Paper per la 53.ma riunione della Società Italiana degli Economisti, Università della Basilicata 18-20 ottobre

Business services, innovation and sectoral growth

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Abstract

By integrating different industry level data sources (OECD Input-Output Tables, OECD Structural Analysis Database and EUROSTAT Community Innovation Survey) for a selected number of European countries, this paper aims at assessing the economic impact of Business services (BS) on client industries. Compared to previous research, the specific value added of this contribution consists of having taken into account both the strength and innovative content of the linkages between BS and user industries as well as to have looked at different mechanisms through which the use of BS inputs affects the performances of user industries. The results of the empirical analysis show that BS have a positive impact on the innovation performances of client industries and, via this channel, also on their sectoral value added growth. Moreover we find a positive effect of BS on the rate of growth of client industries that is not mediated by the introduction of new products and services. This second effect is likely to be related to the production and organizational efficiency gains linked to the use of these services.

Keywords: business services, innovation, industry level data
JEL codes: L80, O30

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1. Introduction

Advanced economies are experiencing a process of transformation by which services account for an increasing share of value added, employment and international trade. Within the broad category of services, business services (BS) play a special role, since their growth has gone hand in hand with a process of reorganisation of the ways in which goods and services are produced, delivered and traded both within and across countries. While there is no consensus in the literature on the precise definition of business services, the latter can be broadly defined as "a set of service activities that - through their use as intermediary inputs - affect the quality and efficiency of the production activities, by complementing or substituting the in-house service functions" (Kox and Rubalcaba, 2007a, p. 4).

The growth of BS has been favoured by the development and diffusion of Information and Communication Technologies (ICT) that have affected the linkages between manufacturing and service industries, on the one hand by increasing the service content of many manufacturing activities, and on the other by facilitating the "splintering" away of activities once performed inside manufacturing firms. This process of structural change, involving new interaction mechanisms between business services and other manufacturing and service industries, affects both the performance of the BS sector itself and of the "user sectors".

As far as the effect of BS on the aggregate performance of economies Kox and Rubalcaba distinguish between a direct effect, stemming from the BS's own rapid growth, and an indirect one connected to the positive effects that BS have on the rest of the economy via the diffusion of specialized and knowledge intensive inputs. Among the two mechanisms the latter is by far the most powerful one, and this especially taking into account the still relatively limited size of BS when compared to the size of both the other main branches of services and the manufacturing business sector as a whole. The existence of an indirect macro-economic effect of BS is in turn based on two basic assumptions and namely: a) that BS represent a very dynamic and innovative component of modern economies; b) that both the innovation and economic performances of firms and industries depend on the quantity and quality of the intangible inputs produced and delivered by the BS sector. While point a) above has been explored by a large amount of evidence, empirical research on point b) is still scarce and this because of the difficulty of measuring the qualitative content of BS output and the numerous channels and mechanisms through which BS affect the performances of client industries.

This paper aims specifically at starting to fill this gap, investigating the economic impact of BS taking into account the composite nature of this heterogeneous sector, the size and content

of the intangible services delivered to client indutries, the extent to which these external inputs are able to support firms' innovation efforts and performances. Such an impact will be empirically assessed at industry level, combining three data sources: the OECD Input-Output Tables; data drawn from the EUROSTAT Community Innovation Survey (CIS) and a set of economic performance indicators drawn from the OECD Structural Analysis (STAN) database. Due to data-constraints the empirical analysis will be restricted to a selected number of EU countries (Germany, France, Italy, Spain and the United Kingdom).

The paper is structured as follows: in the next section the specific contribution of this paper is located within the context of the exiting literature on BS and their economic impact. Section 3 contains a description of the dataset used in the empirical analysis along with some preliminary descriptive statistics on main differences across country and sector in the use of BS inputs and on their innovation intensity. Section 4 presents the model, some descriptive statistics and the results of the econometric estimates on the effects of BS flows on both the innovation and growth performances of client industries. The concluding section summarizes the main results and discusses some possible future developments of this line of research.

2. Literature review

The beneficial economic effects of BS on client industries can be conceptualised and studied taking into account two basic mechanisms. The first one relies upon the classical Smithian law, and more in particular on the scale economies and productivity gains obtainable through increased levels of specialization in the production and delivering of service inputs (Rubalcaba and Kox, 2007). At least part of these beneficial effects will be captured by "downstream sectors" in terms of an increasing availability of intangible production inputs offered at (relatively) low prices. On the basis of this type of argument SMEs (being the major users and producers of these services) are likely to be the ones which benefit the most from the emergence of a specialized market for BS.

The second mechanism has to do with the dynamic efficiency gains brought about by the emergenge of a BS sector. In fact, the Smithian mechanism has not only a quantitative dimension. When framed into a dynamic context, the twin process of market expansion and increased specialization paves the way to qualitative changes in all segments of the new vertically integrated sectors accelerating the introduction of new technologies and

organizational models. This intertwined process of quantitative and qualitative changes has characterized also the emergence and growth of the BS sector. On the one hand, BS "...provide products to client firms that are different (higher quality, more specialized) from the in-house services that the client firms produced in-house beforehand, or that are even completely new" (Kox and Rubalcaba, 2007b, p. 8). On the other hand, BS are likely to stimulate the innovation capacity of client firms, supporting the introduction of new process technologies as well as enhancing their capability to design, develop, introduce, and effectively locate into the market, new or improved products.

This capacity of affecting the dynamic efficiency of client industries is of course highly differenciated within the heterogeneous universe of BS depending (among other factors) on the innovation potential of each specific BS industry and (as a consequence) on the qualitative and innovative content of the specific services provided to the clients. This in turn justifies the great emphasis put by the most recent literature on a particular sub-set of BS and namely those referred to as Knowledge Intensive Business Sectors (KIBS), the non-KIBS being identified as the more routinary business services activities.[1]

Originally, the literature on KIBS has been largely focussed on a rather restricted number of service activities, namely on R&D and ICT related services. The more recent literature on KIBS has progressively enlarged the boundaries and features of this peculiar market, adopting a broader view on the type of actors involved, on the innovative services exchanged, on the type of interactions taking place between KIBS and client industries.[2] Using Miles' words what KIBS do is "locating, developing, combining and applying various types of generic knowledge about technologies and application to the local and specific problems, issues and context of their clients" (Miles, 2005)[3]. Furthermore, far from being constituted by pure market transactions of generic or abstract knowledge in many cases these linkages can be best represented as a "cooperative mode of innovation" in which both KIBS and client industries play an active role (Miles, 2005; Tether and Tajar, 2008). The literature on "service innovation" and "innovation in services" (Sundbo, 1998; Gallouj, 2002; Miles, 2005; Tether, 2005; Gallouj and Savona, 2009; Abreu et al., 2010) has significantly contributed to such a shift of

[1] According to Kox and Rubalcaba, KIBS have a positive impact on the economy through three main channels and namely being major generators of innovations on their own, by diffusing knowledge throughout the economic system and by reducing human capital indivisibilities at the firm level (Rubalcaba and Kox, 2007).

