The role of R/D expenditure: a critical comparison of the two (R&S and CIS) sources of data

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ABSTRACT. The paper explores the relation between two data sources (*R&D* and *CIS surveys*) in the aim of better representing the roles of R/D activity in relation with innovation processes. This paper starts with controlling the relation between the R/D expenditure in the two surveys (*R&D* and *CIS*) for a same group of firms and for the same year (2000) and deals with the question of how much we know at present of the different components of the industrial R/D activity and how we can use the frame of the two surveys for arriving to gain this knowledge. The final aim is that of getting finest grained indicators for studies on the impact of industrial investment on R/D.

KEYWORDS: Industrial R/D, R/D survey, CIS survey

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INTRODUCTION

Since the beginning of '70s, policy makers at OECD placed a growing attention on the "use" of R/D resources and on their techno-economic impact at country level. A new orientation among policy makers has progressively brought to a more integrated policy, incorporating the previously separated and vertically organised fields of science policy and industry policy.

Around '90 S/T statistics were enriched by the introduction of new data and indicators on direct innovation activities, focused on industrial firms, in addition to R/D, bibliometric and patent data. The pillar of the statistics on innovation in Europe has been represented by the Community Innovation Surveys, which introduced new and comparable data.

Statistics on R/D and statistics on innovation activities have had a parallel life since then, mostly in accordance with the idea that *CIS* registered the main part of the R/D activity, excluding what was in amount (mostly Basic research). More recently in occasion of the revision of the *Oslo Manual* this vision was put under examination and the result was that the two surveys have only a small part of R/D data in common, while keeping a separated scope and structure.

The *R&D surveys* concern research expenditures not directly linked to innovation activities, but in the *Frascati Manual* (2002) it is recognised that the R/D statistics must be examined in a conceptual frame which creates a linkage between these input data and output results, such as the innovation process analysis. The *CIS surveys*, dedicated to the innovation processes, assumed a predominant role since its introduction at the beginning of 90's, through the assumption that R/D is only one component in the innovation process and that non-R/D based innovations are very frequent (process innovation, product differentiation based on marketing expenditure). Since then the assumption has been that the R/D relation with innovation was enough well represented through the available statistical instruments. Over time, nevertheless, a new attention has been devoted to the relation between industrial R/D and innovation, first of all deriving from the empirical observation that the industrial *intra-muros* R/D expenditure gave different amount in the two surveys[1]. In the occasion of the *Oslo Manual* revision one of the focus groups has been devoted to analyse the innovation inputs and particularly industrial R/D expenditure.

Except for the changes introduced by a small number of countries, the Innovation surveys, until the most recent one (CIS 4), have surveyed R/D expenditure directly linked to innovation activity (i.e. innovation projects). Many consequences derived from this choice: first of all the role and effects of industrial investment in Basic research has been underscored, but also other types of R/D not directly devoted to product innovation but impacting on innovation at firm, sector and system level. In this light the absorptive capacity derived from R/D activity, with effect on the firm innovation capacity and productivity was underscored, together with the R/D devoted to the design and selection among projects. Referring to the firm capacity of exploiting technological opportunities deriving from public research result or embedded in new machinery or linked to new intermediate goods, Cohen and Levinthal in their seminal work (1989) argued that firms invest in R/D "not only to pursue directly new process and product innovation, but also to develop and maintain their broader capabilities to assimilate and exploit externally available information"[2]. The dual role of R/D is underscored within the innovation surveys, both in its meaning of sustaining firm adoption of capital and intermediate goods and in that one of assimilating information/knowledge input derived or spilled out from external sources. Moreover David *et al*. (2000) referring to model of firm R/D investment behaviour suggested that "among the research projects that a rational decision process would need to consider, is the project for gaining the knowledge required to construct and evaluate its (*firm's*) current innovation possibility set"[3].

This paper starts with controlling the relation between the R/D expenditure in the two surveys (*R&D* and *CIS*) for a same group of firms and for the same year (2000) and deals with the question of how much we know at present of the different components of the industrial R/D activity and how we can use the frame of the two surveys for arriving to get this knowledge.

[1] See OECD (2001), *Assess whether there are changes needed asa result of the comparison of R&D data collected in R&D and Innovation Surveys*, DSTI/EAS/STP/NESTI (2001)14/PART3.

[2] W.M. Cohen and D.A. Levinthal, "Innovation and learning: the two faces of R&D", *The Economic Journal*, 99, Sept 1989, p. 594.

[3] P.A. David, B.H. Hall and A.A. Toole, "Is public R&D a complement or substitute for private R&D? An overview of the econometric evidence", *Research Policy*, vol. 29, April 2000, p. 503.

A better possibility of comparison between the two (*R&D* and *Innovation*) surveys could help in:

- analysing the relation between R/D and innovation at unit level (see also *Oslo Manual* 2005 p. 125);
- getting a better knowledge of how much of and how R/D is commercialised;
- better distinguishing between the different components of industrial R/D activity and consequently getting finest grained indicators for studies on the impact of industrial investment on R/D.

The paper is organised as following: the first paragraph is devoted to a very synthetic history of the two surveys and it is followed by a paragraph where we refer to how the problem of the relation between the two surveys has been recently framed by other scholars. The fourth paragraph deals with our investigation, the presentation of the dataset and the results; finally some conclusion are presented.

1. A SHORT HISTORY OF THE TWO SURVEYS

The concern about the necessity of an integration of the research activity into the economic system appears around the mid of '60s within a debate launched by the OECD on the technological gap between US on one side and Europe and Japan on the other side. At that time the major flows of resources for research activity in Italy was directed to University. The OECD Conference on the technological gap promoted by the Ministries of Science and Technology in 1968 can be considered at the origin of a rethinking on the scientific policy, with its enlargement to the industrial processes of innovation. The General Report presented during the OECD Conference pointed out that the determinants of the technological gap were not in the level of the S-T resources, but in their use for innovation and in the organization of the relation between scientific system, education system and the industrial system of creation and diffusion of innovation.

The OECD event pushed policy makers' attention towards industrial innovation and the support to industrial R/D together with the integration of an innovation policy within the industrial policy and in addition to the public research policy.

The *Oslo Manual* opened the road to a new collection of data and indicators in Europe: a specific survey (CIS) was launched. It was a voluntary survey which had the frequency of one each four years[4] (CIS1, 1993; CIS2 1997; CIS3, 2001).

