Chapter 19

THE USE OF INNOVATION SURVEYS FOR POLICY EVALUATION IN ITALY

by

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Government measures for promoting innovation in industry

Technology and innovation play a major role in wealth creation and economic growth. Governments in all OECD countries have put in place various mechanisms aimed at providing public support for firms, including the provision of public funds, incentives, investment support, technical services and scientific and technological infrastructure.

Identifying and measuring the impact of public support to industry is a difficult task. Recent OECD studies analyse transfers to industrial firms which are categorised in two groups: the first consisting of money transfers (for R&D and innovation contracts, and for procurement of innovated products and processes); the second of financial incentives (regular grants, reimbursable grants, interest rate subsidies, regular loans, conditional loans, guarantees, equity capital, tax concessions, mixed financial incentives) (OECD, 1997).

While the identification of the various measures taken by governments and their comparison across countries has been carried out in a satisfactory way, the quantification of the funds involved is still a difficult task. This information, however, provides a picture of the financial effort made by governments in pursuing their innovation and industrial policies.

Additional elements are necessary to evaluate the effect of government intervention in terms of performance at the firm, industry and national levels, looking not only at the financial incentives, but also at the support that firms receive from the public scientific and technological infrastructure. This can be achieved by asking firms whether government policies have been relevant for their innovations. A key instrument in this respect is the data gathered through innovation surveys based on the *Oslo Manual*.

It may be pointed out that evaluating public policies in a market economy is a fairly difficult task: in particular, government measures in the field of technology often have various objectives (competitiveness, wealth creation) and their effect is linked to many other factors such as the firm's strategy and general economic conditions. Evaluation requires a complex set of considerations on the various objectives and criteria which are relevant. A first step for this task is the assessment of the direct impact that specific policy measures have on the individual firms involved.

Surveys of technological innovation

In the past ten years various initiatives have been developed in order to gather statistical information on innovation in manufacturing industry (Hansen, 1992; Archibugi and Pianta, 1996; Smith, 1989). The data collection follows two approaches: the first consists of identifying the most significant technological innovations and then investigating the characteristics of the firms and of the new products and processes; the second involves carrying out a survey of a country's firms in order to identify those which have introduced innovations during a given period of time (Smith, 1992; Arundel *et al.*, 1995). The first approach focuses on individual innovations (object approach), while the second focuses on the innovating firm (subject approach) (Archibugi, 1988).

The latter has been adopted by an increasing number of countries which in the 1980s launched a series of surveys. However, these surveys are not fully comparable (OECD, 1990).

Experience to date shows that surveys on innovation are not only feasible but yield extremely interesting and useful results (Evangelista *et al.*, 1996; OECD, 1996a). For example, data show that R&D represents only a limited fraction of innovation expenditure, while other factors, such as investment in machinery and equipment and design represent the largest part of firms' financial efforts for innovation. Data show also that the pattern of innovation expenditure changes significantly across industrial sectors (Istat, 1987; Cesaratto *et al.*, 1991).

The OECD published the *Oslo Manual* on the measurement of technological innovation in 1992, and the first revision was adopted in 1997 (OECD, 1992; OECD-Eurostat, 1997).

The *Oslo Manual* focuses on innovation at the level of the firm and is inspired by the neo-Schumpeterian approach and the chain-link model of innovation which views innovation in terms of interaction between market opportunities and the firm's knowledge base and capabilities. The view of innovation is that of a complex and diversified activity with many interacting components, and sources of data need to reflect this. The *Manual*, however, does not cover some other categories of innovation – discussed for example by Schumpeter – such as the opening of a new market, the access to a new source of supply of raw materials or semi-manufactured goods, or the re-organisation of an industry.

The *Manual* concentrates on new and significantly improved products (goods and services) and processes and takes into consideration organisational innovation as long as it is introduced along with technological innovation. The major novelty of the 1997 revision of the *Oslo Manual* consists in the explicit inclusion of services as a target of investigation of innovation surveys (Evangelista, Sirilli, 1995; 1997). This implies some revisions in the definition of technological innovation and innovation activities so as to make them applicable both to manufacturing and service firms (Young, 1996).

The *Oslo Manual* methodology was adopted by EUROSTAT and DG-XIII (European Innovations Monitoring System) within the European Commission, and implemented on a EU-wide basis using a common questionnaire; this survey is known as the Community Innovation Survey (CIS) project. EUROSTAT has now built a comprehensive firm-level database with the CIS data, which contains data on almost 41 000 European firms. CIS was designed to address two main sets of issues. A first objective was to describe the general structure of innovative activities at the country and industry levels. Second, the most ambitious aim was to assess how national innovation patterns differ from one other and the determinants of such heterogeneity.

