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Statistical surveying of scientific research and technological innovation in services: methodological problems from ISTAT surveys

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Abstract

The main methodological issues emerged from the first ISTAT survey on technological innovations in the service sector are described in this paper. The survey has been carried out in 1996-97, with reference to the 1993-95 period.

The survey followed the methodological recommendations on data collection and interpretation suggested by OECD and EUROSTAT - which were subsequently included in the 1997 edition of the Oslo Manual. Thus, the survey was mainly focused on the technological aspects of innovation.

Innovation in market services is a complex and multifaceted phenomenon. Technological innovation – even in the broad meaning of the Oslo Manual – is only a part of the set of activities firms carry out to keep or improve their competitiveness. By the statistical point of view it is not an easy task to identify when technological innovation activities take place as well as to collect data on activities related to innovation, including scientific research.

It is not surprising that several problems have been recorded during the implementation of the survey on innovation in services; the two most important being the following:
1) proposed definitions on technological innovation may not have been fully understood by firms,
2) data on technological innovation of service firms appear to be substantially different from those referred to manufacturing firms and should be carefully interpreted.

Two main topics related to such difficulties will be discussed in this paper:
1) how the definitions of technological innovation in the service sector should be applied; several factors should be actually taken into account, including: the relation between technological and non-technological innovations, and the difference between the introduction of new services and the introduction of new processes;
2) what are the characteristics of research and development (R&D) in the service sector.

1. Technological innovation in the service sector

The service sector[1] plays a key role in the economy of industrialised countries. In 1996, in Italy, the sector of market services represented 52.3% of value added at market prices: which was twice the amount represented by industry.

It should be pointed out that important changes are taking place in the overall service sector, while some activities are undergoing even revolutionary changes. In some sectors of services demand is growing at a very fast pace and firms which have always operated in a local or national market should now face European and sometimes global competition. New technologies are going to play a central role in this process, as well. In fact, new services and processes to produce services are increasingly based on innovative technologies which are often related to innovations in business organisation too.

However, despite the increasing importance that service activities are acquiring in economy, innovative processes in the services are not sufficiently analysed. In fact, only recently surveys are being carried out on technological innovation while statistical surveys on Research and Development (R&D) have been regularly carried out by several OECD member countries from the sixties (in Italy from 1965). In R&D surveys, services have been traditionally considered a sector less important than manufacturing. Even surveys on technological innovation have not paid much attention to services, at least until the 1997 edition of the OECD/EUROSTAT Manual on the collection and interpretation of data concerning technological innovation (Oslo Manual, first edition 1989).

In the mid-nineties, innovation in services was given new attention closely. A number of remarkable pilot studies were started in that period. Statistical surveys on innovation were carried out in Australia (Australian Bureau of Statistics, 1995), in the Netherlands (Brouwer and Kleinknecht, 1995), and in Germany (ZEW - Fraunhöfer Gesellschaft, 1995).

Each of such surveys adopted a more or less broad notion of innovation, depending on the specific characteristics of the national system of innovation concerned, and on the definitions and

[1] The service sector includes a wide range of activities ranging from traditional ones (like wholesale and retail trade), to high-tech ones (like information technology activities and R&D). The table below lists the sectors considered by the ISTAT survey on technological innovation in services, 1993-95. It should be pointed out that the survey has examined even waste disposal and similar activities.

- **50** - Trade, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
- **51** - Wholesale trade and commission trade, excluding that of motor vehicles and motorcycles
- **52** - Retail trade, excluding that of motor vehicles and motorcycles; repair of personal and household goods
- **55** - Hotels and restaurants
- **60** - Land transport; transport via pipelines
- **61** - Water transport
- **62** - Air transport
- **63** - Supporting and auxiliary transport activities; activities of travel agencies
- **64** - Post and telecommunications
- **65** - Banking and financial services, except insurance and pension funding
- **66** - Insurance and pension funding, except compulsory social security
- **67** - Other financial services
- **70** - Real estate activities
- **71** - Renting of machinery and equipment without operator and of personal and household goods
- **72** - Computing and software
- **73** - Research and development
- **74** - Other business activities
- **90** - Waste disposal

methodologies used in surveying innovative activities in the service sector. For instance, Brouwer and Kleinknecht described the Dutch case adopting for their service survey definitions and methodologies already used in surveying innovative activities in the manufacturing sector. On the other side, the ZEW survey widened the field to be surveyed, as innovation was assumed in its broader meaning, this means that even non-technologically innovative activities were included in the survey (first of all, organisational innovation).