CIS survey was centred on manufacturing firms, which were recognised to be the "engine" of innovation. R/D was only one of the inputs of the innovation activities. At the same time the voluntary base of *CIS* and the not always well performing qualitative CIS data, allowed *R&D surveys* to remain the primary source of data in country comparisons.

But *R&D surveys* too underwent critics, mainly on its firms coverage. One of the main critics advanced to *R&D surveys* is that data are biased, they give a representation only of the strong part of the national industry, since only firms with recurrent or formalised R/D activity are included. For countries (such as Italy) with a very large industrial component made by small and medium sized firms, this can bring to a downsizing of the effective R/D activity. Under the influence of CIS results, in recent years some national *R&D surveys* have been enlarged to take into consideration also the occasional R/D activity. In our country this new orientation was introduced by the National Statistical Institute, who manages the yearly *R&D survey*, in 2000[5] and therefore it is present in our dataset.

2. A COMPARISON BETWEEN INDUSTRIAL R/D EXPENDITURE IN R&D AND INNOVATION SURVEY: HOW THE PROBLEM HAS BEEN FRAMED

Godin (2002) introduces the problem in the following way: when in 1981 OECD included for the first time the innovation concept in the *Frascati Manual* innovation activities were excluded from the measurement of R/D[6], because they were defined as re-

[4] Here it is indicated the year of realization of the CIS surveys. Each survey refers to the innovation in the three years before, but R/D expenditure is that of the last one (i.e. CIS3 survey was realised in 2001 and concerned R/D expenditure in 2000).

[5] The adopted procedure was the following: the 2000 *R&D survey* was built using the national database of CIS2 (which included firms with more than 20 employees), including the manufacturing firms registered as having an occasional R/D for innovation. Also service firms were added from the 1996 industrial census. Then the firms list was controlled and only the enterprises active in R/D in the surveyed year were kept.

[6] In 1976 K. Pavitt, as consultant at OECD, suggested to include questions on innovation activities in national R&D surveys in terms of activity (% of activity devoted to innovation) and in terms of output (list of products and processes), recognising the existence of other expenditures that help in turning R/D into economically and technically

lated to scientific activities. National innovation surveys multiplied and interest in measuring innovation grew up in OECD countries. The conceptual framework for developing innovation indicators came from Keith Smith and the Nordic Fund for Industrial Development in 1989. The first Innovation guidelines (the *Oslo Manual*) was adopted in 1992 (then revised twice 1996 and 2005) and chose the subjective approach, a firm based survey on technological innovation activities. Within the measurement problems arising from the new survey there was "the recurring discrepancy between *Innovation* and *R&D surveys* data. *Innovation surveys* recorded significantly less R/D activity than standard *R&D surveys* did because of methodological differences"[7]. Godin lists the following problems:

- different population frames: *CIS surveys* are often conducted on stratified random sample of firms, based on a population of business firms included in some statistical or administrative register, while *R&D survey* is a sort of census on the basis of a list of (known) R/D performers;
- different sampling methods (see above);
- occasional R/D is omitted from *R&D surveys;*
- there are problems with the industrial classification related to the presence of separated R/D specialised units in industrial groups;
- different rates of responses.

Finally Godin (2002) frames the problem in this way:

"Instead of asking what is the better instrument for measuring innovation and have the same measure of R/D in both surveys, we need "to understand and measures the divergence"[8].

A second way of introducing the problem comes from the work done by an *ad hoc* Focus group within the third revision of the *Oslo Manual*, after the *CIS 3* (1998-2000). The group looked at the problem of the level of trustworthiness in R/D expenditure data (and indirectly on Innovation expenditure). The Focus group on innovation inputs formulated the question in the following way (*Revision of Oslo Manual*, Focus Group 3, 2004):

- is the innovation expenditure an extension of the traditional measure of industrial R/D and does the total innovation expenditure include the R/D expenditure or the total innovation expenditure (*Innovation survey*) and the total R/D expenditure (*R&D survey*) are two different sets, only partially intersected?

  R/D expenditure, following the *Frascati Manual* definition, should include research activity non directly linked to innovation (i.e. Basic research); but, even if the *Oslo Manual* refer to the Frascati guidelines for the definition of R/D activities, in its application the Innovation questionnaire asks firms for indicating the R/D expenditure related to innovation activities (successful, on going and failed innovation projects during the three years before the survey).

  The OECD Focus group was articulated in four national sub-groups (Denmark, Spain, Finland, Norway). The result they obtained was that R/D and innovation expenditures were two different sets and that when the question on R/D expenditure is independent from innovation activity the answers are more close to those in *R&D survey* and there is a higher rate of answers.

  The countries included in the OECD Focus Group 3 had the following experiences:
- the Danish Centre for Studies in Research and Research Policy, with the authorization of EUROSTAT, did a *light combined R&D and innovation survey* for 2002[9];
- since 2002, Spain matched the two surveys on the basis of a new and unique sample of firms, and kept the questions on R/D separated and coming before those on innovation expenditures;
- Norway *CIS 3* was a combined *R&D* and *Innovation survey*, with a questionnaire organised in three sections: a) general information; b) R/D activities; c) Innovation activities. Questions on R/D activity are formulated in both the sections b) and c). In this way the rate of R/D expenditure on Innovation expenditure passed from 30% (*CIS 2*) to 60% (*CIS 3*). One of the envisaged benefit is that, having a combined and regular survey on a core of questions on R/D and innovation expenditures, it is then possible to go in depth on related specific aspects by different years;

significant innovation, see B. Godin, *The rise of Innovation surveys measuring a fuzzy concept*, Working Paper, 16, 2002, p.6.

[7] See B. Godin, *The rise of Innovation surveys measuring a fuzzy concept*, Working Paper 16, 2002, p. 20.

[8] B. Godin shares the point of view of a statistician, D. Francoz (2000), *Measuring R&D in R&D and Innovation surveys: analysis of causes of divergence in nine OECD countries*, DSTI/EAS/STP/NESTI, 26. See B. Godin, *The rise of Innovation surveys measuring a fuzzy concept*, Working Paper 16, 2002, p. 22.

[9] The Danish group did also two micro-surveys on (survey 1) large firms belonging to international industrial groups and (survey 2) on medium sized firm, to understand what problems the firms meet and how do they answer to the question on innovation costs.

- Finland included questions on innovation in the *R&D survey*, on a panel of firms, in 1999 and 2001; *CIS 3* kept the traditional frame.

