Innovation Statistics for the European Service Sector

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Executive Summary

This report provides indicators for innovation in the business services sector of the European Union. For comparison, identical indicators are provided, where possible, for the manufacturing sector. The main results are given in Section 4, which compares policy-relevant innovation indicators for services and manufacturing, and Section 5, which calculates a Service Sector Innovation Index (SSII) and uses the results to explore several issues on the nature of innovation by service sector firms.

Section 4 focuses on whether or not innovation policy is adequately serving the needs of service sector firms by comparing innovation indicators for firms in the service and manufacturing sectors. A common concern is that innovation policy could be biased in favour of manufacturing. The results of these analyses are summarized in Table E1 and suggest that policy actions to improve the innovative capabilities of service sector firms should focus on the following aspects, where service firms receive less assistance than manufacturing firms: public procurement and support from innovation programmes. For three policy areas, support could be required under specific conditions ('qualified' in Table E1), while for three areas there is no evidence to suggest that policy is biased against service firms: supply of qualified personnel, support for start-ups, and regulatory burdens.

Table E1. Are policy interventions required to reduce programme bias against service sector firms?

Policy area	Action needed?
1. Encourage service sector firms to use intellectual property	Qualified
2. Public procurement (demand factor)	Yes
3. Improve supply of qualified personnel	No
4. Improve use of and access to public science	Qualified
5. Support foundation of start-ups	No
6. Improve support of innovation programmes for service sector firms	Yes
7. Reduce regulatory burden	No
8. Improve financing	Qualified

Section 5 finds that several of the new member states perform better on service sector innovation than they do on general innovation, as measured in the 'European Innovation Scoreboard' summary innovation index. The results suggest that innovative service sector firms in the new member states could benefit as much from innovation as firms in more innovative countries, even though the nature of the 'innovation' could be very different.

The results of an analysis of knowledge intensive business sectors (KIBS) provide no evidence that KIBS drives overall innovative performance, as measured by a change in the 'European Innovation Scoreboard' summary innovation index. However, the KIBS share of total employment and value-added in 2004 is positively correlated with innovative performance on the 2006 SII. This is probably because of the high level of innovative activity within KIBS itself, such as in software development. The lack of evidence for a driving role

for KIBS could be due to a lack of data for NACE 73, which is a key KIBS sector that includes R&D services and high technology start-up firms.

1. Introduction

The business services sector includes wholesale and retail trade, hotels and restaurants, transport, storage and communication; finance and banking; and real estate, renting and business activities such as consultancy and research firms. On average, business services contributed to 39.9% of total EU-25 employment in 2004 and to 46.2% of EU-25 value-added. This contribution is over twice as large as the contribution of the manufacturing sector to the EU-25 economy. Knowledge Intensive Business Services (KIBS) have also attracted policy interest because of rapid rates of growth in some countries and because it is a highly innovative sub-sector within services.

The relative economic contribution of KIBS has been increasing over time, while that of manufacturing has been declining. The share of total value added inflation corrected due to manufacturing declined by 2.5 % between 1999 and 2004 while the share of all business service value added decreased by 0.3 % and KIBS increased by 6.8 %. Based on these trends and the larger contribution of services to the economy, KIBS are likely to be one of the main factors for future growth within the European Union.

The economic importance of services suggests that improvements in European living standards are likely to depend more on productivity improvements in business services than in manufacturing. This has been demonstrated for the United States, where business services contributed three-quarters of the increase in productivity after 1995 (Bosworth and Triplett, 2007). Much of the productivity increase is due to different types of innovation, developed both in-house by service firms and from service firms adopting productivity enhancing innovations such as ICT.

Although both the economic weight of business services and the importance of service sector innovation to economic prosperity have been recognized for well over a decade, there has been a lag in the collection of European innovation statistics for services and in the development of innovation policies of relevance to service sector firms. There are partly good reasons for this, in addition to the inertia of statistical collection systems and innovation policy. For instance, the manufacturing sector is the source of many of the technical product and process innovations that are adopted by business service firms. However, a growing awareness of the role of non-technological innovation, software, and logistics in innovation has meant that the service sector is no longer (if it ever was) a passive adopter of manufacturing innovations. This is also leading to a rethink of European innovation policy and an evaluation of the steps that might be needed to remove or reduce the policy bias towards manufacturing[1].

This report provides a statistical overview of the European Union's services sector. The purpose is to assist the policy effort to develop a sound "overall assessment of innovation in services" as part of an evaluation of European innovation policies. For this reason, this report

[1] Examples include the report by the European Commission, *Staff working document on innovation in Services* (2007), and the report by the Expert Group on Innovation in Services, *Fostering Innovation in Services - Final Report, 2007*.

focuses on innovation indicators of relevance to policy. In addition to a methodological chapter that describes two main sources of innovation data, the report contains four chapters:

- Chapter 3 provides basic statistics on the contribution of business services to EU-25 employment and value-added, plus data on the innovative status of service and manufacturing firms.

- Chapter 4 gives an overview of available statistics on the innovative strategies and characteristics of industrial and service sector firms. Results are provided for eight specific topics: 1) use of intellectual property, 2) demand conditions, 3) supply of qualified personnel, 4) use of public science, 5) start-ups, 6) innovation support programmes, 7) regulatory burdens, and 8) financial constraints.

- Chapter 5 examines the relationship, at the member state level, between innovation performance in manufacturing and performance in services. The analysis is based on creating summary innovation indicators using CIS-4 data for both the manufacturing and service sectors. The chapter also looks at the role of Knowledge Intensive Business Services (KIBS) in innovative performance.

- Based on the above analyses, Chapter 6 makes a few recommendations for how to improve the measurement of service sector innovation in the future, either through modifications to the CIS or through other surveys.

2. Methodology

The statistics in this report are obtained from two sources: the fourth Community Innovation Survey (CIS-4), which covers the innovative activities of firms in the three years between January 2002 and December 2004, and the Flash Barometer Survey 164 (FBS), which covers the two year period before the fall of 2004. Although the CIS-4 is the main European instrument for innovation indicators, this report also uses the FBS because it obtains useful information that is not available in CIS-4.

Community Innovation Survey (CIS-4)

The CIS-4 is a cross-sectional survey of all firms with over 10 employees in all 27 EU member states. It was conducted in most countries in the spring of 2005, with over 60,000 respondents in total. The survey includes all manufacturing sectors and many, but not all, services sectors (in most countries it does not include hotels and restaurants (NACE section H) or retail trade (Section G, 52)). Aggregate industry level CIS-4 data are available from Eurostat New Cronos website. The disadvantage with using aggregate CIS-4 data is that the data cannot be reanalyzed at the firm level, for example, to look at specific firm size classes or to combine different questions, and it is not possible to calculate the statistical significance of differences between the industrial and service sectors. In addition, for some questions, data are only available for a limited number of countries. All results are weighted to reflect the total population of firms in each country and sector.

Flash Barometer Survey 164 (FBS)

FBS is a cross-sectional survey, conducted in the fall of 2004. It collected data on policy use and the activities of innovative firms for the two-year period before the survey. No data were collected for firms that did not innovate. The results are based on a quota sample of 4,534 innovative small and medium sized enterprises (SMEs) with between 20 and 499 employees in 25 EU countries[2]. The number of sampled firms varies by country, ranging from approximately 100 respondents in each of the smaller member states to 300 respondents in each of the larger states. All analyses were conducted by the authors and the results weighted to reflect the total population of SMEs across the EU-25. Where relevant, the statistical significance of differences between the industrial and service sectors are given.

The limitation of the FBS survey to *innovative* SMEs with between 20 and 499 employees is not a significant problem, since innovative SMEs are the target of a large number of innovation programmes. The FBS survey also obtained data on several topics that were not covered by any of the CIS surveys: the use of eight different types of innovation support programmes, the sophistication of public procurement for innovative products and services, and the level of satisfaction with national university graduates.

The FBS results cover 2,005 industrial SMEs (mining, construction, and manufacturing) and 2,529 SMEs in the service sector. The latter are disaggregated into four sub-sectors: trade, transport, finance and communication, and 'other' services. The 'other' group includes knowledge intensive services, but also SMEs in the hotel and restaurant sector.

[2] Bulgaria and Romania were not included, since at the time they were not member states of the European Union. For more details on the methodology of the FBS survey, see Arundel (2004).

Comparison of CIS-4 and FBS

The general patterns between the CIS-4 and FBS surveys are often comparable, but there is no expectation for the two surveys to give very similar results, due to differences in the surveys. For example, the CIS-4 covers all firms over 10 employees, including very large firms, while the FBS only covers SMEs between 20 and 499 employees. Furthermore, the results for the FBS are for all 25 EU countries at the time of the survey, whereas the CIS-4 results are often missing for several major member states.

This report provides results from both the CIS-4 and the FBS for all industrial firms, all service firms, all manufacturing firms, and for several sub-sectors within services. The definition of each sector in the two surveys is given in Table 2a. The only identical definition is for manufacturing, but the results for all industry and all services are roughly comparable.

Table 2a Sector definitions in the CIS-4 and FBS surveys: NACE codes in parentheses

	CIS-4	FBS
All industry	Mining & quarrying (C), Manufacturing (D), and utilities (E)	Mining & quarrying (C), Manufacturing (D), and Construction (F)
Manufacturing	Manufacturing (D)	Manufacturing (D)
All Services	Wholesale trade (G-51), Transport, storage & communications (I), Financial intermediation (J), Real estate, renting and business activities (K)	Trade (G), Hotels and restaurants (H), Transport, storage & communications (I), Financial intermediation (J), Real estate, renting and business activities (K)
KIBS	K (excl. 70 & 71)[3]	-
All services excluding KIBS	Wholesale trade (G-51), Transport, storage & communications (I), Financial intermediation (J)	
Trade		Trade (G)
Transport		Transport and storage (I 60 – 63)
Finance/communication		Financial intermediation (J), Post and telecommunications (I-64)
Other services		Real estate, renting and business activities (K), Hotels and restaurants (H)

[3] The following NACE classes are included: Computer and related activities (K72), Research and development (K73), Architectural and engineering activities and consultancy (K74.2) and Technical testing and analysis (K74.3). K73 (Research and development) was included on a voluntary basis in CIS-4, therefore it is not available for all countries. It is excluded from the summary indexes in Section 5.

3. Basic Statistics

Table 3a gives basic statistics for 25 EU member states on employment and value added in manufacturing, all business services, and for Knowledge Intensive Business Services (KIBS), which is a subset of all business services. For all 25 EU countries combined, business services contribute over two and half times the value added of manufacturing. The share of business services in total national value added (GDP) varies from a low of 41.3% in Hungary to highs of 64.9% in Luxembourg and 51.9% in the UK.