As for any other data source, the CIS data set is characterised by strengths and weaknesses. Some problems have emerged as data collected by various countries are not fully comparable (Archibugi *et al.*, 1995). However, in spite of these problems, the CIS exercise has proved extremely useful, providing a description of the main factors influencing the innovative behaviour of firms (Evangelista *et al.*, 1996).

Many non-EU countries have collected innovation data using the *Oslo Manual* methodology, *e.g.* Canada, Australia, Hungary and some Eastern European countries. A new round of innovation surveys following this standard methodology started in 1997, and it is expected that these surveys will yield high quality and internationally comparable data.

Measuring the impact of innovation policies through innovation surveys

Innovation surveys based on the *Oslo Manual* ask firms to provide information on a number of aspects (products and processes introduced, objectives of innovation, factors hampering innovation, sources of information for innovation, etc.) with reference to a three year period. Other information (*e.g.* the cost of innovation) is referred to the last year of the given period.

The *Oslo Manual* sets forth methodological standards and provides guidelines for collecting information on various subjects such as the impact of innovation on the performance of the firm, the diffusion of innovation through the socio-economic system, the use of advanced technologies, patenting and appropriability of the results of innovative activities, the acquisition and diffusion of technology. It does not, however, provide any specific guidelines for measuring the use and impact of government policies on firms' strategy and performance.

Although it is not explicitly recommended in the *Manual*, some countries have collected data on this issue by asking firms whether government policies have been relevant in the introduction of innovations by the firm. Italy's innovation survey provides rich evidence on this subject; the findings are presented in the following sections.

This approach to assessing the impact of innovation policies has the following key features:

- ◊ It covers all innovating firms responding to the questionnaire.
- ◊ It allows identification of both the firms for which other sources of information are available (*i.e.* registers of firms receiving financing) and firms for which it would be impossible to check to what extent they have benefited from indirect measures (*i.e.* tax reductions, incentives to innovative investment, use of technical services provided by public agencies, etc.);
- ◊ It relies on the judgement of a firm's manager – often a high ranking one – from the point of view of the interest of the firm which benefits from public support. It may happen that different managers have different perceptions of the same policy measures.
- ◊ It excludes firms which, even though they received public support, have not innovated in the reference period.

Data collected through the innovation surveys can provide useful insights into some unanswered research and policy issues.

Firstly, it can be expected that firms receiving public support will improve their performance. A key question, however, concerns the impact on other firms in the same sector. We can find, on the one hand, technological spillovers leading to an overall improvement of innovation, competitiveness, growth and employment in the industry, or, on the other hand, a zero-sum game can emerge, where the innovative firms benefiting from public policies improve their performance at the expense of domestic competitors. In this case the net benefits of government policies are likely to be modest or nil. In order to shed light on this issue, the findings on the performance of firms benefiting from policies need to be compared to the overall performance of the industry.

Secondly, public policies may either focus on enhancing the technological capabilities of (generally larger) firms which are already innovative, or on stimulating other (generally smaller) firms to introduce innovations. In the former case, public policies might fund activities which firms are likely to carry out in any case, with little net increase of innovative efforts. However, in some high-technology sectors continuing public support might be required simply to allow firms to remain competitive in a rapidly changing market. Public policies need to strike a balance between these two objectives, considering the specificities of the national systems of innovation.

An overview of Italian innovation policy

Italy's science and technology policy aims at improving the effectiveness of the national system of innovation, supporting public research and education and sustaining the competitiveness of the business sector. A major policy area focuses on the promotion of innovation and investment, the diffusion of advanced technologies and the creation of new firms.

The Applied Research Fund and the Technological Innovation Fund are the main funding mechanisms for industrial research and provide grants, low-interest loans and risk capital on the basis of proposals submitted by firms. The former focuses on applied research and has recently been modified to increase support to SMEs for individual and co-operative research projects. The latter supports downstream innovation projects in sectors such as electronics and automotive industries. Specific technologies are promoted also through the National Research Programmes which support research in a variety of fields; the most recent programmes target cardiology technologies, pharmaceuticals, innovative production systems, and textiles. Previous projects include microelectronics and bioelectronic systems, biotechnology, chemicals, and food and agriculture.