The revised *Oslo Manual* (2005) includes the results of these explorative works in the following way:

"Because R/D and innovation are related phenomena, some countries may consider the combination of *R&D* and *Innovation surveys*. There are a number of arguments for and against"[10]. In the list of the "for" arguments the Manual includes: "Country experiences (for example Denmark, Finland, the Netherlands, Norway and Spain) indicate that it is possible to obtain reliable results for R/D expenditures in combined surveys". Among the "against" argument, it is indicated the cost of a combined survey.

The third way of framing the question came from the solution given by the *Oslo Manual* (2005):

"All R/D activities financed or performed by enterprises are included as innovation activities. This includes total intramural and extramural R/D as defined by the *Frascati Manual*. It is also worth emphasising the importance of using the definition and guidelines for R&D of the *Frascati Manual* when collecting data on R/D in *innovation surveys*….This will aid comparisons with *R&D surveys* and facilitate the use of the R/D data separately" (§ 318). Moreover "the basic criteria for distinguishing R/D activities from non R/D innovation activities are "the presence in R/D of an appreciable element of novelty and the resolution of scientific and /or technological uncertainty" or that they "result in new knowledge or use of knowledge to devise new applications" (see *Frascati Manual* § 84 and § 146). These criteria implied that a particular project may be R/D if undertaken for one reason, but not if carried out for another (see *Frascati Manual* § 85)" (*Oslo Manual* §349).

In sum the *Oslo Manual* (2005) states that: "While most R/D activity is related to product or process innovations, some may be related to marketing or organisational innovations. Basic research is by definition not related to any specific innovation. *All R&D is included as innovation activity.* Furthermore R/D is defined as a separated category that includes relevant activities for product, process, marketing and organisation innovation, along with basic research" (*Oslo Manual* § 316).

[10] Oslo Manual, 2005, p. 125, §457.

3. THE ITALIAN COMBINED DATASET

3.1 Aim of the check

We intend to follow the direction indicated by Godin and try "to understand and measures the divergence" between the two surveys on R/D expenditure. At the same time we wish to introduce a reflection on the different components of the industrial R/D expenditures, which could be taken into consideration when studying the (social/private) impact of firm R/D investment.

Here we list some critical aspects to be controlled:

- is there any difference in the R/D expenditure declared by firms in the two surveys?
- what do this different amounts include and how can we get indications on the different components of industrial R/D expenditure?
- how is it possible to deal with the firm absorptive capacity, through R/D data?
- how is the problem of the industrial R/D commercialisation taken into consideration?
- is it possible to deal with R/D not directly used by firms but transferred within their industrial groups?

3.2 Characters of the dataset

Our dataset is the result of the matching between 2000 *R&D* and *CIS 3* Italian surveys.

It is a biased dataset, since it includes mostly medium high sized firms (82.7% are firms with more than 50 employees); it offers information biased towards firms belonging to the medium-high technology sectors[11] (65.8%), identified by the relative high R/D intensity. A large proportion of firms (56%) belongs to industrial groups.

[11] The classification of high and medium high technology manufacturing sectors is based on the Eurostat / OECD's classification- itself based on the ratio of R/D expenditure to GDOP or R&D intensity. See Eurostat, "Science and technology", *Statistics in focus,* 2006.

Table 1. Character of the dataset

Groups of firms	*N. firms*	*%*	*Belonging to ind groups*	*%*	*Medium high tech Sectors*	*%*
Innovators	702	92.25%	397	56.55%	462	65.81%
of which						
Innovators without R/S in CIS	*57*	*8.11%*	*27*	*47.37%*	*35*	*61.40%*
Non innovators	59	7.75%	27	54.24%	33	55.93%
Total observations	761	100.00%	429	56.37%	495	65.04%

The list of firms by sector is in the Appendix: only sectors which are scarcely present in the *R&D survey* are poorly covered in our dataset.

Table 2. Firm by size classes in the dataset

Number of employees	*Dataset*	*%*
1 - 19	29	3.81%
20 - 49	103	13.53%
50 - 249	326	42.84%
250 or more	303	39.82%
Total	761	100.00%

Firms with < 50 employees, well represented in *CIS*, are under-represented in our dataset, since *R&D survey* includes only an aggregated group of firms with "until to 49 employees".

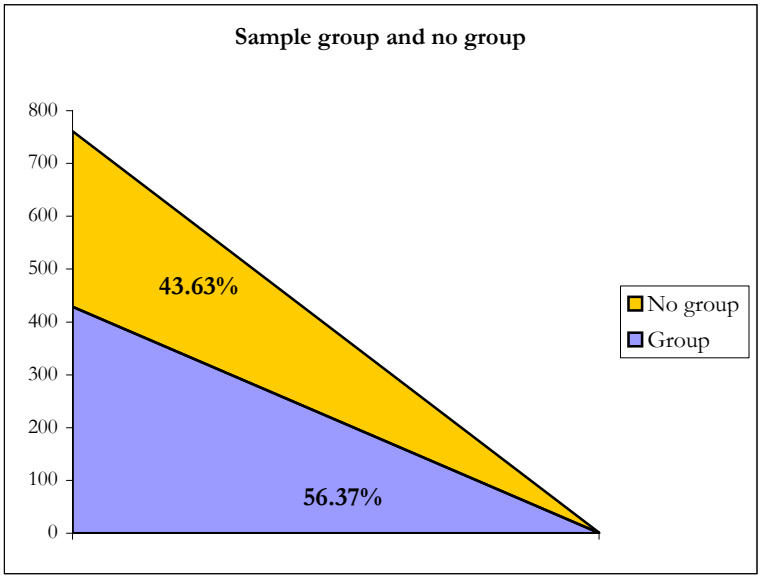

Figure 1. Distribution of firms belonging to industrial groups *versus* not belonging to group in the dataset

Our dataset represents half (47.6%) of the total R/D expenditure of the *R&D survey* on business enterprises.