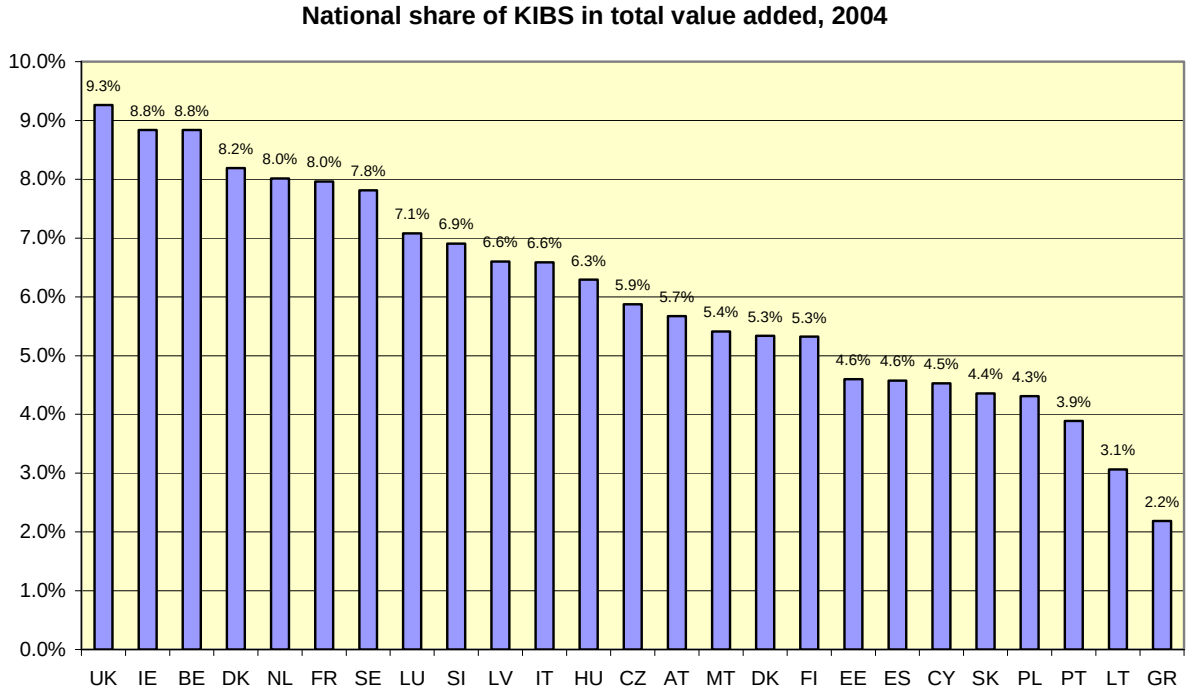
Table 3a. National and EU-25 sector shares in 2004 total employment and value added

	Employment shares			Value added		
	Manu-facturing[1]	Business services[2]	KIBS[3]	Manu-facturing[1]	Business services[2]	KIBS[3]
Austria	18.2%	42.7%	5.4%	19.9%	47.3%	5.7%
Belgium	16.7%	39.1%	4.4%	17.4%	50.9%	8.8%
Cyprus	11.1%	44.3%	1.2%	6.2%	53.8%	4.5%
Czech Republic	30.1%	32.8%	4.0%	25.6%	41.9%	5.9%
Germany	21.1%	40.2%	6.6%	22.6%	47.2%	8.2%
Denmark	15.5%	39.2%	5.3%	14.5%	45.5%	5.3%
Estonia	25.0%	32.0%	1.0%	17.1%	51.2%	4.6%
Spain	17.7%	33.7%	3.5%	16.3%	46.6%	4.6%
Finland	19.8%	34.8%	5.4%	23.5%	43.5%	5.3%
France	14.3%	41.6%	6.5%	13.8%	50.8%	8.0%
Greece	15.8%	31.1%	4.5%	10.7%	51.6%	2.2%
Hungary	25.0%	32.2%	3.3%	22.5%	41.3%	6.3%
Ireland	16.6%	40.1%	4.6%	27.0%	41.4%	8.8%
Italy	23.3%	32.2%	4.5%	19.0%	49.7%	6.6%
Lithuania	20.9%	31.1%	2.1%	20.9%	44.3%	3.1%
Luxembourg	11.5%	53.4%	6.9%	9.4%	64.9%	7.1%
Latvia	17.8%	37.4%	2.3%	13.2%	54.2%	6.6%
Malta	17.9%	40.9%	4.5%	17.8%	46.2%	5.4%
Netherlands	12.7%	47.3%	7.3%	14.0%	49.2%	8.0%
Poland	24.6%	34.2%	3.3%	19.2%	44.8%	4.3%
Portugal	21.6%	35.5%	2.7%	15.7%	45.7%	3.9%
Sweden	16.9%	36.0%	6.9%	19.7%	45.0%	7.8%
Slovenia	31.2%	34.1%	5.8%	25.7%	41.9%	6.9%
Slovakia	26.3%	32.8%	3.6%	23.4%	44.6%	4.4%
United Kingdom	12.7%	49.9%	7.3%	13.7%	51.9%	9.3%
EU-25	16.8%	39.9%	5.8%	18.3%	46.2%	6.6%

Source: EUKLEMS, March 2007
1 = NACE D.
2 = NACE G, H, I, J, and K .
3 = NACE 72+73+74(1 TO 4). Note that KIBS is a sub-sector of business services.
Note: 'Missing' employment and value added shares are largely due to government activities, plus a small share from resources (agriculture (A), fishing (B), and mining and quarrying (C)) and from community, social and personal services (O).

There is greater variation in the contribution of KIBS to value added, ranging from a low of 2.2% in Greece to a high of 9.3% in the UK. For the EU 25, KIBS accounts for 5.8% of total employment and 6.6% of total value added. Figure 3-1 ranks the EU countries in terms of their share of KIBS in total national value added.

Figure 3-1



Source: EUKLEMS, 2007

3.1 Innovative Status

Firms can innovate through technical innovation (new products and processes) and via non-technological innovation (new organizational and marketing methods). Table 3b gives results for technical innovation while Table 3c gives results for non-technological innovation.

As expected, a lower percentage of all service sector firms (34.0%) than all manufacturing firms (39.3%) are technical innovators (introduced either a product or process innovation). A higher share of manufacturing than service sector firms also introduced a product innovation (26.8% versus 22.1%) and a process innovation (29.9% versus 25.7%). The exception is KIBS firms, which are more likely than manufacturing firms to introduce either a product or process innovation (51.5% versus 39.3%) a product innovation (42.0% versus 26.8%), or a process innovation (35.3% versus 29.9%). The patterns for innovative firms only (Part B of table 3b) are similar, although the difference between the share of manufacturing and service firms that introduced a process innovation is very small (76.1% versus 75.6%).

Table 3b. CIS-4: Percent of firms that introduced a product or process innovation

	Product or Process innovation	Product innovation	Process innovation
A. All firms:			
Industry	39.0	26.4	29.8
Manufacturing	39.3	26.8	29.9
Services*	34.0	22.1	25.7
KIBS**	51.5	42.0	35.3
Services (excl. KIBS)	30.2	17.9	23.6
B. All novel product and process innovators:			
Industry	-	67.7	76.4
Manufacturing	-	68.2	76.1
Services*	-	65.1	75.6
KIBS**	-	81.5	68.6
Services (excl. KIBS)	-	59.2	78.2

Data available for EU27 less Latvia, Slovenia and the United Kingdom.
* Services defined as INN_G to K plus K73
** KIBS defined as INN_K plus K73

Source: Eurostat, New Cronos

Non-technological innovation

Table 3c gives the percentage of all firms (part A) and innovative firms only (part B) that introduced two types of non-technological innovations: organizational and marketing innovations. Part A shows that there are no differences in the percentage of all industrial and service sector firms that introduced either an organizational or marketing innovation, an organizational innovation, or a marketing innovation. However, KIBS firms were far more likely to introduce each type of innovation while service firms excluding KIBS were slightly less likely than manufacturing firms to introduce each type of non-technological innovation.

For innovative firms only, a higher percentage of service firms introduce each type of non-technological innovation, with the difference greatest for organizational innovations. There is little difference in organizational innovation rates within the two services sub-sectors, whereas a higher percentage of innovative service firms excluding KIBS (37.2%) introduced a marketing innovation than KIBS service firms (31.3%).

Table 3c. CIS-4: Percent of firms that introduced a non-technical innovation

	Organizational or Marketing innovation	Organizational innovation	Marketing innovation
A. All firms:			
Industry	26.0	22.7	13.1
Manufacturing	26.2	22.7	13.3
Services	26.0	23.7	13.0
KIBS	41.5	38.3	17.7
Services (excl. KIBS)	22.7	20.6	12.0
B. Enterprises with innovation activities:			
Industry	63.5	55.3	32.0
Manufacturing	63.4	55.1	32.3
Services	71.3	64.9	35.6
KIBS	73.6	67.8	31.3
Services (excl. KIBS)	70.4	63.8	37.2

Data available for EU27 less Latvia, Finland, Slovenia, Sweden and the United Kingdom
* Services defined as INN_G to K plus K73
** KIBS defined as INN_K plus K73

Source: Eurostat, New Cronos

4. Innovation in the Industrial and Services Sectors

4.1 Use of Intellectual Property (IP)

Table 4-1a gives the percentage of CIS-4 respondent firms that report an application for each of four types of IP in the preceding three years, while Table 4-1b gives the percentage of SMEs from the FBS that applied for a patent or trademark in the preceding two years. In both surveys, approximately twice as many industrial than service firms applied for a patent and more industrial than service firms applied for a trademark, although the difference is not as large in the FBS survey. A much lower percentage of firms in KIBS apply for a patent than industrial firms (12.0% versus 20.1% in CIS-4) and KIBS firms are also less likely to apply for a trademark.

The percentage of service and industrial firms that registered an industrial design is similar (16.3% versus 18.7% in CIS-4). Service sector firms are slightly more likely than industrial firms to claim copyright (5.9% versus 5.3% in CIS-4). However, this is almost entirely due to KIBS, where 12.5% of firms claim copyright versus 3.2% of other service firms. This is probably due to the use of copyright by computer software firms.

Table 4-1a. CIS-4: Percent of innovative firms that applied for a patent, registered a design or trademark, or claimed copyright between 2002 and 2004

	Patents	Design	Trademarks	Copyright
Industry	20.1	18.7	18.4	5.3
Manufacturing	20.4	18.8	18.7	5.4
Services	8.3	16.3	9.8	5.9
KIBS	12.0	17.6	8.7	12.5
Services – excluding KIBS	6.7	15.5	10.0	3.2

Source: New Cronos. Number of reporting countries by IP are: patents 12, design 16, trademarks 15, copyright 13.

Table 4-1b. FBS: Percent of innovative SMEs that applied for a patent or registered a trademark in the two years before fall 2004

	Patents	Trademarks
Industry[1]	16.9	17.1
Manufacturing	20.9	20.5
Services[1]	8.5	14.0
Trade	9.5	17.9
Transport	5.4	9.5
Finance/Communication	6.1	13.0
Other services (KIBs)	8.7	10.9
Total	12.2	15.4

1: Statistically significant difference between all industry and all service firms for patents ($p < 0.000$) and for trademarks ($p = 0.02$).
Source: FBS 2004, analyses by UNU-MERIT. Based on responses from 2,005 industrial and 2,529 service firms.

Conclusions: A lower percentage of service sector firms use IP than industrial firms, with the exception of copyright where use rates are slightly higher in the service sector. KIBS has the highest percentage of firms using copyright.