[2] KIBS are usually identified in a sub section of the NACE 74 Business service branch and include the following services activities: Legal, accounting, tax consultancy, market research, auditing, opinion polling, management consultancy, architectural, engineering and technical consultancy, technical testing and analyses, advertising, other business activities n.e.c. (Muller and Doloreux, 2009).

[3] See also Muller and Doloreux, 2009, for a review of the literature on KIBS.

perspective, emphasing the important role played by "non-technological" types of skills, competencies and learning processes broadly relating to areas of firms' organization, market characteristics, consumer habits and tastes, financial and legal matters. These developments of the literature bear important implications also for the analysis of the economic impact of an heterogenous set of industres such as BS. In the light of what said above, such an impact should be assessed going beyond the restricted area of KIBS, taking into account the composite nature of BS, the size and content of the services provided to client industries, the ways in which these services match and complement internal firms' competencies and assets. The empirical assessment of these quantitative effects is of course not an easy task due to the difficulty of identifying effective and appropriate measures of (and data on) the qualitative and innovative content of the services delivered to client firms/industries as well as to isolate their specific effect at firm, sectoral or macro level. Thus, it does not come as a surprise that the economic impact of BS has been so far empirically explored in a rather basic and straightforward fashion.

A first way to assess the role of BS[4] on economic performance has been to introduce them as inputs in the production function (Antonelli, 1998; Katsoulacos and Tsounis, 2000; Drejer 2002; Crespi, 2007). Using this methodology for four OECD countries (Italy, United Kingdom, Germany and France) in 1990, Antonelli (1998) finds that the output elasticities of communication and business services are very high and close to the values of the two basic inputs of labour and capital. He concludes that "the knowledge-intensive business service industry is replacing the manufacturing industry as the engine of the accumulation of competencies and knowledge in a knowledge-based economy" (Antonelli, 1998, p. 192)[5]. Similar results are found by Katsoulacos and Tsounis (2000) for the Greek economy. They also regress the residual output growth (the portion of output growth which remains unexplained by the growth of capital and labour) on the change of KIBS inputs for 77 sectors over the period 1980-88, finding mixed results. Drejer (2002), using Danish data for 52 manufacturing and service sectors over the period 1970-1995, finds some support to the hypothesis that business services can have an effect comparable to traditional production factors, although the empirical

[4] Studies aiming at assessing the economic impact of business services have focussed on different aggregates going from a more restrictive definition of KIBS to the inclusion of other service branches such as, depending on the study, Post and Communication services (NACE 64), Financial Intermediation (NACE 65), Computer and related services (NACE 72), R&D (NACE 73), less knowledge intensive business services (all NACE 74).

[5] This perspective is also conveyed by Castellacci in its new sectoral taxonomy of innovation integrating service and manufacturing industries (Castellacci, 2008). Also in this contribution the idea is that the emergence of a new set of general purpose technologies (namely those connected to the emergence of the ICTs) has deeply changed the structure of the sectoral linkages fuelling the process of technological accumulation and economic growth.

analysis shows that this only applies in the case of service sectors, and, partly, for low-knowledge manufacturing industries.

Tomlinson (2000) and Windrum and Tomlinson (1999) investigate the role of services for output and productivity using a different approach. Rather than applying a production function they consider the interaction of labour with two types of intermediate goods, namely material inputs and communication and business services. Their purpose is to test how labour interacts with the intermediate goods consumed in the production process, on the one hand, and the knowledge-intensive services that are also employed in production, on the other. In particular, Tomlinson (2000) finds that for Japan consumption of communication and business services is highly related to both output and labour productivity and that the impact is increasing over time. In the case of the UK, while there is no significant impact on output or productivity in 1979, such an impact becomes significant in 1990, suggesting that the contribution of knowledge-intensive services increases over time. Windrum and Tomlinson (1999) adopt the same approach on a larger sample of countries (UK and Japan in 1990, Germany in 1993, Netherlands in 1994) finding that knowledge intensive services have a positive and significant impact on both output and labour productivity for all countries. However these authors also find that the size of such an impact differs across countries. They conclude that what is important is not the quantity of services in the domestic economy, but the degree of connectivity between services and other economic activities.

Pilat and Lee (2001) decompose aggregate labour productivity growth by industry contributions for five EU countries and find that computer services contributed positively in Denmark, Germany and Italy, but negatively in the Netherlands and Finland. They also find that inputs from non IT business industries contributed negatively with the exception of Denmark. Guerrieri et al. (2005) look at the interaction between business services, innovation and growth and find positive effects of both domestic and imported services on innovation and growth in OECD countries.

Other studies looking at possible spillover effects from BS to other sectors (Antonelli, 1999; Greenhalgh and Gregory, 2000; Baker, 2007; and Camacho and Rodriguez, 2007a and 2007b among others) find, in general, significant spillover effects. In particular Antonelli (1999) finds important effects of business services use on value added of client industries; Greenhalgh and Gregory (2000) show that business services have played a key role in sustaining productivity growth during the 1980s, causing large labour savings in other industries, and contributing to rise product quality in downstream sectors. Baker (2007), using Input-Output Tables for a

sample of 13 OECD countries and introducing BS as an additional input in a production function, finds that in most countries the contribution of BS (including renting of machinery; computer and related activities; R&D and other business services) to production is higher than their cost (however this is the case also for other services). Finally, Camacho and Rodriguez (2007a, 2007b) look at the effects of Knowledge Intensive Services (KIS) (Communication; Computer and related services; R&D services) on productivity of their client industries for a sample of 11 EU15 countries in 1995 and 2000. They find that KIS have in general a positive impact on productivity, although there are important differences across countries and over time. More relevant to our paper, they also aim at assessing how KIS contribute to diffuse technology across industries. They apply a methodology similar to that used by Papaconstantinou et al. (1998) (and applied to service activities by Amable and Palombarini, 1998) assessing which industries incorporate in their products, through the acquisition of intermediate inputs, more embodied R&D. Rather than looking at how much R&D an industry buys (directly and indirectly), they investigate what is the contribution of KIS industries to the diffusion of their own R&D to other industries, relying on the R&D intensity of each KIS industry and on input output tables. They find that KIS industries occupy a relevant position in terms of diffusion of product embodied R&D through intermediate sales. Interestingly, in one of the two contributions (Camacho and Rodriguez, 2007b), they also consider the role of imported intermediate consumption in diffusing the KIS' R&D effort to the rest of the economy. However they do not assess whether such process of technology diffusion has an economic impact either at the country or the sectoral level[6].

Overall, the synthetic literature review reported in this section confirms the growing interest of empirical research on BS (and particularly on its most knowledge intensive component) and on their impact on user industries as well as on aggregate growth. The evidences are however still fragmented and far from defining a comprehensive picture of the extent of these effects and of the channels through which they operate. Among others, two major gaps in the empirical literature can be identified also inspiring the empirical contribution presented in this paper.

[6] Other studies have looked at the impact of BS on the export performance of downstream industries focussing on inter-industry transactions between BS and other sectors using Input-Output tables. Francois and Woerz (2008) find that there are significant and strong positive effects from increased business service openness on exports of the most skill-and-technology-intensive industries in the OECD. Wolfmayr (2008) finds that the interconnectivity between the manufacturing sectors and the service sectors (measured as the amount of service deliveries to the manufacturing sector) has a positive and highly significant impact on export market shares in high-skilled, technology-driven industries.