The 1997 ISTAT survey has adopted the methodologies defined by OECD and EUROSTAT. The proceedings of the preparatory meetings for the 1997 Oslo Manual were an essential source of reference for designing the survey which became the first survey to follow methodologies later officially adopted by OECD and EUROSTAT in the Oslo Manual.

2. ISTAT survey on technological innovation in services

ISTAT has acquired a long and well established experience in carrying out surveys on technological innovation. In fact, the first ISTAT survey in this field - designed jointly with the Institute of Studies on Research of the National Research Council - dates back at mid eighties. Since 1993, with the first *Community Innovation Survey* (CIS) focusing on manufacturing, ISTAT surveys on technological innovation are harmonised within EUROSTAT.

In 1997, ISTAT has carried out a pilot survey on technological innovation in the service sector. A sample of 6,005 firms was surveyed; they represented a population of 19,301 firms with 20 employees and over. A census-like survey was carried for firms with 200 employees and over. Firms were extracted from the ISTAT Business Register. This Register is constantly updated through censuses, specific surveys and data from other ISTAT surveys.

The sample was stratified by 18 economic sectors, 5 employee classes and 4 geographical areas (North East, North West, Centre, South).

The survey was started in November 1996 and it was ended on September 1997, after two reminders had been sent. A total of 3,331 questionnaires were received (55.5% of sample). Data were then checked and processed, and estimates were referred to total population. The answer rate (55.5%) is remarkably lower than the answer rate of the 1990-92 survey on technological innovation in manufacturing. The answer rate for that survey was 68.5%. This difference could be due to the different type of survey: one was census-like (manufacturing sector) and the other was a sample survey (service sector). Probably, for the latter survey, firms had less experience in answering to statistical questionnaires. Other elements caused such a lower answer rate too, including the difficulty for some service firms to fit their activities and status in the definitions suggested by the questionnaire.

One of the most important characteristic of services sector is the increasing rapidity the firms (especially smaller ones) transform themselves through mergers, take-overs or adoption of new trade names. In other words it is very difficult to track firms in the survey population, especially for those Business Registers which are not based on administrative sources, such as the ISTAT Business Register. The higher rate of missing answers is partly due to this condition.

At sectoral level, the highest rate of response (75% of sample) was recorded for the financial services sector. Banks had been informed on the purposes of the survey through the Italian Bankers' association. They were followed by insurance companies (72%), land transport (66%), activities auxiliary to financial services (63%) and activities auxiliary to transport (61%). Lower rates of response were recorded for real estate activities (43% of sample) and sea transport (49%). Financial and insurance companies seem to be more "stable", which means they are easier to find and more available to answer. On the other hand, firms in other sectors (both traditional or technologically advanced ones) are more difficult to find and less available to provide information on their technological innovation activity.

The ISTAT survey on technological innovation has adopted methodologies and definitions from the Oslo Manual on technological innovation. It should be helpful to recall the definition of technological **innovation** suggested to firms surveyed by ISTAT:

> "the set of knowledge, professional skills, procedures, capabilities, equipment, technical solutions required to manufacture goods or provide services ".

Firms were required to specify whether, from 1993 to 1995, "technological innovations" had been introduced, namely new or improved services or processes defined as below:

> "A **service** is regarded as **technologically innovative** if there is a remarkable quality improvement in performance and used technologies resulting from new procedures or improved procedures ";
>
> "The **innovation in process** is the adoption of technologically new methods in production or new methods to provide services. Several changes concerning equipment, production organisation or both may be required ".

Some issues related to the adoption of above definitions will be discussed below.

3. Which kind of technological innovation is adopted in service firms?

The approach adopted for the ISTAT survey complied with methodological recommendations from the Oslo Manual. This implies an important operational advantage: data comparability will be possible, in principle, over countries and over time. In fact, the results from this survey could be compared with data from similar surveys carried out in 13 European countries in 1998, within the framework of the second EUROSTAT harmonised survey on technological innovation (CIS - Community Innovation Survey).

This methodology has been refined through a number of innovation surveys in the manufacturing sector, surveys focused on **technological** innovation in **products** and **processes**.

