (Italy), IDATE (France), Stockholm School of Economics (Sweden), Universidad III de Madrid (Spain), PREST (UK).

and becomes anti-competitive. A specific legislation has not been established yet, but some common principles have been derived on the basis of existing cases.

In what follows, we will first present the involvement of Italian firms in R&D activity and in collaborative R&D activity. We will then examine the Italian innovative system and in particular S&T regulatory policies and the Government's intervention to support innovative activity both at the non-cooperative as well as at the cooperative level. Finally, we will analyze Antitrust policy and IPR.

2. Italian R&D activity

R&D efforts in Italy show a relative delay compared to the US, Japan and most countries in Europe. In fact, in 1997 the Gross Expenditure in R&D (GERD) was 12.503 million dollars (ppp), much below the level of other European countries and the US (Table 1). This amount accounts for 1.05% of the GDP, while in other industrialized countries the average ratio between GERD and GDP is more than 2% (Table 2). The ratio between the Business Expenditure for innovative activity (BERD)³ and GDP (Table 3) in Italy has decreased, as on average in the European Union, but it is lower than in other countries (and it is around the half of the European Union average).

In 1995 intra-muros R&D expenditure (direct investment by firms and public enterprises) was 17.864 billion Lira, equal to an increase of 2,7% with respect to the previous year. Provisional data show that R&D expenditure growth was 7,8% and 6,8% in 1996 and 1997 respectively, while its level increased to 19.249 billion Lira and 20.556 billion Lira respectively in the same two years. According to Table 4, the levels of both private and public research have increased, while their growth has decreased since 1991. Although these figures show a positive trend, Italy ranks 20th compared to other OECD countries in terms of R&D investments over GDP (Istat 1998).

Conversely, with regard to output measures, Italy seems to be rather dynamic in patent performance. In particular, if the number of patent applications filed at the European Patent Office (EPO) in Munich is considered, it is clear that the Italian share is continuously increasing from the early '80s throughout the '90s.⁴ Despite this positive trend in patent applications by Italian firms, the quota of patents registered at EPO is lower than the one of major industrialized EU countries (Table 5). In terms of number of patents on GDP, Italy's position is less than one third with respect to France and Germany (Archibugi 1993).

³ BERD is a subset of GERD and comprises only business expenditure

⁴ Source: EPO-CESPRI database.

An index showing Italian progress in terms of technological convergence towards other more advanced countries is the coverage ratio of the Technological Balance of Payment⁵ (OECD 1998). It has increased since 1992 and in 1995 it was around 77%, close to the performance of Germany and France. This positive result is partially due to the increase in net technological exports following the Lira devaluation in 1992 (Table 6).

Both dimensional and intensity indicators of innovative activity show that Italy is still far from the major industrialized countries in terms of resources invested in formal research and innovation output (patents), but some of them underline an improvement.

The innovative activity of Italian firms is characterized by specialization patterns, geographical distribution and size of the firms.

Areas of specialization in terms of patents. A deeper analysis of the trends and characteristics of the Italian pattern of specialization is provided, to shed light on the sectoral characteristics of the areas of specialization and non-specialization (Breschi et al. 1997).

The revealed technological advantage⁶ (VTRS>0) in the 1995-1997 period (Table 7) shows that Italy is specialized in traditional sectors, such as footwear, clothing, furniture, agriculture, industrial specialized machinery. A positive value for VTRS has been found for industrial automation, electronic classes (domestic appliances and light) and aerospace. Specialization is stronger in those sectors which are internationally competitive in exports. If the dynamic of specialization is considered, the data show that the pattern of specialization has grown stronger in time. This evolution suggests that cumulative patterns of specialization and path dependence coexist in the Italian innovation system. Considering VTRS values, no specialization exists for core R&D sectors, even though a convergence towards industrialized countries has been detected over the last decade with patent quotas moving from 1,3 (1978-84) to 1,9 (1985-91) (Malerba and Gavetti, 1996). The pattern of specialization is very unstable in high technology, while it is stable and cumulative in the traditional sector.

Geographical pattern. Innovative processes and organizational patterns of innovation systems are interdependent, i.e. systems of innovation are affected either by the specific evolution

⁵ The TBP registers the commercial transactions related to international technology transfer. The coverage ratio is the coefficient obtained by dividing receipts by payments. It shows to what extent a country covers its own requirements of technological imports by its corresponding exports.

⁶ VTR is computed taking into account 49 technological classes (Malerba 1998) $VTR_{ij} = (P_{ij} / \sum_i P_{ij}) / (\sum_j P_{ij} / \sum_i \sum_j P_{ij})$, where P_{ij} is the amount of R&D expenditure in country i in sector j . The normalized index used in the tables is defined as $VTRS_{ij} = VTR_{ij} - 1 / VTR_{ij} + 1$, whose values ranges between -1 and $+1$, with a positive value showing specialization that sector.

of national industrial structure or by the specific characteristics of each industrial sector. In fact each sector is characterized by specific technological imperatives that affect the pattern of specialization and the geographical distribution of innovative activity (Basili et al. 1995).

Patent data (Table 8) show that the Northwest is the leading region with more than 80% of patents (in electronics classes). For those classes in which Italy is specialized (traditional sectors), the Northwest and the East account together for 80% of total innovation. As for type of innovation, the Northwestern regions are characterized by product innovation, while in Southern and Central regions process innovation prevails. Data show that in Italy there is a geographical distribution of innovative activity. Northwestern regions maintain a leading position in innovative activity, while Southern regions, apart from aerospace, play a marginal role. The emerging dynamic market is formed by Central regions (Emilia-Romagna, Tuscany, Marche, Umbria and Veneto).

SMEs firms versus large firms. The participation of small and medium-sized enterprises (SMEs) is a characteristic of the Italian actors of the innovation system. Small firms are mainly situated in traditional industries (textile, clothing, footwear, etc), even if recently their presence has emerged in more dynamic sectors such as robotics and automation. These firms have been growing internationally, especially by adapting and tailoring to customer needs and to ever-changing demand (Malerba, 1993).

As shown in Table 9, in Italy the largest firms are the most innovative ones in terms of innovation activity characteristics. R&D and productive investments are the main sources of innovation for both SMEs and large firms, the former being the major source of innovation for large firms while the latter for small firms. Patents and licenses are an innovation tool for medium-sized firms (Table 10). In terms of co-operation in R&D activity, large firms are the most involved, in particular in collaboration with universities and foreign firms and the National Research Center (CNR). Small firms show a preference for cooperation with other firms (both national and foreign) instead of collaboration with other entities (Table 11).

In high technological sectors (Table 12), 120 large firms own 58.8% of patents. Large firms are defined as those with more than 500 employees and they represent 21.5% of firms of which size information is available. Medium enterprises, which are 34.5% of the sample, applied for 917 patents, i.e. 28% of the total, while 44% of the sample, represented by small firms, own only a 13.2% share of patents (Malerba 1998).

These data show that a peculiarity in Italy is the great presence of SMEs, with large firms being the most innovative enterprises. The reason behind this behavior may depend on two factors, first a

long formalized and expensive procedure⁷ to apply for patents. Second, SMEs carry out only a small part of formal R&D and introduce incremental innovation through channels like learning by doing, interacting processes and acquisition of new machinery.

In short, we can describe the Italian innovation system as follows: there is an oligopolistic core of large firms which accounts for most of the Italian research activity. Besides this innovative core, there is a small set of small firms operating in the high technology sectors and a large sample of SMEs in the traditional sectors or in micro-mechanics and instrumental mechanics, specialized in customized production of final and intermediate products.