In an effort to stimulate technology diffusion, the government also provides firms with grants for purchasing high-technology machinery and subsidised loans for selling and purchasing machine tools.

As regards infrastructure, the government has launched a major initiative to establish thirteen science parks, notably in the less developed Southern part of the country (the *Mezzogiorno*), which are expected to act as business incubators and local centres for spreading the use and acquisition of technology.

Investment measures in Italy have generally aimed at assisting manufacturing industries, within the limits set by EU guidelines and directives. Under the Multi-Regional Operative Programme financed by the EU, special measures target the creation of new enterprises, the starting up of new businesses by young entrepreneurs, regional development, and the creation of a database to provide information on existing investment incentives. Under the "Tremonti" Decree of 1994, the government offered fiscal incentives for investment. More recent fiscal incentives include tax credits and rebates, as well as the reduction of financial penalties for formal irregularities.

The Italian industrial structure is characterised by a large share of small and medium-sized enterprises, sometimes located in "industrial districts". Over 70 per cent of industrial employment is in establishments with fewer than 100 employees and those with less than ten employees account for about 50 per cent of jobs. This creates particular problems for the design of innovation policies, emphasizing the issues of technology transfer and diffusion of innovation. A variety of agencies – established by central and local governments and by private and public organisations – operating at the regional and sectoral levels provide services, consultancies and information to small and medium-sized firms.

Such efforts, however, meet serious obstacles in the lack of human and financial resources formally devoted to innovation by smaller firms. Greater attention is therefore given to their inclusion in the current innovation programmes. Under the Multi-Regional Operative Programme, at least 50 per cent of funding must be geared to smaller firms. Other measures include credit to co-operative enterprises, support for the lease and purchase of high-technology equipment, support for innovation and development of new products and processes, and assistance in exporting to non-EU markets (see also OECD, 1996b).

The effectiveness and outcome of such a variety of innovation policies has been investigated by several scholars, mostly using case studies as well as quantitative analyses of the pattern of public and private R&D expenditures (see Gerelli, 1982; Antonelli and Pennacchi, 1989).

A major step forward in the evaluation of innovation policies requires a direct assessment of their impact by the firms that are supposed to benefit from them. This information has been made available by the results of the innovation surveys on Italian firms carried out in the mid-1980s and in the early 1990s, documenting the impact of various policies on the innovative choices of Italian firms. In the following sections the findings for the 1990s and 1980s are illustrated.

The impact of Italian innovation policies in the 1990s

The Italian innovation survey was conducted by ISTAT on those firms that had introduced innovations in the 1990-92 period (ISTAT, 1995); the study was carried out in the framework of the European Community Innovation Survey (CIS) (see OECD-Eurostat, 1997; Archibugi *et al.*, 1995).

The results shed new light on the extent and nature of innovative activities in Italian industry. The highlights of the findings (investigated in Archibugi *et al.*, 1996) can be summarised as follows.

Of 23 000 firms surveyed, one-third – 7 553 firms – have introduced a product or process innovation, and these firms account for two-thirds of total employment and sales. Small firms with between 20 and 49 employees account for 52 per cent of such innovating firms, while the large firms – with more that 500 employees – which had innovated numbered only 377, *i.e.* 5 per cent of the total. Process innovations tend to be more frequent than product innovations. The total expenditure for the introduction of innovations shows that R&D accounts for 36 per cent, design and trial production for 14 per cent and innovation-related investment represents 47 per cent of total expenditure. Similar results have been found for other European countries (see Evangelista *et al*., 1996).

In addition to this general data, the Italian innovation survey provides important information on the relevance attached to innovation policies by firms. Table 1 reports firms' responses on the importance of different types of public initiatives in support of innovation, ranging from funding programmes, both Italian and European, to the provision of services and to public procurement.

Table 1. Number of innovating firms according to the degree of importance of different kinds of government intervention in the introduction of innovations during 1990-92

Types of government intervention	Firms with not important score		Firms with important score		Firms with important score				
					Of little	Moderately	Very	Crucial	Average score[1]
		%		%	Importance	important	important		
Government funds	4 532	60.0	3021	40.0	486	875	1222	438	2.5
EC funds	6 432	85.2	1121	14.8	275	339	386	121	2.3
Indirect financial incentives	5 605	74.2	1948	25.8	505	507	630	306	2.4
Research services from public organisations	6 850	90.7	703	9.3	361	227	94	21	1.7
Technological services from public organisations	6 661	88.2	892	11.8	461	273	139	19	1.7
Public procurement of research	7 100	94.0	453	6.0	206	142	75	30	1.8
Public procurement of supplies	6 933	91.9	620	8.1	237	169	146	68	2.1
Others	7 261	96.3	292	3.7	33	64	109	86	2.8

The average score was calculated attributing the following scores: (1) = of little importance; (2) = moderately important; (3) = very important; (4) = crucial.
Source: Istat, 1995.

