Innovation survey indicators: Any progress since 1996?

Or how to address the 'Oslo' paradox: we see innovation surveys everywhere but where is the impact on innovation policy?

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1. Introduction

The first Blue Sky conference in Paris in 1996 introduced a wide audience to some of the results of the first Community Innovation Survey (CIS) from 1993, which was arguably one of the most innovative major sources of new innovation data at the time. Building on research dating back to the late 1970s, the goal of the CIS and other innovation surveys was to obtain data on a diverse range of ways of innovating, particularly forms of innovation that did not depend on R&D, and to provide output measures of innovation.

Since the first CIS, innovation surveys based on the Oslo Manual have become institutionalized, particularly in Europe where the CIS is now implemented every two years in all EU-25 member states. The first results of the fourth CIS, referring to innovative activities between 2002 and 2004, are now available for several EU countries and should be available for all member states over the next few months. The fifth CIS will be in the field in early 2007 and planning for the sixth CIS, which will implement the recommendations of the 3rd edition of the Oslo Manual (OECD, 2005), is already underway.

With data available from several consecutive CIS surveys, one would think that the European policy community would be actively using CIS indicators to assess the ability of national innovation systems to respond to the challenges of the knowledge economy. Unfortunately, this hasn't happened to anywhere near the extent that one would have expected in 1996. The results of a series of in-depth interviews by UNU-MERIT with European policy analysts and a review of major European white papers on innovation shows that the European policy community still relies on long-established indicators for R&D and patents. The effect of the CIS is largely diffuse, influencing general perspectives rather than the development of concrete policy actions. There are of course exceptions, such as the use of CIS data on collaboration in the evaluation of relevant policies in the Netherlands.

R&D and patents are excellent indicators of firm investment in developing innovations in-house through creative activities, particularly in manufacturing, but they are insufficient for capturing innovation as a process of diffusion, the

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development of distributed knowledge bases that are an essential feature of the knowledge economy (Smith, 2002; 2005), the continual increase in the economic importance of the service sectors, and many informal innovative activities. The latter could be particularly important as over two-thirds of scientists and engineers in the private sector are not employed as researchers (Bell, 2006).

The CIS collects data that could be used to fill some of the gaps in our knowledge of innovation, but unfortunately the CIS has not been fully exploited for this purpose. The main cause is a continued focus on a science-push or linear model of innovation. The countless announcements of the death of this model and its presumed replacement with 'systemic' models using Schumpeterian definitions of innovation are decidedly premature. The science-push model based on R&D is probably the dominant model in use today by the policy community, although no one refers to it anymore by its name[2]. This has resulted in a lack of demand on the part of policy makers for a wider range of CIS indicators, and a lack of supply from academics and national statistical offices of them.

An example of the European policy focus on supply-side innovation policies is the Lisbon Agenda, and specifically the Barcelona Council's initiative to solve the European Union's competitiveness problem by its proposal to increase European R&D intensity to 3% of GDP by 2010. This has probably set back the slow progress over the 1990s towards an enlarged view of innovation that includes informal activities. Not only is the 3% goal impossible to attain due to Europe's industrial structure – even by 2015, but insufficient R&D is only part of the problem.

With a few exceptions, academic analysis of the CIS, using econometric models, has had little impact on European innovation policy. The UNU-MERIT interviews found that policy analysts rarely used this body of research because the papers were not focused on their needs. As a check, we evaluated 162 academic papers using CIS data and found that only 21 (13%) made any policy recommendations[3]. Even then, many of the papers only include a few sentences or a single paragraph of relevance to policy. One of the problems, as pointed out by Veugelers and Cassiman (2005), is that CIS results for one country do not provide strong evidence for policy development. Policy relevant results need to be replicated across several countries, which is blocked by restricted access to CIS data from more than one country[4].