Policy relevance: Formal, registered IP (patents, trademarks and design registration) are less widely used by service firms than by industrial firms. Policy action would be appropriate if the lower use of these forms of IP was due to a lack of information or experience with using IP. However, another option is that the lower use rate is due to fewer eligible inventions, designs, and brands within the service sector that can be protected using IP. The large gap for trademarks suggests a lack of information or experience by service sector firms, since trademarks should be equally relevant to both industrial and service sector firms. Conversely, the lower rate of product innovation in the service sector (see section 3.2 above) suggests that a smaller percentage of service sector firms have inventions or designs that could be protected using IP or which the requirements for formal IP. If this is true, there is little evidence in support of policy action.

More information is needed to determine the cause of the lower use of formal IP by service sector firms. As a first step, an analysis of CIS-4 micro-data could determine the rate of patent applications and design registration by service and manufacturing firms that introduced a product innovation based on a tangible good. The patent application rate among these service sector firms (after controlling for firm size and other factors) should be much higher than the rate for service sector firms that did not introduce a good. If not, low experience with or information about the patent system could be a factor limiting the use of patents by service sector firms.

4.2 Demand for Innovative Products

Investment in innovation will be influenced by perceptions over the potential market demand for innovative products. Demand can originate with final consumers, other businesses, and with the public sector.

The CIS includes two questions on the effect of low demand as a reason not to innovate. In the analysis given below, the results to the first question (A in Table 4-2a) are limited to innovative firms that report that uncertain demand is an important factor hampering their ability to innovate. The results for the second question (B) are for all firms that state that they did not innovate because of a lack of demand.

A higher percentage of innovative industrial firms (13.4%) than service sector firms (10.7%) report a lack of demand as a problem, although there is little difference between KIBS and manufacturing firms. For all firms, the problem is most prevalent in the KIBS sector, although this could be because of new start-ups that by definition face uncertain demand.

Table 4-2a. CIS-4: Percent of firms reporting a lack of demand for innovative products and processes

	A	B
	Percent innovative firms giving high importance to 'uncertain demand for innovative goods or services' as a factor hampering innovation	**Percent all firms (includes non-innovators) giving high importance to 'no need to innovate because of a lack of demand for innovations'**
All Industry	13.4	2.7
Manufacturing	13.5	2.7
All Services	10.7	2.8
KIBS	13.1	3.7
Services (excl KIBS)	9.4	2.6

Source: Eurostat, New Cronos. The number of reporting countries is 21 for column A and 13 for column B.

The FBS focuses on the possible effect of sophisticated government procurement as a potential driver for innovation. It asks SMEs if public sector customers are more or less demanding of innovative characteristics of their products or services than private sector customers (Table 4-2b). A statistically significant higher percentage of industrial (18.5%) than service firms (14.4%) report that public sector clients are more demanding than business sector clients, although a large majority of firms in both major sectors report no difference.

Conclusions: Industrial firms could be more sensitive to demand conditions than service sector firms, with a higher percentage of them reporting that low demand hampers their ability to innovate. A higher percentage of industrial firms also report that the public sector demands higher innovative content in their goods and services than service sector firms. KIBS firms (and financial/communication firms) are more similar to industrial firms than other service sub-sectors.

Table 4-2b. FBS: Percent firms reporting that public sector clients demand a higher or lower level of innovation from their products or services than business sector clients

	Higher	Lower	No difference[1]	
Industry[2]	18.5	9.9	71.6	100
Manufacturing	16.0	10.6	73.4	100
Services[2]	14.4	12.5	73.1	100
Trade	12.2	11.3	76.5	100
Transport	18.3	4.2	77.5	100
Finance/Comm	16.5	18.3	65.1	100
Other services	15.7	13.8	70.4	100
Total	16.0	11.5	72.5	100

1: Includes a small percentage of firms that report 'Don't know' or 'it depends'.
2: Difference in distribution of responses between all service and all manufacturing sectors is statistically significant with p = 0.02.
Source: FBS 2004, analyses by UNU-MERIT. Based on responses from 911 industrial and 1,273 service firms that report selling products or services to the public sector.

Policy relevance: With the exception of the transport sector, a slightly lower percentage of service sector firms face high public sector demand conditions for innovations than industrial firms. There could be room to encourage innovation in other service sub-sectors through more demanding government procurement conditions.

4.3 Qualified personnel

Well-trained, knowledgeable personnel are essential to both the ability to develop innovations in-house and to adapt innovations acquired from external sources to the needs of the firm.

The CIS asks innovative firms about the importance of a 'lack of qualified personnel' as a factor hampering their ability to innovate. More industrial than service sector firms report this factor as of high importance (11.8% versus 9.6%). There is little difference within the service sub-sectors, with equivalent percentages of 9.7% for KIBS and 9.4% for all service sectors excluding KIBS.

The FBS survey asks SMEs about their level of satisfaction with the qualifications of national university graduates (see Table 4-3a). There are no statistically significant differences between all industrial versus all service firms, nor any notable differences between sub-sectors in services (results not shown). Only 8.1 percent of industrial SMEs are somewhat or very dissatisfied with the qualifications of national graduates compared to 8.2% of service sector SMEs.

Table 4.3a FBS: Satisfaction with the level of qualifications of national university graduates hired by the firm. Percent by level of satisfaction

	Industry	Services	Total
Very satisfied	34.8	37.6	36.4
Somewhat satisfied	54.6	51.0	52.5
Somewhat dissatisfied	6.5	7.2	6.9
Very dissatisfied	1.6	1.0	1.2
Don't know	2.5	3.2	2.9
Total	*100%*	*100%*	*100%*

No significant differences (p = 0.423), nor when broken down by sub-sector.
Source: FBS 2004, analyses by UNU-MERIT. Based on responses from 712 industrial and 830 service firms that report hiring a national university graduate in the previous 2 years.

Conclusions: A lower percentage of service than industrial sector firms have problems with obtaining adequate personnel for innovative activities. There is no difference between the two main sectors in terms of satisfaction with the qualifications of university graduates.

Policy relevance: Service sector firms have slightly lower difficulties obtaining qualified personnel than manufacturing firms. Based on these results, there is no reason to preferentially favor service sector firms in innovation programmes to improve the supply of trained personnel.

4.4 Links with Public Science

Due to the complexity of many modern technologies and the need to combine technology in new ways, firms frequently need to source knowledge and capabilities from a wide range of other firms and institutions. Of particular interest to policy is the function of the 'public science' sector, defined as publicly funded universities or other higher education institutions plus government or public research institutes. National innovation policies have been frequently redesigned to enable public science to transfer research results with potential commercial applications to the private sector. As this system has largely been developed for manufacturing, there is concern that service sector firms could be at a disadvantage. This could have two undesirable effects – public science outputs of relevance to the service sector could languish, and service sector firms could fail to pick up and exploit research results that could improve productivity or open new markets.

CIS-4 contains several relevant questions, based on the percentage of firms that collaborate with public science and the percentage of firms that give a 'high' rating to the importance of public science as a source of information to their innovation activities (see Table 4-4a). Results are available separately for universities/higher education institutes (UNIV) and for government/public research institutes (GOV). The question on collaboration also asks respondents to indicate which collaboration partner was 'most valuable for their innovation activities?'

Table 4-4a. CIS-4: Use of public science by innovative firms

	Collaboration			Information source of high importance	
	UNIV	GOV	Univ/gov most important collaboration partner	UNIV	GOV
Industry	9.9	6.5	3.9	4.9	3.7
Manufacturing	9.8	6.4	3.9	4.8	3.6
Services*	7.4	5.7	3.2	2.7	2.4
KIBS**	16.3	11.5	8.1	5.4	4.3
Services – excluding KIBS	4.0	3.4	1.4	2.3	5.7

Data available for EU27 less Austria, Denmark, Finland, Italy, Latvia, Slovenia, Sweden, Malta, and the United Kingdom
* Services defined as INN_G to K plus K73
** KIBS defined as INN_K plus K73

Source: Eurostat, New Cronos.

As shown in Table 4-4a, a slightly higher percentage of innovative manufacturing firms (9.8%) than service sector firms (7.4%) collaborate with universities. The same pattern holds for the percentage of firms that report that collaboration with public science was the most valuable for them (3.9% in manufacturing versus 3.2% in services). However, almost all collaboration with public science in the service sector is due to KIBS.

The pattern of differences between manufacturing and service firms is more accentuated for the percentage of firms that give public science a high rating as an information source (right

side of Table 4-4a), and it is larger than it is for collaboration. This is particularly noticeable for universities, where 4.8% of manufacturing firms give this source a high rating versus 2.7% of service firms – a difference of 78%. Again, a higher percentage of KIBS firms give public sciences a higher rating than other service sectors, although the difference is lower than for collaboration.

CIS-4 also collects data on other information sources, including market mediated sources (suppliers, customers, competitors and consultants) and publicly available sources (conferences, publications, and industry associations). Policy has less impact on the use of market mediated sources than it does on linkages between public science and firms. There are only small differences in the percentage of firms that give high importance to each market mediated and publicly available information source. In contrast, firms active in KIBS are less likely than manufacturing firms to draw on information obtained from suppliers (19.4% of KIBS firms versus 22.9% of manufacturing firms) and more likely to obtain information from customers (33.1% of KIBS firms versus 27.3% of manufacturing firms). Full results are given in Annex A.

Conclusions: The greatest difference between the service sector and manufacturing in the use of public science is in the percentage of firms that give universities a high rating as an information source (1.8:1), followed by governments as an information source (1.5:1), and collaboration with universities (1.3:1). The lowest difference is for the percentage of firms that collaborate with government (1.1:1). Collaboration by service firms with universities is almost entirely accounted for by KIBS, which has almost double (1.7 times) the collaboration rate of all manufacturing firms combined.

Policy relevance: With the exception of KIBS, service sector firms are considerably less likely to collaborate with universities than manufacturing firms. Whether or not this is due to a bias in favor of manufacturing in collaboration programmes is not clear from the limited data available here. Service sector firms outside of KIBS could have little to gain from university research results, which are often far from the market. The fact that the gap between manufacturing and services declines for collaboration with government and public research institutes, which tend to focus on applied research, suggests that part of the lack of collaboration with universities is due to research results that are not of use to service sector firms.

The much higher difference between manufacturing and service sector firms for the importance of universities as a general information source suggests that universities, even when they are used for collaboration, provide less useful information to service firms than to manufacturing firms.

4.5 Newly Created Innovative Firms

Innovative new firms (or start-ups) provide an important potential for increased employment, productivity, new technologies, and improved methods of delivering goods and services. For all of these reasons, governments are interested in supporting start-ups and creating conditions that encourage their growth.

Although the CIS-4 survey cannot be used to identify start-ups because it contains no data on the age of establishment of the firm, the CIS-3 micro aggregated data provides information about start-ups between the years 1998-2000.

According to Table 4-5a, there were proportionally more start ups between the years of 1998 and 2000 in all industry, manufacturing and services excluding KIBS for all firms than for innovative firms only. On the other hand, for services in general and for KIBS, there are proportionally more start-ups among innovative firms.