It is remarkable that a large majority of the 7 553 innovating firms surveyed declared that the existing innovation policies have had no relevance for the introduction of innovations. Sixty per cent of firms attached no importance to government funds and 85 per cent to EC funds; 74 per cent did not use indirect financial incentives (including easier fiscal and credit terms, and tax cuts for investment), while other policy tools, such as the provision of R&D and technological services or public procurement are not relevant for 90 per cent of innovating firms.

Among the firms attributing some importance to innovation policies, the average score (ranging from 1: "of little importance" to 4: "crucial"), is generally above 2 (between "moderately important" and "very important"), with lower values for research and technological services.

Table 2 shows the same data broken down by firm size and sector. The share of enterprises that recognise the importance of government funds for innovation policies steadily increases with firm size, from one-third of companies with less than 50 employees to 52 per cent in the 500-999 class and to 71 per cent in firms with more than 1 000 employees.

In fact, a high proportion of the largest firms acknowledged the relevance of the various policy tools: 71 per cent in the case of government funding programmes, 50 per cent in the case of EC funds, 39 per cent for indirect financial incentives, about 28 per cent for R&D and technological services, and about 20 per cent for public procurement. In most cases a clear break can be identified between the responses of the medium-sized firms (up to 999 employees) and those of the largest firms, which appear to be the main recipients of Italian innovation programmes.

Table 2. Percentage of innovating firms declaring that different policies have been relevant in the introduction of innovations during 1990-92, by size class and industry

Classes of employees Sectors of economic activity	Government funds	EC funds	Indirect financial incentives	Research services from public organisations	Technological services from public organisations	Public procurement of research	Public procurement of supplies
20-49	34.3	12.2	26.2	7.6	9.7	5.3	7.8
50-99	42.1	14.7	24.7	8.6	11.1	5.6	7.9
100-199	47.0	18.9	26.2	13.0	16.2	6.4	8.9
200-499	47.6	14.9	22.0	9.9	15.6	6.2	7.9
500-999	51.9	19.0	25.5	14.4	15.3	8.8	8.3
1000 and more	70.8	49.7	39.1	28.0	26.7	21.1	18.0
Total	40.0	14.8	25.8	9.3	11.8	6.0	8.2
Other transport equipment	48.2	25.5	29.1	15.5	16.4	17.3	22.7
of which: - Railroad equipment	53.8	15.4	7.7	7.7	23.1	30.8	30.8
- Aircraft	76.2	52.4	47.6	23.8	23.8	38.1	52.4
Paper	47.9	18.9	27.9	8.4	8.9	6.3	7.4
Radio, TV and communication equipment	46.3	16.1	20.8	11.4	17.4	12.1	17.4
Wood (furniture excluded)	45.3	13.4	31.3	6.7	11.2	6.1	8.4
Office and Computing Machinery	45.2	32.3	32.3	16.1	16.1	22.6	25.8
Basic metal industries	43.9	16.0	27.9	5.7	8.6	4.5	6.1
Non Metallic Minerals	43.1	12.7	27.4	9.3	13.4	5.9	8.4
Mechanical machinery and equipment	43.1	15.8	23.9	10.1	12.4	6.1	7.6
of which: - Non electrical engines. & turbines	50.0	19.6	27.2	12.5	14.7	6.2	8.0
Machine tools	47.6	17.2	29.0	10.3	11.0	6.2	7.6
Metal products	41.1	16.5	29.7	9.4	13.2	6.7	9.7
Textiles	41.0	14.9	27.0	7.6	9.9	2.8	4.1
Optical and precision instruments	40.6	12.3	19.6	11.9	17.8	10.5	18.7
Motor vehicles, engines & parts	40.2	21.6	26.6	11.6	13.6	5.5	9.0
of which: - Motor vehicles	66.7	40.0	53.3	26.7	20.0	6.7	13.3
Oil refineries	40.0	14.3	20.0	5.7	11.4	2.9	11.4
Chemicals	40.0	13.4	22.4	14.5	17.1	7.4	5.8
of which: - Pharmaceuticals	45.9	16.2	32.4	20.7	25.2	9.0	3.6
Food, Drink and Tobacco	39.5	16.5	24.4	8.8	8.8	3.4	4.5
Rubber and Plastic	39.5	11.9	25.4	8.3	10.8	5.5	6.1
Printing and Publishing	38.2	8.6	25.4	5.4	4.3	3.2	5.7
Electrical Machinery	36.3	14.4	23.8	7.6	12.8	5.7	13.8
Electrical, gas and water production	35.2	20.4	14.8	20.4	24.1	5.6	3.7
Other manufacturing	32.5	12.1	26.3	9.4	9.4	4.6	5.9
Leather and Footwear	29.6	13.2	27.5	9.3	10.0	6.4	6.1
Coal and Min. extraction	25.7	17.2	34.3	14.3	17.2	14.3	17.2
Wearing apparel	24.9	8.9	24.4	4.4	6.2	5.3	6.7