[2] Over the last decade (CEC, 1995), and particularly since the Lisbon Agenda of 2000, the European policy community has consistently stressed the central role of innovation to European competitiveness, although a close reading of major policy documents shows that the concept of innovation in use is primarily R&D.
[3] Based on a UNU-MERIT database maintained by Dr. Cati Bordoy on papers, in English, of microeconomic analyses of CIS data. The database was last updated in June 2006.
[4] Another option for improving the policy relevance of the CIS is for data access for academics to be conditional on the provision of an accessible but in-depth discussion of the relevance of the research results to policy.

This paper makes the case for returning to some of the original goals of the CIS and gives a few examples of new policy-relevant indicators that could be constructed using CIS data[5]. These new indicators include an output measure with improved international comparability, an indicator for knowledge diffusion, and a set of indicators for how firms innovate. The goal is to improve the impact of the CIS by improving the relevance of CIS indicators for policy.

2. The policy context for innovation indicators

In order to be useful, indicators must be relevant to someone – either academics, business managers, or policy analysts. Since the delay in publishing CIS indicators is usually too long for business managers, and since academics prefer access to micro-data, the primary audience for CIS indicators is the policy community.

Over the past two years, UNU-MERIT has interviewed 67 members of the policy community, 55 from 15 European countries and 12 from Canada, Japan, Australia, and New Zealand, on their use of and need for innovation indicators, including CIS indicators. R&D indicators are the most widely used and considered to be the most valuable. In contrast, the respondents only referred to a few examples of the use of the CIS in policy making or evaluation. Several interviewees stated that the use of the CIS was reduced by concerns over data quality, but this was not a widespread view and the quality of the CIS has been improving over time. The main types of new indicators that the interviewees would like to have concern the process of commercialization and collaborative activities involving innovation. The latter had the highest policy interest, cited by interviewees from all but two of the 19 countries.

The policy focus on R&D indicators reflects the dominance of policies to support R&D. There are no accurate measures of the amount of funding for other types of innovation policies, but an extensive database of innovation programs in each of the EU member states is available on the TrendChart website. A thorough search identified 54 programs with a focus on the diffusion of technology or skills, particularly to small and medium sized firms (SMEs)[6]. This is unlikely to cover all non-R&D innovation programs, but it should capture the range of programs on offer. Annual expenditure in Euros was available for 85% of the 54 programs. The programs were divided into two main groups: policies which did not involve R&D and policies where R&D could (although not necessarily) be involved.

[5] Godin (2002) comments that the innovation surveys “ended up measuring innovation the way they measured R&D, i.e. in terms of inputs and activities”, rather than fulfilling their original goals of measuring outputs. My view is that the design of the CIS questionnaire does meet the original goals. The problem is in how the data are used.

[6] See http://trendchart.cordis.lu/.

The former group of policies included:

1. Training staff from SMEs, particularly in technology requirements and innovation management.
2. Technology adoption subsidies, particularly for modernization.
3. Subsidies to acquire licenses to new technology.
4. Subsidies to hire skilled S&E staff.
5. Manufacturing extension services – help identify firm needs for new technology.[7]

These five policies are designed to assist firms with very low innovative capabilities. On average, the ten new member states, plus Greece and Portugal, spend eight times more on a per capita basis on these programs than the more developed EU member states, but in both groups of countries these programs account for less than 0.02% of GDP. This is only about 2% of EU public expenditures on R&D. Even allowing for under reporting in the TrendChart database, programs that do not involve R&D probably account for less than 5% of all government support for innovation.

The low public investment in these types of policies suggest that indicators for the diffusion of technology or skill upgrading are unlikely to ever hold much value for the policy community, with the possible exception of the new member states. However, these policies could be relatively more important to SMEs (a target of many policy actions) than their low cost would suggest. An Innobarometer survey in 2004 asked a sample of 4,534 innovative SMEs, covering all 25 EU member states, if any of eight types of innovation support programs were 'crucial to any of your innovation projects, such that the innovation would not have been developed without the support". An analysis of the results found that the most crucially important type of support was for collaboration (31.5%), followed by programs to support research (25.0%) and thirdly the adoption of process technology (14.3%) (Arundel, 2004). The latter is supported by many of the five types of programs given above, while the first and fourth programs can be relevant to collaboration by improving the innovative capabilities of the firm.