For both all firms and for innovative firms only, a higher percentage of firms in services and in KIBS were start-ups compared to the manufacturing and industry sectors. Start up formation is highest in KIBS, particularly among innovative firms.

Table 4-5a. CIS-3: Percentage of novel manufacturing and service sector firms founded between 1998-2000

	% founded between 1998-2000	
	All firms	Novel innovators
Industry	3.4%	3.0%
Manufacturing	3.4%	3.0%
Services	3.9%	4.8%
KIBS	6.6%	8.6%
Services – excluding KIBS	3.1%	2.7%

Data available for EU27 less Denmark, Finland, France, Italy, Netherlands, Sweden and the United Kingdom
Results are weighted, with Germany making up for half of the weighted population

Source: Eurostat, CIS-3 micro-aggregated data. Calculations by UNU-MERIT.

Another source of information, the FBS, asks if firms were founded before 1979, between 1979 and 1998, and since 1999 (up to five years before the survey). There is no statistically significant difference in the share of new (founded in the previous five years) innovative industrial versus innovative service sector firms. However, within the service sector, 15.8% of innovative transport firms are new, compared to an average of 9.8% of all innovative service sector firms (see Table 4-5b).

Table 4.5b Percent of innovative manufacturing and service sector firms founded within the previous 5 years

Industry[1]	11.0
Manufacturing	10.2
Services[1]	9.8
Trade	9.3
Transport	15.8
Finance/Communication	6.9
Other services	9.9
Total	10.3

1: No significant difference; p = 0.18.

Source: FBS 2004, analyses by UNU-MERIT. Based on responses from 2,005 industrial and 2,529 service firms.

Conclusions: The CIS-3 aggregated data indicates that a higher share of firms in services than in manufacturing are start ups. The highest rate is in KIBS. The FBS data do not find a significant difference in start-up shares between all services and all manufacturing, but this could be due to differences in the two samples.

Policy relevance: The results suggest that there is no need to preferentially support start ups in the service versus manufacturing sectors. In general, start-up formation rates are either higher in services (CIS-3) or there are no difference in the rates (FBS).

4.6 Innovation Support Programmes

Policy support for innovation is widely believed to favor industrial over service sector firms. If true, this could partly be due to higher levels of investment in innovation in industrial firms, or at least in activities such as R&D where public support is widely available. A careful evaluation of a possible bias in innovation support to industrial firms should be based on the percentage of firms by sector, that are eligible for receiving specific types of support. For example, only firms that perform R&D are eligible for R&D subsidies or tax credits[4].

The CIS-4 data only permit an evaluation of the percentage of all innovative firms that receive public support, although access to the micro-data would permit an analysis of the percentage of R&D performing firms that obtain public support. In contrast, the FBS survey collects data on eight types of activities and eight types of innovation support linked to these activities.

Table 4-6a gives the CIS-4 results for the percentage of firms that report any public support for innovation and the percentage that report support from the European Union. A substantially higher percentage of industrial firms (28.3%) than service sector firms (16.1%) report any support (mostly from regional or national authorities), although KIBS firms (23.4%) perform almost as well as industrial firms. Although a higher percentage of industrial than service firms receive support from the European Union, the ratio is less skewed towards industry (a ratio of 1.4:1 for industry/services compared to 1.8:1 for any support). This is entirely due to a higher percentage of KIBS firms than industrial firms receiving EU support.

Table 4-6a CIS-4: Percent of innovative firms that receive public support for innovation

	Any public support[1]	European Union Support
All Industry	28.3	5.3
Manufacturing	28.5	5.3
All Services	16.1	3.9
KIBS	23.4	7.1
Services (excl KIBS)	12.9	2.6

1: Support from local/regional authorities, central government, or the European Union.
Source: Eurostat, New Cronos. The number of reporting countries is 17 for any public support and 14 for EU support.

Table 4-6b provides the FBS results for the percentage of eligible SMEs that report public support for their innovative activities. Compared to service sector SMEs, a statistically significant higher share of *eligible* industrial SMEs report any public support, support for using innovation advice services, R&D, hiring new graduates, introducing new processes, and collaborating with other firms or universities. For example, 'N' gives the number of SMEs that are eligible to receive public support. For R&D, 1,284 out of 2,005 industrial SMEs report performing R&D in-house or contracting out R&D and were therefore eligible

[4] This is not the full picture, since firms that do not perform R&D might be interested in doing so if they could receive subsidies.

for public support for R&D. Of these 1,284 eligible SMEs, 20.3% reported receiving "public support for R&D within your firm or for R&D contracted out to other organizations".

The largest difference in support for eligible SMEs is for hiring new graduates (ratio of 2:1 in favor of industrial firms) and for R&D support (ratio of 1.8:1 in favor of industrial firms).

Table 4-6b FBS: Percent of innovative industrial and service sector firms reporting public support for eligible innovative activities (IB)

	Industry		Services		P
	N	%	N	%	
Any public support	2,005	**34.7**	2,529	26.7	**<0.000**
For use of innovation advice services	604	**42.2**	708	36.0	**0.029**
For participating in an innovation network	285	39.6	352	34.3	ns
For training in support of innovation activities	1,087	17.4	1,500	17.4	ns
For market research for innovations	735	14.5	1,013	13.3	ns
For in-house or contracted out R&D	1,284	**20.3**	1,439	11.5	**<0.000**
For hiring new university graduates	739	**12.9**	880	6.5	**<0.000**
For introducing innovative processes	1,159	**10.8**	1,335	7.3	**0.003**
For collaborating with firms, universities, etc.	2,005	**7.9**	2,529	5.5	**0.001**

Ns = not significant ($p > 0.05$)

Source: FBS 2004, analyses by UNU-MERIT. Based on responses for up to 2,005 industrial and 2,529 service firms (for 'any' support).

Table 4-6c gives FBS results for the main results of public support for innovation while Table 4-6d gives the percentage of SMEs that reported that public support was 'crucial' to at least one of their innovation projects in the previous two years. 'Crucial' is defined in the question as 'the innovation could not have been developed without the support'.

The most frequently cited result of public support for industrial SMEs, other than 'no notable effect', is to 'reduce innovation costs'. This is cited by 23.9% of eligible industrial SMEs compared to 16.6% of eligible service SMEs. Conversely, the most frequently cited result for service sector SMEs (excluding 'no notable effect') is to 'improve the quality of innovations'. This is significantly more frequently cited by service sector SMEs (22.7%) than by industrial firms (13.6%).

These are intriguing differences. One possibility is that industrial firms are more successful than service sector SMEs in obtaining support for viable innovation projects that they might have conducted anyway, resulting in a reduction in costs, but with less effect on quality. This would occur if the quality requirements were largely known beforehand and were part of the innovation project goals. In contrast, public support of innovation projects might be producing better outputs (improved quality) without substituting for investments that the service sector SMEs would have made anyway (lower percentage reporting a reduction in costs). The interpretation that industrial SMEs would have conducted the innovation projects even with public support is not supported by Table 4-6d, where equal percentages of industrial and service sector SMEs (23.9% versus 24.4%) report that public support was crucial to at least one innovation project. However, this result does not entirely contradict the

above interpretation because Table 4-6d only refers to at least one project. Of note, the highest percentage of service SMEs reporting 'crucial' support is in 'Other services', which includes KIBS.

Table 4-6c FBS: Main result of public support for innovation. Percent respondents stating that public support helped to:

	Industry	Services	Total
Improve the quality of innovations[1]	13.6	**22.7**	18.3
Reduce innovation costs[1]	**23.9**	16.6	20.1
Speed up the innovation process	12.1	10.9	11.5
Reduce risks	7.6	7.7	7.6
No notable effect	26.3	26.5	26.4
Other	2.7	3.5	3.1
Don't know	13.8	12.1	12.9
Total	*100*	*100*	*100*

1: Difference between the industrial and service sectors is statistically significant ($p < 0.05$).

Source: FBS 2004, analyses by UNU-MERIT. Based on responses from 743 industrial and 722 service SMEs that reported receiving public support for their innovative activities.

Table 4-6d FBS: Percent of SMEs that report that public support was crucial to at least one of their innovation projects in the previous two years

Industry[2]	23.9
Manufacturing	27.4
Services[2]	24.4
Trade	16.8
Transport	5.7
Finance/Communication	18.0
Other services	30.5
Total	24.2

1: Crucial is defined in the questionnaire as 'the innovation could not have been developed without the support'.
2: No significant difference between all service and industrial firms; $p = 0.26$.
Source: FBS 2004, analyses by UNU-MERIT. Based on responses from 743 industrial and 722 service firms that reported the use of one of more public support programmes for innovation.

Conclusions: The results unequivocally show that innovation support policies favor industrial over service sector SMEs, at least in respect to innovative SMEs. The largest bias is for R&D support and subsidies to hire university graduates, but there are also significant differences in support for using innovation advice services, introducing innovative processes, and for collaboration. There is no difference in the percentage of industrial and service sector SMEs that find public support to be crucial to at least one innovation project, but the types of benefits differ, with a higher percentage of service sector SMEs reporting quality improvements and industrial sector SMEs reporting reduced costs.

Policy relevance: There is a good case for redesigning innovation support programmes to remove any bias towards favouring industrial over service sector SMEs. The problem is particularly serious for R&D support programmes. The results of the effects of innovation support suggest that the service sector could be making better use of public funds than the industrial sector, although this intriguing result requires further research.

4.7 Regulatory Burden on Innovation

A constant concern is that poorly designed regulations can inhibit investment in innovation. The effect of regulation on the innovative activities of industrial firms has been widely studied, but a lot less is known about the service sector. Some results on this issue are available from the FBS survey.

The FBS respondents that had introduced a product or service innovation in the previous two years were asked if the need to meet national regulations for their innovations placed their firm at a competitive disadvantage in respect to their competitors. The regulations were divided into four types: environmental, consumer protection, safety, and product design characteristics. Similar questions were asked of firms that had introduced a process innovation, except that the option on product design was not relevant and therefore not included. The results are given in Table 4-7a.

Table 4-7a FBS: Percent of innovative SMEs that report that national regulations for product and process innovations place their firm at a competitive disadvantage compared to their competitors

	Type of regulation			
	Environmental	**Consumer protection**	**Safety**	**Product design**
Product and service innovations				
Industrial firms	**26.2**	12.1	**25.5**	**17.9**
Service firms	15.8	15.0	19.4	12.1
P value	*< .000*	*ns*	*0.001*	*< .000*
Process innovations				
Industrial firms	**22.2**	9.6	**25.2**	
Service firms	16.4	**14.4**	21.6	
P value	*< .000*	*< .000*	*0.04*	

Source: FBS 2004, analyses by UNU-MERIT. Based on responses from 929 industrial and 1,172 service firms that introduced a product innovation, and 1,159 industrial and 1,335 service firms that introduced a process innovation.

With one exception, a significantly lower percentage of service sector than industrial SMEs report problems with national regulations for product and process innovations. The exception is the effect of consumer protection regulations on process innovations (which could involve service delivery), where 14.4% of service sector SMEs report problems compared to 9.6% of industrial SMEs.