3. Government's actions to promote investments in R&D

3.1 Promotion of R&D in general

Generally speaking, several policy tools, which may affect the innovation process at the firm level, are at the disposal of governments. They can be briefly summarized in three broad categories: taxation schemes, public procurement for high-tech products/services and direct financial subsidies for research activities.

The Italian government's action to encourage private R&D activity consisted primarily of financial incentives, namely facilitated credits and grants. This policy started in the reconstruction period. At that time, the impressive diffusion of R&D laboratories inside firms was considered an important element of economic growth and this process was strengthened by technological public policy. A generic subsidization of R&D expenditure was thought to be more effective than the government's intervention in specific areas of research: the government offered financial arrangements to decrease research costs, without targeting specific projects or particular technological fields. Neoclassical and also Schumpeterian analyses provide a theoretical argument to support this choice: financial incentives or tax reductions are optimal means to increase R&D expenditures up to the point where private and public returns are equal. This strategy was pursued until the early '80s, through a wide range of instruments aimed at sustaining the production and the diffusion of technological knowledge.

The first attempt to make the government's intervention more selective is Law 46, February 17, 1982, which provides different incentives to sustain specific sectors of national relevance. On the basis of this law, two funds, the "Fondo Speciale per la Ricerca Applicata" (FRA) and the "Fondo

⁷ For a detailed analysis of the Italian high technological sector refer to Malerba 1998.

Speciale Rotativo per l'Innovazione Tecnologica" (FRT), were set up.⁸ The former was created to support applied research and diffusion of its results. The latter was meant to sustain relevant technical advances in the last stages of applied research.

This new approach allows firms, research societies, consortia and public entities to autonomously submit projects, which are subsequently selected for subsidization by the Ministry of University, Scientific and Technological Research (MURST). According to the specific technological area, selection criteria are based on the originality and the follow-up chances of the projects in the business world in the short-medium run. Therefore, Law 46 is a tool to direct R&D activity in the specific technological areas of national interest.

FRA. FRA is meant to sustain R&D projects of private firms, consortia, public entities, societies for research, private centers of research and consortia between private firms and public entities. The applications for research projects funds filed by a single entity are continuously decreasing, while the demands submitted by consortia of firms and public entities are growing.⁹

Funds for FRA are granted by the Istituto Mobiliare Italiano (IMI) upon submission of requested documents. Subsidies are *ex-post*, i.e. they are distributed after the firm has undertaken R&D costs, in an average span of five years. The total amount of funds will be determined each year on the basis of the government's financial budget.

According to Law 46/82, updated by Law 652/92, a 20% share of the total fund is devoted to SMEs, while 40% is reserved for activity in the South of Italy and a 10% share is devoted to international projects.

Articles 2 and 7 of Law 46/82 define the mechanism for the provision of financial resources. Projects carried out by SMEs with a cost lower than 2.5 billion Lira receive a subsidy up to 70% of the global cost of the project and up to a maximum amount of 1750 million Lira. Projects carried out by companies, consortia and research centers with a cost between 2.5 and 10 billion Lira are funded by grants and by subsidized loans, decided by a decree of the Ministry of Industry, following the advice of a technical committee. Each phase of the project, from applied research to experimentation, has to be developed in Italy. Law 346/88 regulates applied research projects whose cost is greater than 10 billion lira. A fixed share mechanism to allocate resources for this type of projects is not established under this law.

FRA represents the most relevant support to high-tech projects for Italian manufacturing. In 1990, its subsidies amounted to 806.1 billion Lira, accounting for roughly 8.2% of the BERD. Table

⁸ Actually FRA was created by Law 1089 in 1968, but only the following legislation n.46/1982 rigorously explained the fund's objectives and functioning procedures.

⁹ Source: CER-IRS, *La Trasformazione Difficile*, (1993)

13 shows the funds distribution classified by geographical location and firm size from 1983 to 1992. Unfortunately, FRA was not active between 1994 and 1995 for bureaucratic reasons. On average, the resources distributed by the fund are around 1000 billion lira per year.

Looking at the characteristics of the subsidized firms and their geographical distribution, two features emerge. First, there is an asymmetry between large and medium-small companies. The latter account for almost 50% of the total funds demanded, but they receive only roughly 10% of the total funding, which is dramatically lower than their reserved share of 20%. Second, the percentage of funds granted by FRA to Southern Italy is lower than the reserved share of 40%.

Despite its ambitious aims, FRA activity has been extensively conditioned by the discontinuity and insufficiency of financial funds, which depend on the budget constraint of the Italian administration. Moreover, its activity has been influenced by Community legislation, which implies the communication of all projects involving a minimum cost of 20 million ECU. Due to this procedure, large corporations seem to be more oriented to small size, low risk projects with a poor technological content, which require lower financial grants¹⁰, than to more costly projects. Thus, FRA turns out to be inadequate not only for SMEs, which receive in practice a low share of the funds, but also for large companies. In the meantime, the projects presented between 1992 and 1994 decreased in terms of dimension from 3.300 billion Lira to 1.380 billion Lira, and in terms of number from 200 to 90, as an effect of economy slowdown, money cost and privatization on the one side, and as an effect of the access to other programs, which may guarantee a higher probability of success for firms on the other side. Interestingly, the simplification in the application rules for SMEs and the reduction of the project evaluation time positively affected the number of applications for FRA funds. In fact, in 1995 they increased by 50% with respect to the previous year (Malaman, 1997).

FRT. FRT has been created to promote relevant technological advances in the last stages of applied research activity. The subsidized costs are related to all the pre-competitive stages of research activity, from design to experimentation. Table 14 shows FRT's activity in terms of number of projects subsidized and amount of resources devoted to these projects.

Law 317/91 introduced further facilities for SMEs under FRT, in terms of the procedure to submit demands. On average, a share of 25% of the total amount of the fund is targeted to SMEs. A higher share of SMEs is subsidized by FRT than by FRA. This trend can be explained by a peculiarity of SMEs innovative activity. Innovative efforts are primarily focused on incremental innovation, imitative activity and technological renewal. In this respect, FRT seems to be an

¹⁰ Source: Falzoni in *La Ricerca Scientifica* (1990) and CER-IRS (1993) on IMI data set.

instrument suited to promote SMEs innovative efforts and, consequently, to be particularly suitable to sustain R&D activity in the Italian manufacturing field. If SMEs do not conduct research activity inside R&D laboratories they are denied access to FRA funds.

The competence and the areas of intervention for the two funds are not clearly defined, creating some confusion and overlapping between them. Moreover, to increase the efficiency of both FRA and FRT it would be necessary to drastically reduce the period between the application and the decision to provide a subsidy (which is around 8 months).

With regard to the diffusion of technical knowledge, Law 46/82 does not explicitly introduce any mechanism to promote technological follow-up. In particular, relative to the possible diffusion of the research results, art.11 says that the State owns research outcomes. However, productive exploitation of the innovation and patent use by the firms members of the agreement are allowed for. More precisely, the property right can be relinquished to the members of the agreement against payment¹¹.

More generally, the government has promoted the process of diffusion by facilitating investments in new machinery or renewal of production equipment. A successful example of these types of policies is represented by Law 1329/65 (Sabatini Law, 1965)). Table 15 summarizes the number and the costs of the subsidized projects between 1983 and 1992. Initially, Law 1329/65 was introduced to subsidize specialized machinery firms, but within a few years it had changed into a relevant instrument to promote technological diffusion. In fact, SMEs innovate mainly by the acquisition of new materials, machinery and technological components. The objective of speeding up the technological development of SMEs has been pursued also by the introduction of Law 696/83, modified by Law 399/87, which allows firms to buy new high-tech machinery by means of subsidized credits, (see Table 16).