Although innovation through the diffusion of technology and related skills is currently of marginal interest to the policy community, increased interest in the role of demand in innovation could lead to greater interest in diffusion indicators. Both the influential Aho Report (CEC, 2006) and the proposed Competitiveness and Innovation

[7] Most EU countries support a system of regionally-based technology transfer or innovation offices to provide support and technical advice, such as the Manufacturing Advisory Service (MAS) in the UK, or OSEO-ANVAR in France. They provide general education programs including demonstration

Framework Program (CIP) (CEC, 2005) stress markets and demand, including the role of lead users and the slow rate of adoption within Europe of information technology in the service sector. The CIP proposal notes that ‘making innovation work means innovation capacity building, the uptake of new technologies and of existing technologies in a new context and carrying them through to the business level”. In order to achieve these goals, the CIP proposes an entrepreneurship and innovation program to support the transfer of technology, the uptake of technologies and applications, and cooperation between universities and firms. Two other sections of the CIP proposal support ICT adoption and the creation of markets for sustainable production methods and energy efficient technology.

Both the Aho Report and the CIP proposal are part of a gradual shift in Europe from supply-side support for the creation of new ideas to a concerted effort to ensure that these ideas find their way to firms that can apply them to their new products, processes and services. This is reflected in the interviews mentioned above, with policy makers interested in new indicators for commercialization.

3. New CIS indicators

Almost all publicly available CIS indicators, such as those available on Eurostat’s NewCronos website or included in the Eurostat publication *Innovation in Europe* (EC, 2005), are simple frequency indicators based on one CIS survey question, such as the percentage of firms that applied for at least one patent or the percentage of SMEs that reported collaborating on innovation. Complex indicators based on the responses to more than one question are rare. The best known example is the percentage of innovative firms, which is constructed from the results to four CIS questions.

Complex indicators can be much more revealing of firm strategies than simple indicators and consequently could be of great value to the policy community. This section gives examples of new complex indicators of relevance to markets, knowledge diffusion, and innovative capabilities. The new indicators are obtained from analyzing the micro-aggregated CIS-3 data that was released by Eurostat in July 2006[8]. A major drawback is that the dataset only contains results for two highly developed countries, Belgium and Iceland, and for 10 less innovative EU member states – one more illustration of the problem of access to CIS data. Nevertheless, the results illustrate what could be done with new ways of using the CIS to construct indicators. These indicators could also be constructed in the future using CIS-4 data, since the relevant information is also obtained by the CIS-4 questionnaire.

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projects, visits to successful innovative firms, help with identifying relevant new technology, and courses on innovation management.

The new indicators provided below only use non interval level data with high response rates to the specific question. Interval level questions suffer from higher non-response rates, resulting in a high percentage of missing values when results are combined across indicators, resulting in unrepresentative results[9].

3.1 New to Market products

The published CIS indicators include an indicator for the innovation sales share, defined as the percentage of total product sales, aggregated across all firms, due to products that were 'new to the firm's market'. The indicator is widely used, including in the European Innovation Scoreboard. The best performing European countries on this indicator, using CIS-3 results, are Spain with an innovation sales share of 16.3%, followed by Finland (14.5%) and Portugal (10.8%). In comparison, rates are much lower in Germany (6.2%), France (5.8%), Belgium (5.1%), the Netherlands (3.1%), and the UK (1.7%).