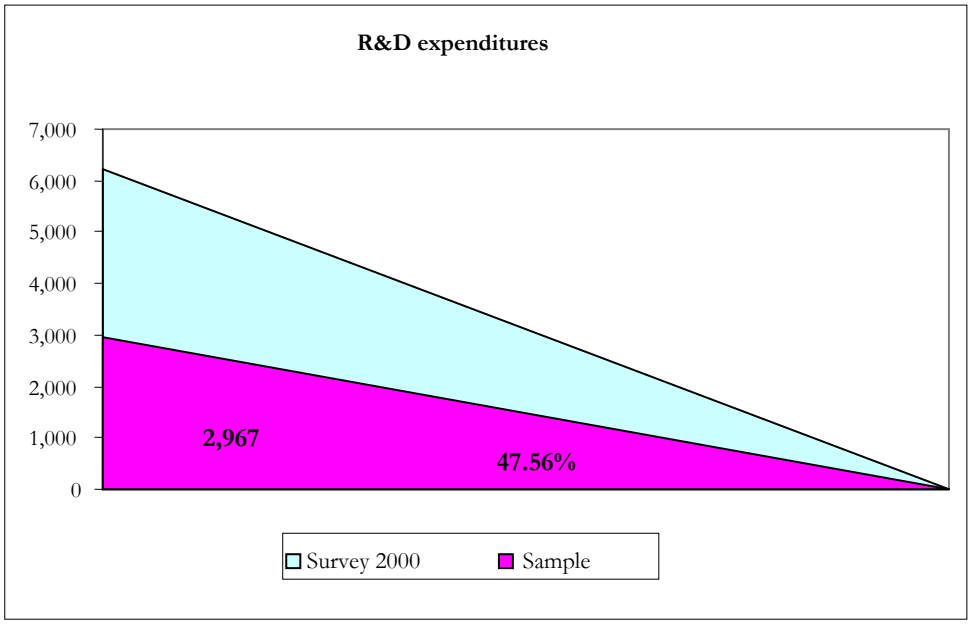

Figure 2. R/D expenditure in the *R&D survey* 2000 and in our dataset (millions of Euro)

Some R/D activity is registered in the *R&D survey* also within non innovators and innovators with non (intra-muros) R/D based innovation, but its amount is relatively low (and lower than the weight in terms of number of firms, see Tab. 1). In particular the non innovators seems to be a marginal group in terms of intra-muros R/D expenditure, when controlled by *R&D survey*.

Table 3. Distribution of total intramuros expenditure in R*&D survey*

Groups of firms	*% distribution of Total intramuros exp. in R&D survey*
Innovators	98.69%
of which Innovators without R/D	*3.96%*
Non innovators	1.31%
Total observations	100.00%

Our analysis is concentrated on 691 innovators, excluding 11 innovators without R/D activity in the *R&D survey*. Non innovators are not included since CIS don't give information about R/D for them.

3.3 Results

A first result is that there is a large difference in the innovators' *intra-muros* R/D expenditure registered by the two surveys for the same firms and for the same year (2000).

Table 4. Total intra muros R/D expenditure registered by *R&S* and by *CIS* and the difference (1000 Euro)

	Total R/D	*Basic research*	*R/D without Basic research*
Tot. intra-muros R/D in *R&D*	2,967,167.3	111,783.0	2,855,384.3
Tot. intra-muros R/D in *CIS*	2,101,166.5	-	-
Difference	836,255.6	-	754,217.7

The R/D expenditure difference represents about 30% of the total amount of *intra-muros* R/D registered in the *R&D survey* and 25% if we exclude Basic Research, which is currently taken as the major source of difference between the two surveys.

A second outcome is that the two sets of R/D expenditures data (derived from the two sources of data) are not intersected, except in one case: firms in our dataset don't declare the same amount of R/D in *R&D* and in *CIS survey*: about 76% of firms declare more intra-muros R/D in *R&D survey* compared with *CIS* and about 24% declare less *intra-muros* R/D in *R&D survey than in CIS*. We call the first group **RES> CIS** and the second group **RES<CIS**.

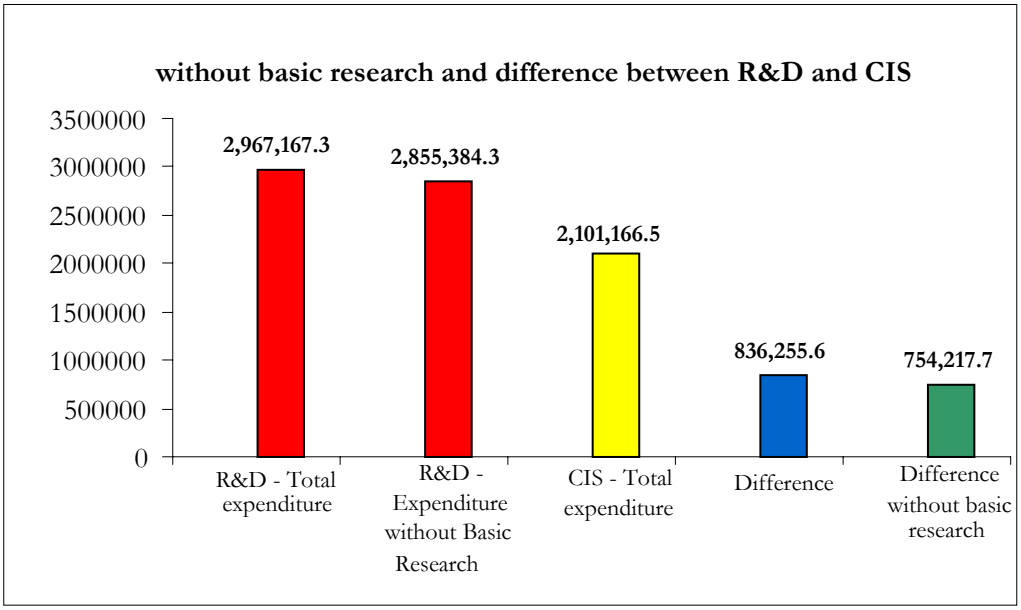

Figure 3. R/D *intra-muros* expenditure by source of data

Table 5a. Intra muros R/D expenditure registered WITHIN *R&S* and *CIS* by group and the difference (1000 Euro)

Groups	*R&D*	*CIS*	*Difference*
R&D > CIS	2,411,950.3	1,348,060.2	1,063,890.0
R&D < CIS	515,828.9	743,463.3	-227,634.4

In the table below it is reported the difference between the amount of R/D declared in the two surveys by the different groups of firms; the last row reports the aggregated (at dataset level) difference. In the RES<CIS group firms declare 227,634.401 thousand Euros less in *R&D survey* than in *CIS.*

Table 5b. Two different groups in the dataset: the R/D expenditure difference declared in *R&D survey* in comparison with *CIS survey* (thousand Euros)

Groups	*Number of firms*	*%*	*Intra-muros R/D expend. difference*	*Average expend. difference*
RES > CIS	525	75.98	1,063,890.0	2,026.5
RES =CIS	1	0.14		
RES <CIS	165	23.88	-227,634.4	-1,379.6
Total firms	691	100	836,255.6	1,210.2

RES>CIS is the more important sub-group in terms of firms (76% of the dataset).