Conclusions: A lower percentage of service sector SMEs than industrial SMEs report that national regulations on product and process innovations place them at a competitive disadvantage. Only consumer protection rules affect service sector SMEs more than industrial SMEs.

Policy relevance: There is no need to preferentially favor service sector firms in efforts to reduce the regulatory burden on firms, with the possible exception of consumer protection rules.

4.8 Access to Financing

Knowledge asymmetries combined with the inherently risky nature of innovation can result in sub-optimum private sector investments in innovation. Part of the solution is healthy venture capital markets combined with expertise in assessing risk and management needs. It is possible that this expertise is more developed for manufacturing sectors than for service sectors. If true, this would create greater difficulties for service sector firms to raise external capital, particularly if innovation projects are costly.

Table 4-8a gives CIS-4 results for three relevant questions on financial constraints for innovation. The first question (A) asks about a shortage of funds within the firm. A higher percentage of manufacturing than service sector firms report problems, which could be related to higher innovation costs. As shown in column C, a higher percentage of manufacturing than service sector firms give a high rating to the constraints imposed by high innovation costs. In terms of external financial sources, a higher percentage of manufacturing than service sector firms report difficulties (17.9% versus 13.5%). As for the KIBS firms, 22.2% reported that innovations costs are too high, but only 16.6% reported a lack of external finance as a serious barrier to innovating, while 22.4% reported lack of funds within the firm as a serious barrier for innovation. Many KIBS firms are likely to be new start-ups (as seen in section 4.5) that could produce products relevant to services or manufacturing, implying that there is a lack of venture capital[5] in general, rather than a bias in supply towards manufacturing[6].

Table 4-8a CIS-4: Financial constraints for innovation: percent innovative firms giving a ' high' importance rating for financial barriers to innovating

	A	B	C
	Lack of funds within enterprise	Lack of finance from external sources	Innovation costs too high
Industry	22.7	17.9	26.1
Manufacturing	22.9	17.9	26.1
Services	17.6	13.5	20.8
KIBS	22.4	16.6	22.2
Services – excl. KIBS	15.9	12.4	20.3

Data available for EU27 less Malta and the United Kingdom
* Services defined as INN_G to K plus K73
** KIBS defined as INN_K plus K73

Source: Eurostat, New Cronos.

[5] EVCA (European Private Equity & Venture Capital Association) publishes annual data on venture capital activity in Europe. EVCA assigns venture capital investments by a mix of product and technology groupings. This classification method is not commensurate with the division used in this report between manufacturing, services and KIBS. For instance, the EVCA categories of communications, computer-related, medical/health related, and consumer related categories, accounting for 55.6% of 2005 VC investments, include an unknown mix of both manufacturing and service activities. (EVCA, 2006, p 81).

[6] Firms without products on the market are assigned to the service sector. For example, R&D intensive biotechnology firms that can take years to market a product are assigned to NACE 73 until they have a product on the market. At this point they will be reassigned to the sector with the highest share of total employment. As an example, a firm active in diagnostics research in NACE 73 could be reassigned to pharmaceutical manufacturing. Consequently, KIBS contains firms that will eventually be shifted to manufacturing.

Policy relevance: There is no evidence for a bias towards manufacturing in innovation policies to support financing of innovation activities. In fact, enterprises in the services sector were less likely to report high innovation costs as a barrier for innovation compared with manufacturing firms, suggesting that innovation is less expensive in the service sector. However, the results for both services and manufacturing indicate that there might be a problem due to underdeveloped venture capital markets within Europe.

5. National Innovation Performance

This section first looks at national performance in service sector innovation and then turns to the relationship between innovative performance in services versus innovative performance in manufacturing and the possible effects of KIBS on economic performance.

5.1 Summary Innovation Indexes for Services Based on CIS-4 Data

The Service Sector Innovation Index (SSII) contains many of the same indicators included in a similar service sector summary index in the 2006 report on innovation in services[7]. However, the 2006 index was based on CIS-3 data, covering innovative activities between 1998 and 2000, whereas this SSII uses more recent CIS-4 data for 2002-2004.

Indicator Selection

The 23 indicators in the SSII are given in Table 5-1a, which also divides the indicators into different innovation related themes and compares them with indicators used for the 2006 index. Three main factors influenced the choice of indicators.

First, we selected indicators to cover the main elements of innovation performance in the service sector: 1) human resources; 2) innovation demand; 3) public support for innovation; 4) product and process innovation; 5) product and process outputs; 6) non-technological innovation; 7) non-technological innovation outputs; 8) commercialisation; and 9) intellectual property. Annex B describes the indicators in more detail.

Second, The Joint Research Centre (JRC) conducted a principal component analysis using a larger original set of 30 indicators. The JRC identified 16 key indicators for service sector innovation after excluding indicators that were missing for a large number of countries and which were redundant, based on the principal component analysis.

Third, several indicators were included, even if they were redundant, because they were directly relevant to policy concerns. Examples include indicator 2.1 (share of firms reporting that lack of qualified personnel is an important issue for them) and indicator 5.1 (reduced materials and energy), which is relevant to environmental policy.

Construction of the SSII

The SSII is calculated for the following sectors:

- Manufacturing (NACE D)
- Services (including NACE G51 (wholesale), NACE I (transport, storage and communication), NACE J (financial intermediation), NACE K72 (Computer and related activities), NACE 74.2 (Architectural and engineering activities and consultancies) and NACE K74.3 (Technical testing and analysis)
- KIBS
- Services excluding KIBS

[7] See Kanerva et al (2006) for more on the SSII 2006 and a literature review on innovation in services.

Table 5-1a Service sector innovation indicators

	Indicator	Code	Countries with data out of EU-27	Similarity with SSII 2006
	HUMAN RESOURCES			
1.1	Share of firms engaged in training for innovation purposes	TRAINING	20	Same as SSII 2006 indicator 1.2
1.2	Share of firms reporting lack of qualified personnel as an important issue – *reversed indicator*	LACK_PERS	18	Same as SSII 2006 indicator 1.3
	INNOVATION DEMAND			
2.1	Share of firms reporting uncertain demand as an important issue – *reversed indicator*	UNCERT_DEM	21	Similar to SSII 2006 indicator 2.1
2.2	Share of firms reporting no need to innovate because no demand for innovation – *reversed indicator*	NO_DEM	13	Not used in SSII 2006
	PUBLIC SUPPORT FOR INNOVATION			
3.1	Share of firms that received any public funding for innovations	PUB_FUND	17	Not used in SSII 2006
	PRODUCT AND PROCESS INNOVATION			
4.1	Share of firms engaged in intramural R&D	INTRA_RD	19	Not used in SSII 2006
4.2	Expenditures in intramural R&D (% of total innovation expenditure)	EXP_INTRA_RD	12	Similar to SSII 2006 indicator 3.1
4.3	Share of firms engaged in acquisition of machinery etc.	ACQ_MACH	20	Not used in SSII 2006
	PRODUCT AND PROCESS OUTPUTS			
5.1	Share of firms with highly important effects in reduced materials and energy	EFF_MAT	16	Not used in SSII 2006
5.2	Share of firms with highly important effects in improved flexibility	EFF_FLEX	24	Not used in SSII 2006
5.3	Share of firms with highly important effects in improved quality	EFF_QUAL	24	Not used in SSII 2006
5.4	Share of firms with highly important effects in reduced labour costs	EFF_LBR_COST	18	Not used in SSII 2006
	NON TECHNOLOGICAL INNOVATION			
6.1	Share of firms that introduced organisational and/or marketing innovations	ORG_MKT_INNO	20	Similar to SSII 2006 indicators 4.3 and 4.4
6.2	Share of firms that introduced organisational innovations	ORG_INNO	20	Same as SSII 2006 indicator 4.4
6.3	Share of firms that introduced marketing innovations	MKT_INNO	19	Same as SSII 2006 indicator 4.3
	NON TECHNOLOGICAL INNOVATION OUTPUTS			
7.1	Share of firms with highly important effects in reduced time to respond	EFFORG_RESPTIME	18	Not used in SSII 2006
7.2	Share of firms with highly important effects in improved quality	EFFORG_QUAL	18	Not used in SSII 2006
7.3	Share of firms with highly important effects in reduced costs	EFFORG_COST	15	Not used in SSII 2006
	COMMERCIALISATION			
8.1	Turnover of new and significantly improved products only new to firm (% of total turnover)	TURN_PROD_NEWFIRM	19	Same as SSII indicator 6.2
8.2	Share of firms that have new or significantly improved products new to market	PROD_NEWMKT	24	Not used in SSII 2006
	INTELLECTUAL PROPERTY			
9.1	Share of firms that applied for a patent	IPR_PAT	12	Same as SSII 2006 indicator 7.1
9.2	Share of firms that registered an industrial design	IPR_DSG	16	Same as SSII 2006 indicator 7.3
9.3	Share of firms that registered a trademark	IPR_TM	15	Same as SSII 2006 indicator 7.2

Sectors K72, K74.2 and K.74.3 form the KIBS sector (Knowledge Intensive Business Services), which is looked at separately.[8]

The denominator for all SSII 2007 indicators includes all firms, including those that did not innovate in the survey period from 2002 to 2004.

The methodology used for calculating the SSII 2007 is the same as that used for SSII 2006. For all sectors and indicators the data are transformed into re-scaled values using the Min-Max method[9]:

$$x_{cij}^{r} = \frac{(x_{cij} - \min(\forall_c \forall_j x_{ij}))}{(\max(\forall_c \forall_j x_{ij}) - \min(\forall_c \forall_j x_{ij}))}$$

where x_{cij}^{r} is the re-scaled value for country c of indicator i and sector j: x_{cij}. The re-scaled value is obtained by first subtracting the minimum value for indicator *i* in sector *j* for all countries with data and then dividing by the difference between the maximum and minimum value for indicator *i* in sector *j*. All values are thus transformed to a value between 0 and 1, with the maximum value transformed to 1 and the minimum value transformed to 0.

For three indicators – lack of qualified personnel, uncertain demand and no demand for innovation – re-scaled values are reversed by swapping maximum and minimum values in the formula above. This maintains the general rule that "more" (i.e. non-lack) is "better". The Service Sector Innovation Index (SSII) is then calculated by taking the unweighted average of the re-scaled values of the indicators.

Methodological Issues

In order for a country to be included in the SSII, data must be available for a minimum of 16 of the 23 indicators, as shown in Table 5-1b. Consequently, the SSII is only calculated for between 17 and 20 countries.

CIS-4 aggregate data are unavailable for all countries. Table 5-1a shows for how many EU countries data are available for each indicator. For some indicators, data are only available for about 50% of the EU-27 countries. Table 5-1b gives the number of countries for which the

[8] Sector K73 (research and development) is normally included in KIBS, but it was not included in the SSII because the inclusion of this sector in CIS-4 was voluntary, and consequently, many EU countries did not include it (see http://europa.eu.int/estatref/info/sdds/en/inn/inn_cis4_sm.htm for a description of the included sectors). Including K73 in the index would have resulted in a considerable drop in the number of included countries. Similarly, other K74 sectors (K74.1, K74.4, K74.5 and K74.8) are normally included in KIBS, but CIS-4 covers these again on a voluntary basis, and no separate data are available from NewCronos. See page 2 of the European Foundation for the Improvement of Living and Working Conditions (2005) for a definition of KIBS.