In a way this approach was "translated" to be applied in the services sector as well.. In fact, in the ISTAT survey have been examined those firms which have introduced, in the 1993-95 period, **technological** innovations in **services** or **processes**. However, this "translation" of methodologies from the manufacturing sector to the services sector implies a number of problems. For instance, in the service sector, limiting the survey only to technological innovation means that the field is even more restricted than in the manufacturing sector. This mainly because innovation in "organisation" is quite common among services firms and because it can be assumed that in service firms the innovation process is comparatively less dependent on "technological" innovation than in the industrial sector.

Technological and non-technological innovations

The most recent edition of the Oslo Manual acknowledges the importance of "organisation innovations " or, more broadly, of "non technological" innovations (a specific annex deals with these topics). However, in such Manual it is recommended the use of ad hoc surveys - other than those on technological innovation - to gather data on "non-technological" innovations.

The Manual specifies what activities should not be considered "innovations" and thus should not be surveyed. A list of these activities is shown below:

- the ordinary replacement of capital equipment not related to technological innovation;
- the delivery of "customerised" services;
- only external differentiation of services;
- any intervention on the context where services are produced;

			INNOVATION			*Not innovation*
			Maximum	Intermediate	Minimum	
			New to the world	(a)	New to the firm	Already in firm
TPP	Technologically new	Product				
		Production process				
		Delivery process				
INNOVATION	Significantly technologically improved	Product				
		Production process				
		Delivery process				
Other innovation	New or improved	Organisation				
Not innovation	No significant change, change without novelty, or other creative improvements	Product				
		Production process				
		Delivery process				
		Organisation				

The chart above, from the Oslo Manual, can be useful to describe the approach adopted in the ISTAT survey. Only new services and production processes related to technological innovation have been considered (see first column on the left). Technologically advanced activities which had previously been carried out by the firm cannot be included among innovations (see last column on the right), as well as not innovative activities - as slight improvement in services, *customisation activities*, etc..

It is useful to remind that, despite their importance is acknowledged, "non-technological" innovations (including innovation in organisation) should not be surveyed according to the Oslo Manual.

A remark should be also made on the so-called (Miles, 1995) *delivery innovations*. In the service sector it is important if a service - despite being not improved in itself - is provided to customer using new procedures, from a technological point of view as well. Travel agencies are a very good example. They provide the same service (air, sea or any other type of transport), but procedure to provide service are constantly improved. For example real-time phone bookings or over the Internet, credit card payment which use networked information technology, etc. On the one hand, Ian Miles and other researchers suggested that these innovations are important in the service sector and should be considered autonomously. On the other hand, in the Oslo Manual these innovations are assumed to be simply technological innovation of process, as shown by the chart.

As far as the ISTAT[2] survey is concerned, it should be interesting to analyse the effects of excluding non technologically new processes and services introduced onto the market.

For instance, in the banking sector, new services of *telephone banking* were recorded, while the offer of new types of bank account (such as bank account at fixed charges and with specific benefits, as discounts on further services: transport, hotels and similar establishments) was not included.

[2] This paragraph is mainly based on the analysis of the description of innovation activities provided by firms themselves. Data can be considered only from a quality viewpoint, as it is not possible to process them as figures.

In the field of insurance companies, new types of insurance policies were not included. However, technological innovations concerning processes were included, such as dedicated telephone lines with automated attendant to notify accidents, or the use of smart systems for the automatic evaluation of insurance risks.

On the whole, organisational innovations without technological contents have been not considered. Thus, organisational changes - as a new distribution of local branches of banks or insurance offices as well as the combined supply of financial and insurance services provided by an insurance agent - have not been surveyed unless they were associated to technological innovations including new types of on-line communication between insurance agents and central office or teller automation for banks.

Also in other sectors can be jointly identified technological and non technological innovations, such as in transport and auxiliary activities or trade. These two sectors may offer interesting examples of organisational innovations too.

In transport sectors, the trend recorded by the ISTAT survey is towards a fragmentation of service production and offer. Carriers are going specialised, new firms are rapidly established (especially small and very small firms) to deal with specific market segments. Transport services are now sold using an increasing number of innovative ways to reach the largest number of customers at the lowest cost and in the easiest way. In the re-organisation both of specific firms and of the whole sector, the technological innovation of means of transport and of telecommunications networks plays a central role.

In trade sectors a completely different trend is recorded. Here activities are being concentrated in large distribution companies which purchase goods from manufacturers, and in some cases they package them too. Then goods are directly shipped to retail shops, thus wholesalers are no longer needed. The structural dynamics of this sector is deeply affected by this development which can be considered a “leading factor” for technological innovation. So, information technology and on-line connections become essential to make firms able to manage effectively increasing flows of goods from manufacturers to consumers.