These results are puzzling and act to reduce confidence in the CIS. For example, the common perception is that Portugal should not perform almost three times better on this indicator that the Netherlands and almost five times better than the UK. The explanation is that the question asks about sales from products that are new to the *firm's* market. There can be a large variation in what constitutes a market and in the sophistication of that market. Portuguese and Spanish firms could be outperforming the Netherlands and the UK because they are introducing innovations, already available on other markets, into a less developed domestic market. Furthermore, the firm does not need to have developed the innovation itself, but could simply be passing on an innovation that was developed by another firm based in a different market. Consequently the indicator is misleading – its interpretation in the Netherlands is not equivalent to its interpretation in Spain or Portugal.

The misleading characteristic of this indicator can be partially solved by building a complex indicator that includes data from a CIS question on the firm's market: local, national, or international[10]. A reasonable assumption is that firms that have introduced a new-to-market innovation *and* are active on international markets are subject to greater competition and therefore 'new-to-market' innovations will be more comparable among firms based in different countries.

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[8] All results are weighted to reflect the population of firms in each country.
[9] National statistical offices or Eurostat can solve this problem by imputing missing values using other information on the firm that is available from the CIS, but this technique was either not applied to micro-aggregated dataset or confidentially concerns resulted in a large number of missing values.
[10] The question asks for the firm's main market. An international market can include a neighbouring country. The CIS-4 questionnaire will provide more accurate results because it asks about local, national, other EU, and non-EU international markets.

Table 1 gives results for three new-to-market indicators. Column A gives the publicly-available indicator for the innovative sales share, with firms based in Portugal, Spain, Romania, the Czech Republic and Slovakia performing better than firms based in Belgium. Belgium's relative performance improves using the column B indicator for any new-to-market innovation. Indicator C gives the results for the complex indicator that gives the percentage of firms that introduced any new-to-market innovation *and* were active on an international market[11]. Using this indicator, Belgium is the leading country, while Spain shifts from the best performer using indicator A to the worst performer. These results suggest that the apparent success of Spain using indicator A is from product sales on the domestic market that may already be available on other markets. In general, the complex indicator C provides results that should be more comparable across countries.

Table 1. New to market innovation indicators

		A	B	C	
		Innovative product sales share	Any new to market innovation	Any new to market innovation *and* active on an international market	Ratio C/B
Belgium	BE	5.1	18.0	8.2	0.45
Bulgaria	BG	2.1	6.3	1.0	0.17
Czech	CZ	7.2	12.3	7.4	0.61
Estonia	EE	4.5	13.9	4.7	0.34
Greece	GR	2.9	11.3	2.2	0.19
Spain	ES	16.3	11.3	1.2	0.11
Iceland	IS	2.0	11.1	2.9	0.26
Lithuania	LT	4.3	13.1	2.7	0.21
Latvia	LV	2.3	17.8	6.4	0.36
Portugal	PT	10.8	19.8	4.4	0.22
Romania	RO	7.8	13.8	3.5	0.25
Slovakia	SK	6.2	8.0	3.4	0.43

Source: CIS-3 micro-aggregated data referring to innovative activities in 1998-2000.

3.2 Diffusion

Diffusion based innovation is an essential and important aspect of innovation. Knowledge diffusion includes both embodied knowledge, where the purchase of advanced machinery provides access to the knowledge contained in the equipment (which does not need to be understood) and disembodied knowledge[12], obtained from

[11] Given full interval level data, the indicator can be calculated as the share of total product sales from new-to-market innovations by firms active in international markets.

