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Do KIBS make manufacturing more innovative? An empirical investigation of four European countries ☆

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ABSTRACT

This paper estimates the innovation impact of the vertical integration of knowledge-intensive business services (KIBS) into manufacturing. The concept of an economy's vertically-integrated sectors is used in order to measure the innovative knowledge transferred directly and indirectly from KIBS to manufacturing in a production-based manner, and to estimate its impact on various proxies for manufacturing inventions. By merging OECD data on sectoral R&D and input–output tables with sectoral patent applications and patent quality indicators from the Pastat and OECD Patent Quality Indicators databases, respectively, a panel of 18 manufacturing sectors is built for the four largest European countries – France, Germany, Italy and the UK – from the mid-1990s to the mid-2000s. Those industries which integrate R&D embodied in KIBS production flows more intensively and extensively are industries with greater inventive efforts and higher quality patents. In terms of policy, strengthening the linkage between KIBS and manufacturing appears to be as crucial as supporting KIBS activities and service innovations.

1. Introduction

Two decades after the seminal contribution by Miles et al. (1995), Knowledge Intensive Business Services (KIBS) are still attracting a great deal of attention. Important new insights have been obtained into their role at different levels of analysis: micro and sectoral (e.g., Tether, 2005; Corrocher et al., 2009; Consoli and Elche-Hortelano, 2010; Doloreux and Shearmur, 2010), urban and regional (e.g., Tödtling et al., 2006; Antonietti et al., 2013; Shearmur and Doloreux, 2014), and macroeconomic (e.g., Mas-Verdú et al., 2011; Hauknes and Knell, 2009; Di Cagno and Meliciani, 2005; Desmarchelier et al., 2013).

A feature shared by these streams of research is their attention to the complex kind of knowledge exchange that KIBS perform with their clients, especially with firms operating in manufacturing industries. The relative knowledge interaction occurs through both disembodied and embodied flows of codified and tacit knowledge, respectively, which overlap to differing extents with the production relationships between KIBS and manufacturing (Landry et al., 2012).

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The present paper focuses on and extends the investigation of 'production-embodied' flows of knowledge between KIBS and manufacturing based on the use of input–output analysis (e.g., Baker, 2007; Tomlinson, 2000a, 2000b; Windrum and Tomlinson, 1999). In particular, it brings two pieces of value added to such investigation. Firstly, rather than a simple input–output approach, we adopt a more sophisticated one based on the notion of vertically-integrated sector (or subsystem). This perspective has recently proved quite useful in investigating the relationships between manufacturing and services, especially in the aftermath of the explosion of outsourcing practices from the former to the latter (Ciriaci and Palma, 2012; Montresor and Vittucci Marzetti, 2011). Secondly, rather than a standard production function approach to the impact of KIBS on the productivity of manufacturing (e.g., Antonelli, 2000; Katsoulacos and Tsounis, 2000), we use a 'knowledge production function' with a long tradition in innovation studies at the firm level (Griliches, 1979; Crèpon et al., 1998). Using this original framework of analysis, we investigate the extent to which KIBS' innovative knowledge enters into vertically-integrated manufacturing sectors through production-based flows, and in so doing increases their innovation capacity, as it can be proxied by the quantity and quality of their inventive (i.e., patent) efforts.

An empirical investigation is carried out with respect to the four largest EU economies, whose KIBS have been shown to be pivotal and have different intersectoral patterns of vertical integration (Ciriaci and Palma, 2012; Windrum and Tomlinson, 1999), that is: France, Germany, Italy and the UK, for the decade which spans from 1995 to 2005. To this end, the OECD Input–Output and the ANBERD databases are combined and merged with sectoral patent applications from the Pastat dataset[1] and patent quality data from the OECD Patent Quality Indicators database. In a panel framework, country, sector and time-specific effects are thus controlled for.

The paper is organised as follows. Section 2 illustrates the theoretical background. Section 3 describes the methodological approach, Section 4 sets out the data used and the empirical application. Section 5 comments on the results and Section 6 concludes.