These examples can not obviously offer a coherent model of relations between technological and non-technological innovations. The complexity of this sector should be mainly pointed out, also if organisational innovations emerge as relevant in the context of overall innovation activities.

The ISTAT survey seems to confirm the strong correlation between technological and organisational innovations also if it is not clear what kind of relations exists between them. On the other hand, such relations have not been considered in the survey that has been focused only on technological innovation. Thus, the ISTAT survey cannot provide information on non technological activities which at the present stage have not been sufficiently investigated to be considered for a statistical survey.

On this point, Miles (1995) argues that organisational innovation - which has probably a greater positive influence on productivity than technological innovation - is difficult to record and it is not uniformly diffused in the service sector for the following reasons:

- difficulty in assessing to what extent prices and profits may increase due to an improvement in the quality of services;
- organisational innovations are easy to imitate;
- the introduction of organisational innovations by firms is often due to external competitive pressure more than to strategic choices.

New services and new processes

One of the specific characteristic of the service sector is the close interaction between service production and use, which is called "co-terminality".

In particular, it has been called "servuction" the activity aimed at producing a “pure service”, thus differentiating it from the "production" of goods. In point of fact, the production of goods is often connected to the production of one or more services and viceversa. This means that there is a convergence of the two activities towards an undifferentiated production of tangible and intangible goods.

This is a real problem in carrying out surveys on innovation. In particular firms in a number of borderline sectors are concerned, that is sectors between industry and services. As a result, firms may be asked “wrong” questions during statistical innovation surveys.

The supply of gas, water and electric power is the most critical sector from this viewpoint. Firms in this sector (which in Italy are mainly public-owned) are strongly oriented towards distribution activities, and almost every innovation aims to improve the supply of gas, electric power or water. Production plays only a very secondary role. Production is limited to the following activities: deviating and purifying water, management of small-size electric power-plants or cogeneration plants. According to the economic activities classification, these activities should be considered as “industrial” ones and companies are asked whether “product innovations” had been introduced, even though they are focusing on “service innovation” also because their product does not seem to be “improvable”.

Cheese factories are a very different instance. Because of the prevailing activity is determined on the basis of the number of employees involved in a specific activity, cheese factories are classified as service firms, mainly involved in trade and delivery activities, since a greater number of employees works to sell perishable dairy products, rather than in the actual production. Nevertheless, cheese factories consider production to be their main activity and it is not easy for them to determine if any “service innovation” has been introduced.

Firms selling timbers are another example. It is known that these firms, selling timber to artisans or end users, usually trim to size wood. In some cases wood is cut to assemble furniture, as it were a kit. Is it possible to define this kind of activity as mere trade or we can identify a manufacturing activity as well?

This is an important problem. Taking into account these methodological problems, in some surveys on innovation it has been let to firms the choice to specify whether innovations introduced concerned products or services.

Any discriminating criterion appears to be arbitrary. Both if we would ask service firms to forget they “manufacturing-like” activities or we would suggest manufacturing firms to neglect their auxiliary service activities, we would lose relevant information the firms can provide us with.

An interesting proposal has been discussed in the literature: to define a continuous line along which every activity would be classified, from the production of sheer goods (textile-clothing, jewellery, etc.), to the combined supply of goods and services (cars, electronics, etc.) to providing sheer services, without any established clear-cut division between different activities. The adoption of this approach would allow to jointly record product and service innovations.

Generally speaking, it can be assumed that because of the close relation between product and service innovations, in the future any distinction between surveys on industrial and service activities (at least in defining distinct questionnaires) should be overcome.

Unfortunately, it does not seem possible to speed up the implementation of combined surveys on innovation in manufacturing and services, at least not as the state-of–the-art of surveys on technological innovations harmonised at OECD and EUROSTAT level.

On the one hand, in the Oslo Manual it is acknowledged that the traditional distinction between industry and services is becoming less meaningful and, what is more, that innovation is often increasingly spread from the service sector to the manufacturing sector (the production of software in the information technology sector is an example). On the other hand, the Manual suggests that

those manufacturing firms using free loan equipment provided by the firm only customer (in this case the large size firm is carrying out innovation plans and making the related investments, while the small-size firm innovates processes and products, but with no charge).