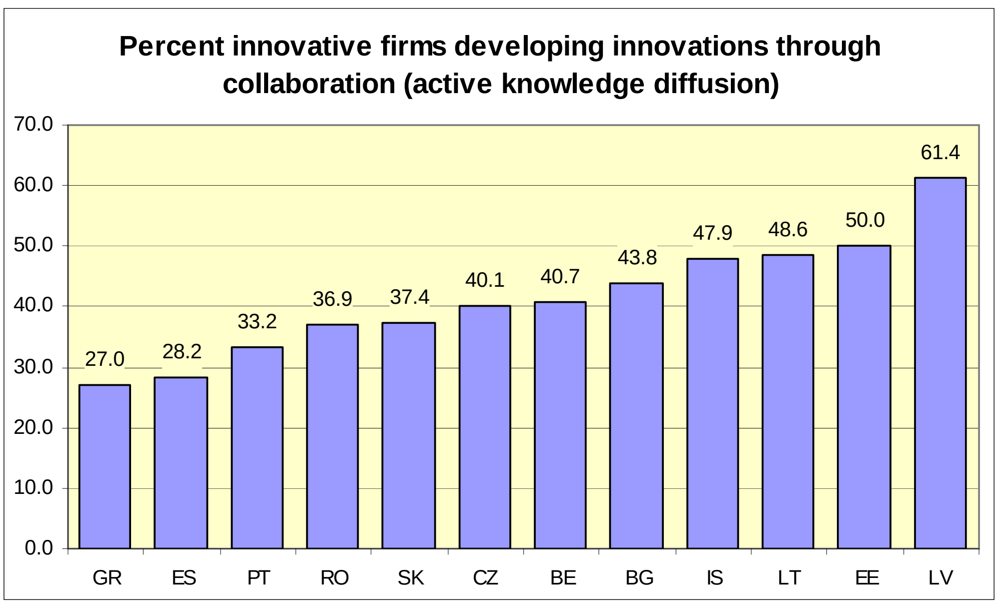
[12] A good indicator for disembodied knowledge transfer could be produced using the CIS question on expenditures on the acquisition of machinery, equipment and software. This has not been available for

open and freely available sources such as scientific publications or attending a trade fair, and knowledge obtained directly from other people through collaboration. The third edition of the Oslo Manual (OECD, 2005) stresses the importance of collecting information on each of these three methods of diffusion.

These three types of knowledge diffusion can also be divided into two groups: active knowledge diffusion in which firms primarily obtain their innovations through collaboration with other firms or institutions, and non-interactive knowledge diffusion in which firms only obtain external knowledge through open sources or through purchasing technology. In the former case firms will invariably need to interact with other firms or institutions and sometimes collaborate on their innovation projects. In the latter case almost all innovative activity occurs in-house.

Active knowledge diffusion can be identified using the CIS-3. It is defined here as a positive response to one or more of three questions: the firm's *product* innovations were developed mainly in cooperation with other enterprises or institutions, or the firm's *process* innovations were developed mainly in cooperation with other enterprises or institutions, or the firm had one or more cooperation arrangements on innovation with other firms or institutions. The results are given in Figure 1.

Figure 1.



Source: CIS-3 micro-aggregated data referring to innovative activities in 1998-2000.

all EU countries due to a high non response rate to this question, but the response rate in CIS-4 appears to have improved substantially.

Other types of indicators for diffusion can also be constructed. For example, it is possible to combine knowledge diffusion through both technology adoption and through active collaboration by including firms that give a positive response to acquiring advanced machinery and equipment, or which report that their product and process innovations were mainly developed by other firms. Such an indicator can identify the importance of all types of diffusion to firms. For the 12 countries in our data set, 78.7% of firms report innovating through one or more diffusion-based methods, highlighting the crucial importance of diffusion to innovation.

3.3 How firms innovate

The CIS defines a firm as innovative if it has introduced at least one product or process that was new to the firm itself. This means that a firm can be innovative even if it purchases new technology off-the-shelf with minimal effort on its own part, while other respondent firms might have extensive in-house R&D projects to develop innovations. The consequence is that the widely available indicator for the percent of firms that innovate is of minimal value to policy because it provides no information on innovative capabilities. An increase or decrease in this indicator does not necessarily mean that innovation support policies have failed or succeeded – a net increase could be due to a decline in the share of firms with highly developed innovative capabilities combined with an increase in minimally innovative firms.