2. Theoretical background

In nearly twenty years of intense research, the analysis of KIBS has been enriched with several definitions and approaches (for a review, see Muller and Doloreux, 2009). Some of them focus on the actors (companies or organisations) that deliver the services at stake (e.g., Miles et al., 1995; Bettencourt et al., 2002a,b) and treat 'KIBS' as the supply of a qualified, knowledge-intensive service (e.g., Amara et al., 2009; Rodriguez and Ballesta, 2010). Other definitions instead address the nature of these service activities (e.g., Den Hertog, 2000; Gallouj, 2002) and treat 'KIBS' as a particular kind of economic sector with an important role in promoting innovation and growth at the aggregate level (e.g., Baumol, 2002; Oulton, 2001).

Although it also draws on the former approach, this paper is grounded in the second research stream. Henceforth, KIBS will be understood as "a category of service activities, which is often highly innovative in its own right, as well as facilitating innovation in other economic sectors, including both industrial and manufacturing sectors" (den Hertog, 2000, pp. 504–505).[2]

This definition directly points to a function of KIBS which is the focus of this paper (on the other KIBS function, see Den Hertog and Bilderbeek, 1998). KIBS perform key activities in innovation systems (e.g., Muller and Zenker, 2001; Tether, 2005). Not only are they innovative per se, because they introduce new marketable services and technological applications; they also act as knowledge carriers with respect to other sectors, especially manufacturing ones, and in this way work as 'innovation propellers' at the system level (Castellacci, 2008).

Knowledge transfer is the core activity that KIBS undertake (especially) with respect to manufacturing sectors (Leiponen, 2006). This is a manifold activity which involves KIBS in the generation and diffusion of different types of knowledge, both codified and tacit, in developing problem-specific and innovative solutions for their manufacturing clients (Landry et al., 2012). In this process, two aspects require special attention, possibly more than those in the extant literature: i) the production-based transmission of KIBS knowledge; and ii) the techno-economic impact of this knowledge transmission.

2.1. The 'production-based' transmission of KIBS knowledge

The production and use of KIBS knowledge occur through frequent and specialised interactions between KIBS and their clients (Koschatzky and Stahlecker, 2006), not only in the form of explicit (e.g., contractual) knowledge transfers and cooperation agreements, but also via production relationships like exchanges of services, intermediate commodities and capital goods. This latter kind of production flow between KIBS and manufacturing is beneficial for the latter in two main respects. Firstly, it conveys to manufacturing sectors a tacit kind of KIBS knowledge which cannot reach them in ways other than embodiment in the items exchanged (Hauknes and Knell, 2009; Papaconstantinou et al., 1998). One can think of the purchase of a newly (KIBS) developed software product that encapsulates some 'unwritten' functions which the (manufacturing) client discovers by exploring its use.

Secondly, the production interaction between KIBS and manufacturing can also affect the diffusion of codified KIBS knowledge, even in the absence of an actual embodiment. As regional and urban studies have widely shown, by becoming involved in (repeated) market relationships, partners can build up and increase their 'cognitive proximity' (Boschma, 2005). In brief, they can augment the degree of overlap between their learning routines and mental frameworks, and become better able to understand and absorb the explicit knowledge that they exchange (Montresor and Vittucci Marzetti, 2008). One can think of a (disembodied) consultancy that a KIBS delivers to a (manufacturing) client in order to improve its strategic positioning, benefiting from the experience accumulated by

[1] On the combined use of R&D and patent data at the inter-industry level, see the recent work by Panizza and Squicciarini (2014).

[2] KIBS thus include business-devoted activities such as consultancy, research and engineering, which are characterised by intensive professional knowledge (i.e., a technical area or discipline) and are dedicated to other productive sectors (providing them with customised problem solving), rather than to final consumption (Miles et al., 1995). A more precise account of the identification of these sectors will be provided in the next section. On the classification of KIBS see, among others, Miles et al. (1995), Muller and Zenker (2001) and Martinez-Fernandez and Miles (2006).