First, by directly relating the relevance of BS inputs/flows to economic performance indicators (of user firms/industries and economies) these studies do not take into account (and explore empirically) the presence of very different channels and mechanisms through which BS exert their effects on economic systems. Somewhat simplifying the picture, it is possible to assume that a more intense use of BS inputs can exert a positive impact on client industries (or firms) through (at least) two main channels, that is: either improving the efficiency of production processes and business models (through the introduction of organizational innovations, the adoption of new business models and outsourcing strategies leading to a relocation of tasks and production/service functions) or by enhancing their innovation performances. Most of the empirical literature reviewed above does not explicitly acknowledge these two mechanisms and does not disentangle them empirically.

Second, as stressed above (and shown in the following section), the innovation performances of BS industries are very diverse across countries and this is likely to be reflected in the innovative content of BS inputs and eventually in their contribution to the economic performance of client industries. This linkage between the innovation performance of BS and the economic performance of the industries using BS inputs has not yet been investigated in a systematic and direct way and with the use of appropriate data. In most of the empirical literature reviewed in this section BS inputs and flows are in fact measured on a purely economic dimension dismissing the potential presence of marked differences in the quality and innovative content of BS services activities and outputs.

This paper aims at making a step ahead in the two mentioned directions, in particular by disentangling the indirect effects of BS on downstream industries through enhanced innovation performance and by taking into account at the same time the economic size and innovative content of BS inputs.

3. The innovativeness and degree of connectivity of Business services

The main hypothesis of this paper is that Business services affect the economic performance of user sectors through two main mechanisms and namely supporting the innovation capacity of their clients (in particular their capability of introducing new or improved products/services) and by enhancing their production and organizational efficiency. Although KIBS are the natural candidates to play such a strategic role we can in principle assume that, to various degrees, most BS can have an impact on client industries through at least one of the channels identified

above. This is the reason why we have adopted a rather broad definition of BS sectors including the following (NACE) industries: Post and Telecommunication (64), Computer and Related Activities (72) and Other Business Activities (74). Financial Intermediation Services (65), in other studies being part of business services, have been excluded since the mechanisms through which they are expected to contribute to the economic performance of downstream industries are very different from those identified for the other sectors included in business services. We have also excluded R&D services (73) and this is for two main reasons. The first one is that we want to focus on the contribution provided by less formalised innovative inputs to sectoral innovation and growth; the second one (more technical in nature) is that in the regression analysis the contribution of R&D services will be captured by the variable measuring the total innovative costs of client industries, the latter including also the expenditures for the acquisition of external R&D services.

We rely on two sets of information to assess the potential role of business services on the performance of other industries: their own innovativeness and the degree of connectivity between these sectors and the rest of the economy.

In order to measure these two different dimensions, we combine the EUROSTAT Community Innovation Surveys (CIS) data with the OECD Input-Output Tables (2010). CIS data are those elaborated by the University of Urbino for the SIEPI/SI database. Compared to the CIS data made available by EUROSTAT, the SIEPI/SI data set provides a wider set of CIS indicators at industry 2digit level and for four different CIS waves (in this study we use only CIS3 and CIS4 data, that is those covering the periods 1998-2000 and 2002-2004). This was made possible by integrating and elaborating data directly from national data providers through special cooperation agreements[7]. In particular we use CIS data to measure the innovative (or more broadly the qualitative) content of BS sector output (and other industries) and Input-Output data to measure the economic linkages between business services sectors and client industries.

Due to data constraints, the dataset covers 5 European countries - Germany, France, Italy, Spain, and the United Kingdom - for 20 manufacturing and 17 services sectors (two digit Nace Rev. 1 classification). The detail of sectors is provided in the Appendix.

In this study the innovation intensity of the BS sector is measured taking into account the

[7] In order to investigate the link between innovation and several dimensions of the innovative activity, the SIEPI/SI database includes measures of economic performances, demand and composition by professions and education levels on the six largest countries that were part of the EU before the new accessions (Germany, France, Italy, the Netherlands, Spain and the United Kingdom) from 1995 to 2007 (Pianta et al., 2011).

total amount of innovation expenditures as a share of total turnover. Given the broad set of BS industries taken into account in this study this indicator will be used either as a proxy of the actual innovative content of the inputs provided to the client industries or (in the case of the less technologically intensive BS sectors) as a (rough) proxy of the qualitative (value for money) content of the services provided. The choice of using innovation expenditure data rather than data on firms' innovation output (such as the percentage of turnover due to innovative products) was dictated by the fact that in the case of services the former data are likely to be much more reliable (Evangelista and Sirilli, 1995)[8]. Moreover when we include also BS industries in the empirical analysis an innovation output indicator could cause problems of endogeneity.

Table 1 allows to compare the innovation intensity of Business Services (in 2004) across the five countries considered in our data set and to highlight the main differences between the innovation intensity of BS and that characterizing the total manufacturing industry, total services and the total business sector. In the case of BS we have computed the innovation intensity indicator with reference to two different aggregates: one including the R&D sector and the other excluding it. The R&D sector is in fact a somewhat atypical industry, that is one characterized by an extremely high innovation intensity.[9]

[Table 1 here]

As expected, in all countries BS emerge as the most innovative component of services. In some countries (France, Italy and Spain) the innovation intensity of the BS sector (when the R&D sector is also included in the BS) is even higher than the one observed in the manufacturing sector. In assessing the innovation intensity of BS, as emerging from the figures reported in Table 1, one should also take into account that a very large component of BS (in particular the "Other business services" sector) includes also low-innovative service activities. Table 1 also shows large cross-country differences in the innovation intensity of BS. The most innovative BS sector (net of the R&D component) is found in Germany, followed by France and the United Kingdom (with similar values) while Spain and Italy show lower values. This hierarchy

[8] Another option could be to use as a weight the share of innovative firms. We decided not to use this weight since it could be biased due to intersectoral differences in firms' average size.

[9] Total innovation expenditure includes the total expenditure for four categories: intramural In-House R&D (includes capital expenditures on buildings and equipment specifically for R&D), acquisition of R&D (extramural R&D), acquisition of machinery, equipment and software (excludes expenditures on equipment for R&D) and acquisition of other external knowledge.

is rather stable across sectors and reflects the overall technological intensity of these different economies. Overall, what these descriptive figures seem to suggest is that BS play some role in determining (directly, through their own innovation activities, and indirectly, through the provision of innovative inputs to the rest of the economy) differences in the overall performances of national innovation systems.

Input-Output Tables make it possible to measure the intensity of the linkages between BS and other industries. The strength of these linkages - or put in other words, the BS intensity of the user sectors - can be assessed looking at the share of BS inputs purchased by each client industry either on total production or total inputs. In our case, for each downstream sector this BS intensity index is computed as the sum of the expenditure devoted to the acquisition of services from Post and Telecommunications, Computer and related activities and Other business activities, all divided either by the total production of the user sector or by the total expenditure of the sector for intermediate inputs.

Table 2 shows the values of these two complementary BS intensity indicators - for 2005 - for all five countries taken together, and for each country separately, distinguishing across groups of sectors[10]. We do not distinguish between domestic and imported BS inputs since the imported flow of BS counts only for a small fraction of the share of total inputs[11].