Technological agencies. As far as technological agencies are concerned, the Ministry of Industry announced the creation of an agency, called Agitec, for innovation and technology transfer. This agency, organized as a society, whose main partners are Mediocredito Centrale, Enea and Unioncamere, is mainly devoted to designing and implementing programs of technological investments for SMEs and to the creation of new high tech firms. In addition, it offers some complementary services like technological check-up, recruiting of domestic and international partners for research projects and information and documentation for accessing national or Community funds for R&D expenditures. Following this example, some other centers of

¹¹ For an analysis of pool patents, refer to section 5.

technological diffusion have been created: they are based on the collaboration among universities and firms and their activity is oriented to regional areas (ARPA, ASTER, etc.), others are societies where ENEA cooperates with other firms in specific fields (Polo tecnologico, etc.).

A relevant intervention by the government to diffuse technological knowledge and know-how has been the creation of scientific parks and technological agencies, which will be analyzed below in relation to measures to support cooperative R&D activity.

3.2 Promotion of R&D cooperation

The intrinsic characteristics of the Italian industrial structure as well as the public policies pursued during the last fifty years have reduced or impeded the opportunities of interactions between public and private research institutions. On the one hand, public authorities set up a series of policy tools, such as fiscal and financial incentives, which sustained long-term research, mainly basic research. On the other hand, the industrial pattern of specialization biased towards traditional products and small firms, expressed a low demand of scientific knowledge. However, a new trend in policy making is emerging, to implement policies designed to promote co-operation between research centers and industry, other than financial incentives. An example of this new trend (De Marchi et al.1998) is the creation of an interface structure, INFN, ASI, ENEA etc, to establish commercialization structures for research products; the creation of service and innovation centers, to locally support technology transfers and also to promote the creation of high tech firms; a patent office to provide information and assistance on patent application.

At present, the legal layout of the cooperation agreements is relevant for revenue laws. However, in Italy there are no tax credits to provide incentives for technological cooperation among firms. In fact, government action takes the form of facilitated credit instead of tax facilities.

Regarding the government's role in directly influencing technological cooperation, we should distinguish three different types of cooperation. *First*, cooperation among firms, for instance short-term contracts regarding a project of research or the joint use of R&D laboratories, the commercialization of a new product, the licensing of a patent, the creation of a RJV and so forth. *Second*, cooperation between private and public institutions, namely cooperation between private firms and universities and public research centers. *Third*, new structures for cooperation such as technological parks, public laboratories and research centers.

The Italian government's action has mainly privileged the first two types of intervention. In particular a great effort has been done to increase cooperation between firms, universities and public entities and to support private joint activity of technological research. Although a

systematic and coherent line of action to promote cooperative R&D is missing, we consider a set of specific programs, which have been quite influential in promoting joint R&D.

Progetti Finalizzati - PF. CNR established a program to fund specific innovative projects, Progetti Finalizzati. This program aims specifically at promoting research coordination between public and private laboratories and research centers, in particular between universities and companies. It is focused on the pre-competitive stage of research and, in particular, on high risk and delayed return projects of research. Areas of interest are energy, food, health environment and advanced technology. The broad objectives of PF are: i) the decrease of Italy's technological dependency on foreign countries (as on BTP); ii) the improvement of human capital; iii) the development of Southern Italy and in general of all the lesser industrialized regions.

Three different categories of PF can be distinguished. The first type of PF has essentially the role of stimulating basic research and it is mainly addressed to universities and to the public system of research. In this sense these projects have promoted cooperation between public research centers inside and outside academia. The second type of PF is meant to support concrete public action. In other words, this type of PF supports the public operator's demand of knowledge in order to improve the quality of public services or to provide the necessary information and knowledge for long-term planning and intervention. Finally, the last category of PF aims at promoting technological development. These PF support fields of research where important technological follow-ups for the productive sector are expected in the short and medium term. Six fields of national interest have been promoted, namely: food, health, environment, advanced technology, energy and a last one specifically addressed to the analysis of some peculiar features of the Italian economy. Firms participation is allowed in all three categories of PF, but in practice it is limited to the last category. Tables 17 and 18 summarize the PF carried out between 1975 and 1986, and the resources provided by CNR.

It is a common opinion that the third type of PF is the most effective in promoting innovation and that it has produced the most promising results.¹² These PF have efficiently developed high risk projects, with promising follow-up as for instance in the case of electronics and telecommunications. They also offered many SMEs a chance to cooperate in high-tech projects, and they have effectively promoted cooperation between firms and universities.

Programmi Nazionali di Ricerca – PNR. The National Programs of Research (PNR) are research programs organized by MURST, but directly addressed to promote private industrial

¹² S.Ginebri in *La Ricerca Scientifica* (1990).

research in the private sector. They represent the natural extension of PF and are based on knowledge, competence and information created by PF. They are addressed to firms, to carry out high risk projects characterized by a multidisciplinary approach. 10% of the total subsidies is reserved for the training of researchers.

Recent legislation comprises part of the EC norms: the Italian President's Decree D.P.R. 240/1991 introduces EC regulation 85/2137, 1985 which establishes the European Group of Economic Interest (GEIE). The GEIE is an instrument to promote cooperation between firms and between private entities and public institutions. The GEIE's goal is not that of attaining its own profit, but that of promoting partners' development and profitability. Therefore, it is particularly useful in the case of R&D activity jointly conducted by several partners. The GEIE is particularly valuable in the case of cooperation among SMEs. In fact, it allows the creation of a group even without capital; partners can choose to contribute to the group with cash, but also with assets or services. For this reason it is a relevant institution in Italian S&T policy.

Another effort of Italian policy makers to foster firms cooperation is Law 95/95 art.3. For the period 1995-97 it planned the allocation of 5% of the authorized budget in favor of CNR, ENEA, and FRA which aimed at promoting cooperation among firms, universities and research centers.

The involvement of Italian firms in European programs to promote R&D cooperation is substantial.¹³ At present, more than 10% of the Italian industrial R&D effort is performed through international cooperative programs and two thirds of these collaborations are financed by public subsidies.¹⁴ European Community funds are the third source of R&D funding for Italian firms after FRA and FRT. Italian participation is considerable in the fields of energy, industrial technologies and information. Italian participation is characterized by the large contribution of SMEs, as opposed to the domestic case where the share of SMEs is relatively small. Conversely, technologically advanced countries such as Germany, France, Great Britain and the Netherlands show a strong presence of large firms in comparison to SMEs.

Consortia. Consortia represent a new structure to support R&D co-operation. They were established in 1980 (Law 382) to promote co-operation in educational activities, students' curricula and complex research. Law 46/82 does not foresee specific incentives for the creation of consortia or other forms of R&D cooperation. Examples of consortia are CILEA focused on electronics and the Italian institute for physics. Since 1985 other entities, such as firms and research centers have

¹³ Refer to chapter 2 of this book.

¹⁴ G.Antonel, R.Malaman in *La trasformazione difficile* – Sesto rapporto CER-IRS, (1993)

been involved. It is relevant to point out that CNR, like universities, can be a partner in such consortia. So far CNR has taken part in 26 projects where many industrial firms were involved.