Source: Istat, 1995.

Smaller firms, on the other hand, are marginally involved in most actions; they attach the greatest importance to government funds (one-third of respondents, a share which increases with firm size) and to indirect financial incentives (one-quarter of firms). In fact, the indirect financial incentives (easier fiscal and credit terms, and tax cuts for investment) represent the policy which has the most uniform impact across size classes. The share of largest firms declaring that this type of policy has been relevant is only one-third higher than the share of smallest firms, while for government funds it is twice as high and for EU funds it is four times as high. The almost automatic nature of indirect incentives appears to reduce the entry barriers for small and medium-sized firms (relative to large ones); even in these more favourable conditions, however, only one firm in four acknowledged such policies as important.

Data in the lower part of Table 2 show the same data broken down by sector, ranked according to the importance attached to government funds. The industries where Italian technology policies have had the greatest impact on innovation in firms include motor vehicles (66 per cent of firms attributed importance to government funds and 53 to indirect incentives), aircraft (76 and 48 per cent), railways equipment (54 and 8 per cent), engines and turbines (50 and 27 per cent), office machinery (45 and 32 per cent), communication equipment (46 and 21 per cent), machine tools (48 and 29 per cent), paper (48 and 28 per cent), wood (45 and 31 per cent), pharmaceuticals (46 and 32 per cent). EU funds have been relevant mainly for the aircraft, motor vehicles and office machinery industries, which also attached above-average importance to the provision of R&D and technological services and to procurement policy.

These results show that most public actions and funds are targeted to the largest firms in the high technology sectors; they also appear quite relevant for them. However, the Italian innovation survey unveils a much larger body of innovating firms of smaller size and active in all industries; more than half of all firms introducing innovations have less than 50 employees and two-thirds attach no relevance to the most widespread tool of innovation policy, *i.e.* the granting of government funds; for an overwhelming majority of such firms all other policies are equally irrelevant.

Of the 7 553 innovating firms, about 4 500 considered existing government funds irrelevant, and 2 500 have less than 50 employees. For a large population of small dynamic firms, the existing policy tools appear to be inadequate for supporting their innovation needs. Further investigations are needed to identify the specific types of innovations introduced by such firms and their economic relevance; appropriate new policy tools might be developed in order to fill this major gap in the set of Italian innovation policies.

How does the sectoral structure of innovation and the impact of public policies relate to the performances shown by Italian manufacturing sectors in the early 1990s? A number of studies (Pianta, 1996*a*; 1997; see also Cesaratto and Stirati, 1996) have shown that no clear link emerges in terms of growth of value added from 1990 to 1994, but, when employment is considered, the industries with a greater relevance of innovation policies – and with a greater technological intensity, measured also in terms of innovation expenditure – tend to show the most serious reductions in employment (average annual reductions of 5.5 per cent in motor vehicles, 4.6 per cent in office machinery, 3.7 in machinery, against the 2.9 per cent fall for total industry).

While all sectors show a reduction in employment between 1990 and 1994, traditional industries with a lower innovation intensity have had more limited job losses. This may be also the result of the strong export performance of these industries following the devaluation of the Italian currency after 1992.

More specific research should investigate the link between relevance of innovation policies and firms' performance, but the overall economic and employment impact of technology policies looks far from satisfactory. The responses of firms regarding the relevance of innovation policies show no relation to the pace of growth in value added across industrial sectors or size classes; in terms of employment, technology policy appears to further support the dominant pattern of labour-saving innovations typical of firms' strategies in the 1990s (Pianta, 1996*b*). When the aims of innovation policy are set in the broader context of public policy objectives, the desirability of such an outcome might be seriously called into question.