The solution to this problem is to develop a set of indicators that describe *how* firms innovate, using a methodology that assigns all CIS firms to one and only one category. Previous research has taken this approach (Tether, 2001; Arundel, 2004), but the relevance of the results were either hampered by a lack of policy interest or the use of questions with high non response rates, requiring complex and non-transparent statistical routines to assign all firms to the best fitting innovation category.

The method proposed here and summarized in Figure 2 avoids the non response problem by only using nominal level questions and improves policy relevance by focusing on two innovation characteristics that are important to European policy based on the UNU-MERIT interviews: collaboration and formal innovation based on R&D or patenting. The first axis for the indicator is whether or not the firm is involved in active knowledge diffusion based on collaboration (defined above), while the second is whether or not the firm has formal in-house creative activities, as measured by a positive response to one of two questions: the firm performs R&D or the firm has applied for at least one patent. These are defined as ‘inventive’ firms that are most likely to produce innovations that contain a major technical advance. The alternative consists of informal innovators that could develop innovations on an ad hoc basis, such as through production engineering. Of note, Figure 2, and the results given in Table 2 and Figure 3, exclude non-innovative firms, which account for a large share of all firms in several of the less innovative countries[13].

Figure 2: How innovative firms innovate

Percentages in bold sum to 100% of all innovative firms

Formal in-house creative innovation

Non-collaborators			Collaborators
	A *Inventive non-collaborative innovators* **24.7%**	**B** *Inventive collaborative innovators* **18.1%**	
	D *Informal non-collaborative innovators* **41.4%** **(***8.9% are technology adopters)*	**C** *Informal collaborative innovators* **15.8%**	

Informal or no in-house creative innovation

Source: CIS-3 micro-aggregated data referring to innovative activities in 1998-2000.

The goal for policy is to increase innovative capabilities by shifting the national distribution of innovative firms upwards and towards the right in Figure 2 – and to encourage non-innovative firms, particularly in less innovative countries, to enter one of the four innovative categories. Of note, the lower left hand quadrant D accounts for the largest share of innovative firms, at 41.4%. This group includes firms that only innovate through adopting technology developed by other firms or institutions, essentially ‘off-the-shelf’ innovators, that account for 8.9% of the total.

Table 2 gives some characteristics of the four groups of firms, with separate results given for technology adopters in the lower left quadrant D of Figure 2. Compared to the average, a significantly lower proportion of firms in quadrant D are active on international markets, source external knowledge (although almost all innovative firms source some knowledge for the innovative activities from external sources), and have introduced both a product and a process innovation. These results suggest that the non-collaborative informal innovators have less intensive innovative activities that the other groups, but some of them could have reasonably advanced innovative capabilities.

[13] The share of non innovators is 50.0% in Belgium, 88.4% in Bulgaria, 68.1% in the Czech Republic, 63.4% in Estonia, 66.9% in Spain, 71.9% in Greece, 46.7% in Iceland, 71.8% in Lithuania, 60.8% in Latvia, 54.0% in Portugal, 82.8% in Romania, and 80.4% in Slovakia.

Table 2. Characteristics of innovative firms

	A Inventive non-collaborators	B Inventive collaborators	C Informal collaborators	D-1 Informal non-Collaborators	D-2 Technology adopters
International market[1]	25.5%	36.9%	22.7%	17.4%	9.5%
Source external knowledge[2]	89.2%	95.8%	88.6%	82.8%	82.5%
Product innovator	85.1%	85.9%	64.1%	66.0%	52.8%
Product & process innovator	43.3%	64.4%	42.1%	31.2%	10.9%

Source: CIS-3 micro-aggregated data referring to innovative activities in 1998-2000.

1: Firm's main market.
2: Gave a rating of 'high' or 'medium' importance to at least one of 7 external knowledge sources for their innovative acitivies: suppliers, customers, competitors, universities, government research institutes, conferences/meetings/journals and fairs/exhibitions.