Table 2 conveys a series of very interesting indications which can be summarised as follows:

first, service sectors make a much larger use of BS inputs than manufacturing sectors. BS inputs in the service sector account (on average for the five countries) for 8.4% of total production and 18.8% of total intermediate inputs. The corresponding values for the manufacturing sector are 5.8% and 8.6% respectively. The manufacturing gap in the BS intensity is therefore much larger when the latter is measured as a share of BS inputs on total intermediate inputs. This result can be due to the difficulty of properly measuring total output in services;

second, there are some broad cross-country sectoral regularities. Within the manufacturing sector the use of BS inputs is broadly associated to the technological intensity of the different

[10] The detail of sectors is provided in the Appendix. In order to increase the comparability with other sectors, Business Services do not include the intra-industry flow: for sector 64, the indicator sums at the numerator the flow of inputs which comes from sectors 72 and 74; for sector 72, inputs come from sectors 64 and 74; for sector 74, inputs come from sectors 64 and 72.

[11] In 2005, considering the whole economy, the share of BS inputs imported on total BS inputs (excluding R&D) is 7% in Germany and France, 8% in Italy, 15% in Spain and 10% in the United Kingdom (source OECD Input-Output, 2010).

industries. This clearly emerges looking at the sectoral differences in the BS intensity across Pavitt's industry groups. The BS intensity is higher in technology-driven industries such as Science Based and Specialized Suppliers sectors. In services, the financial sectors are particularly BS intensive (as already found by Baker, 2007). It is also worth to notice the relatively high role of BS inputs in trade and leisure industries. This could suggest that for these traditional branches of services BS inputs can represent an important source of innovation, productivity gains and competitiveness;

third, there seem to be only marginal differences across countries in the average aggregate BS intensity. The most intensive use of BS is found in France (8.5% on total production). The other four countries show lower values but are rather close to each other;

fourth, and more interesting, when data on the use of BS inputs are broken down jointly by country and sector some broad cross country regularities, as well as marked country specificities, emerge, somehow reconciling some contrasting results emerging from previous literature on this point. While Guerrieri and Meliciani (2005) find significant industry effects explaining the use of finance, communication and business services across industrialised countries in 1990 (with knowledge intensive industries showing higher values than labour and scale intensive industries), Baker (2007) stresses the heterogeneity of industrial linkages of the business services sectors (NACE 71-74) across countries (9 EU countries in the mid '90s). Table 2 shows that within the manufacturing sector, Science Based and Specialized Suppliers industries show a higher use of BS inputs than Scale Intensive and Suppliers Dominated sectors (with the exception of France). However, a clear hierarchy among Pavitt classes emerges only for Germany. More interestingly, the right-side of Table 2 highlights a clear-cut contrast between two (country specific) different structures of interactions between BS and the rest of the economy. In Germany, despite the relatively limited role played by the service sector, the use of BS inputs by the manufacturing industry is highest among the five countries. This aspect is consistent with the innovation intensity of the German BS sector described in Table 1. Conversely, in the United Kingdom, BS are prevalently integrated within the broader category of services, with a particular role played by the financial sectors[12]. This evidence is therefore largely consistent (and somehow further support and qualify) the common stereotyped contrast between a "manufacturing based" German economic model and a UK Service based one.

[12] Also Windrum and Tomlinson (1999) point to this important difference in the pattern of sectoral interdependences between BS and other sectors in Germany and the UK.

[Table 2 here]

Finally, looking at variations over time (2000-2005), it appears that the BS intensity has slightly increased in all sectors with the exception of Science based industries and Finance.

4. The empirical analysis

4.1 A stylised model of the effects of BS on downstream industries

Our basic research hypothesis (which will be empirically tested through a two stage econometric model) is that BS industries contribute to enhance the growth performances of client industries through (among others) two main channels: either improving their "production and organizational efficiency" or enhancing their "innovation competitiveness" (i.e. enhancing their capability to introduce new products). These two mechanisms and channels are depicted (in a rather stylised fashion) in Figure 1. The impact of BS on the production and organizational efficiency of user industries is expected to come mainly from their contribution to the re-organization of production, and from their support to internal organizational changes, outsourcing processes, and the introduction of more efficient business models as well as process technological innovations. In the simplified scheme presented in Figure 1, static efficiency gains (cost savings) obtained through pure outsourcing processes (both at a national or global scale) can also be considered to be part of this "production efficiency" mechanism.

The innovation competitiveness mechanism emphasises the role of BS as a provider of intangible innovation inputs, which are expected to: a) complement the internal innovation efforts and competencies of client industries; b) enhance their innovation capability and, in particular, their capacity at developing and introducing new products and eventually; c) affect their economic performance. Different industries within the broad group of BS might contribute more to one or the other of these two channels. For example, while computer and related activities have been shown to actively contribute to technological innovation, other business services contribute mainly to non technological innovations such as organisational development, human resources management, etc. The different impact of different branches of BS on user industries is a relevant issue that is not explored in this paper and is left for future research.

[Figure 1 here]

4.2 An innovation-weighted indicator of the BS intensity in client industries

As already pointed out in Section 2 the strength of the two mechanisms depicted in Figure 1 is expected to be related to both the "economic size" and "innovation content" of BS inputs. In order to take into account both the "quantitative" and "qualitative" dimension of BS inputs we combine two different sets of data: one measuring the innovation intensity of the BS (provider) sector with a second one measuring the amount of BS inputs purchased and used by client industries. In synthesis, what we do is "weighting" the BS intensity of "downstream" industries by the innovation intensity of the "upstream" BS sectors. The "innovation weights" of BS inputs are derived from the CIS database (CIS, 2004) and are country specific; the BS intensity indicator is built using Input-Output tables and reflects the economic inter-dependencies across industries[13]. The basic idea behind our "innovation-weighted BS intensity indicator" is similar to that adopted by Papaconstantinou et al. (1996) in order to measure embodied technology diffusion across sectors[14]. The indicator is computed as follows:

$$BS_{ikt} = \frac{\sum_{j=1}^{3} bs_{jikt}}{Y_{ikt}} \frac{\sum_{j=1}^{3} inn_{ji}}{\sum_{j=1}^{3} turn_{ji}}$$

where *i* is the country, *k* is the destination sector, *t* is the time period, *j* is the business services (upstream) industry (Communication, Computer and related services, Other business services), *bs* is the expenditure for each BS input in sector *k*, for country *i* at time *t* (drawn from Input-Output tables), *Y* is either the downstream sectoral production or downstream total intermediate inputs[15], *inn* the total innovative expenditure and *turn* the total turnover[16].

The first term of the innovation-weighted BS indicator varies from sector to sector and captures the degree of connectivity between BS and downstream industries for each country,

[13] Usual drawbacks in the use of Input-Output Tables to describe the knowledge flows among sectors are the inevitable consequence of the classification available and the static nature of the matrix based on a Leontief technology (Papaconstantinou et al. 1996).

[14] Papaconstantinou et al. (1996) compute the technology embodied in a product of an industry as the sum of its own R&D and that which is embodied in its purchases from other industries (as direct and indirect purchases of intermediate inputs and domestic investments). In our paper, rather than focusing on R&D we consider direct flows of technology-weighted BS inputs to downstream industries.