In order to assess the impact of innovation policies on firms' performance a crucial step is the possibility to compare the different characteristics of groups of firms identified on the basis of the importance they assign to government policies.

Table 3 shows the patterns of innovative activity and economic performance of Italian firms broken down according to the importance attached to the first type of public policies listed in Tables 1 and 2, *i.e.* the provision of government funds, which is the action most often cited as relevant by firms.

Table 3. Innovative firms ranked by the importance assigned to government funding for innovation for the introduction of technological innovation during 1990-92

Importance of funding	Firms		Employees		Sales 1992		Annual growth rate of sales	Innovation -related sales	Innovation expenditure per employee
	No.	%	No.	%	Billion lire	%	%	%	lire
Not relevant	4 352	60	494 502	36	174 414	36	-9	22	584
Of little or moderate importance	1 361	18	439 772	32	167 858	34	9	28	2 686
Very important or crucial	1 660	22	441 314	32	148 673	30	18	26	3 084
Total	7 553	100	1 375 588	100	490 944	100	3	25	1513

Source: Istat.

Sixty per cent of firms attach no importance to government funding, but these firms account for 36 per cent of employment and sales, showing that small firms are concentrated in this group. Public funds are considered of little or moderate importance by 18 per cent of firms, representing one-third of employees and sales, the same share shown by the 22 per cent of firms judging public funds very important or crucial. The strong structural difference between (generally smaller) innovative firms attaching no relevance to public funds and the others is confirmed also by the gap in the innovative expenditure per employee (*i.e.* the sum of R&D, design, trial production and innovation-related investment, shown in the last column of Table 3), with the former spending for innovations five times less than the latter.

What is the impact of such structural differences on performance? The evidence is contradictory. In spite of the large differences in innovation intensity, the shares of firms' sales which are related to the innovations introduced are remarkably similar: 26 per cent in the case of firms considering public funds very important, 22 per cent for those attaching no relevance to them. The outcome of innovative efforts in terms of share of firms' sales does not appear to be greatly influenced by access to public funds.

On the other hand, a clear difference emerges again when the average annual rate of change of sales from 1990 to 1992 (at current prices) is examined: firms considering public funds to be very important have an 18 per cent growth rate, while firms attaching no relevance to them show a 9 per cent decrease. These results discriminate clearly between firms' performances, but the differences might be associated with factors other than access to innovation funds, such as the different size and market power of firms, the impact of the recession of the early 1990s, the specificities of sectors, etc. Deeper analyses are therefore required for providing a definitive answer to the impact of innovation policies on the performances of Italian innovative firms.

The relevance of sectoral patterns is examined in Table 4, where the top ten (out of 82) sectors of manufacturing industry are ranked on the basis of the share of firms considering government funds for innovation very important or crucial. We find a mix of advanced technology fields (aerospace, railroad equipment, office machinery, machine tools) and of other industries (metals, bicycles, paper, bricks and rubber). The ranks of these ten sectors are also listed for key variables showing their innovative and sales performance.

Table 4. Top ten sectors in importance of government funding for the introduction of innovations in firms during 1990-92

Manufacturing sectors	% of firms answering "very important or crucial"		Innovation expenditure per employee		Innovation-related sales		Annual growth rate	
	Rank	%	Rank	(million L)	Rank	%	Rank	%
Aerospace	1	52.4	5	19.1	21	37.1	46	5.3
Railroad equipment	2	50.0	17	7.5	7	46.9	60	1.7
Non ferrous metals	3	35.3	67	2.4	77	10.6	64	1.0
Metal moulding	4	32.7	60	2.8	54	20.2	69	-0.6
Bicycles and motorcycles	5	32.6	13	9.4	3	65.7	53	3.7
Office and computing machin.	6	32.3	1	32.2	1	74.4	57	2.9
Bricks	7	32.1	46	3.7	71	14.7	5	16.7
Paper	8	30.3	69	2.3	40	26.9	65	0.3
Machinery tools	9	29.7	12	10.0	29	31.1	73	-1.8
Rubber products	10	29.5	81	1.7	13	43.5	43	5.7

Source: Istat, 1997.