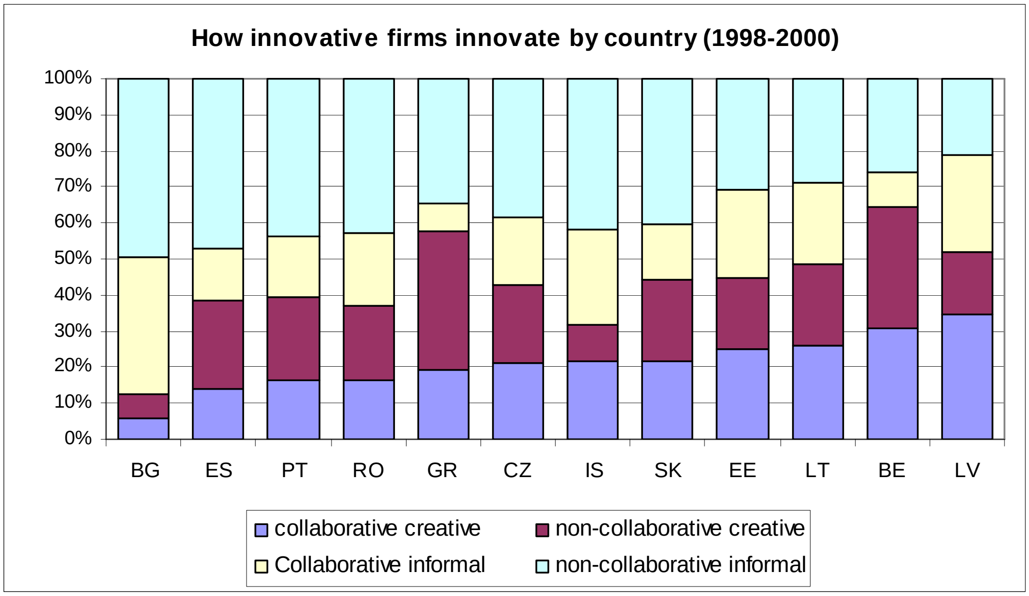
Figure 3 shows that there are large differences in how firms innovate by country. Spain, and Greece have low percentages of innovative firms that collaborate on innovation compared to Belgium, particularly firms that are inventive innovators. Almost all innovative firms in Bulgaria innovate through informal non-R&D based activities, whereas this proportion is much lower in Belgium and in Greece. Information on the distribution of how firms innovate should help policy analysts to better understand national innovative capabilities and to develop appropriate policy actions that can shift firm capabilities to greater collaboration and inventiveness. As shown in Table 2, both of these characteristics are associated with a higher incidence of activity on international markets, product innovation, and combined product and process innovation.

Conclusions

This paper proposes that one of the main barriers to the use of the CIS by the policy community is a lack of indicators and analyses that are relevant to policy needs. In part this is not surprising because one of the main goals of the CIS was to provide data on non R&D based innovative activities, whereas innovation policy is dominated by supply-side R&D support programs. Changes in the policy focus that stress demand, commercialization, and collaboration should increase the value of the CIS, if the CIS data are used to develop appropriate indicators on these issues and if academics discuss the policy relevance of their econometric analysis.

One of the main problems to date is a lack of an interface between the policy community and statistical offices and academics who use the CIS data. One respondent to the UNU-MERIT interviews noted that analysis "must be pull driven – pulled by policy interest and not the other way around. Without these interface mechanisms, the analytical results of the CIS are not visible." Otherwise, according to a second respondent, the results of the CIS were rarely used to inform policy because of the "long, long distance between the analysts and people who write papers based on the CIS and the decision-making level at ministries".

Figure 3



Source: CIS-3 micro-aggregated data referring to innovative activities in 1998-2000.

The three examples of new types of indicators that could be created using the CIS data are in response to the suggestions from the policy analysts interviewed by UNU-MERIT. However, this is an ad-hoc and incomplete method of identifying the types of indicators that would help the policy community. In this respect Statistics Canada is a good example of how to do things right. The division responsible for the Canadian Innovation Survey is frequently in contact with its users from government ministries and can provide customized analyses of data or implement additional surveys, based on funding by the ministry making the request. This process ensures an ongoing interface between Statistics Canada and the users of innovation data, and ensures that Statistics Canada has the in-house expertise to respond to user needs.