An explanation of these two groups of divergent R/D expenditure between *R&D* and *CIS* surveys is needed. We look for a structural explanation (the components of the R/D expenditures) in both the subgroups of our dataset[12].

In case of R/D expenditure higher in *R&D survey* (RES>CIS) we can make the hypothesis that the R/D non registered by CIS survey, since non attached to innovation projects, can:

- be an R/D investment which enables innovation projects based on the adoption of elsewhere produced innovations. Therefore the difference between intramuros R/D attached to innovation projects and the remaining R/D activity, found in *R&D survey*, can measure the absorption capacity of firms;
- it can represent, mainly the Basic research component, the firm capacity of building and evaluate/select a set of innovation possibilities;
- can be sold directly to the market;
- can be sold/circulated within the industrial group to which a firm, specialised in research activity, belongs.

The industrial R/D can have an impact on firm economic performance (besides through innovation projects) as capacity of selecting innovation projects, as capacity of absorbing and of using externally produced innovation, as sale of R/D services to other

[12] Occasional R/D don't look like playing a relevant role: the total difference (124,148.44 thousand Euros) due to firms declaring occasional R/D activities, which is present in both subgroups, represents only 15% of the total difference in the dataset. Besides, the direct amount of the occasional R/D is not available within *CIS* or *R&D surveys.*

firms and as transfer of R/D result within the industrial group.

Here below we look, through the information that we can get from our matched dataset, to each of this component for understanding if it is present and which weight it has within the R/D expenditure difference registered between the two surveys. We do it mainly within the subgroup declaring more R/D in the *R&D survey* and representing 76% of our dataset.

We try also to test the hypothesis that some structural reason (i.e. not only random reasons) can explain why a subgroup of firms declares less R/D in *R&D survey* than in *CIS*. The hypothesis is that in this case firms declare a higher value of 2000 R/D expenditure since some change happened (probably in development expenditure linked to innovation) between 2000 and 2001/2002, the year of the CIS survey realization.

First of all we look at the distribution of R/D expenditure by type in the dataset and in the two subgroups. For doing it we use the data in our dataset deriving from *R&D survey:*

Table 6. Intra-muros R/D (1000 Euro) in the dataset

R/D	*Total exp.*	*N of firms*	*Average exp.*	*st. dev*	*min*	*max*
Basic Research	111,783.0	70	1,596.9	1,600.19	28.9	41,356.3
Applied Research	1,340,129.1	513	2,612.3	11,564.05	1.6	280,236.2
Development	1,515,255.1	517	2,930.9	12,174.08	7.8	186,824.1

Basic research, in principle, is not included within *CIS* survey. As the table 4 showed, the weight of this component of the difference between the two surveys is relatively limited. This can be confirmed if we look at the subgroup RES>CIS: the total expenditure in Basic research represents only 8% of the subgroup R/D difference between the two surveys.

Table 7. Distribution of intra-muros R/D by type in the group RES>CIS

R/D	*N. obs*	*Total expend.*	*Average expend.*
Basic Research	55	88,616.8	1,611.2
Applied Research	369	1,157,938.0	3,138.0
Development	372	1,165,395.4	3,132.8

Within RES<CIS there is a high value of development expenditure by firm compared with applied and basic research; this is a necessary condition but it is not sufficient to affirm that the difference come from new expenditures in development registered by CIS in 2001/2002.

Table 8. Distribution of intra-muros R/D by type in the group RES<CIS

R/D	*N. obs*	*Total expend.*	*Average expend.*
Basic Research	15	23,166.2	1,544.4
Applied Research	113	162,870.4	1,441.3
Development	104	329,792.3	3,171.1

The other aspect is that Basic research is concentrated in 15 firms, which have a high level of basic research expenditure. This fact allows to think that firms in the subgroup reported a misleading value of R/D expenditure derived from the group consolidated R/D.

In table 9 we look at the location of R/D activities.

The RES<CIS subgroup, declaring more R/D in *CIS*, is surprisingly characterised by a relative lower weight of R/D located within the production (and the design) function, while they have a relative higher weight of R/D located within divisional laboratories, i.e. the influence of R/D activity developed within a multidivisional group is relatively more important.

Table 9. Distribution of R/D activity by location (in % of the total number of firms by row)

Groups	*Central Laboratories*	*%*	*Divisional laboratories*	*%*	*Within design function*	*%*	*Within Production function*	*%*
Dataset (761 obs)	274	36.0	98	12.8	385	50.6	472	62.0
RES>CIS (525 obs)	200	38.1	66	12.6	279	53.1	339	64.6
RES<CIS (165 obs)	61	36.9	24	14.5	84	50.9	94	56.9

Note: The rows don't give a sum of 100 since multiple answers are possible

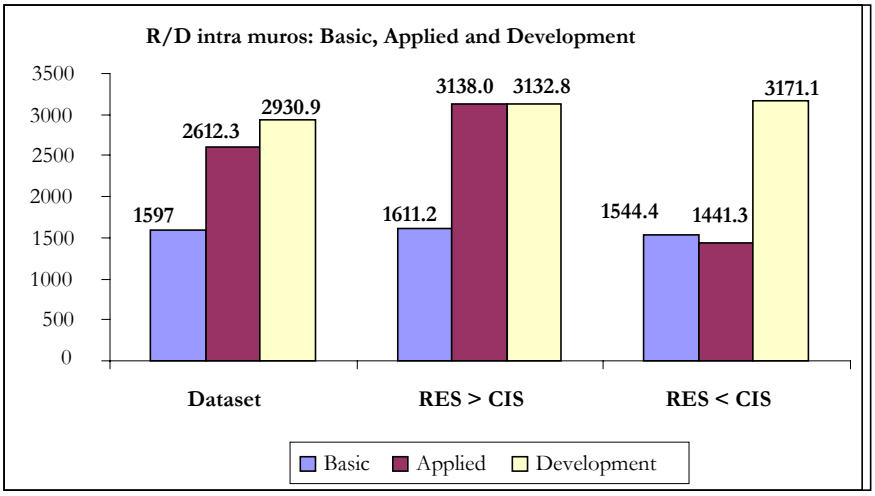

Figure 4. Distribution of the average R/D expenditure by type

Unfortunately it is not possible to know what is the amount of the R/D located within divisional laboratories, but only the total R/D of these firms. Moreover the weight in terms of firms with research located in divisional laboratories is not really different between the two subgroups and finally it is not easy to support the idea that only some firm includes the group consolidated value of R/D expenditure.