A strong result is the lack of relationship between the relevance of access to public funds and the innovative expenditure per employee, the share of innovation-related sales and, even more, the growth rate of sales in 1990-92. The association found at the firm level between relevance of government funding and growth of sales disappears when the industry level is investigated. This suggests that most of the growing sales of innovating firms have been obtained at the expense of domestic competitors; instead of stimulating the expansion of production for the whole industry, a higher access to public funds is associated to below-average growth rates for the industry aggregates. While more detailed research is needed to compare the impact of government innovation policies at the firm and industry levels, this evidence points out the contradictory and complex nature of the outcomes we can find for Italian innovating firms.

The impact of Italian innovation policies in the 1980s

A comparison over time of the relevance of innovation policies for Italian firms is possible with the first Italian innovation survey carried out in the mid-1980s. The first survey found that 8 220 firms had introduced an innovation in the 1981-85 period (ISTAT, 1987; 1990; see also Archibugi *et al.*, 1991; Cesaratto *et al*., 1991; Evangelista, 1995; 1996).

Unfortunately, the same question on the relevance of innovation policy was not asked in the 1980s' questionnaire, but related information is available on the share of firms which have received public funds for innovation from a variety of government programmes.

Survey data show that 36 per cent of the 8 220 innovating firms had received some funds, with the share ranging from 29 per cent in the case of smallest firms to 48 per cent in firms with more than 500 employees.

The survey had also identified 2 701 most innovative firms, defined as those introducing both product and process innovations and carrying out in-house R&D, design or patenting activities. Among them the shares of firms receiving public funds are higher, ranging from 34 to 52 per cent in the extreme size classes, with a 45 per cent share for total industry.

It seems reasonable to compare the share of the 8 220 firms receiving public funds in the 1980s with that of the 7 553 firms considering relevant government funding for innovation in the 1990s (probably because they actually received it). The share is 36 per cent of the 1980s and 40 per cent of the 1990s, with the highest changes in the class of large firms, and with some progress also for smallest firms. Over the last decade, innovation policies appear to have consolidated a pattern of concentration on the largest firms, a somewhat peculiar result, considering the structure of Italian industry.

Table 5 shows how the firms which have benefited from public programmes evaluate the effectiveness of individual innovation programmes of the 1980s. Assigning a score from 0 (not relevant) to 6 (extremely relevant), the 2 701 most innovative firms gave the highest score (3 for total industry, evenly spread across size classes) to government funds for innovation, closely followed by financial incentives (at variance with Table 1, here the average score is calculated including the "not relevant" answers). Much lower scores have been assigned to the provision of R&D and technological services and to public procurement, with little differences across size classes.

Table 5. Evaluation of the effectiveness of different kinds of government innovation policies[1] by the 2 701 most innovative Italian firms[2] in 1981-85

Average scores

Classes of employees	Public funds (IMI fund L.46/82)	Financial incentives	R&D services from public organisations	Technological services	Public procurement of R&D	Public procurement of supplies
20-49	2.7	2.7	1.2	1.4	1.0	1.2
50-99	3.0	2.9	1.2	1.4	1.0	1.0
100-199	3.3	2.8	1.0	1.3	0.7	0.8
200-499	3.2	2.6	1.0	1.2	0.9	1.0
500 and more	2.9	2.4	1.1	1.0	1.3	1.3
Total	3.0	2.7	1.1	1.3	1.0	1.1

1. The degree of effectiveness was attributed with a score of 0 for "not relevant" and from 1 to 6 for the positive answers.
2. Firms which have introduced both product and process innovations and carried out in-house R&D, design or patenting activities.
Source: Istat, 1990.

Comparing these results to those of Table 2 on the degree of importance attached in the 1990s to the same kinds of policies, a broad similarity emerges in the impact of different policy tools. A major difference however emerges in the case of large firms, which in the 1990s consider all programmes of greater importance than in the previous decade. This further supports the evidence of an increasing concentration of innovation policy efforts on the largest Italian firms.

The relationship between private and public funding for innovation and the different typology of firms benefiting from various innovation policies in the 1980s have been investigated by several studies (Cardone *et al.*, 1990; De Marchi and Napolitano, 1991) which, however, did not provide conclusive evidence on the specific impact of public programmes for innovation.

The case of environmental innovation

An additional insight into the dynamics of innovation policies, incentives and constraints is provided by the section of the Italian innovation survey of the early 1990s devoted to environment-related innovation. Firms have been asked to rank the importance of different environmental problems – atmospheric emissions, water emissions, waste production and recycling, acoustic pollution, others – in the innovations they introduced in the 1990-92 period.