Scientific and technological parks. In 1990 the Ministry of Treasury, of University and Research and of Extraordinary Interventions in Southern Italy signed the Agreement Program (Programma di Intesa 7/12/1990) to promote and develop scientific and technological parks in Southern Italy, as instruments for the implementation of the policies to promote and diffuse technology. The Agreement Program was established in response to the need of developing scientific and technological skills, to allow technological transfer to small firms and to create synergies between firms and public centers, in particular in Southern Italy. Scientific and technological parks have been created as consortia or societies. This agreement was in line with European policies to promote technological regional development and with Italian policies for the development of Southern Italy. Based on this agreement, approved by the ministerial decree (D.M.) 25/03/1994 n.225¹⁵, 13 technological parks have been created in Southern Italy since 1997. Cooperation among firms, universities and scientific institutions in the parks is devoted to sustain pre-competitive research, development, planning, and the creation of new products, in particular in the high technological industrial sector. The aims are various and range from sustaining local growth and the creation of new innovative firms, to the creation of services for new small enterprises.¹⁶

Local programs. Finally, programs promoted by local authorities are also worth mentioning, for example regional regulations in Lombardy (34/1982 and 34/85 (art.6)) define two specific types of intervention. The first one considers financial facilities for research agreements between SMEs and specialized centers of research (up to 40% of the cost of the project and up to 300 million lira is covered by a grant). The second one provides subsidized credits repayable in the medium term to finance product innovation by small-sized firms. The regional Law (r.l.) 7/93 introduces capital account subsidies for process and product innovations in Lombardy. Finally, r.l. 35/97 provides grants for the participation of firms in Lombardy to applied research programs. Another example is provided by the autonomous province of Trento, which passed a law aimed at fostering cooperation between industry and university (Malerba 1993).

¹⁵ The procedures for the creation of the parks were established by the Conversion law (legge di Conversione) 5/11/1996 n. 573

¹⁶ For more specific detail refer to the D.M. 25.03.1994, n.255.

Finally, we summarize the features of Italian S&T policies. First, the role of the state in R&D is dominant: basic research is mainly carried out by public institutions and a large share of private R&D efforts is supported by the government through financial subsidies; in the period between 1990-1996, on average 12% of BERD has been financed by the government.¹⁷ Second, S&T policies are based on broad goals and do not offer clear guidelines for technological efforts at the firm level. Moreover, the Italian government did not pursue a top-down approach with the aim of stimulating private R&D by means of public procurement and the launch of advanced projects of research related to both civilian and military needs. Equally, it has not followed a bottom-up approach, in order to stimulate the R&D effort at the firm level, to speed up the diffusion of technological know-how and to strengthen the linkage between firms and universities/centers of research. Finally, S&T policies are haunted by delays and discontinuities. Various efforts in the direction of promoting R&D cooperation have been implemented, however further effort is needed to create an organic and unified policy framework, specifically related to RJVs.

In summary, Italy is characterized on the one hand by a weak and unorganized system of instruments to favor R&D, as shown in the above section, and on the other hand by firms which are behind their European competitors in terms of R&D activity, as shown in section 2.

Given that we examined Italian R&D activity and policies, focusing in particular on cooperative R&D, we follow the analysis concentrating on the question whether cooperation in R&D may affect competition among firms. In fact, RJVs may lead to collusive behavior not only at the R&D level but also at the product level. For this reason, we will cast a glance at the characteristics of competition and anti-trust policies in Italy and at their relationship to RJVs.

4. Anti-trust Policy

Competition policy in Italy began in 1990, even though the original draft legislation dates back to the early fifties. The essential has been transformed into law, defining the economic behaviour to be controlled and the procedures for so doing (in particular with the institution of the *Autorita' Garante delle Concorrenza e del Mercato*, the Antitrust Agency).

Italian Anti trust policy is regulated by law 287/90 which is derived from European anti-trust law. The implementation of the norms reflects precisely articles 85 and 86 of the Treaty of Rome. Regulation of agreements, abuse of dominant position and mergers and acquisition are essentially the same as the EU's. In particular, in Italy, as at the EU level, exceptions for limited

¹⁷ OECD, *Main Science and Technology Indicators*, n.2, 1997

periods may be granted to agreements or categories of agreements restricting competition provided that they improve supply conditions and result in substantial benefits to consumers.

There is, however, a distinguishing feature at the sectoral level between Italian and EC law. Italian anti-trust law does not include any special provision for the agriculture and the transport sectors, while European law provides a special treatment for these two sectors. Italian antitrust policy has special provisions aimed at protecting the international competitiveness of Italian firms. These provisions reflect the strong presence of SMEs in the Italian economic environment. However, these exemptions can only be applied whenever anti-competitive actions of Italian firms do not affect competition in the European Union (Vanzetti, 1996).

Like the European one, Italian law considers the firm as the unit to be regulated. The concept of firm for both the European and the Italian antitrust is rather broad: it includes business activities with and without legal personality, including non-profit institutions.

The enforcement powers are vested in an independent agency, Autorita' Garante, which has a total organisational independence and the freedom to spend the financial resources it receives every year from the Parliament. The independence of the Autorita' Garante in terms of extent of its action is peculiar to Italy: in fact the Antitrust agencies in France, Germany, the United Kingdom or even the US do not have the same degree of independence and autonomy as the Autorita' Garante. The government can only influence the activity of the Autorita' Garante in general terms but not in respect of individual cases. Moreover, the enforcement powers over certain sectors are vested in other institutions (Banca di Italia for credit, Garante per la Radiodiffusione e l'Editoria for broadcasting and publishing).

The industries which are most often investigated by the Autorita' Garante are the chemical industry (traditionally characterised by high concentration degrees for technical/economic reasons) and the food industry for mergers and acquisition; the cement and concrete industry and the insurance business for cases of agreements; the telecommunications industry and airport sector, for cases of abuse of dominant position (Gobbo et al. 1998).

If anti-trust policy is related to RJVs, we find out that anti-trust laws and RJVs are linked in two ways. On the one hand, the antitrust law regulates the restriction of competition to which the type of the agreement may lead per se (Art. 85 of the Treaty). On the other hand, it investigates on whether patents, and more generally intellectual property rights, originating from RJVs, may result in an abuse of dominant position by an individual partner or by all the members collectively (Art.86 of the Treaty). This last concern will be examined in Section 5.

R&D agreements and joint ventures are not considered by European law as restrictive to competition: "...agreements to carry out common research projects and develop the results till the

industrial application stage will not influence the competition position of the partners” (Ghidini-Hassan, 1994).

However, special agreements among partners, may fall under the brunt of the antitrust legislator when they limit the R&D activity, or the access to pre-existing knowledge or the use of research results by one or more partners. Specifically, the legislation is against agreements restricting the partners’ activities outside the joint venture (even jointly with non-member firms). Moreover, the agreement should not prevent or restrict the circulation of research results to non-member firms, unless such results are protected by patents. There are exceptions to these general rules, on a case-by-case basis, whenever restrictions are useful in order to enhance research benefits. So far, the activity of the Autorita’ Garante have never dealt with RJVs.

5. Intellectual Property Rights

Intellectual property laws pursue the following goals: rewarding innovators for their creative efforts, disseminating innovations, promoting a more competitive environment through the development of new products or productive processes. On the other side, protection of this right and the exclusive use of innovation may arise concerns in terms of competition policies. However, both policies play a complementary role in providing sufficient incentives for innovation and economic growth. This is particularly true as far as pool patenting is considered, in relation to RJVs, which not only promote innovation but may also arise a concern for market concentration, as emphasised in the previous section.

In what follows, first the Italian patent regulation system is presented and second, the IPR and competition policy links are analysed.