[9] For all sectors and indicators the data are transformed into re-scaled values by first using a square root transformation method for skewed variables. For more on this square root transformation method, see Esty, DC, Levy, M, Srebotnjak, T and A de Sherbinin (2005), 2005 Environmental Sustainability Index: Benchmarking national environmental stewardship. New Haven: Yale Center for Environmental Law & Policy.

index is calculated and the minimum number of indicators in any country.[10] In order to get good coverage of indicators (at least 70%), a large number of countries had to be dropped from the indexes.

Table 5-1b SSII 2007 and its sub indexes – coverage issues

Sector	Number of countries included (out of 27)	Minimum number of indicators per country	Share of total number of indicators (out of 23)
Services (SSII)	17	16	70%
Manufacturing	20	16	70%
KIBS	18	17	74%
Services excluding KIBS	17	16	70%

A further problem with the CIS-4 data is that some countries appear to under or over perform due to missing data and other countries under or over perform due to a national bias in how firms respond to the CIS survey. A similar pattern had been observed with CIS-3 data.

Another problem is that some of the indicators are based on yes or no questions (i.e. 'Have you done A?') that do not account for differences in the intensity of an activity. For example, a Finnish firm which trains staff for its innovative activities is, on average, expected to spend a larger share of its turnover on staff training than a Greek firm. A further step in the development of service sector indexes could be to include more 'intensity indicators'.[11] This problem is partly addressed in the indicators based on ordinal questions that ask about the importance of factors such as human resources, demand, and outputs. The results are based on the share of firms that identify each factor is 'very important'.

One indicator, R&D expenditures, is also available from alternative sources (the OECD STAN database). However, the OECD R&D data (R&D as a share of value added) are not used because they are only available for 13 countries and they are not available for the KIBS sector. Furthermore, replacing indicator 4.2 with R&D as a share of value-added has almost no effect on the results. A correlation between the service sector SSII based on indicator 4.2 and the SSII using R&D as a share of value added gives an almost perfect relationship, with an R^2 value of 0.987.

Due to the above constraints, a certain degree of care must be taken in interpreting and using the SSII indexes for policy purposes.

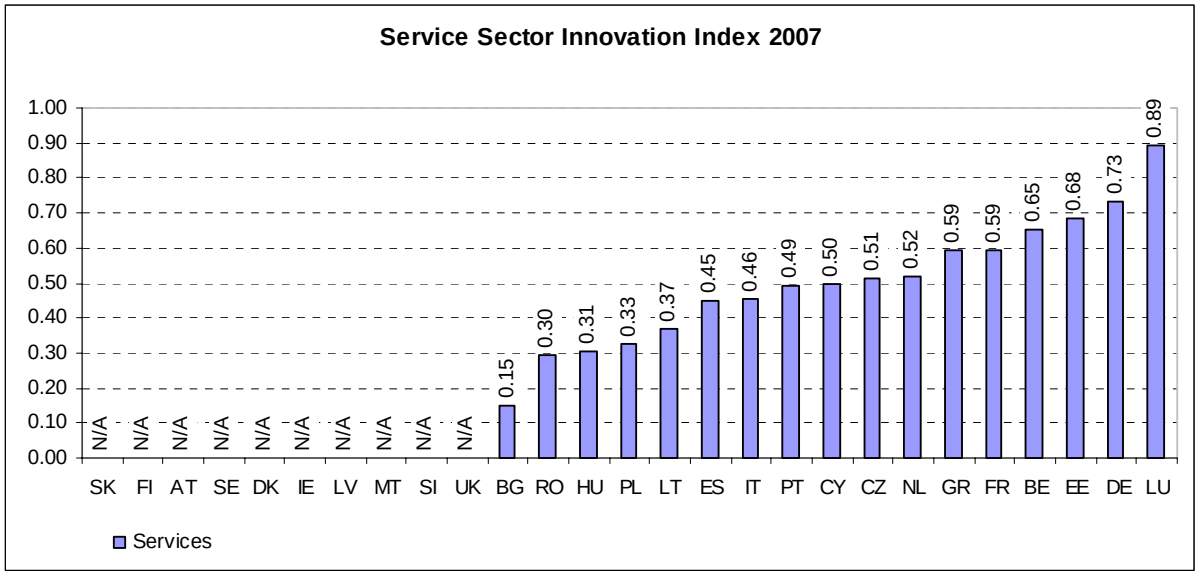
Figure 5-1a gives the SSII 2007 for total services. Ten countries are excluded due to lack of data. Of the remaining countries, the best performer is Luxembourg, followed by Germany and Estonia. The worst performing countries in this index are Bulgaria and Romania.

Figure 5-1b gives the SSII 2007 results for the KIBS sub sector only. Again, a large number of countries have been excluded due to missing data. The results are somewhat unexpected, with Greece leading the KIBS summary index. This result is partly due to Greece scoring highly in the effects from both product/process innovation and organisational innovation.[12]

[10] Note that for each country the included indicators vary.
[11] The EIS uses such indicators, which may partly explain the different rankings between the SSII and the EIS.
[12] Greece also has excellent data coverage with no missing data.

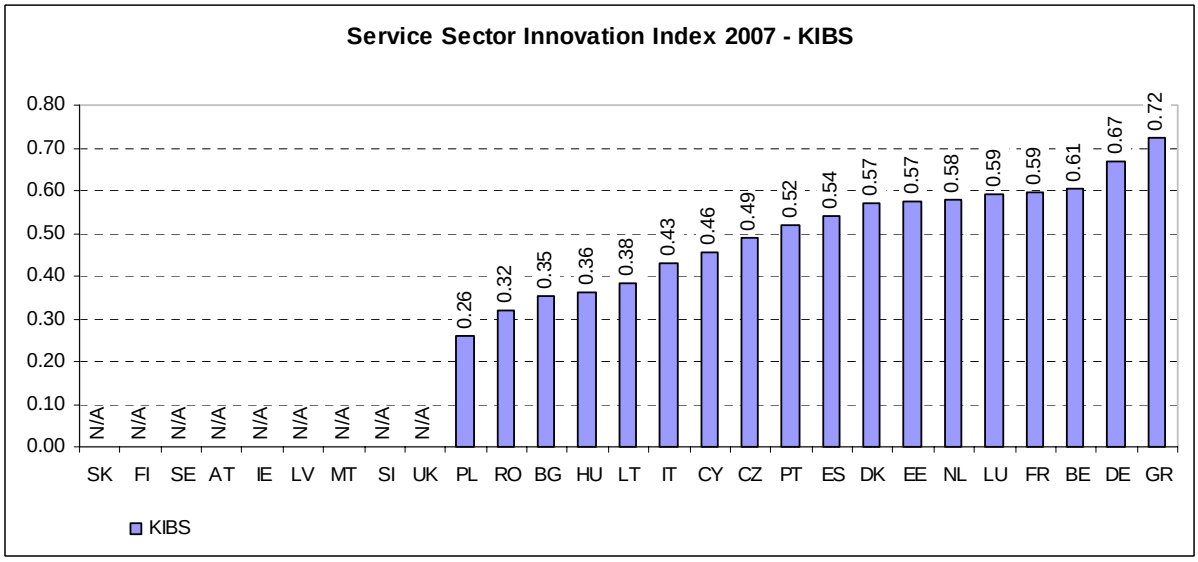
The next best performing countries for KIBS are Germany and Belgium, and the worst performers are Poland and Romania.[13]

Figure 5-1a



Source: Eurostat, New Cronos.

Figure 5-1b

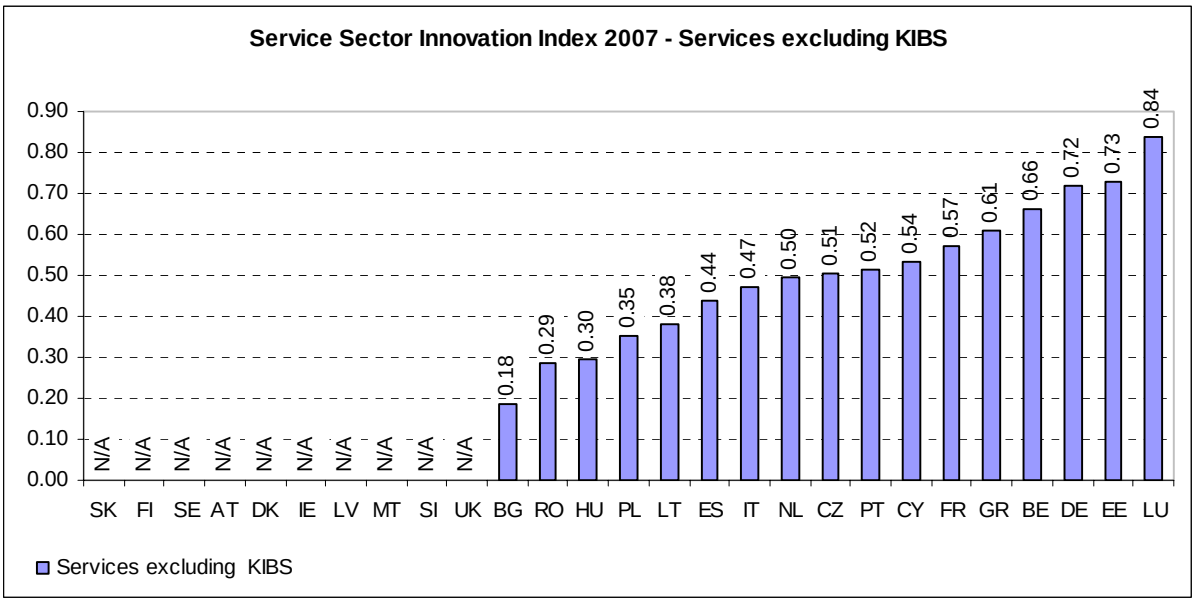


Source: Eurostat, New Cronos.

[13] Poland has relatively poor data coverage, which may partly explain its poor performance.

Figure 5-1c shows the SSII for all service sectors excluding KIBS. There is almost no difference with the SSII for all services including KIBS, with an R^2 of 0.99. Luxembourg leads again, as it does with the SSII that includes KIBS, although the rank order of Estonia and Germany are switched compared to the SSII for all services.

Figure 5-1c



Source: Eurostat, New Cronos.

The next section provides an evaluation of the some of the factors that might be driving service sector performance.