The specification of the most suitable person of the firm to answer statistical questionnaires is another important element, as far as the quality of data provided by surveys on technological innovation is concerned. This is a common problem for surveys on manufacturing as well as on services. Most statistical surveys on firms require data which are usually available in the administrative branch of the firm, while innovation surveys need to identify within firms that people who is able to provide both qualitative and quantitative information on innovation.

Therefore, while for small-size firm in the industrial and services sectors the information required by surveys on innovation may be provided by owners/entrepreneurs (sometimes a managing director or a business consultant may be helpful for economic-financial data), the scenario for large-size firm is rather different.

First of all, it should be pointed out that, on the whole, manufacturing firms are more definitely organised than service firms. As a consequence, it is easier to find in such firms reliable persons who can provide the required information and who can sum up information to answer the questionnaire. The sharing of management control and strategic choices which are in a way centralised play an important role.

It has been often difficult - during the ISTAT innovation survey - individuate who could answer the questionnaire in medium and large size firms of the service sector. Choices related to technological innovation do not seem to be so centralised in such firms. They are usually left to local units (in particular for firms managing transport or communication networks) which are only partly responsible for their choices towards the central office. What is more, information gaps may be recorded for the same firm, where several innovative activities have been carried out in different places. It often happens that - despite the huge amount of data that is provided – a completely and coherently filled in questionnaire is not supplied, which means that a complete picture of innovation in the firm is not provided, at least for statistical purposes.

The above mentioned problems should be faced from a methodological point of view. A greater flexibility is obviously required in the definition of what a statistical unit should be. With reference to the above problems, it is clear that a rigid definition of statistical unit may lead to misunderstanding or coincidence on the one hand, on the other hand it may make impossible to have the required answers.

The strict “subjective” approach of the Oslo Manual should be integrated with a more “object-oriented” approach focused on the specific innovation activities. However surveys should not neglect the context in which innovations are implemented, in this way it would be easier to survey even innovative activities resulting from the co-operation of different subjects, such as activities carried out at sub-firm level.

5. The role of research and development within the framework of service innovative activities

The role played by Research and Development (R&D) as a component of the overall technological activities carried out by firms is a further problem posed by the analysis of data on technological innovation in service firms. Miles (1995) and others pointed out that the role of R&D in the service sector has been underestimated, so far. In fact, for long time it was believed that services firms were only users of technological know-how developed by others, especially in the manufacturing sector.

This approach has been recently modified by two phenomena.

Firstly, large-size manufacturing firms seem to be oriented towards using R&D services provided by other firms, either controlled firms or non-profit research centres. This means that R&D activities are carried out by institutions which can operate freely in the research market and there are remarkable savings for large firms, as large research laboratories are no longer needed, in buying R&D services on the market. But these new firms, whose only purpose is research, should be included in the service sector and surveyed for statistical purposes, even though they are financed or receive orders from the manufacturing sector. Secondly, the rapidly increasing diffusion of information and communication technologies has particularly influenced those service sectors which are characterised by "a very high technological intensity" – such as research and development, information technology services and telecommunications. Other sectors have been partly influenced, namely those sectors where the new technologies allowed to change completely the production process of supplied services (banking, insurance companies, retail trade, etc.). Additionally, even less technologically oriented sectors have been influenced by the growing diffusion of information and communication technologies and they also are carrying out R&D (more or less formally established) activities to have the best performance from the adoption of the new technologies.

R&D in Italian services firms

Research carried out by service firms is only partially recorded by the yearly ISTAT survey on R&D in Italy. In fact only larger firms in the following sectors have been considered: telecommunications, air or railway transport, information technology services (besides, quite obviously, the R&D sector). In 1995 data were gathered from 97 service firms which reported a total intra-muros R&D expenditure slightly over 1,000 billions lire, out of 9,500 billions lire spent on research by a total of about 1,500 Italian firms carrying out research in 1995.

Alison Young (1996) has pointed out that a 10% of money spent on research by service firms on the total R&D spending would place Italy among the "medium R&D spenders" for this sector. Other industrialised countries are reported to spend around 15% on research in services, except those countries where the coverage of the service sector is not sufficient yet.

Then, even though the coverage of the ISTAT R&D survey already includes all sectors recommended by the OECD, still there is a number of service firms which has not been surveyed yet.