5.1 Italian Patent Regulation System

The first law about property rights on invention in Italy dates back to 1939. This law n.1127/39, has been continuously modified up to Law n.338/1979 which conforms the national regulations to European standards. Thus, also the Munich agreement (October 5, 1973) and the European Patent have been introduced into the Italian patent system. This implies that Italian innovators can choose whether to file their inventions with the European or the National patent system. The European system will grant property rights within some or all the states subscribing to the Munich agreement while the national one will do so just within National boundaries.

European legislation mostly overlaps with national norms and the effects of the European patent are the same as the national one, even though some important differences exist. As for Italy, the most relevant difference is that Italian patent can be granted without an examination, unlike the

European ones. In fact, in Italy the inventor submits his/her request to the Italian Patent Office and although the legislation provides for a formal examination of the request, the examination does not deal with technical details and it analyzes neither the originality nor the patentability requirements. The time of submission is important, as in case of conflict between inventors, the Italian system works on the “first to file” criterion. In contrast, when the request is submitted to the European Patent Office by the inventor, there is a compulsory preventive examination before receiving the patent aimed at assessing the originality of the invention.

In what follows we will focus on the Italian patent, in particular on an aspect which is specifically relevant for RJV: the rights concerning patents in the case of a team invention. There are two kinds of rights related to the patent: the right to obtain it and the right to the economic exploitation of the results of the invention.

The right to obtain the patent. By art.29 of Invention Law (l.i.), all the co-inventors have the right to obtain the patent. The law considers as co-inventors those members of the group that developed research activities aimed at the creation of the new invention, but not those that worked on other parts of the research projects or whose activity was not creation-oriented. As for the rules concerning team patents, the patent law refers to the standard rules on joint ownership. The problem is that such rules only regulate the sharing rules of the patent once the patent is obtained. There is no specific law defining the rights for co-inventors to file for patents. However, according to common practice, the decision to ask for a patent has to be taken by the majority of the co-inventors. When the application for the patent is submitted by just one or a minority of co-inventors, this is equivalent to the application for the patent by an individual without legal rights. In any case the absence of norms makes the situation unclear and imprecise.

The right to the economic exploitation of the results of the invention. As reported above, there is no specific legislation regarding the economic exploitation of the results of the invention. Normally the general norms on joint ownership are applied. Ownership is held equally by all co-inventors unless otherwise specified; the ownership share is transferable and each partner has a right of pre-emption on it; the patent is an indivisible object; the decision on its use and licensing should be taken by the majority of the co-inventors (art.1105), while the decision on exclusive licensing should be taken unanimously (art.1108, comma 3, C.C.).

Art. 20 of the Invention Law establishes that these are the norms for the mentioned rights, except in case of different agreements among the parties involved. Particularly, if the parties form a society to carry out the research project, the business law will rule the above mentioned rights.

Special sectors. Italian patent law was born to protect inventions in the mechanic sector. Some special developments have characterised specific sectors. Special provisions regard in particular the patent for the chemical sector, for new vegetal varieties and for microchips.

In chemistry, some special norms have been introduced to determine what a new finding is and the requisites of novelty and originality, necessary to deliver the patent. Novelty requires particular criteria when the compound is described in chemical and physical terms. Originality, instead, is related to both the structure and the function of the compound found by the inventor.

In the case of new vegetal varieties the patentability requisites are modified; particularly the requirements for novelty are less strict, as well as those for originality. Homogeneity and stability are *ad hoc* for this kind of invention. Moreover there is a system of double protection for new vegetal varieties, that allow the request for the usual patent or for the special protection. The process to obtain the patent requires an examination by the Ministry of Agriculture and Forestry.

The microchips sector is characterised by high amounts of investments and high risk of copying. Following the European Commission directive December 16, 1986, n.54/1987, special provisions for microchips have been introduced Law n.70, 21 February 1989. This law's approach is similar to the one for patent law, but the word registration is used instead of patent (Vanzetti, 1996).

5.2 Patents and Monopoly

Competition policy and intellectual property laws are both founded on the intent to promote economic advance, technical progress and consumer welfare. Antitrust laws seek to prevent certain behaviours that may restrict competition to the detriment of consumer welfare. In a long run view, consumer welfare depends also on the availability of new products and on the increased quality of existing goods. Thus, both competition policy and intellectual property rights are complementary means of promoting innovation, technical progress and economic growth to the benefit of the consumer and the whole economy. For the purpose of antitrust analysis two issues should be considered: (i) intellectual property should be regarded as comparable to any other form of property; (ii) the possession of an intellectual property does not necessarily confer market power upon its owner.

The mere possession of an intellectual property right does not necessarily guarantee the possibility to exercise anti-competitive practices. IPR intrinsically have a monopolistic aspect, given that they may limit production, exchange and imports of the patented products. Market power arising from holding IPR may be used to restrict competition between technologies that are economic substitutes or to exclude new technologies from the market. Further restrictions to the

economic activity and competition derive from the fact that national patents impose the implementation of the innovation within national borders and may protect from competition of imported foreign substitute products.

The privileges granted by the patent do not imply *per se* a restriction to competition or an abuse of dominant position, as referred to in artt. 85-86. The key question is to try to identify a borderline between the IPR legislation and competition law. A specific legislation has not been established yet, but on the basis of existing cases some common principles have been derived.¹⁸

A restriction of competition should be considered with respect to the global competitive structure of the market and not only in relation to the parties involved. The exploitation of the patent through contracts and agreements is acceptable by the legislator, as far as it enhances economic and technological progress, art.85n.3 (Tavassi, 1998). With this respect the ENI/Montedison case is an example of the application of art.85 n.3. In this case cross-licensing of patents and know-how in the chemicals and thermoplastics industries are involved. The agreements between ENI and Montedison related to their efforts to rationalise their production in certain chemical feedstock and in thermoplastics, industries suffering from serious overcapacity in the EU. The firms agreed to reduce their cracking capacities at the feedstock level and to specialise at the thermoplastic level, with each firm ceasing the production of certain thermoplastics. Patents and know-how were cross-licensed on a non-exclusive basis in connection with the plan. The Commission exempted the agreements under Article 85 n.3, as they helped to resolve a serious problem of overcapacity more quickly and completely than would otherwise have been possible. Moreover, the fact that each firm retained cracking capacity and the right to use its own intellectual property (the patents and know-how were licensed non-exclusively), meant that each firm remained a potential competitor in the thermoplastics field it had abandoned, limiting the restraint on competition (OECD 1989).

Consequently, there is an overlapping between the patent and the antitrust legislation and it is not always obvious which of the two should be applied. The patent law is applied as long as there is no dominant position; while, the anti-trust law is applied whenever the patent right will constitute dominant position and/or lead to an abuse of dominant position. Thus, the uncertainty boils down to the difficulty of defining a dominant position and the relevant market concerning such abuse (Sena, 1990, 1998).

¹⁸ The Ciba-Geigy/Sandoz merger case is an example of the degree to which competition policy interacts with IPR. This merger combined two of only a few entities capable of commercially developing a broad range of gene therapy products and threatened to significantly reduce competition to innovate in that area. The merger reduced incentives for other companies to enter a field where they would in future have only one source of necessary IPR instead of two and only one potential buyer for resulting technology. Accordingly, the competition Authority abstained from blocking the merger only after the parties agreed to certain compulsory licensing conditions (OECD 1998). Other cases in which the above distinction is established by the court of Justice are Park Davis, Sirena Emi Records, Renault and Volvo, Warner Bros, Emi Electrola and Magill.