[15] We consider both measures of BS intensity since, from the descriptive analysis, differences (especially between services and manufacturing sectors) have emerged.

[16] The indicator is normalized to be coherent with others variables.

sector and time period. The second term is country-specific and constant across sectors and gives a weight to economic transactions between BS and other sectors according to the innovation intensity of upstream BS sectors (it is drawn from CIS, see Table 1). Due to availability of data, the second term is calculated only for 2004 (the final period) and extended to both periods[17].

4.3 The econometric model

In order to represent the different channels of propagation of the effects of BS activities on client industries - as depicted in Figure 1 - a two-stage model is applied. In the first stage the impact of the use of BS inputs on the innovation performance of client industries is estimated. In the second stage the predicted value of the first stage is included as a regressor, together with BS intensity indicator and other regressors, in the equation modelling the impact of BS on economic performance. Differently from most studies (reviewed in Section 2) we use as a performance variable "value added growth", rather than productivity. There are several reasons justifying such a choice: first, our sample includes among downstream industries many services sectors for which traditional productivity measures (such as turnover or value added per employee) are likely to be not very effective and reliable (Griliches, 1992; Wölfl, 2004). In fact, the growth of the value added variable seems to be the most appropriate and comprehensive performance indicator if the two types of mechanisms shown in Figure 1 - those acting via an enhancement of both production and organizational efficiency and innovation competitiveness - want to be estimated. Moreover, an enhancement of the product-related innovation performances of downstream industries (influenced by the use of BS inputs) is expected to affect first and foremost the growth rates of industries.

In the first stage, we estimate (for each country, sector and time period) the impact of business services to the share of turnover due to improved or new products (*turnin*) controlling for the total innovative expenditure per employee (*inn*), human capital (the share of employees with a degree, *quni*) and an indicator of the average firm size (*firmsize*); country, sectoral (distinguishing services and the four Pavitt sectors) and time dummies are also included:

$$turnin_{i,k,t} = \alpha_0 + \alpha_1 BS_{i,k,t} + \alpha_2 inn_{i,k,t} + \alpha_3 firmsize_{i,k,t} + \alpha_4 quni_{i,k,t} + \gamma_i + \delta_k + \zeta_t + \varepsilon_{i,k,t} \quad (1)$$

[17] This is due to data constraints and in particular to the fact that CIS data for Germany (CIS 3, 2000) on total turnover and total innovative costs are not available at 2 digit level in SIEPI/SI database (and, as already pointed out, not provided by EUROSTAT).

where *i*=country, *k*=sector group and *t*=time.

In the second stage the predicted value of the first model (*pturnin*) is included in the value added (*va*) growth equation to investigate jointly the direct and indirect effect of BS (innovation weighted) inputs on sectoral economic performance.[18] We also control for investment (gross fixed capital formation on value added, *gfcva*) and country, sector groups and time dummies. More in detail, the gross fixed capital formation variable is included to as a proxy of changes in production capacity, capital intensity and might also capture embodied technological change. Pavitt dummies are inserted in order to take the technological differences among manufacturing sectors into account. A services dummy is also included.

$$\Delta va_{i,k,t} = \beta_0 + \beta_1\, pturnin_{i,k,t} + \beta_2\, BS_{i,k,t} + \beta_3\, gfcfva_{i,k,t} + \theta_i + \mu_k + \lambda_t + \eta_{i,k,t} \qquad (2)$$

For robustness checks we also try with a richer set of control variables in the value added growth equation (including different measures of human capital and indicators related to process innovation).

Since *pturnin* (the predicted value of turnover in the first equation) is a generated regressor, we correct the variance–covariance matrix of the estimators of the second equation following the Murphy–Topel (1985) methodology[19]. The advantages of the two stage estimation is that it is possible to distinguish the contribution that BS have on the economic performance of user sectors through their contribution to the innovative performance (the capability of introducing new products) of these sectors from other channels. In fact, while the coefficient β_2 in equation (2) captures the impact of BS on sectoral value added growth that is not mediated by their impact on innovation, the effect of BS on growth "via innovation" is given by the product between the coefficients α_1 and β_1. If all three coefficients are positive and significant we can conclude that BS contribute to the performance of user sectors both via innovation and via other channels. On the other hand if α_1 and β_1 are positive and significant but β_2 is not the BS contribution to sectoral value added growth comes only via its impact on the innovation

[18] While the use of an innovation weighted BS input should better capture the impact of BS on their clients' own innovativeness (as estimated by the first stage equation), the choice between a simple measure of BS flows and a weighted one in the case of measuring its direct effect on the economic performance of user sectors (as estimated by the second stage equation) is somewhat more doubtful. However, as already pointed out in section 2, we think that most mechanisms through which BS affect the performance of user sectors work more effectively when the quality of BS inputs is high (this is the case, for example, for the capability of BS to contribute to production and organizational efficiency).

[19] For details on how to implement this procedure see Hole (2006).

performance of user sectors, while the opposite occurs if β_2 is positive and significant but either α_1 or β_1 are not (there is a positive impact of BS on growth but it comes from channels different from product innovation).

The possibility of multicollinearity is checked through the VIF analysis (Variance Inflation Factors). The structure of the model somewhat reduces the presence of possible problems of endogeneity: in fact, in the first equation, we simply regress an innovation output variables against innovative inputs and structural variables; in the second regression, the innovation variables refer to the first year (respectively, 2000 and 2004) of the two periods for which the variable "change of value added" has been computed (2000-2003; 2004-2007). This means that in equation 2 an implicit (though rather short) time lag between the innovation and the economic performance variable is introduced.

4.4 Data and descriptive statistics

The dataset merges information drawn from four different sources of data. These are indicated in Table 3 together with the specification of the period for which variables are measured.

[Table 3 here]

All monetary variables are expressed in Euro. Nominal variables have been changed at constant prices (2000) using sectoral (from STAN) and OECD GDP deflators. For the United Kingdom, the original figures provided are transformed using the exchange rate expressed in PPP (drawn from Eurostat, Prices and purchasing power parities, Statistics in Focus 53, 2004).

Table 4 shows the main descriptive statistics for each variable in each period. We can observe that the average rate of growth of value added is close to zero in the period 2000-2003 rising to 1.8% in the period 2004-2007. Among innovation variables both the share of total turnover due to new or improved products and total innovative expenditure per employee have slightly increased between the two periods. The share of employees with a degree has increased more markedly (from 18.6% to 21.2%) while the share of gross fixed capital formation on value added has declined (from 19% to 17%). Finally both innovation-weighted indicator of the BS intensity have only marginally increased. These general trends hide the presence of very different behaviours of individual sectors and countries as can be seen from the large standard deviations reported in the table.

[Table 4 here]

4.5 Regression results

Tables 5 and 6 report the results of the estimation of the two-stage model described in the previous section. Two specifications are presented. The first one excludes BS sectors from client industries while, in the second one, the whole sample is considered. When BS industries are introduced, BS inputs used by each sub-BS sector are considered net of the inputs acquired by firms belonging the same sub sector (see note 10)[20]. Moreover, to check for robustness, we use two different indicators of BS intensity, one standardised by user industries' output and the other by user industries' total inputs.