Data from the 1995 ISTAT survey on R&D in the service sector are shown in table 1. On the whole, service firms selected for their R&D activity belong to the following sectors: R&D services, information technology services and business services (engineering and technical services are particularly important).

These data confirm the relevance of firms carrying out R&D as main activity (they represent two thirds of the total amount spent on R&D in the service sector), as well as the important role played by activities related to information and communication technologies in the growth of R&D in services.

The percentage of service firms performing R&D on the total number of Italian firms carrying out research is lower (6.4%) than the weight of such firms in terms of total expenditure on intra-muros R&D (10.5%). Besides, service firms recorded an average expenditure on R&D higher than that of manufacturing firms. This proves that so far, only large-size firms have been considered in the R&D survey and that R&D in small-size service firms is currently underestimated.

Table 1. R&D expenditure of service firms in Italy, 1995.
Millions of 1995 current lire.

Sector	Num. of firms carrying out R&D	Expenditure on Intra-muros R&D	Expenditure on extra-muros R&D
Trade of motor-vehicles	1	..	..
Wholesale trade	6	22.514	373
Land transport	2	..	..
Activities auxiliary to transport	2	..	..
Post and telecommunications	4	142.403	10.600
Information technology services	29	122.951	23.471
Research and Development	32	616.564	12.041
Other business services	20	84.199	5.718
Waste disposal	1	..	..
Total of service firms	97	1.004.467	52.881
As percentage of total	*6,4%*	*10,5%*	*13,5%*
Total of firms carrying out R&D	1.526	9.540.714	391.910

Source: ISTAT survey on R&D, 1995.

Note: data concerning grouping with less than three firms (.. in the table) cannot be published owing to statistical secret.

To specify the characteristics of R&D carried out in the service sector, table 2 shows how much service firms spend on R&D in the following seven technological areas: new materials, information technology, electronics, bio-technologies, environmental technologies, energy technologies and aerospace technologies. Around 5% of R&D expenditure is devoted to information technologies by the total of R&D performing firms, however for service firms this figure rises over 10% (and up to 70% for firms in the sector of information technology services). This is important as service firms are no longer only users of information technology, as they are becoming producers of such technologies.

The “technological profile” of the “business services” sector is another interesting element; firms in this sector invest almost 50% of their total expenditure to carry out researches in almost all the high tech areas above mentioned. Such a strong effort in a so broad range of technological areas is partly due to the heterogeneity of this sector, but at the same time, it highlights the flexibility of R&D performing firms. It may be assumed that firms are ready to adjust cross-cutting capabilities and skills to a wide range of technological fields, in particular skills related to system engineering and management of complex systems.

Also in the service R&D sector, the technological activities of firms cover a wide range of areas, but the whole service sector firms is showing a propensity to orient research towards a wider range of targets than in the manufacturing sector, where research is strictly limited to technologies characterising the specific activity of firms.

Table 2. R&D activity of service industries in Italy And advanced technologies. Year1995.

Sector	Percentage of expenditure on R&D by technological area						
	Technology of materials	Information technology	Electronics And Telecommunications	Bio-technologies	Environmental technologies	Energy Technologies	Aerospace technologies
Trade of motor-vehicles	.	.	.	.	4,2%	.	.
Wholesale trade	3,5%	2,2%	1,1%	18,7%	10,5%	3,5%	.
Activities auxiliary to transport	4,6%	.	4,6%	.	2,3%	11,5%	.
Post and telecommunications	.	0,6%	4,8%	.	1,8%	.	.
Information technology services	0,5%	70,0%	3,8%	.	.	0,1%	.
Research and development	7,0%	1,6%	1,1%	1,4%	0,3%	0,9%	.
Other professional services	18,3%	5,1%	6,6%	1,7%	8,6%	5,4%	4,1%
Waste disposal	.	.	.	.	100%	.	.
Total of service industries	6,0%	10,1%	2,4%	1,4%	1,5%	1,1%	0,4%
Total of enterprises carrying out R&D	7,9%	5,0%	6,2%	1,1%	1,2%	1,0%	0,4%

Source: ISTAT survey on R&D, year 1995.

The reduced number of firms included in the ISTAT R&D survey is one of the main limitations of available data, especially with reference to the service sector. This problem can be at least partially overcome using data from the ISTAT survey on technological innovation in service firms. This survey provides some information on R&D as well, with reference to the period from 1993 to 1995. Differences between the two surveys both in terms of contents and coverage of sample have been widely discussed in literature. Here is important to remind that the R&D survey takes into account a limited sample of firms which presumably are carrying out R&D activities, gathering information on those activities, while the survey on technological innovation aims to determine whether "technological innovation" activities have been performed, within a sample of firm representing the whole population of firms in a specific sector.