So far the Autorità Garante has taken a stand in a couple of cases involving an intellectual property licensing agreement. In one of the two¹⁹, the Autorità Garante stated that competition rules apply to the exercise of intellectual property rights. In particular, the exercise of an exclusive intellectual property right may infringe competition rules if it prevents, restricts or impedes competition to a significant and unjustifiable degree on any of the markets in which the right is exercised. The Autorità Garante ruled that the contracts were to be considered prohibited agreements, on the grounds that the exclusivity clause was not necessary to enhance market efficiency (OECD 1998). In the other one²⁰, the Autorità Garante expressed its negative opinion on the patentability of some models, since patents could distort competition in the relevant market and create an economic damage for consumers (Sena, 1998, Tavassi 1998).

Patent pooling and cross licensing is an area where competition law can and should be applied to restrict anti-competitive use of IPR among firms, which are actual or potential competitors, as in the case of RJVs. Patent pooling is normally pro-competitive if it is strictly confined to sharing complementary patents. However, companies could seek to combine substitute technologies and thereby reduce horizontal competition. This could happen in the context of settling patent litigation. Even where pooled technology clearly combines complementary rather than substitute technology, concerns are raised regarding treatment accorded to non-members and to technology improvements. Patent pools could amount to collective boycotts which significantly reduce the competitive power of existing or future competitors. Consumers also stand to lose if the patent pools require such generous sharing of any technological improvements that the incentive to make improvements is significantly reduced. A rule of reason approach seems eminently suitable to review the effects of patent pooling.

6. Concluding remarks

The Italian system of innovation shows some specific features. On the one hand, there is a clear gap between Italian expenditures in R&D and those of most industrialized countries. On the other hand, Italy shows a good level of technological dynamics carried out by SMEs especially in traditional sectors.

S&T policy to promote innovative activity covers a considerable share of R&D expenses and in the last decade some incentives for cooperative R&D have been introduced.

¹⁹ The proceeding related to two agreements concluded between Associazione Italiana Calciatori (AIC) and the Panini spa. According to these agreements, the AIC had assigned to Panini the exclusive right to use images of the soccer players wearing their team colours, by publishing and marketing them on self-adhesive stickers, together with albums for stickers and other published items for collection.

²⁰ This is the case about cars spare parts (Riv.Dir. Ind., 1994).

The Italian government's action for innovative activity has been analyzed from two different points of view: research promotion and promotion of cooperative R&D. Research promotion has primarily taken the form of facilitated credits and grants to stimulate innovative activity and to speed up the diffusion of technological knowledge. With regard to the promotion of R&D cooperation several governmental instruments have been analyzed, however a specific and coherent strategy to sustain RJVs does not yet exist in Italy.

Italian Antitrust Policies and Intellectual Property Rights mainly derive from European legislation. The analysis proposed shows that there are no specific features discouraging or encouraging the creation and the performance of RJVs.

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Table 1
GERD-Gross Expenditure in R&D (million \$, ppp)

	<i>ITA</i>	<i>FRA</i>	<i>GER</i>	<i>UK</i>	<i>USA</i>	<i>JAP</i>	<i>UE</i>	<i>OCSE</i>
1993	11,483	26,430	36,409	21,246	165,624	74,382	121,604	379,963
1994	11,340	26,509	37,323	21,759	168,946	75,235	124,476	388,592
1995	11,244	27,052	38,497	21,148	183,496	82,057	127,477	432,996
1996	11,795	27,842	39,694	21,249	193,780	82,816	132,448	458,796 ^P
1997	12,504 ^P	28,260	43,168		206,466 ^P			
1998			44,840					

Source: OCSE, 1998

Table 2
GERD as a percentage of GDP

	<i>ITA</i>	<i>FRA</i>	<i>GER</i>	<i>UK</i>	<i>USA</i>	<i>JAP</i>	<i>UE</i>	<i>OCSE</i>
1986	1.13	2.23	2.73	2.33	2.91	2.75	1.93	2.35
1987	1.19	2.27	2.88	2.24	2.87	2.82	1.96	2.35
1988	1.22	2.28	2.86	2.02	2.84	2.86	1.96	2.33
1989	1.24	2.33	2.87	2.23	2.80	2.98	1.99	2.34
1990	1.03	2.42	2.73	2.22	2.77	3.07	1.99	2.38
1991	1.32	2.41	2.61	2.11	2.84	3.00	1.96	2.31
1992	1.20	2.42	2.48	2.13	2.74	2.95	1.92	2.23
1993	1.14	2.45	2.42	2.15	2.61	2.88	1.92	2.18
1994	1.06	2.38	2.32	2.11	2.51	2.84	1.87	2.12
1995	1.01	2.34	2.30	2.02	2.61	2.98	1.84	2.15
1996	1.03	2,32	2.29	1,94	2.62	2,83	1,84	2,17
1997	1,05 ^P	2,26	2,39		2,64 ^P			
1998			2,39					

Source: OCSE, 1998

Table 3
BERD - Business Expenditure in R&D - as a percentage of GDP

	<i>ITA</i>	<i>FRA</i>	<i>GER</i>	<i>UK</i>	<i>USA</i>	<i>JAP</i>	<i>UE</i>	<i>OCSE</i>
1986	0.66	1.31	2.00	1.55	2.10	1.83	1.25	1.50
1987	0.68	1.34	2.08	1.50	2.07	1.86	1.27	1.50
1988	0.70	1.35	2.07	1.47	2.00	1.94	1.28	1.60
1989	0.73	1.41	2.07	1.49	1.96	2.08	1.29	1.61
1990	0.76	1.46	1.98	1.51	2.00	2.15	1.29	1.64
1991	0.77	1.48	1.81	1.42	2.07	2.12	1.25	1.59
1992	0.67	1.51	1.70	1.42	1.98	2.03	1.21	1.52
1993	0.61	1.51	1.62	1.44	1.85	1.90	1.19	1.46
1994	0.56	1.47	1.54	1.38	1.78	1.87	1.16	1.42
1995	0.54	1.43	1.53	1.32	1.88	1.94	1.14	1.45
1996	0.56	1.43	1.51	1.26	1.92	2.01	1.15	1.48
1997	0.57	1.38	1.63		1.96			
1998			1.65					

Source: OCSE, 1997

Table 4
Private and public R&D in Italy (billion Lira)

<i>Year</i>	<i>Total</i>	<i>Percent Variation</i>	<i>Public Research</i>	<i>Percent Variation</i>	<i>Private Research</i>	<i>Percent Variation</i>
1988	13,300		5,600		7,700	
1989	14,800	11.3	6,100	8.9	8,700	13
1990	17,000	14.9	7,100	16.4	9,900	13.8
1991	18,881	11.1	7,841	10.4	11,040	11.5
1992	19,660	4.1	8,019	2.3	11,640	5.4
1993	(prov.) 20,268	3.1	8,517	6.2	11,751	1
1994	(prov.) 19,939	-1.6	8,442	-0.9	11,497	-2.2

Source: Elaboration of ISTAT data

Table 5
Patent Applications for some EU countries (EPO, %)

Countries	1978-84	1985-1991	1992-1994	1995-1996
<i>Italy</i>	2.1	3.4	3.4	3.4
<i>Belgium</i>	0.9	0.8	0.8	0.8
<i>France</i>	10.7	8.9	8.1	8.0
<i>UK</i>	6.9	6.3	5.2	4.2
<i>Germany</i>	24.6	21.2	18.9	19.8
<i>Netherlands</i>	4.1	4.1	2.9	3.2
<i>Spain</i>	0.1	0.3	0.4	0.3
<i>Sweden</i>	2.1	2.5	1.4	1.5
<i>Switzerland</i>	5.3	4.0	3.3	3.1
<i>Japan</i>	14.5	20.3	20.9	20.5
<i>United States</i>	26.7	26.3	29.6	28.8
<i>Rest of the World</i>	1.9	1.9	5.1	5.7
<i>Total</i>	100	100	100	100