All in all, the estimation of the two-stage model shows that BS have a positive impact on innovation output and, via this channel, also on sectoral value added growth. Moreover we find a positive effect of BS on the rate of growth of user industries that is not mediated by the introduction of new products and services. This second effect is likely to be related to the production and organizational efficiency gains linked to the use of BS (as also highlighted in the literature). The existence of these two complementary effects is robust to both including and excluding BS sectors from client industries and to both measuring BS intensity as a share of total output and of total intermediate inputs. More in particular, results of the estimation of the first-stage equation show that the industry innovation output is positively affected by internal firms' innovative efforts (as captured by total innovation expenditures), by human capital (as captured by the share of employees with a degree) and by average firms' size. Country effects show that, conditional on our explanatory variables, Germany, Italy and Spain have a higher share of turnover due to improved or new products with respect to France and the UK, while this share is lower on average for services than manufacturing industries (here the ranking sees the higher coefficient for science based industries, followed by specialised suppliers, however in most estimations coefficients are not significantly different from that of supplier dominated industries (the base category) at conventional levels). Looking at the determinants of sectoral growth (second-stage equation), we can observe that innovation performance (the predicted value from the first stage equation - *pturnin*) and (innovation weighted) BS inputs exert a positive impact in both specifications (including and excluding BS from client industries), while investment (gross fixed capital formation on value added) has a significant impact only in the specification that includes BS sectors.

[20] Regression results are robust also to the introduction of internal flows of BS in BS downstream sectors.

Comparing the results of the specification excluding and that including BS, we can observe very similar coefficients for most variables. However the role of human capital for innovation performance appears to be higher when including BS sectors (we can both observe a higher coefficient and significance level), while, surprisingly, BS related innovation inputs do not appear to play a larger role on the innovation output when downstream BS industries are included (the coefficient and significance levels are lower in the specification including BS).

We also tried other specifications of the sectoral value added equation including different measures of human capital (the share of employees with a university degree and the share of managers over total employees) and some proxies for process innovation (the innovation expenditure for the acquisition of machinery and equipment and the share of firms trying to reduce labour costs) but neither of these variables was significant. In all cases, however, the significant direct and indirect effect of the BS innovation index remained robust.

Overall, regression results provide consistent evidence on the positive role of BS on client industries as found (using different data and methodologies), among others, by Antonelli (1999), Greenhalgh and Gregory (2000), Baker (2007) and Camacho and Rodriguez (2007a, 2007b). Differently from previous studies, however, we highlight the existence of at least two different channels through which BS impact on the performance of client industries. First BS contribute to enhance innovation performance of user sectors (which, in turn, positively affects sectoral growth); second they exert an additional impact not mediated by the introduction of innovative products possibly via "production and organizational efficiency gains". This second effect may capture different transmission mechanisms highlighted in the literature and broadly referring to either process technological innovations or to the use of BS inputs which are not strictly technological in nature, able to stimulate and support the introduction of organizational innovations, the adoption of new business models and outsourcing strategies leading to a relocation of tasks and production/service functions within and beyond firms' boundaries.

[Table 5 here]

[Table 6 here]

5. Conclusions

The evidence presented in this paper provides strong empirical support on the positive impact that BS exert on the rest of the economy. Compared to previous research, the specific value added of this contribution consists of having further explored and qualified these effects, taking

into account both the strength and innovative content of the linkages between BS and user industries as well as to have looked at different mechanisms through which the use of BS inputs affects the performances of client industries. The empirical evidence is composed of two parts - a descriptive and an econometric one - each providing interesting and complementary indications on the composite nature of BS and on their multifaceted impact.

The descriptive evidence presented in Section 3 has shown some important differences in the intensity in the use of BS by client industries both across countries and even more across sectors. Services, and in particular the financial sector and the BS sector itself, emerge as the major users of BS inputs while within the manufacturing sector the BS intensity clearly reflects the overall innovation dynamism of industries. The comparison of the "BS intensity" of the five countries taken into account in our analysis - with the leading position of France and Spain at the bottom - provides some additional support to the positive role that BS might play in complementing "internal" innovation efforts and in sustaining the innovation and economic performances of national economies at large. A very interesting result is the presence of very different country-specific models of interdependencies between BS and the rest of the economy. All in all, what this descriptive evidence seems to suggest is that in analysing the macroeconomic effect of BS what is likely to be relevant is not only the intensity of economic flows originating from BS but also its "structure" (as also stressed by Windrum and Tomlinson, 1999).

The most important value added of this paper consists of having taken into account the innovation content of BS inputs, as well as the presence of different mechanisms through which BS affect the economic performances of client industries. Both aspects have been empirically assessed in Section 4 modelling and estimating the contribution provided by BS on the growth performances of client industries via two distinct channels: one operating via an enhancement of the production efficiency performances of the user industries; a more indirect one operating through the effects that BS inputs exert on the innovation performances (i.e. product related innovativeness) of client industries. The econometric estimates confirm that both types of mechanisms are at work and that hold and are robust to several econometric specifications and also when BS are included among the beneficiaries of their own inputs (i.e. are included among the downstream industries). These results somewhat complement the descriptive evidence presented in Section 3 leading us to draw the following very broad methodological and interpretative indication: the macro-economic effects of BS can be related to (and analysed looking at) three basic dimensions and namely i) the size (and growth) of this

macro-sector, ii) its innovative performance, iii) the structure, intensity and innovation content of the linkages between this composite set of industries and the rest of the economy.

This contribution should be seen as a first attempt of shedding light on the relevance of these different dimensions and as a tentative way of modelling and estimating the different mechanisms through which BS are expected to affect the performances of innovation and economic systems. As already mentioned, the analysis has been limited by several data constraints which somewhat ask for some caution in the interpretation of results. We end this contribution by listing just three of them which identify also future developments of this line of research.

First of all the country coverage is rather limited and this is largely due to having merged Input-Output and CIS data. Such a merge, though representing a major methodological contribution of this exercise, has in turn prevented us to explore in more depth country models in each of the three dimensions listed above as well as in the economic and innovation effects of BS. Hopefully these constraints will be somewhat released in the near future provided that the "actual" sectoral and country coverage of both CIS data and Input-Output dataset will be extended.

Second, the time span taken into account in this paper is relatively short and not fully appropriate to strengthen the econometric robustness of the analysis. A similar concern can be raised with respect to the cross-section nature of the dataset used. Both these constraints could be somewhat released by the possibility of linking longitudinally both Input-Output and CIS data. This possibility is at the moment rather limited. Both the limitations in the number of countries and in the time-series has not allowed us to look for differences in the role of BS between groups of client industries, a relevant issue that is left for future research.

Third, due to the technological imprinting of CIS in our empirical analysis we have not been able to properly measure innovation inputs and performances which are not strictly technological in nature. The innovation content of BS inputs have in fact been measured using a somewhat "technological biased" variable, that is the amount of (technologically related) innovation expenditures sustained in the BS sector; on the other hand, the innovation performances of downstream industries has been measured taking into account the share of turnover due to improved or new products, and this indicator - especially in the case of the manufacturing sector – has a clear technological connotation. A more direct and appropriate empirical assessment of the non-technological content of BS inputs and of the firms' innovation performances represents another important area of improvement of this line of

research. Unfortunately we have still very poor and limited quantitative data on non-technological innovation (as the ones provided by CIS) and this represents a serious obstacle to extend the research in this direction.