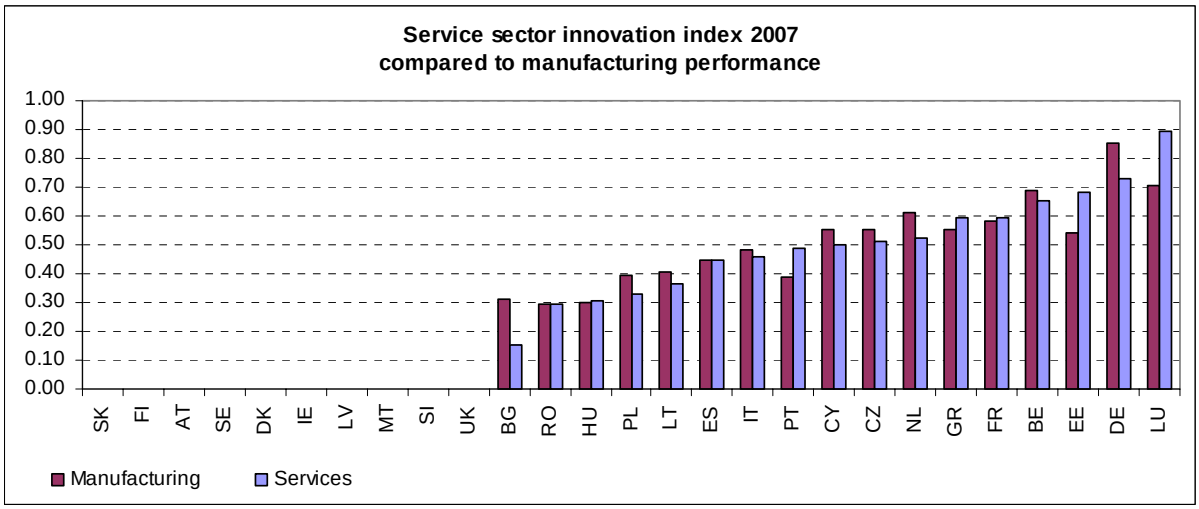
Service Sector Innovation and General Innovative Performance

One possibility, which was raised by the 2006 SSII, is that it is easier for firms to develop and implement non-technological innovations than technological innovations. Since non-technological innovation is more common in services, this suggests that innovative performance in the service sector in the new member states (which lag behind the older EU states) could improve more quickly than in manufacturing. A second possibility is that innovative performance in the most knowledge intensive KIBS sectors could spill over into general innovative performance in both services and manufacturing.

Figure 5-1d compares the SSII 2007 with an index for manufacturing constructed with an identical set of indicators[14]. On average, the national difference in performance between the two major sectors is highly correlated, with an R^2 of 0.76, although there are a few differences between performance in manufacturing and services. Luxembourg and Estonia perform better on services than on manufacturing, while Bulgaria, Germany, the Netherlands and Poland perform better in manufacturing.

[14] This is why the manufacturing version of the SSII differs from other indices such as the EIS, which uses a different set of indicators.

Figure 5-1d



Source: Eurostat, New Cronos.

Performance on the SSII 2007 is also correlated with the 2006 innovation performance index from the European Innovation Scoreboard (EIS). For all services combined, the correlation with the 2006 EIS gives an R^2 of 0.43; when KIBS is excluded the correlation gives the same R^2 of 0.43, and the correlation between the 2006 EIS and the SSII for KIBS only gives a weaker R^2 of 0.28[15]. These results show that performance in service sector innovation is positively correlated with general innovation performance, as measured by the EIS, but there is no evidence to show that KIBS is especially important as a driver of general innovation.

The 2006 service sector index (see Kanerva et al., 2006) found that several new member states such as the Czech Republic, Latvia and even Romania scored relatively well in service sector innovation. This pattern still continues in the 2007 SSII, although to a smaller extent. Estonia ranks in the top three performers for service sector innovation, but most of the new member states have below average performance.

One explanation for the difference in the results of the 2006 and 2007 SSII is due to the different indicators included in each index. The 2007 SSII includes more output indicators, with seven output indicators that were not included in the 2006 SSII (four indicators for the effects of product and process innovation and three indicators for the effects of non-technological innovation).

If firms in new member states (plus lagging innovative performers in the older states) are able to catch up more quickly on service sector innovation, they should be able to turn a given level of inputs for service sector innovation into a greater amount of economically beneficial outputs than firms in the more established states.[16] A comparison between the average difference in performance on nine 2007 SSII input indicators (input index) and nine 2007 output indicators (output index) shows that the new member states have an advantage, but it

[15] The correlations are based on data for 15 countries.

[16] Innovation outputs are often defined as the innovation itself, such as the introduction of an innovation product or process to the market, a patent as an output indicator of R&D, etc. Conversely, this analysis defines innovation outputs as the observed effects of innovation, such as improved quality or an increase in turnover.

is very small. The average difference from the average input/output ratio for the new member and 'lagging' states (shown in bold in Table 5-1c) is 0.01 compared to –0.02 for the more established states.

Table 5-1c Difference in performance on SSII innovation outputs and inputs

	Output index	Input index	Difference in the ratio compared to the average ratio of -0.08
Belgium	0.64	0.65	0.08
Bulgaria	**0.13**	**0.08**	**0.13**
Cyprus	**0.57**	**0.47**	**0.19**
Czech Republic	**0.43**	**0.55**	**-0.03**
Germany	0.68	0.75	0.01
Estonia	**0.65**	**0.85**	**-0.11**
Spain	0.36	0.50	-0.06
France	0.51	0.61	-0.01
Greece	**0.66**	**0.64**	**0.10**
Hungary	**0.18**	**0.35**	**-0.09**
Italy	0.30	0.51	-0.12
Lithuania	**0.18**	**0.37**	**-0.11**
Netherlands	0.42	0.50	0.00
Portugal	**0.40**	**0.66**	**-0.18**
Romania	**0.30**	**0.17**	**0.21**

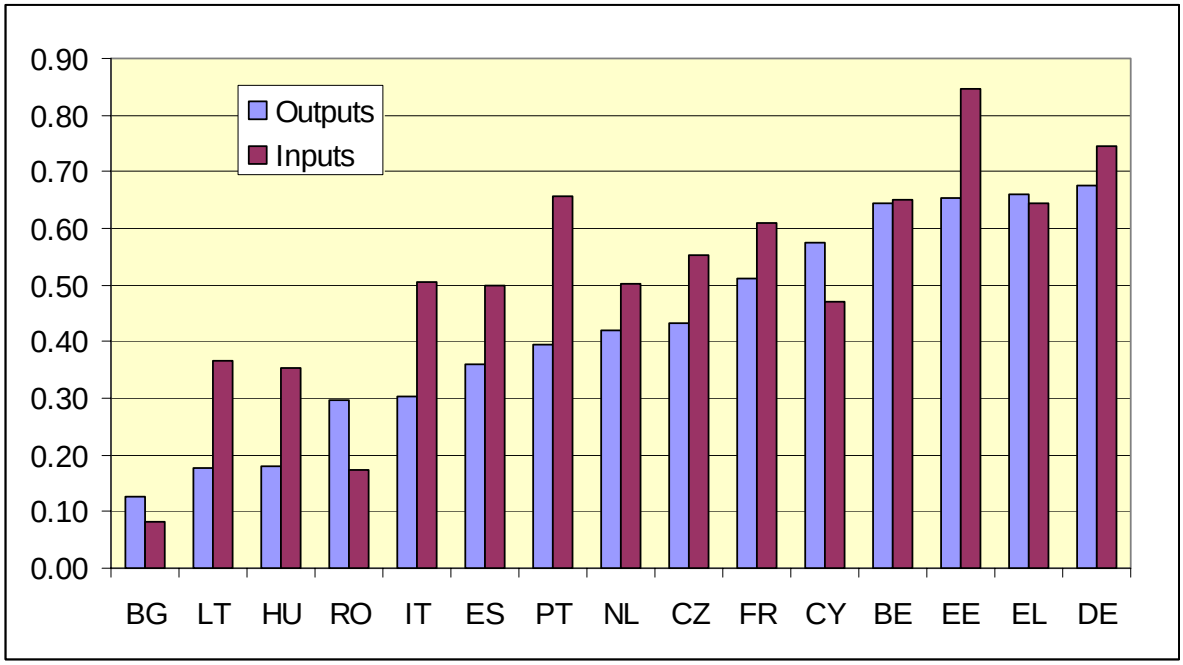
Notes: The input and output indices are calculating using the method described in Section 51.

Innovation inputs: engaged in training for innovation (1.1), received public funding (3.1), perform intramural R&D (4.1) expenditures on intramural R&D as a share of total innovation expenditures (4.2), acquired new machinery etc (4.3), introduced an organizational innovation (6.2), introduced a marketing innovation (6.3), registered an industrial design (9.2), registered a trademark (9.3).

Innovation outputs: reduced material/energy use (5.1), improved flexibility (5.2), improved quality (5.3), reduced labour costs (5.4), organizational innovation reduced response time (7.1), organizational innovation improved quality (7.2), organizational innovation reduced costs (7.3), turnover from new to firm products (8.1), at least one new to market innovation (8.2).

Figure 5-1e gives the results for the input and output indices by order of performance on the output index. Lithuania, Hungary, Italy, Spain, Portugal and Estonia perform better on service sector innovation inputs than on innovation outputs and are possibly receiving less benefits from their investments than firms in Bulgaria, Romania, and Cyprus, which perform better on outputs. However, both sets of results are for current performance. Relatively large investments in service sector innovation today could result in better output results in the future.

Figure 5-1e. Performance on the service sector input and output innovation indices



5.2 Does KIBS Play a Key Role in Innovation?

The economic weight of KIBS has been increasing in many countries. For the EU-25 countries, employment in KIBS increased by 7.9% between 1999 and 2004. As the KIBS sector includes many R&D intensive firms that provide services to other firms, such as R&D and software development, one possibility is that growth in the KIBS sector could drive innovation throughout an economy. If true, the size of the KIBS sector should be positively associated with national innovation performance and the rate of growth in KIBS should be positively associated with the rate of growth in innovation performance.

Both hypotheses were explored using two measures of the economic weight of the KIBS sector: KIBS value-added as a share of national value-added and KIBS employment as a share of national employment. Both measures were obtained from an analysis of the EU-KLEMS data, which provides sector level employment and value added for the EU-25 up to 2004. The data were also used to calculate the average annual change in the percentage growth of KIBS value-added and employment for the five years between 1999 and 2004.

National innovation performance is assessed using the EIS summary innovation index (SII) for 2006, plus the average change in the SII over the preceding four years. Analyses were also conducted for total manufacturing and total services[17]. The correlation results are summarized in Table 5-2a.

[17] The indicator for the change in the SII is relative to the performance of other EU states, using the min-max method. The correlations were also conducted using the same method for the change in KIBS value added and employment, but it resulted in lower R^2 values than the absolute change measure.

Table 5-2a. Correlations between value added and employment and performance on the Summary Innovation Index

	R^2	
	2006 SII	**4 year change in SII**
1. 2004 values for manufacturing, business services and KIBS		
Manufacturing share of total 2004 value added	0.005	-0.156
Business services share of total 2004 value added	0.004	**0.214**
KIBS share of total 2004 value added	**0.358**	0.128
Manufacturing share of total 2004 employment	0.153	0.000
Business services share of total 2004 employment	**0.215**	0.044
KIBS share of total 2004 employment	**0.521**	0.068
2. Five year change in manufacturing, business services and KIBS (1999 – 2004)		
Change in manufacturing value added	**-0.23**	0.002
Change in business services value added	**-0.24**	0.02
Change in KIBS value added	**-0.14**	0.06
Change in manufacturing employment	0.003	0.000
Change in business services employment	0.000	0.03
Change in KIBS employment	-0.10	0.001

The first section of Table 5-2a gives the correlation results between the 2004 measures of the economic weight of manufacturing, business services and KIBS, measured as the percentage of total value added and employment, and the 2006 SII and the change between 2003 and 2006 in the SII. The data are available for 25 EU member states. KIBS value added and employment shares are positively correlated with 2006 SII performance. This is because countries where KIBS has a relatively high economic weight, such as UK, Denmark and Sweden, have better innovative performance than countries where KIBS has a low economic weight, such as Poland, Portugal and Greece. KIBS therefore appears to be a component of innovative performance, but we do not know if KIBS drives economic performance throughout the economy. A better measure of this is if growth in KIBS improves growth in innovative performance.