Source: EPO

Table 6
Technological Balance of Payments – Coverage Ratio

	<i>ITA</i>	<i>FRA</i>	<i>GER</i>	<i>UK</i>	<i>USA</i>	<i>JAP</i>
1989	0.50	0.83	0.78	0.91	5.47	1.00
1990	0.58	0.76	0.91	0.76	5.31	0.91
1991	0.60	0.71	0.79	1.01	4.49	0.94
1992	0.55	0.72	0.72	1.08	3.94	0.91
1993	0.57	0.71	0.70	1.12	4.24	1.10
1994	0.58	0.73	0.77	1.17	3.96	1.25
1995	0.77	0.73	0.78	1.19	4.27	1.43
1996		0.75	0.75	0.81		1.56
1997			0.85			

Source: OECD 1998

Table 7
Technological classes where Italy is specialised in

	<i>1° VTR</i>	<i>2° VTR</i>	<i>3° VTR</i>
<i>1978-1984</i>	Clothing/Footwear (0.64)	Artificial and Natural Fibres (0.57)	Furniture (0.49)
<i>1985-1991</i>	Clothing/Footwear (0.69)	Artificial and Natural Fibres (0.53)	Furniture
<i>1992-1994</i>	Clothing/Footwear (0.67)	Furniture (0.64)	Artificial and Natural Fibres (0.56)
<i>1995-1997</i>	Clothing/Footwear (0.62)	Electric devices (0.53)	Artificial and Natural Fibres (0.48)

Source: Cespri on EPO database

Table 8
Patents by regions 1978-1991 (%)

	<i>Northwest</i>	<i>Northeast</i>	<i>Centre</i>	<i>South</i>
Food and Tobacco	36.1	36.8	26.1	1.0
Clothing and Footwear	17.9	74.8	7.3	0.0
Furniture	53.7	25.5	20.8	0.0
Agriculture	46.5	32.1	18.4	3.0
Energy	69.6	9.9	17.5	3.0
Chemicals	72.8	10.0	11.2	5.0
Pharmaceuticals	54.9	19.6	24.5	1.0
Fibre, Wood, Paper	63.9	24	11.8	0.6
Metallurgy	55.4	10.4	28.2	5.0
Machines	43.0	38.7	16.8	1.0
Transports	79.6	10.5	7.6	2.3
Mechanic Engineering	55.6	27.4	14.9	2.1
Electro-technical	58.9	25.2	14.9	1.0
Optics and measurement tools	66.0	17.8	15.1	1.1
Electronics	84.4	5.3	8.1	2.2
Telecommunications	73.8	1.6	21.5	3.1

Source: EPO/CESPRI e CNR-ISRDI

Table 9
Characteristics of innovation activity in Italy (1990-1992) per employees (% on total)

<i>Employees</i>	<i>Innovative firms</i>	<i>Firms with R&D</i>	<i>Employees of innovative firms</i>	<i>Sales of innovative firms</i>
20-49	25.9	11.7	27.5	2931
50-99	40.8	23.4	41.6	43.0
100-199	48.0	33.3	48.7	47.8
200-499	58.5	47.5	59.8	67.3
500-499	74.0	61.0	74.5	79.1
1000 and>	84.3	78.5	9135	95.9
Total	33.1	18.6	61.5	70.7

Source: Archibugi et al.1996

Table 10
Sources of Innovation 1990-1992 (%)

<i>Employees</i>	<i>R&D</i>	<i>Patents and licence</i>	<i>Design</i>	<i>Production</i>	<i>Marketing</i>	<i>Productive Investments</i>	<i>Total</i>
20-49	14.9	1.5	9.4	7.7	1.9	64.6	100
50-99	16.3	1.3	8.4	8.5	1.7	63.8	100
100-199	19.8	1.7	12.8	9.0	2.2	54.5	100
200-499	27.6	2.2	9.1	9.6	2.2	49.3	100
500-999	26.0	1.6	13.4	8.1	1.3	49.6	100
1000 and>	46.7	0.8	4.8	5.7	1.2	40.8	100
Total	35.8	1.2	7.4	6.9	1.5	47.2	100

Source: Archibugi et al. 1996

Table 11
Cooperation among firms and other institutions (% values on total firms with R&D)

Cooperation with:	Number of Employees					Total
	0-49	50-199	200-499	500-999	1000 and>	
<i>Other Italian firms</i>	18.8	20.2	22.1	35.7	48.2	30.1
<i>Other foreign firms</i>	18.8	15.2	20.8	35.7	69.4	33.9
<i>Of which : UE</i>	12.5	15.2	11.7	21.4	47.1	23.5
<i>Outside UE</i>	6.3	0.0	9.1	14.3	22.4	10.3
<i>Italian universities</i>	12.5	14.1	18.2	35.7	51.8	27.9
<i>Foreign Universities</i>	0.0	3.0	10.4	9.5	27.1	11.9
<i>Of which : UE</i>	0.0	3.0	5.2	4.8	15.3	6.9
<i>Outside UE</i>	0.0	0.0	5.2	4.8	11.8	5.0
<i>Scientific and technological parks</i>	0.0	2.0	1.3	2.4	10.6	4.1
<i>Consortia cities research</i>	0.0	2.0	1.3	2.4	10.6	4.1
<i>CNR</i>	6.3	10.1	13.0	11.9	44.7	20.1
<i>ENEA</i>	0.0	4.0	9.1	11.9	21.2	10.7
<i>Other</i>	0.0	0.0	2.6	0.0	1.2	0.9

Source: Confindustria

Table 12
Innovative firms size in high tech sectors

<i>Employees</i>	<i>Firms</i>	<i>% of firms</i>	<i>Patents</i>	<i>% of patents</i>	<i>Ratio</i>
0-50	156	27.91	278	8.49	0.30
51-100	90	16.1	156	4.76	0.30
101-250	128	22.9	370	11.29	0.49
251-500	65	11.63	547	16.7	1.43
501-1000	47	8.41	237	7.23	0.86
1001 and>	73	13.06	1688	51.53	3.95
Total	559	100.00	3276	100.00	

Source: EPO-CESPRI database 1998

Table 13
Law 46/82 - FRA interventions (billion Lira)

	<i>SMEs</i>	<i>Big Enterprises</i>	<i>Total</i>
Italy			
1983	74.5	321.1	395.6
1984	67.4	276	343.4
1985	92	847.3	939.3
1986	83.3	1,228.1	1,311.4
1987	124.6	1,012.5	1,137.1
1988	80.8	534.5	615.3
1989	45.4	441.8	487.2
1990	107	699.1	806.1
1991	85.7	796	881.7
1992	33.2	302.6	335.8
North and Centre of Italy			
1983	62.9	243.1	306
1984	55.6	206.9	262.5
1985	86.7	636.6	723.3
1986	70.8	766.4	837.2
1987	109.1	778.6	887.7
1988	75.1	425.1	500.2
1989	43.5	361.7	405.2
1990	90.3	529.3	619.6
1991	72.2	430.4	502.6
1992	31.9	142.8	174.7
South of Italy			
1983	11.6	78	89.6
1984	11.8	69.1	80.9
1985	5.3	210.7	216
1986	12.5	461.7	474.2
1987	15.05	233.9	249.4
1988	5.7	109.4	115.1
1989	1.9	80.1	82
1990	16.7	169.8	186.5
1991	13.5	365.6	379.1
1992	1.3	159.8	161.1