Fortunately, several actions are underway to improve available indicators based on the CIS and to solve some of the problems with microeconomic analysis. The OECD, Eurostat, and the group of Nordic countries are currently supporting research on the development of new CIS indicators. The OECD is also organising a series of parallel econometric analyses of innovation survey data in order to overcome problems of data access due to confidentiality restraints. To date, 14 countries are participating. This should provide more robust results on major policy issues such as the link between innovation and productivity. Eurostat is also developing a ‘safe access centre’ to permit academic access to CIS data from several European countries.

Finally, due to its industrial structure with large fixed investment in low and medium technology sectors, Europe cannot attain its goal of a marked increase in productivity over the short term without a significant increase in the innovative capacity of low and medium technology manufacturing sectors, the service sectors, and the public sector. Innovation in these sectors is strongly influenced by innovation as a diffusion process, whereas R&D based invention is more crucial to high technology manufacturing. The CIS was designed to provide data on many types of innovative activities and consequently should be a key source of useful data for the European policy community. Research to develop indicators, descriptive analysis, and econometric analysis needs to revisit some of the issues that led to the development of the CIS in the first place.

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References

Arundel, A. (2004) *The Use of Innovation Support Programs by European SMEs: An Analysis of the Innobarometer 2004 Survey*. TrendChart statistical papers, December 15. http://trendchart.cordis.lu/scoreboards/scoreboard2004/pdf/Innobarometer%202004_MERIT%20analysis.pdf, last accessed September 12, 2006.

Arundel A and Hollanders H. (2005) *EXIS: An Exploratory Approach to Innovation Scoreboards*. TrendChart statistical papers, March. http://trendchart.cordis.lu/scoreboards/scoreboard2004/pdf/EXIS.pdf, last accessed September 12, 2006.

Bell, M. (2006) Science and Technology for Development: Ripe for L20 initiatives? Background paper to the L20 Workshop, UNU-MERIT, Maastricht, March 7-8, 2006.

CEC (Commission of the European Communities) (1995). *Green Paper on Innovation*, CEC, Luxembourg.

CEC (Commission of the European Communities) (2005) Proposal for a Decision of the European Parliament and the Council Establishing a Competitiveness and Innovation Framework Program (2007-2013), COM(2005) 121 Final, Brussels, April 6.

CEC (Commission of the European Communities) (2006). Creating an Innovative Europe, Office for Official Publications of the European Communities, Luxembourg, January. http://ec.europa.eu/invest-in-research/pdf/download_en/aho_report.pdf, last accessed September 12, 2006.

EC (European Commission) (2005), *Innovation in Europe: Results for the EU, Iceland and Norway*. Eurostat, Luxembourg.

Godin, B. (2002) *The Rise of Innovation Surveys: Measuring a Fuzzy Concept*. Project on the history and sociology of S&T statistics, Working Paper no. 16, CSIIC, Montreal.

OECD (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, OECD, Paris.

Smith, K. (2002) What is the knowledge economy? Knowledge intensity and distributed knowledge bases. *INTECH Discussion Paper Series 2002-6*, United Nations University, Maastricht.

Smith, K. (2005) Measuring Innovation, in Fagerberg J (ed) *The Oxford Handbook of Innovation*.

Tether B. (2001) Identifying Innovation, Innovators and Innovative Behaviours: A Critical Assessment of the Community Innovation Survey (CIS). CRIC Discussion Paper No. 48, CRIC, University of Manchester, December.

Veugelers R. and B. Cassiman. (2005) R&D cooperation between firms and universities: Some empirical evidence from Belgian manufacturing. *International Journal of Industrial Organization* 23:355-379.