Acknowledgment

This paper is based on the Italian project MIUR 2007 “Innovation and economic performance in services”. We thank the referees of the Special issue on The role of business services for innovation, internationalization and structural change for comments.

Appendix

Table A.1. Sectors (with Nace code) and grouping.

Nace Rev.1 Isic Rev.3	*Sectors name*	*Grouping*
15-16	FOOD PRODUCTS, BEVERAGES AND TOBACCO	SD
17	TEXTILES	SD
18	WEARING APPAREL, DRESSING AND DYEING OF FUR	SD
19	LEATHER AND LEATHER PRODUCTS AND FOOTWEAR	SD
20	WOOD AND PRODUCTS OF WOOD AND CORK	SD
21	PULP, PAPER AND PAPER PRODUCTS	SII
22	PRINTING AND PUBLISHING	SII
24	CHEMICALS AND CHEMICAL PRODUCTS	SB
25	RUBBER AND PLASTICS PRODUCTS	SII
26	OTHER NON-METALLIC MINERAL PRODUCTS	SII
27	BASIC METALS	SII
28	FABRICATED METAL PRODUCTS, except machinery and equipment	SD
29	MACHINERY AND EQUIPMENT, N.E.C.	SS
30	OFFICE, ACCOUNTING AND COMPUTING MACHINERY	SB
31	ELECTRICAL MACHINERY AND APPARATUS, NEC	SS
32	RADIO, TELEVISION AND COMMUNICATION EQUIPMENT	SB
33	MEDICAL, PRECISION AND OPTICAL INSTRUMENTS	SB
34	MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS	SII
35	OTHER TRANSPORT EQUIPMENT	SS
36-37	MANUFACTURING NC AND RECYCLING	SD
50	SALE, MAINTENANCE AND REPAIR OF MOTOR VEHICLES; RETAIL SALE OF FUEL	TD
51	WHOLESALE, TRADE & COMMISSION EXCL. MOTOR VEHICLES	TD
52	RETAIL TRADE EXCL. MOTOR VEHICLES; REPAIR OF HOUSEHOLD GOODS	TD
55	HOTELS AND RESTAURANTS	TD
60	LAND TRANSPORT	TR
61	SEA TRANSPORT	TR
62	AIR TRANSPORT	TR
63	SUPPORTING AND AUXILIARY TRANSPORT ACTIVITIES	TR
64	POST AND TELECOMMUNICATIONS	BS
65	FINANCIAL INTERMEDIATION except insurance and pension funding	FIN
66	INSURANCE AND PENSION FUNDING, except compulsory social security	FIN
67	ACTIVITIES RELATED TO FINANCIAL INTERMEDIATION	FIN
70	REAL ESTATE ACTIVITIES	FIN
71	RENTING OF MACHINERY AND EQUIPMENT	FIN
72	COMPUTER AND RELATED ACTIVITIES	BS
73	RESEARCH AND DEVELOPMENT	BS
74	OTHER BUSINESS ACTIVITIES	BS

Table 1. Total innovation expenditure as a share of total turnover (percentages values) - 2004.

	Germany	*United Kingdom*	*France*	*Italy*	*Spain*
Manufacturing	5.15	3.96	3.58	2.24	1.55
Services	1.31*	0.91	1.21	1.13	0.54
Business Services (without R&D)	3.15	2.35	2.39	2.08	1.70
Business Services (with R&D)	3.61	2.80	3.86	2.50	2.68
Manufacturing and services	3.05*	1.59	2.03	1.66	0.89

*Sectors 52, 55, 70, 71 are excluded from the estimate.

Source: SIEPI/SI database

Table 2. BS intensity across sectors and countries - 2005.

BS inputs as a share of total output	*Germany*	*United Kingdom*	*France*	*Italy*	*Spain*	*Average across countries*	*Change 2000-2005*
Science Based	10.3%	3.8%	7.6%	5.9%	6.6%	6.8%	-0.6%
Specialized Suppliers	8.3%	4.6%	6.9%	6.2%	5.4%	6.3%	0.3%
Scale Intensive	6.9%	3.0%	7.3%	5.0%	4.9%	5.4%	0.3%
Suppliers Dominated	5.6%	3.3%	7.5%	4.1%	5.2%	5.1%	0.3%
Manufacturing	7.5%	3.5%	7.3%	5.2%	5.5%	5.8%	0.1%
Transport	3.4%	10.0%	9.3%	9.0%	5.3%	7.4%	0.2%
Trade and Leisure	6.3%	9.3%	10.1%	8.8%	6.1%	8.1%	0.7%
Finance	7.0%	13.1%	12.4%	7.5%	6.4%	9.3%	-0.4%
Research & Development	15.6%	18.6%	14.6%	8.6%	8.3%	13.1%	0.8%
Business Services	3.7%	10.0%	7.3%	9.2%	8.2%	7.7%	0.2%
Services	5.7%	11.2%	10.1%	8.6%	6.6%	8.4%	0.1%
Total	6.7%	6.8%	8.5%	6.6%	5.9%	6.9%	0.1%

BS inputs as a share of total inputs	*Germany*	*United Kingdom*	*France*	*Italy*	*Spain*	*Average across countries*	*Change 2000-2005*
Science Based	16.5%	6.4%	11.0%	8.5%	9.4%	10.3%	-0.5%
Specialized Suppliers	13.1%	7.5%	9,6%	8.6%	7.9%	9.3%	0.1%
Scale Intensive	10.3%	4.7%	10.3%	6.9%	7.1%	7.9%	0.3%
Suppliers Dominated	8.4%	5.6%	11.0%	5.9%	7.2%	7.6%	0.3%
Manufacturing	11.6%	5.8%	10.5%	7.3%	7.8%	8.6%	0.1%
Transport	6.1%	18.3%	16.0%	13.9%	8.7%	12.6%	0.5%
Trade and Leisure	15.1%	21.0%	21.2%	15.9%	14.2%	17.5%	1.4%
Finance	19.2%	31.3%	30.5%	23.5%	17.8%	24.5%	-0.5%
Research & Development	29.1%	48.7%	25.4%	23.5%	26.0%	30.5%	0.9%
Business Services	8.9%	26.3%	17.6%	19.3%	19.0%	18.2%	0.8%
Services	12.9%	25.9%	21.2%	18.4%	15.4%	18.8%	0.6%
Total	12.2%	14.2%	15.0%	11.9%	10.9%	12.9%	0.3%

Table 3. Data sources and temporal matching.

Variables	*Source*	*Period 1*	*Period 2*
Compound Annual Rate of Growth of Value Added	STAN	2000-2003	2004-2007
Share of total turnover due to new or improved products	CIS(SIEPI/SI)	2000	2004
Innovation-weighted BS Indicator	I-O Tables and CIS(SIEPI/SI) (2004)	2000	2005
1000s euros on total innovative expenditure per employee	CIS (SIEPI/SI)	2000	2004
Average Firm size – Employees per firm	CIS (SIEPI/SI)	2000	2004
Gross Fixed Capital Formation on Value Added	STAN	2000	2004
Share of employees with a degree	LFS	2000	2003

Table 4. Descriptive statistics.