Source: IMI

Table 14
Law 46/82 – FRT interventions (billion Lira)

	<i>SMEs</i>		<i>Big Enterprises</i>		<i>Total</i>	
	<i>number of projects</i>	<i>Cost of Projects</i>	<i>Number of Projects</i>	<i>cost of projects</i>	<i>number of projects</i>	<i>cost of projects</i>
Italy						
1983	182	713.8	96	2,555.9	278	3,269.7
1984	168	367.8	57	454.7	225	822.5
1985	121	302.6	42	729.2	163	1031.8
1986	219	657.7	90	1194.3	309	1,852
1987	131	344.6	65	631.8	196	976.4
1988	151	456.3	64	634.8	215	1,091.1
1989	163	547.6	80	702.7	243	1,250.3
1990	179	758	104	1041.9	283	1,799.9
1991	150	521.3	95	1170.6	245	1,682.9
1992	147	444.2	130	1133.2	277	1,577.4
North and centre of Italy						
1983	175	696	86	2,291.8	261	2,987.8
1984	161	351.7	55	446.6	216	798.3
1985	114	287.7	37	696.5	151	984.2
1986	210	632.8	81	1,008.1	291	1,640.9
1987	131	344.6	60	574.2	191	918.8
1988	148	448.1	58	594.9	206	1,043
1989	161	543.2	76	622.4	237	1,165.6
1990	174	736.5	96	871.4	270	1,607.9
1991	149	510.0	89	1,077.1	238	1,587.1
1992	143	435.6	127	1,023.2	270	1,458.8
South of Italy						
1983	7	17.8	10	264.1	17	281.9
1984	7	16.1	2	8.1	9	24.2
1985	7	14.9	5	32.7	12	47.6
1986	9	24.9	9	186.2	18	211.1
1987	0	0	5	57.6	5	57.6
1988	3	8.2	6	39.9	9	48.1
1989	2	4.4	4	80.3	6	84.7
1990	5	21.5	8	170.5	13	192
1991	1	2.3	6	93.5	7	95.8
1992	4	8.6	3	110.0	7	118.6

Source: Ministry of Industry

Table 15

Law 1329/65 - Number of projects and funds granted to the subsidized projects (billion Lira)

	<i>Italy</i>		<i>North and Centre</i>		<i>South</i>	
	<i>Number of projects</i>	<i>cost of projects</i>	<i>Number of Projects</i>	<i>Cost of Projects</i>	<i>Number of projects</i>	<i>cost of projects</i>
1983	3,953	587.6	3,570	546.5	383	41.1
1984	3,203	650.7	2,833	598.4	370	52.3
1985	5,808	908	4,983	816.3	825	91.7
1986	9,119	1,572.3	7,661	1,424.7	1,458	147.6
1987	30,260	3,957.2	24,632	3,518	5,628	439.2
1988	25,350	3,602.3	20,863	3,216.9	4,487	385.4
1989	21,888	4,201.8	18,276	3,882.5	3,612	319.3
1990	15,989	3,218.8	13,271	2,945.2	2,718	273.6
1991	19,155	5,887.1	16,282	5,410.2	2,873	476.9
1992	17,596	5,606.7	14,745	5,152.6	2,851	454.1

Source: Mediocredito Centrale

Table 16

Law 399/87 - Number and cost of the subsidized projects (billion Lira)

	<i>Number of project</i>	<i>Cost of project</i>	<i>Contribution</i>
Italy			
1987	848	245,8	61,4
1988	2.478	634,3	157,8
1989	1.236	269,3	65,4
1990	2.353	550,4	131,9
1991	2.095	430,6	104,8
1992	2.286	493,6	118,6
North and Centre			
1987	847	245.6	61.3
1988	2,471	632.6	157.2
1989	1,230	268.4	65.1
1990	2,341	546.9	130.8
1991	2,071	424.3	102.8
1992	2,271	489.6	117.4
South			
1987	1	0.2	0.1
1988	7	2	0.6
1989	6	0.9	0.3
1990	12	3.5	1.1
1991	24	6.3	2
1992	15	4	1.3

Source: Ministry of Industry

Table 17
PF carried out between 1976 and 1986

		<i>Cipe resolution time</i>	<i>Actual or foreseen time</i>
<i>01 Alimentary Sources</i>			
0101	Improvements in vegetal production for alimentary and industrial purposes through genetic intervention	09.10.1975	1976-1981
0102	Research of new proteinic sources and new alimentary formulation	09.10.1975	1976-1981
0103	Plant protection products and regulators	09.10.1975	1976-1981
0104	Fruit and vegetables preservation, transport and distribution by containers	09.10.1975	1976-1981
0105	Consolidation, development and conversion of national aquaculture	09.10.1975	1976-1981
0106	Defence of animal population genetic resources	09.10.1975	1976-1981
0107	Increase of alimentary supply of animal origin	09.10.1975	1976-1981
0108	Agricultural mechanisation	09.10.1975	1976-1981
0109	Growth of agricultural resources productivity (Ipra)	09.10.1975	1976-1981
<i>02 Health</i>			
0201	Preventive medicine	09.10.1975	1976-1983
0202	Virus	09.10.1975	1976-1981
0203	Reproduction biology	09.10.1975	1976-1981
0204	Biomedical technologies	09.10.1975	1976-1981
0205	Test of neoplastic growth	24.02.1978	1978-1983
0206	Preventive and rehabilitative medicine	27.05.1982	1982-1987
0207	Infectious disease	27.05.1982	1982-1987
0208	Genetic engineering	27.05.1982	1982-1987
0209	Biomedical and sanitary technologies	27.05.1982	1982-1987
02010	Oncology	08.06.1983	1984-1988
<i>03 Territory and environment</i>			
0301	Land preservation	09.10.1975	1976-1981
0302	Oceanography and sea ground	09.10.1975	1976-1981
0303	Geodynamics	09.10.1975	1976-1981
0304	Environment quality promotion	09.10.1975	1976-1981
0305	Vulcanology national group	08.06.1983	1983-1987
<i>04 Advanced Technologies</i>			
0401	Support for navigation and air traffic control	09.10.1975	1976-1982
0402	Power laser	12.05.1977	1978-1983
0403	Superconductivity	24.02.1978	1978-1982
0404	Informatics	25.01.1979	1979-1983
0405	Fine and secondary chemistry	05.07.1979	1980-1985
0406	Transports	17.01.1980	1981-1986
0407	Metallurgy	27.03.1980	1981-1983
0408	Mechanical technology	27.05.1982	1981-1986
0409	Electronic materials and devices at solid state	06.03.1985	1985-1990

05 Energy

0501	Energiser I	09.10.1975	1976-1981
0502	Energiser II	22.12.1982	1982-1987

06 Various

0601	Sciences for the enhancement and Preservation of artistic heritage	12.05.1977	1979
0602	Italian economy structure and evolution	27.05.1982	1983-1987
0603	Civil Service organisation and functioning	06.03.1985	1986-1990

Source: CER-IRS, 1993

Table 18
PF cost (million Lira at price 1980)

1976	32,895
1977	54,988
1978	58,942
1979	61,627
1980	80,000
1981	63,409
1982	76,555
1983	96,755
1984	101,052
1985	71,759
1986	88,698
1987	70,632

Source: Cnr, *L'organizzazione dei progetti finalizzati, 1977*; Cnr, *Programmi esecutivi dei singoli PF* for years 1985, 1986; Cnr, *Relazione del Presidente del Cnr sullo stato della ricerca scientifica e tecnologica*, various years.