A better analysis of the R/D activity when firms belong to industrial groups should represent a good improvement of the *R&D* and *innovation surveys*.

We explore the relation between the distribution of R/D expenditure in the two subgroups RES>CIS and RES<CIS through a Kolmogorov-Smirnov test for equality in distributions. Clearly the two distributions have different means, since one has only negative values and the other positive values. In order to compare their form we make a translation of the RES<CIS (RES-CIS<0) on positive values.

Table 10. Kolmogorov - Smirnov test for equality in distributions

	K_S statistic	*P-value*	*P-value corrected*	
RES > CIS vs RES <CIS	0.2485	0.000	0.000	different

We find out that the two distributions of R/D expenditure are different, therefore we can assume that the causes generating these two subgroups are different.

Now we go on looking for various components within the R/D difference in RES>CIS.

The localization of the development of the product can indicate if there are firms specialised in R/D, whose research results circulate within the group or is sold in the market.

Table 11. Development of products-Dataset

Development of products	*Freq*	*Percent*
Missing value	162	21.28
Within the same firm or the same group	495	65.04
In collaboration with other enterprises	89	11.7
Only by other enterprises	15	1.98
Total	761	100

Table 12. Development of products- RES>CIS

Development of products	*Freq.*	*Percent*
Missing value	82	15.6
Within the same firm or the same group	360	68.7
In collaboration with other enterprises	70	13.3
Only by other enterprises	13	2.4
Total	525	100

Table 13. Development of products- RES<CIS

Development of products	*Freq*	*Percent*
Missing value	21	12.73
Within the same firm or the same group	126	76.36
In collaboration with other enterprises	17	10.3
Only by other enterprises	1	0.61
Total	165	100

Only in a minority of case products are developed outside the firm, by other enterprises and mainly within the subgroup RES>CIS (13%). But it is not evident when the products are developed within the firm or within the group: there is only a partial information about a division of labour among firms.

Within *R&D survey* it is possible to know how many firms offer R/D services to other firms (and to other public institutions) through R/D contracts. And this information allows to get an indicator of R/D sold on the market.

Table 14. R&D contracts - Dataset

Groups	*R&D contracts*	*%*
Innovators	177	25.0
Non innovators	*14*	23.7%
Total	191	25.1%

About 25% of innovators supply their research activity through contracts. Within the subgroups of our dataset the percentage of firms which sell R/D through contracts is respectively of 27% and 21% (see Tab. 15). Again it is not possible to know the amount of these R/D contracts; it is only possible to measure the difference in R/D expenditure registered by the firms, which have R/D contracts, but it is not really worth.

Table 15. R&D contracts by group

Groups	*R&D contracts*	*%*	*R/D difference for firms with R/D contracts*	*Mean*
RES > CIS	143	27.2	747,412.9	5,226.7
RES < CIS	34	20.6	-185,109.98	-5,444.4

In sum if we look at the subgroup RES>CIS where R/D is higher *in R&D survey* than in *innovation survey* we find that:

Total number of firms in the subgroup:	*525*	1,063,890.0 *expenditure difference of which*
Basic research	8% in terms of expenditure and 9% in terms of firms	
R/D contracts	*27%*	*in terms of firms*
R/D specialised firms (not developing product in house)	*13% in terms of firms*	

Now we explore the presence of components of R/D finalised to organise a set of innovation possibilities and to select among them and moreover of R/D investment finalised to adopt process innovation developed outside the firm and to use extra-firm knowledge.

Some character of our dataset, connected with this exploration are:

Firm acquiring *extra-muros* R/D from other firms are about 40%[13].

Firms with (only) process innovation are about 8%. Firms with product and process innovations are 431 (see Tab. 16), i.e. about 57%. In sum about at least 50% of firms in our dataset can use R/D investment to support use or adoption of extra-firm innovation.

Moreover firm declaring of doing R/D finalised only to product are 269 in *R&S* compared with 168 in *CIS,* that seems to be the indication of R/D investment non directly finalised to innovation but supporting the setting and choice among current or future product innovation projects.

Table 16. Aim of R/D as declared in *R&D* and *CIS surveys*

Research finalised to	*N° obs - R&D*	*N° obs - CIS*
Only product	269	168
Only process	55	63
Product - process	431	431

We test the role of R/D in facilitating the absorption of innovation embodied in capital goods purchased to firms as the probability of getting an innovation process, including among the explanatory factors the firm's R/D expenditure not directly linked to innovation projects (i.e. the difference between the two surveys at firm level). For getting clearer results we apply a probit model to firms declaring only process innovation.

In the literature we find that an interesting application of measuring the effect of R/D for innovation absorption, i.e. for process innovation, is in Parisi, Schiantarelli and Sembenelli (2003)[14].

We use a simple robust probit model estimating the probability of the introduction of a process innovation as a function of the firm investment in fixed capital[15], the firm R/D expenditure for innovation projects (firm R/D in *CIS*), the R/D difference (firm's R/D in *R&D* survey not registered

[13] *Extra-muros* R/D can be an indicator of acquisition of R/D from other firms, included from firms in the same group. There isn't a relevant difference in the *extra-muros* R/D amount registered by the two surveys. Firm with *extra-muros* R/D are about 300.

[14] As the authors write (p. 4): "The effect of R&D on growth through its effect on facilitating the absorption and transfer of new technologies have been analysed for OECD countries by Griffith, Redding and Van Reenen (2001) and by Guellec and Van Pottelsberghe (2001). Our (*the authors*) results provide interesting micro based support for the importance of the technology absorption effect of R&D at the firm level".

[15] We use the data available in our matched dataset: investment in fixed capital is the "acquisition of machinery and equipment" registered by CIS3, which should be the capital investment devoted to implement or improve products and processes.

in *CIS*), the interaction between fixed investment and the R/D difference and firm size. Standard errors are adjusted for intra-industry correlations. The results are reported below.