Period 1	*Mean*	*S. d.*	*Min*	*Max*
Compound Annual Rate of Growth of Value Added	-0.56%	4.98	-19.30%	16.71%
Share of total turnover due to new or improved products	14.92%	12.86	0.17%	52.79%
Innovation-weighted BS Indicator (on total production)*	11.64	7.25	3.00	42.00
Innovation-weighted BS Indicator (on total input)*	20.63	15.47	4.00	89.90
1000s euros on total innovative expenditure per employee	4.66	8.02	0.05	55.84
Average Firm size – Employees (Thousands) per firm	0.11	0.12	0.02	0.80
Gross Fixed Capital Formation on Value Added	19.00%	11.4	3.00%	54.00%
Share of employees with a degree	18.61%	15.17	0.68%	70%
Period 2	*Mean*	*S. d.*	*Min*	*Max*
Compound Annual Rate of Growth of Value Added	1.78%	5.59	-20.88%	34.05%
Share of total turnover due to new or improved products	15.61%	12.91	1%	76.13%
Innovation-weighted BS Indicator (on total production)*	12.25	8.04	2.00	39.00
Innovation-weighted BS Indicator (on total input)*	21.34	14.05	3.00	59.00
1000s euros on total innovative expenditure per employee	4.93	6.82	0.05	34.26
Average Firm size – Employees (Thousands) per firm	0.11	0.15	0.02	0.83
Gross Fixed Capital Formation on Value Added	17.00%	8.53	3.00%	44.00%
Share of employees with a degree	21.20%	15.9	2.34%	76.70%

* including BS sectors

Table 5. The impact of business services on technological innovation (first stage).

Dependent variable *Share of turnover due to new or improved products*	*BS excluded*					
	N. obs=185			*N. obs=185*		
(OLS estimate)	*Coefficient*		*t-value*	*Coefficient*		*t-value*
BS innovation index (total production)	0.320	***	2.72			
BS innovation index (total input)				0.176	***	2.64
Total innovation expenditure per employee	0.425	***	3.4	0.421	***	3.37
Average firm size	28.439	***	4.58	31.023	***	4.9
Share of employees with a degree	0.133	*	1.7	0.116		1.45
Germany	10.792	***	3.28	11.328	***	3.47
France	-3.150		-1.15	-2.745		-1.01
Italy	13.501	***	5.28	13.732	***	5.35
Spain	11.357	***	4.19	11.904	***	4.31
Science Based	5.195		1.59	5.854	*	1.81
Specialized Suppliers	3.501		1.25	3.809		1.37
Scale Intensive	-0.787		-0.38	-0.750		-0.36
Services	-5.245	**	-2.28	-6.453	***	-2.63
Time dummy for the second period	-5.959	***	-3.26	-5.958	***	-3.26
Constant	-1.692		-0.69	-1.546		-0.63
Adjusted R^2	0.484			0.483		

Note: *, **, *** denote significance at respectively 10, 5 and 1 per cent

Dependent variable *Share of turnover due to new or improved products*	*BS included*					
	N. obs=199			*N. obs=199*		
(OLS estimate)	*Coefficient*		*t-value*	*Coefficient*		*t-value*
BS innovation index (total production)	0.226	**	2.05			
BS innovation index (total input)				0.117	*	1.89
Total innovation expenditure per employee	0.463	***	3.69	0.463	***	3.68
Average firm size	23.617	***	3.95	25.411	***	4.17
Share of employees with a degree	0.206	***	3.03	0.192	***	2.76
Germany	12.817	***	4.02	13.195	***	4.16
France	-2.437		-0.93	-2.187		-0.83
Italy	14.553	***	5.84	14.663	***	5.86
Spain	10.598	***	3.99	10.925	***	4.02
Science Based	4.089		1.29	4.648		1.48
Specialized Suppliers	3.243		1.17	3.536		1.28
Scale Intensive	-0.789		-0.38	-0.725		-0.35
Services	-4.165	*	-1.84	-4.895	**	-2.04
Time dummy for the second period	-6.572	***	-3.63	-6.558	***	-3.62
Constant	-1.650		-0.68	-1.424		-0.59
Adjusted R^2	0.461			0.459		

Note: *, **, *** denote significance at respectively 10, 5 and 1 per cent

Table 6. The impact of business services on sectoral growth (second stage).

Dependent variable: Compound Annual Rate of Growth of Value Added (2000-2007)	*BS excluded*					
	N. obs=156			*N. obs=156*		
(Murphy-Topel Procedure)	*Coefficient*		*t-value*	*Coefficient*		*t-value*
Share of turnover due to new or improved products (predicted)	0.146	**	2.16	0.182	***	3.25
BS innovation index (total production)	0.185	**	2.3			
BS innovation index (total input)				0.106	**	2.36
Gross fixed capital formation on value added	0.059		1.21	0.045		0.89
Germany	-1.187		-0.67	-1.430		-0.87
France	0.993		0.69	-1.291		0.87
Italy	-1.948		-1.23	-1.825		-1.16
Spain	-0.828		-0.51	-0.839		-0.52
Science Based	-3.974	**	-2.02	-4.445	**	-2.11
Specialized Suppliers	-1.558		-1.07	-1.865		-1.28
Scale Intensive	-0.197		-0.18	-0.191		-0.18
Services	1.683		1.3	1.170		0.89
Time dummy for the second period	3.164	***	2.68	3.358	***	2.91
Constant	-5.084	***	-3.42	-5.133	***	-3.33
Adjusted R^2	0.187			0.189		

Note: *, **, *** denote significance at respectively 10, 5 and 1 per cent

Dependent variable: Compound Annual Rate of Growth of Value Added (2000-2007)	*BS included*					
	N. obs=163			*N. obs=163*		
(Murphy-Topel Procedure)	*Coefficient*		*t-value*	*Coefficient*		*t-value*
Share of turnover due to new or improved products (predicted)	0.127	*	1.89	0.153	***	2.72
BS innovation index (total production)	0.175	***	2.62			
BS innovation index (total input)				0.091	***	2.66
Gross fixed capital formation on value added	0.077	*	1.78	0.073	*	1.68
Germany	-1.177		-0.66	-1.225		-0.76
France	0.962		0.73	1.196		0.89
Italy	-2.118		-1.41	-2.110		-1.49
Spain	-0.892		-0.57	-0.964		-0.65
Science Based	-3.599	*	-1.83	-3.804	*	-1.85
Specialized Suppliers	-1.280		-0.89	-1.391		-0.97
Scale Intensive	0.245		-0.23	-0.24		-0.23
Services	1.248		1.02	0.637		0.52
Time dummy for the second period	3.177	***	2.71	3.350	***	2.93
Constant	-5.024	***	-3.57	-4.983	***	-3.49
Adjusted R^2	0.186			0.183		

Note: *, **, *** denote significance at respectively 10, 5 and 1 per cent

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Figure 1. The impact of Business sector on the innovation and economic performances of user industries.