Technological innovation is defined - as mentioned above - as the introduction of new products and services, or of new production processes. A number of activities are included in technological innovation, from scientific research (that surveyed by the R&D survey, as well), to technology transfer or the mere acquisition of new equipment.

In the technological innovation survey in the services sector (which has been widely described above) 227 firms of the sample (representing 826 firms of the whole service sector) reported having carried out R&D activities in 1995.

Thus we can estimate that about 826 service firms have performed R&D in Italy during 1995, while less than 100 firms have been surveyed by the R&D survey: it should be quite obvious as a consequence to include a higher number of service firms in the R&D survey. However, some remarks are to be made.

In the past, comparisons made between R&D surveys and technological innovation surveys (also if with reference to the manufacturing sector) showed that in the latter survey firms overestimate their effort in research activities. Often a number of non specific activities are reported

by firms under the heading “research”, they include: “exploratory” activities (market researches, non continuous patterning activity, etc.), or occasional research activities.

For this reason, most of firms carrying out R&D activities according to the survey on technological innovation is not able to fill in the questionnaire of the R&D survey which is mainly designed survey systematic research activities.

Table 3. Comparison of surveys on R&D (1995)
And on technological innovation in services (1993-95).

ISTAT surveys	R&D (1995) Service sector	Technological innovation (1995) In services	
		sample	*population*
Number of firms Carrying out R&D	97	227	826
Intra-muros + extra-muros Expenditure for R&D (millions lire)	1.057.348	1.262.642	1.630.156
Average expenditure for R&D (millions lire)	10.900	5.562	1.974

Source: ISTAT.

Table 3 gives evidence to the above notions: it is easier for the R&D survey to identify large-size firms with systematic research activities (that is with greater expenses), whereas the survey on technological innovation is more oriented to provide data on a greater number of firms with less organised R&D activity.

Nevertheless, the technological innovation survey can provide useful information on the characteristics of R&D in the service sector, especially with reference to the distribution by sector of R&D expenses. Data from this survey (see table 4) show that the highest R&D “intensity” is recorded - as it may be expected - in the service R&D sector, at least considering the percentage of firms carrying out R&D on the total number of firms which have introduced innovations.

However a great number of firms is performing R&D even in sectors which were not traditionally considered having a high R&D “intensity”, such as insurance or sea transport. This is an unexpected result which is not related to any systematic development of R&D activities (as in the R&D sector), nor – at least not as prevailing activity – to software development (as in the information technology service). In some sectors, including sea transport or wholesale sectors, R&D activities may consist in market researches and related activities but it is more difficult to identify what kind of R&D activities are carried out in financial or insurance sectors, unless, similarly to what has been observed in the US, we would assume that such activities mainly consist in software development.

Following such hypothesis, specific skills to develop information technology solutions could be found within financial and insurance companies (as well as in other service firms); these skills should sustain the fast diffusion of information and communication technologies in these sectors.

Table 4. Innovation and R&D expenditure by sector

according to the ISTAT survey on technological innovation in services, from 1993 to 1995.

Sectors	Number of innovating firms	Number of firms Carrying out R&D activities	% of R&D performers	R&D exp. in 1995 (mill. lire)	Average R&D expenditure per firm in 1995 (mill. lire)	Percentage of total expenditure for innovation activities in 1995 devoted to R&D
Motor-vehicle trade	369	1	0,3%	..	..	2,1
Wholesale trade	1562	178	11,4%	29.330	164,8	4,5
Retail trade	507	45	8,9%	1.355	30,1	1,0
Hotels and restaurant	428	23	5,4%	1.029	44,7	2,1
Land transport	450	36	8,0%	14.611	405,9	1,5
Sea transport	39	13	33,3%	179	13,8	0,8
Air transport	23	1	4,3%	..	..	1,8
Activities auxiliary to transport	348	28	8,0%	6.613	236,2	4,3
Post and telecommunications	6	3	50,0%	279.651	93.217,0	25,4
Banking and financial services	567	101	17,8%	39.661	392,7	3,3
Insurance companies	99	50	50,5%	16.369	327,4	9,1
Auxiliary financial services.	100	6	6,0%	270	45,0	0,6
Information technology services	528	177	33,5%	115.326	651,6	18,3
Research and development	65	38	58,5%	823.984	21.683,8	83,9
Other business activities	810	121	14,9%	299.641	2.476,4	50,2
Waste disposal	71	6	8,5%	49	8,2	0,0
Total	5.979	826	13,8%	1.630.156	1.973,6	23,6
Employee classes						
20-49	3.603	408	11,3%	50.961	124,9	5,8
50-99	1.097	131	11,9%	59.315	452,8	14,1
100-199	551	107	19,4%	133.475	1.247,4	30,1
200-499	418	85	20,3%	425.018	5.000,2	47,8
500-999	155	43	27,7%	393.227	9.144,8	56,8
1000 and over	154	53	34,4%	568.159	10.720,0	15,8
Total	5.979	826	13,8%	1.630.156	1.973,6	23,6