Coefficients are expressed in term of elasticity by holding all the exogenous variables fixed at their average level. The coefficient on fixed investment is positive and significant at 5% level; R/D expenditures registered in CIS are not significant; RES-CIS difference (in firm *intra-muros* R/D) is positive and significant at 10%, while the coefficient of the interaction term between investment and R/D difference is not significant. The size of the firm (in terms of employees) is also significant (even if negative) at 5%. If the R/D non finalised to innovation projects increases of 10%, the probability of a process innovation increase of about 1%.

This regression seems to be globally significant (the Chi2 p-value is significant at 5%) even if the pseudo R2 is quite low (about 0.03). It is of worth to notice that we have used this probit model only to check for correlations "qualitatively" since problems of endogeneity due to simultaneity and variables omission cannot be prevented at this stage of analysis.

If we test the probability of introducing only a product innovation, by keeping the same variables, the result is quite different. The table below reports results.

Table 17. Probit regression (only process)

Elasticities after probit y = Pr(only process) = 0.0557827		
Variable	*ey/ex*	*Std. Err.*
Investment	0.1758272**	0.07554
R/D intra muros expenditures - CIS	-0.1895111	0.12109
R/D intra muros difference R&D-CIS	0.0986551*	0.06305
Investment x R/D intra muros difference R&D-CIS	-0.4345433	0.82521
Employees	-0.4268861**	0.24943
Number of obs	525	
Wald chi2(5)	14.07	
Prob > chi2	0.0151	
Pseudo R2	0.0285	
Log pseudolikelihood	-16.257.198	
Std. Err. adjusted for 32 clusters in Ateco		

Table 18. Probit regression (only product)

Elasticities after probit y = Pr(only product) = 0.21782559		
Variable	*ey/ex*	*Std. Err.*
Investment	-0.1245975	0.11738
R/D intra muros expenditures - CIS	0.0301776**	0.0148
R/D intra muros difference R&D-CIS	-0.0403372*	0.02218
Investment x R/D intra muros difference R&D-CIS	0.0228001	0.02972
Employees	-0.1423882	0.1041
Number of obs		
Wald chi2(5)	525	
Prob > chi2	non available	
Pseudo R2	0.0244	
Log pseudolikelihood	-162.57198	
Std. Err. adjusted for 32 clusters in Ateco		

In this case the role of the two components of R/D expenditure (creation and adoption) is different: the value of R/D expenditure registered within *CIS survey* is significant at 5%, while the R/D difference is significant at 10%, but with a negative sign; the other variables are not significant. It should be assumed, with a certain approximation, that the increasing of a not finalised to innovation project R/D, is related to a decreasing probability of doing a product innovation. In any case, as in the case of the previous regressions, this conclusion has to be taken carefully.

Finally we explore, through a simple correlation, the relation between the aggregated R/D expenditures in our dataset derived from *CIS survey* and from *R&D survey* and from the two subgroups RES>CIS and RES<CIS on one side and the innovation performance on the other side.

We tried before the relation between R/D expenditures and the percentage of sales coming from innovation activity, but the results were statistically non significant.

The relation between R/D expenditures and patents as registered in *R&D survey* gave the following results:

Table 19. Simple correlations between "patents and R/D expenditures

From CIS	0.7035*
From R&D	0.8615*
R&D > CIS	0.7137*
R&D < CIS	-0.0027

Note: * = 5% of significance;
R&D < CIS = observations with an intra-muros R/D expenditures greater in CIS than in R&D;
R&D > CIS = observations with a intra-muros R/D expenditures greater in R&D than in CIS

Te Rho coefficient varies between –1 and 1. We find a high value of correlation for the first three groups, but *R&D survey* gets a better fit, higher of 1.6. We don't find any correlation for the group RES<CIS, notwithstanding the high correlation coefficient in the other cases, and this could indicate the presence of misleading values of R/D expenditures in this subgroup.

4. CONCLUSION

The analysis of a combined dataset, matching data from *R&D* and *Innovation surveys* showed first of all the existence of a consistent differences in the collected R/D expenditures for the same group of firms and for the same year (2000). Our dataset was biased towards medium and large sized firms with a consistent investment in R/D, representing the half of all the R/D expenditure registered by R&D survey in 2000.

This biased character of the dataset doesn't represent a real problem, since the same *Oslo Manual* (2002, p. 128) states that the underscored R/D activities in the low sized firms class doesn't affect significantly the total amount of R/D expenditures.

Moreover we found out that the dataset was composed of two different subgroups, declaring respectively a value of R/D higher in R/D survey (RES>CIS group) or lower (RES<CIS group) when compared with the value declared in *CIS survey*.

We tried to explore the structural reasons of this differences, looking at the components of the R/D expenditures, which we assumed to be represented by:

- R/D embodied in innovation projects;
- R/D sold to market or transferred within groups, since more than half of the firms in the dataset belong to industrial groups;
- the R/D investment finalised to build and evaluate a set of innovation possibilities or finalised to absorb innovation and knowledge externally acquired.

We assumed that it could be of interest to know about the presence and the relative amount of the different R/D expenditure components, since it could allow more fine grained analysis, especially at firm level, of an impact on innovation activity or of an impact in terms of firm economic performance.

In particular it could be useful to have a better identification of firms' absorbing capacity and of the proportion of R/D which is commercialised.

The possibility of looking at the R/D composition in terms of type of research helped us in identifying a relevant contribution of Applied research and Development when a positive difference of R/D expenditure is found between *R&D* and *CIS surveys*, while the weight of Basic research on this difference is low.

We advanced the hypothesis that when a negative difference is present between *R&D* and *CIS* survey for R/D expenditure it can depend on an adjusted value of R/D[16], linked to innovation projects, since the CIS collect the 2000 R/D expenditure one year

[16] Probably mostly of Development, which is a high component of R/D in this subgroup.

later and the amount of R/D linked to innovation projects is based on an estimation. Another possibility could be the use of consolidated R/D expenditure at the group level in this subgroup of firms (RES<CIS), given the high value of Basic research concentrated in a small number of firms and the relatively to the average high presence of R/D located in multidivisional laboratories. These hypotheses, nonetheless, cannot be well checked; better information on R/D expenditure attributed to innovation projects when firms belong to groups should be needed.

Morover, the difference (positive and negative) we found in comparing R/D expenditure in the two surveys by firm has different structural causes, as the Kolmogorov text on the R/D expenditure distribution confirmed. and the absence of a correlation between R/D and output (patents) in the subgroup RES<CIS, while it is strongly significant in all the other three cases, reinforce the hypothesis that here we face some misleading value of R/D expenditure.