The results are shown in Table 6. Forty-nine per cent of firms assigned some importance to the reduction of noise levels in their innovations, 43 per cent paid attention to atmospheric emissions, 38 per cent acted on waste and recycling, 36 per cent were concerned with water emissions. The average score of firms declaring that environmental factors were relevant is between "moderately important" and "very important".

Table 6. Environment-related innovations in Italian industry

Number of innovating firms according to the degree of importance of different environmental aspects in the introduction of technological innovations during 1990-92

Environmental aspects	Firms with "not important" score		Firms with "important" score		Little importance	Firms with "important" score		Crucial	Average score[1]
						Moderately important	Very important		
		%		%		(2)	(3)	(4)	
Atmospheric emissions	4 320	57.2	3 233	42.8	588	965	1272	408	2.5
Water emissions	4 873	64.5	2 680	35.5	644	796	932	308	2.3
Waste production and recycling	4 650	61.6	2 903	38.4	796	922	920	265	2.2
Acoustic pollution	3 835	50.8	3 718	49.2	858	1181	1369	310	2.3
Others	5 758	76.2	1 795	23.8	1 374	141	194	86	1.4

1. The average score has been attributed with the following scores: (0) = not important; (1)= of little importance; (2) = moderately important; (3) = very important; (4) = crucial.
Source: Istat, 1995.

The lack of familiarity of firms with questions on such issues suggests some caution in interpreting the results. In particular, it is likely that issues of workplace safety and health (*e.g.* reduction of noise levels) have been included among the environmental aspects. Such shares are in the same range of the 40 per cent of firms considering government funds for innovation important (Table 1), but are much higher than the impact of other innovation policies.

The innovations introduced by Italian firms in the 1990s appear to have been equally influenced by government technology policies and by the environmental policies setting standards or providing incentives for introducing less polluting and dangerous products and processes.

It should be pointed out that in the early 1990s no large-scale environmental policies were implemented, little funding was available for anti-pollution programmes and that the enforcement ability of the public authorities was generally low. However, environmental issues have often been supported by the setting of specific standards and regulations with which firms are required to comply. It would appear that these environmental constraints may have been more influential on firms' innovation choices than the offer of incentives, technology services and procurement.

These data suggest that firms in their innovative choices pay substantial attention to external constraints on environmental issues, including workplace safety and health, on which public policy,

market requirements (such as the ISO quality standards) and a variety of social forces may exercise some pressure. This impact may be even greater than that of most deliberate policies aiming at particular aspects of innovation *per se*. In other words, innovating firms appear to react to a similar degree to the "carrot" of specific innovation policies and to the "stick" of external constraints, standards and pressures of a non-economic and non-technological nature imposed on them by policy and society. This evidence may suggest some rethinking of the most effective means for inducing technological change in firms.

Some conclusions and recommendations

The findings of the Italian innovation survey of the 1990s show that most public actions and funds have been targeted to the largest firms in the high-technology sectors; they also appear generally relevant for these firms. However, the survey has pointed out the existence of a much larger body of innovating firms of smaller size, active in all industries; the existing policy tools are not adequate for supporting the innovation needs of this broader population of firms.

So far, the main policy tool used by smaller firms has been the indirect incentives for new investment embodying innovation. This has further increased the orientation of Italian industry towards labour-saving innovations which have had a serious negative impact on employment.

These findings should not be without consequences for the design of technology policies. There is a clear need to favour innovations which expand capacity and create new markets, rather than those of a labour-saving nature carried out by firms within their restructuring strategies.

Filling the gaps in existing innovation patterns may require actions to stimulate research efforts by firms, the diffusion of innovations across the economy, the evolution of industry towards high-technology, high-skill and high-wage activities. A new role may also be played by policies which open up new demand and organise emerging markets based on the new technologies.

A more serious problem concerns the effectiveness of the current tools used for innovation policy. They have mostly taken the form of monetary incentives; we should perhaps investigate whether they have at times increased the incentives to firms to do what they were already doing anyway, while being unable to expand aggregate economic activity, generate spillovers to other firms and favour the more radical technological and structural changes required by the current transformation of the economy.

From the evidence offered by the Italian case, it appears that innovation surveys provide interesting data for the evaluation of public policies. Questions on this subject should be included in the new surveys in order to gather highly promising information on the impact of innovation policies on firms' behaviour, and to make international comparisons possible.

NOTE

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