Source: ISTAT survey on technological innovation in services, from 1993 to 1995.
Note: Totals may differ from figures in the table owing to rounding to refer data to the total population.
Data concerning grouping with less than three firms (.. in the table) cannot be published owing to statistical secret

Taking into account the 1995 average R&D expenditure of the service sectors listed above, the following remarks can be made:

1) R&D firms and firms providing business services have an average expenditure respectively of 21.6 and 2.5 billions lire in 1995, information technology firms spent on average about 650 millions lire. These figures confirm that firms in these sectors are the most R&D oriented within the whole service sector.

2) Nonetheless, other sectors have had remarkable investments in R&D as well: 406 millions lire on average for land transport firms (including Italian State Railways), 393 millions for banks, 327 millions for insurance companies, 236 millions in firms providing transport services and 165 millions in wholesale trading firms.

3) The relevance of this “creative effort” (that is of R&D investments) for innovation in the service sector it may be partly reduced when these investments are considered as percentage of the total

expenditure for technological innovation. It is interesting to note that while R&D expenditure accounts for 84% of total expenditure for technological innovation in the service R&D sector, 50% in the sector of business services and 18% for the information technology service sector, while figures for the other sectors are below the average. In fact R&D expenditure accounts for only 1.5% of total expenditure for technological innovation in the sector of land transport, 3.3% in banking, 4.3% in auxiliary services to transport, 4.5% in wholesale trade and 9.1% in the insurance sector.

R&D in the service sector

The analysis of scientific research activities in service firms is still at the beginning. More in-depth analyses (statistical analyses as well as analyses based on case-studies) would allow to outline better the profile of "research" activities in service firms. Specific adjustment of definitions and methodologies may be required, especially for technological innovation. However, two issues seem to be more urgent from a methodological point of view.

The analysis of the results of the survey on technological innovation rises the first question, concerning the clear definition of activities aiming at developing software within the framework of research definitions provided by the Frascati Manual. Even assuming that software development could be included within research activities, a number of problems are to be solved. First of all it would be necessary to establish which software related activities are covered by definitions in the Frascati Manual – namely, sufficiently innovative and creative activities – and which software activities should be directly referred to ordinary production of services and products. On the other hand, available statistics at international level show that when the weight of software development is increasing on the total R&D activity, those sectors with relevant software development activities emerge as large R&D performers. In this context, the sector of information technology would have a leading position as R&D performer, but also other sectors - such as the financial and insurance ones - would appear to be large investors in R&D. Such a new interpretation would deeply affect statistical survey methodologies on R&D and innovation.

The second question concerns the difference between formally established R&D (as such included in the surveys adopting methodologies from the Frascati Manual) and non formally established R&D (the Frascati Manual refers, in this case, to surveys on technological innovation). Small and medium size firms are particularly affected by this problem, in particular in the service sector. In the manufacturing sector it is possible to consider as formally established those research activities which are mainly carried out by an employee (in terms of full-time employee working in R&D). It would be very difficult to apply this criterion to the service sector where there are no clear cut boundaries between research, development and specific forms of "application development". Financial and insurance companies are a meaningful instance. It is not easy to differentiate R&D activities (according to the Frascati Manual) from activities more directly related to production. Employees work not only to develop software for company information technology systems but are also busy in the daily routine to adjust the information technology system to the meet the specific requirements of the company. From a statistical point of view it will be very difficult to record information on this type of activity using traditional surveys. It is then necessary to define a methodological framework aimed at integrating R&D surveys and surveys on technological innovation.

6. Future interventions on survey methodologies

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