The second section of Table 5-2a looks at the growth relationship. Contrary to expectations, growth in manufacturing, KIBS and business services are negatively (although very weakly) correlated with the 2006 SII, while there is no relationship at all with the change in the SII. The negative correlation with the 2006 SII is due to different development patterns in the new member states and in the other EU countries. The new member states have experienced rapid growth, particularly in manufacturing and business services, but their SII performance is much lower than in the older EU member states.

Conclusions

As with the 2006 SSII, several of the new member states perform better on service sector innovation than they do on general innovation, as measured in the 'European Innovation Scoreboard' summary innovation index. This suggests that service sector innovation is 'easier' than innovation in the manufacturing sector. However, several of the new member states, such as Estonia and the Czech Republic, also perform well in manufacturing when using the identical set of indicators as for services. Part of the explanation could be due to the fact that the SSII contains a large number of output indicators that measure the effect of innovation on the firm, such as a reduction in energy or labour inputs. These are relative rather than absolute measures. Innovative firms in the new member states could benefit as much from service and manufacturing sector innovation as firms in more innovative countries, even though the nature of the 'innovation' could be very different. The equivalency of benefits is supported by the results in Table 5-1c, which shows a slight advantage in outputs relative to inputs for the new member states compared to the more innovative EU countries.

The results of the analysis of the role of KIBS provide no evidence in support of a key role of KIBS in driving overall innovative performance, as measured by the change in the SII (Summary Innovation Index from Trend Chart). However, KIBS as a share of total employment or value-added in 2004 is positively correlated with innovative performance on the 2006 SII. This is probably because of the high level of innovative activity within KIBS itself, such as in software development.

An important caveat for these conclusions is due to a serious limitation with the CIS-4 data, where many countries do not include NACE sector K73. This is a key KIBS sector that includes R&D services. It is also the sector to which many high technology start-ups that do not yet have products on the market will be assigned, such as many small biotechnology and nanotechnology firms.

6. Improving Indicators for Business Services Innovation

Several limitations with the research in sections 4 and 5 point to the need to improve innovation data for the services sector. This section briefly summarizes possible improvements to data availability that could be obtained from either providing new CIS indicators or altering the methodology of the CIS.

1. CIS data are obtained from NewCronos. Research on service sector innovation (and on innovation in the manufacturing sector) would be considerably improved if NewCronos provided disaggregated results for the CIS-4 questions 2.1 and 3.1 on product and process innovation. Question 2.1 collects data on whether or not the firm introduced new or significantly improved goods and new or significantly improved services. Results for these two options could be used to obtain a better measure of the types of new products introduced both by manufacturing and service firms. Similarly, question 3.1 asks firms if they introduced new or improved methods of manufacturing or producing goods or services, new or significantly improved logistics, delivery or distribution methods, and new or improved supporting activities such as maintenance systems or purchasing operations.
2. CIS data are missing for far too many countries. Every effort should be made to ensure full coverage for all CIS questions.
3. All countries should be encouraged to survey NACE sector 73.

Many other new indicators could be constructed using CIS data, such as a measure of new to market innovations that controls for large differences in what constitutes a 'market'[18]. Work on new indicators is currently underway through a joint OECD-Eurostat project. Results should be available in the fall of 2007.

[18] See Arundel A., Innovation survey indicators: What impact on innovation policy? *Proceedings of the Blue Sky II Forum*, OECD, forthcoming.

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Annex A

Table A.1 Percent of firms giving a high importance to different information sources

A. As % of enterprises with innovation activities

		Internal	Market sources				Institutional sources		Other sources		
		Within Enterprise/ Group	Suppliers	Clients/ Customers	Competitors/ Others firms in the sector	Consultants/ Commercial Labs/ Private R&D institutes	Universities	Government	Conferences/ Trade fairs / Exhibitions	Scientific journals / Publications	Professional/ Industry associations
Industry		44.7%	22.9%	27.0%	11.8%	6.3%	4.3%	3.0%	13.0%	8.2%	5.4%
	Manufacturing	44.8%	22.9%	27.3%	11.8%	6.2%	4.2%	3.0%	12.9%	8.2%	5.2%
Services		47.1%	23.6%	26.2%	13.1%	5.2%	2.7%	2.3%	9.6%	8.7%	6.3%
	KIBS	57.1%	19.4%	33.1%	9.8%	4.4%	4.2%	2.9%	8.6%	12.2%	4.4%
	Services (less KIBS)	43.6%	25.1%	23.7%	14.3%	5.5%	2.2%	2.0%	9.9%	7.5%	7.0%

Source: New Cronos, Eurostat
EU27 less Austria, Denmark, Latvia, Malta, Slovenia, Sweden and the United Kingdom
Services and KIBS do not include K73

Annex B

SSII 2007 – Description of indicators

	Code	Description
		Human resources
1.1	TRAINING	Share of firms using training - Percentage of firms that used internal or external training for their personnel directly aimed at the development and/or introduction of innovations during the three years covered by the survey. Only innovative firms are asked this question in CIS-4.
1.2	LACK_PERS	Lack of qualified personnel – Hampering factor internal to firms, expressed as the percentage of firms indicating that their innovation activities had been greatly hampered by lack of qualified personnel. As this is a negative factor, the indicator values are reversed when calculating the SSII scores (see Section 5.1). All firms are asked this question in CIS-4.
		Innovation demand
2.1	UNCERT_DEM	Uncertain demand for innovation – Hampering factor related to markets, expressed as the percentage of firms indicating that uncertain demand for their innovative goods/services is a highly important issue for them. As this is a negative factor, the indicator values are reversed when calculating the SSII scores (see Section 5.1). All firms are asked this question in CIS-4.
2.2	NO_DEM	No demand for innovation – Hampering factor related to markets, expressed as the percentage of firms indicating that a highly important reason for them not to innovate is that they face no demand for innovations. As this is a negative factor, the indicator values are reversed when calculating the SSII scores (see Section 5.1). All firms are asked this question in CIS-4.
		Public support for innovation
3.1	PUB_FUND	Public funding for innovations – Percentage of firms that have received any public financial support for innovation activities during the three years covered by the survey. The funding may have come from local or regional authorities, central government or the European Union. Only innovative firms are asked this question.
		Product and process innovation
4.1	INTRA_RD	Engagement in intramural R&D – Percentage of firms that have engaged in in-house R&D activities during the three years covered by the survey. Only innovative firms are asked this question.
4.2	EXP_INTRA_RD	Expenditures in intramural R&D (% of total innovation expenditures) - This indicator is defined as the ratio of all internal R&D expenditures and total innovation expenditures, which includes intramural and extramural R&D, acquisition of machinery, equipment and software, and acquisition of other external knowledge. The indicator relates to the formal creation of new knowledge within firms.
4.3	ACQ_MACH	Acquisition of machinery, equipment and software – Percentage of firms that have acquired advanced machinery, equipment or computer hardware or software to produce new or significantly improved products and processes in the three years covered by the survey. Only innovative firms are asked this question.
		Product and process outputs
5.1	EFF_MAT	Effects in reduced materials and energy – Percentage of firms that report highly important effects from product (good or service) and process innovations in terms of reduction in materials and energy per unit output. Only innovative firms are asked this question.

	Code	Description
5.2	EFF_FLEX	Effects in improved flexibility – Percentage of firms that report highly important effects from product (good or service) and process innovations in terms of improved flexibility of production or service provision. Only innovative firms are asked this question.
5.3	EFF_QUAL	Effects in improved quality resulting from product/process innovation – Percentage of firms that report highly important effects from product (good or service) and process innovations in terms of improved quality in goods or services. Only innovative firms are asked this question.
5.4	EFF_LBR_COST	Effects in reduced labour costs – Percentage of firms that report highly important effects from product (good or service) and process innovations in terms of reduction in labour costs per unit output. Only innovative firms are asked this question.
		Non-technological innovation
6.1	ORG_MKT_INNO	Organisational and/or marketing innovations – Percentage of firms that have introduced either organisational innovations or marketing innovations during the three years covered by the survey. All firms are asked this question in CIS-4.
6.2	ORG_INNO	Organisational innovations – Percentage of firms that have introduced at least one organizational innovation, defined as the implementation of new or significant changes in firm structure or management methods that are intended to improve the firm's use of knowledge, the quality of goods/services, or the efficiency of work flows. All firms are asked this question in CIS-4.
6.3	MKT_INNO	Marketing innovations – Percentage of firms that have introduced at least one marketing innovation, defined as the implementation of new or significantly improved designs or sales methods to increase the appeal of the firm's goods/services or to enter new markets. All firms are asked this question in CIS-4.
		Non-technological innovation outputs
7.1	EFFORG_RESPTIME	Effects in reduced time to respond – Percentage of firms that report highly important effects from organisational innovations in terms of reduced time to respond to customer or supplier needs. All firms are asked this question in CIS-4.
7.2	EFFORG_QUAL	Effects in improved quality resulting from organizational innovation – Percentage of firms that report highly important effects from organisational innovations in terms of improved quality of goods/services. All firms are asked this question in CIS-4.
7.3	EFFORG_COST	Effects in reduced costs – Percentage of firms that report highly important effects from organisational innovations in terms of reduced costs per unit output. All firms are asked this question in CIS-4.
		Commercialisation
8.1	TURN_PROD_NEWFIRM	Turnover of new-to-firm, not new-to-market products (% of turnover) – this indicator is defined as the ratio of total turnover of products (goods or services) that are new or significantly improved to the firm, but not to the market, and the total turnover. This indicator is also used as a proxy for the diffusion or implementation of products (goods/services) or state-of-the-art technologies already introduced elsewhere.
8.2	PROD_NEWMKT	New-to-market products – Percentage of firms that have new or significantly improved products (goods or services) new to the market. This definition brings with it some ambiguity because the definition of 'new to market' depends on the firm's own market. A new to market innovation for a firm that is only active locally can therefore be substantially different from a new to market innovation for a firm whose market is global.

	Code	Description
		Intellectual property
9.1	IPR_PAT	Using patents – Percentage of firms indicating that they have applied for at least on patent during the three years covered by the survey. This indicator captures new knowledge created anywhere within the firm and not just within a formal R&D department (less common in the services sector firms).
9.2	IPR_DSG	Using designs – Percentage of firms indicating that they have registered industrial designs to protect their innovation during the three years covered by the survey.
9.3	IPR_TM	Using trademarks – Percentage of firms indicating that they have registered trademarks to protect their innovation during the three years covered by the survey.