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Title and Abstract

Title: University Links with Knowledge Intensive Business Services: Explaining the Variation in the Spatial Nature of these Links

Introduction

Universities are increasingly characterised as important sources of knowledge for innovation and, as such, are regarded as key nodes within knowledge networks. Indeed, interest in knowledge networks has increased as the innovation process becomes less an isolated, atomistic endeavour but a collective, open and systemic process (Lawson & Lorenz, 1999; Chesbrough, 2003). As a result, innovative outputs result from interactions and alliances, both formal and informal, with a wealth of external actors in order to utilise knowledge from outside the firm rather than just the resources within a firm (Contractor & Lorange, 2002).

Abstract

This paper focuses on university-industry linkages involving KIBS firms. We conceptualise U-I linkages as formal research partnerships, i.e. inter-organisational agreements designed to pursue a collaborative R&D project (Council on Competitiveness, 1996; Perkmann & Walsh, 2007). The objective of this paper is to examine formal U-I linkages involving KIBS firms and assess the factors that determine their geographic proximity. The role typically ascribed to universities in the innovation process focuses on producing and transferring knowledge to the private sector for commercialisation (Mansfield, 1995; Bok, 2003; D'Este & Patel, 2007; Huggins *et al.*, 2008). Consequently, universities have been placed at the centre of regional innovation systems and the regional economic development process (Charles, 2003; Goldstein & Renault, 2004; Lawton Smith, 2007; Huggins *et al.*, 2008); in addition policymakers have

enthusiastically embraced this view of universities and consequently focussed on interventions to encourage collaboration with firms in order to facilitate the transfer of technology and knowledge in order to promote competitiveness (Goldfard & Henrekson, 2003; Lambert, 2003; Perkmann & Walsh, 2007; Wilson, 2012). KIBS firms are also important components of the regional innovation system. Firstly, KIBS are one of the fastest growing sectors within advanced economies (Miles & Boden, 2000); within Europe the growth rate of the KIBS sector has outstripped that of all other sectors since 2000 (Chadwick *et al.*, 2008; Huggins, 2011). Secondly, KIBS firms are not only innovative in their own right but also act as catalysts of innovation within other firms (den Hertog, 2000).

Through empirical examination of a unique dataset comprised of information on formal university-industry linkages, Knowledge Transfer Partnerships (KTPs), we examine the effect of the characteristics of the firm, the characteristics of the university and the regional in which the firm is based in order to assess their influence on the geographic scope of the U-I linkages. This paper makes a significant contribution to the burgeoning literature in this area through examining a hither-to un-researched area, namely formal KTPs and exploring the geographic scope of these linkages.

Methodology

This paper is based on quantitative analysis of U-I linkages involving KIBS firms from a unique dataset compiled from information on Knowledge Transfer Partnerships (KTPs). KTPs represent collaborations between universities and outside organisations which are designed specifically to transfer knowledge between the two for innovation[1]. Consequently, the KTPs covered a wealth of different activities, covering the six areas of innovation in KIBS Sectors set out by Amara *et al.* (2009); product, process, delivery, strategic, managerial and marketing innovations. Using data on KTPs provides a clear understanding of these formal and on-going U-I linkages allowing us to examine the extent to which the distance over which these occur varies according to geographic location of the firm, the characteristics of the firm and university involved.

For the purposes of defining the KIBS sector we follow the 'standard' definition, broadly focussing on SIC categories 72, 73 and 74 which include technology-based services such IT and software consultancy and research and development activities and professional business services such as legal, accountancy, consultancy and marketing services (Muller & Zenker, 2001; Chadwick *et al.*, 2008; Shearmur & Doloreux, 2009; Doloreux & Shearmur, 2010).

In order to assess the factors affecting the geographic proximity of formal U-I linkages involving KIBS firm we adopt a two stage process firstly using descriptive statistics to examine trends across the firms and regions and secondly a negative binomial regression model. Prior to the data analysis we constructed our dependent variable, recording the geographic proximity between the two parties in the collaboration. Following D'Este *et al.* (Forthcoming) we measure geographic proximity as the inverse of the square root of the distance between the partners ($1/d_{ij}$) where d_{ij} is the square root of the distance between firm *i* and university *j* in kilometres, with a minimum distance of 100 metres where the two partners are located in the same

postcode district.

Diagnostic tests established the proximity variable had a significant skew, with a kurtosis score of 15.034. Therefore, we utilise non-parametric statistical techniques that do not assume the variable is normally distributed such as Man-Whitney U-Tests and Kruskall-Wallis Tests.. As well as being significantly skewed, the dependent variable is also significantly over-dispersed with the variance of the sample (1460.010) significantly greater than the mean (37.57). The existence of both the skew and the over-dispersion negates the use of standard OLS regression techniques as well as Poisson regression, traditionally utilised in the case of count data; in these circumstances a negative binomial regression model is the most appropriate choice and has been used for similar studies (Hilbe, 2009; Ponds *et al.*, 2010).

Findings

The results provide a significant insight into the determinants of the geographic proximity of KIBS U-I linkages. Firstly, we find that geographic proximity of U-I linkages is not uniform across the entire KIBS sector but varies by sub-sector. This appears to confirm other work in this area that highlighted the different types of knowledge utilised in the provision of different types of services within the KIBS sector and we extend this work by outlining the fact that geographic proximity differs according to the type of service and knowledge utilised.

In terms of size effects, we find that geographic proximity is significantly higher for small firms than for all others. This evidence suggests that the KIBS sector is subject to similar patterns with respect to firm size as other sectors (Lawton Smith & Bagchi-Sen, 2006; Hewitt-Dundas, 2011; Laursen *et al.*, 2011). Small KIBS firms may also lack the resources to deal with the search and maintenance costs involved with knowledge networks over a wide area.

University characteristics are important determinants of the geographic proximity of KIBS U-I linkages. Researcher density has the largest effect of all, suggesting that research activity both generates relevant knowledge and drives the formation of external networks. Importantly, researcher density has a negative effect on geographic proximity; therefore higher levels of research within an institution mean the university's networks have a greater reach. International reputation also has a significant negative effect on geographic proximity; a world leading university also has a longer reach. Finally, we find evidence that the type of institution influences geographic proximity in line with the findings of Laursen et al (2011).

As well as the type of firm, the location of the firm is important in terms of geographic proximity. We find that the geographic proximity of KIBS U-I linkages differs across the regions of the UK, some exhibiting higher levels of proximity than others. The socio-economic conditions of the region in which the firm is located also influences the geographic proximity of KIBS U-I linkages. The magnitude of these effects is lower than firm or university characteristics. This suggests that different cultures may exist within the regions – influencing the choice of local or non-local partners. The magnitude of these effects is lower than firm or university characteristics.

Conclusions

The most important results are that geographic proximity varies according to the sub-sector of the firm and also the type of university involved in the collaboration. The reputation and research prowess of the university has a significant and negative effect on geographic proximity, suggesting that greater research prowess drives non-local linkages. Finally, the socio-economic characteristics of the region in which the firm is located have a small but significant influence on geographic proximity.

Implications

The main implication of these findings is that the determinants of the spatial distance over which KIBS firms develop U-I linkages are complex, thus merely encouraging these firms to collaborate with their nearest institution may not be useful. Instead, encouraging KIBS firms to locate the appropriate partner may be the best practice.

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[1] The partnerships are facilitated through grants available from UK Government agencies plus a contribution from the collaborating organisation. KTPs involve organisations from all sectors of the economy, including both manufacturing oriented firms and service sector firms as well as public and third sector organisation