The presence of a positive difference of R/D, besides the research devoted to innovation projects, which we could verify at firm level, is the interesting point of departure for identifying other components of R/D. "The concept of absorptive capacity is important not only at country or industry level, but also at the firm level: internal R/D helps the firm in absorbing innovations generated outside the firm and embodied in new investment goods"[17]. We could control the impact of R/D not devoted to innovation projects on the probability of getting an innovation process together with investment in machinery and equipment and found out a positive and significant relation, while the impact of R/D devoted to the firm innovation project resulted not statistically significant. This is an interesting result, since currently R/D is used as an homogeneous and aggregated expenditure. The control on the role of the positive difference in R/D on the probability of getting a product innovation, confirmed the different role (on creation and on adoption) of the two components of R/D, identified through the *R&D* and the *Innovation surveys*.

Moreover we tried to identify other destination of the positive difference in R/D by firm, in particular the destination to the market and to other firms within a division of roles in industrial groups.

The available data don't allow to get a measure of this two components in terms of expenditure, we only know that a third of firms in the subgroup RES>CIS work with R/D contracts and that a smaller percentage is specialised in research activity, without developing products internally. Again a better information on the relation between firms belonging to an industrial group could improve the trustworthiness of R/D data.

The two surveys remained logically separated and the recent OECD indication of better connecting them seems to be the necessary direction. Inserting industrial R/D survey in a larger context of innovation strategies, dealing with a better identification of the R/D components and of the way in which R/D is distributed and circulated in systems of innovation is a challenge towards future approach for building better tailored STI indicators.

[17] Parisi, Schiantarelli and Sembenelli (2003, p. 21).

REFERENCES

Acs Z., Audretsch D., Braunerhjelm P., Carlsson B., 2003, *The missing link: the knowledge filter and endogenous growth*, paper presented at the DRUID Summer School Conference 2003, Copenhagen, June 12-14.

Castellacci F., Grodal S., Mendonca S., Wibe M., 2005, "Advances and challenges in innovation studies", forthcoming in *Journal of Economic Issues.*

Cohen W.M. and Levinthal D.A., 1989, "Innovation and learning: the two faces of R&D", *The Economic Journal*, 99, Sept.

Commissione delle Comunità Europee, 2000, *L'innovazione in un'economia fondata sulla conoscenza*, COM(2000) 567.

David P. A. and Foray D., 1995, "Assessing and expanding the science and technology knowledge base", *STI Review*, n.16, OECD, Paris.

David P.A., Hall B.H. and. Toole A.A., 2000, "Is public R&D a complement or substitute for private R&D? An overview of the econometric evidence", *Research Policy*, vol. 29, April.

Godin B., 2002, "*The Rise of Innovation Surveys: Measuring a Fuzzy Concept*", Project on the History and Sociology of S&T Statistics, Working Paper, n. 16.

Jaffe A.B., 1986, "Technological opportunity and spillovers of R&D: Evidence from Firms' Patents, Profits and Market Value", *American Economic Review*, vol. 76, n. 5, Dec, p. 984.

Mairesse J. and Mohnen P., 2002, "Accounting for innovation and measuring innovativeness: an illustrative framework and an application", *American Economic Review*, vol. 92, n. 2, May.

Mortesen P., "Element in CIS 3 Questionnaires – Why?", 21st CEIES Seminar *Innovation Statistics – more than R&D indicators.*

OECD, (2001)*, Assess whether there are changes needed asa result of the comparison of R&D data collected in R&D and Innovation Surveys*, DSTI/EAS/STP/NESTI (2001)14/PART3.

OECD, 1997, "R&D, Innovation and Competitiveness", OECD S&T Indicators N 2, Paris.

OECD, 1997, Proposed Guidelines for Collecting and Interpreting Technological Innovation Data, *Oslo Manual*, second edition, Paris.

OECD, 2005, Proposed Guidelines for Collecting and Interpreting Technological Innovation Data, *Oslo Manual*, Paris.

Parisi M.L., Schiantarelli F. and Sembenelli A., 2003, *Productivity, Innovation Creation and Absorption and R&D: Micro Evidence for Italy,* draft, Nov.

Smith K, 2002, *What is the knowledge economy? Knowledge intensity and distributed knowledge bases*, www. intech.unu.edu/publications/discussion-papers/2002-6.pdf.

Smith K., 2000, *Innovation indicators and the knowledge economy: concepts, results and policy challenges*, STEP Group Oslo, Nov.

APPENDIX

Distribution of firms in the dataset by ateco

Ateco	*Percent*
14. Other mining and quarrying	0.13
15. Manufacture of food products and beverages	3.94
17. Manufacture of textiles	3.42
18. Manufacture of wearing apparel; dressing and dyeing of fur	0.39
19. Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	1.18
20. Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.92
21. Manufacture of pulp, paper and paper products	1.05
22. Publishing, printing and reproduction of recorded media	0.66
23. Manufacture of coke, refined petroleum products and nuclear fuel	0.53
24. Manufacture of chemicals and chemical products	15.64
25. Manufacture of rubber and plastic products	4.99
26. Manufacture of other non-metallic mineral products	4.86
27. Manufacture of basic metals	2.50
28. Manufacture of fabricated metal products, except machinery and equipment	4.86
29. Manufacture of machinery and equipment n.e.c.	14.85
30. Manufacture of office machinery and computers	1.71
31. Manufacture of electrical machinery and apparatus n.e.c.	6.96
32. Manufacture of radio, television and communication equipment and apparatus	6.31
33. Manufacture of medical, precision and optical instruments, watches and clocks	2.10
34. Manufacture of motor vehicles, trailers and semi-trailers	3.94
35. Manufacture of other transport equipment	2.37
36. Manufacture of furniture; manufacturing n.e.c.	2.63
40. Electricity, gas, steam and hot water supply	0.79
41. Collection, purification and distribution of water	0.39
50. Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	0.13
51. Wholesale trade and commission trade, except of motor vehicles and motorcycles	0.53
55. Hotels and restaurants	0.13
60. Land transport; transport via pipelines	0.13
63. Supporting and auxiliary transport activities; activities of travel agencies	0.19
64. Post and telecommunications	0.13
65. Financial intermediation, except insurance and pension funding	1.18
66. Insurance and pension funding, except compulsory social security	0.26
67. Activities auxiliary to financial intermediation	0.13
70. Real estate activities	0.26
72. Computer and related activities	2.63
73. Research and development	3.42
74. Other business activities	3.15
Total	100

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