Small Firm-University Knowledge Networks: Evidence from the UK and the US

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Abstract

The focus of this paper is on university knowledge transfer as a form of networked learning through which innovation occurs. The overall aim of the paper is to examine the university knowledge sourcing practices of small firms in the UK and the US as means of contributing to a better understanding of how these may differ across national cultures. Based on firm-level case study data, we delineate a range of types of sourcing and transfer from which we find distinct variations in innovation practices across the UK and the US firms. In general, UK firms appear to be involved more explorative in sourcing knowledge – with their key interest being to seek the latest research which could lead to more radical innovation. The nature of knowledge among the US firms is often different, and is related more to accessing knowledge via exploitative means – with firms interacting with universities, more to improve their existing technologies or expertise. The results suggest that the nature of the networks and interactions small firms utilise to engage in knowledge sourcing from universities differ across national boundaries. The empirical evidence presented in the paper draws attention to the specificities of the university knowledge sourcing activities of the innovative small firms in the UK and the US. It is concluded that there appears to be a need for a review of the existing policies, which are often limited to a uniform, and in the case of the UK a 'copy-cat', approach.

Introduction

Innovative firms are increasingly recognised as significant contributors to economic development (Siegel et al., 2003; Lambert, 2003). Therefore, it is crucial to understand the complex and interactive processes underpinning innovation. This is especially important in the context of the dynamics of firms whereby their innovation processes move beyond their internal structures (Chesbrough, 2003), and knowledge is accessed through inter-organizational networks (Huggins et al., 2010; Huggins et al., 2008). Universities often play a prominent role in these networks and are thus are viewed as key knowledge producers in the context of regional economic development (Cooke, 2004; Premus et al., 2002; Saxenian, 1996). Firms can use a variety of approaches when they source knowledge, with each potentially yielding different results ranging from small-short term outputs to large long-term outputs (March, 1991). In this context, March (1991) develops a distinction between explorative and exploitative organizational learning. The notion behind explorative learning refers to discoveries, new undeveloped ideas, with little emphasis on improving internal competencies; and is principally associated with non-linearity of innovation. Conversely, exploitative learning is focused on improvements in knowledge by means of organic growth; resembling more a linear innovation path. The difference between adopting one of two approaches may be resource-based, with a good balance between the two being associated with the highest levels of effectiveness (Gupta et al., 2006; March & Levinthal, 1993; March, 1991). In this respect it is important to consider the relational assets, especially network capital in the form of inter-organisational networks, underpinning the processes through which either form of learning occur in an externalised environment (Huggins, 2010; Huggins & Johnston, 2010).

The focus of this paper is on university knowledge transfer as a form of networked learning through which innovation occurs. We consider the types of networks accessed by firms, in particular alliance networks and contact networks (Huggins & Johnston, 2010). Alliance networks are characterised by collaborative network approach, whilst contact networks are based on maximizing knowledge access through existing contacts. The focus on university-industry interactions as means of facilitating improved business innovation has been partly stimulated by the national and regional policy developments (Lambert, 2003; Siegel et al., 2003). Although such interventions are aimed at correcting the market imperfections, there is little attention devoted to how firms in different national settings access and utilise externally sourced knowledge in the context of organizational learning. Also, there is little evidence of cross-border differences in knowledge sourcing of firms, which could provide significant insights for policymakers. The overall aim of the paper is to examine the university knowledge sourcing practices of small firms in the UK and the US as means of contributing to a better understanding of how these may differ across national cultures.

Conceptual Framework

University Knowledge Transfer and Networks

Knowledge plays a key role in the competitiveness of regions, nations, sectors and firms. At its most fundamental level, the knowledge base of an economy can be defined as the capacity and capability to create and innovate new ideas, thoughts, processes and products and to translate these into economic development, i.e. increasing the value of a regional economy and the associated generation of wealth (Huggins & Izushi, 2007). The knowledge-based view of the firm specifically focuses on knowledge as the key competitive asset of firms, emphasizing the capacity to integrate tacit knowledge, or ‘knowing how’, as distinct from explicit knowledge, or ‘knowing about’ (Grant, 1996; Mowery et al., 1998; Huggins, 2000). More and more it is not just the knowledge possessed or created by a firm internally but knowledge from external sources that is regarded as one of the key factor is in the innovation process. This practice has been labelled ‘open innovation’ (Chesbrough, 2003) and is regarded as the hallmark of the most innovative firms. Therefore, knowledge networks

are a crucial element underlying the economic success and competitiveness of both firms and regions (Huggins, 2000; Malecki, 2002; Huggins & Izushi, 2007; Malecki, 2007), with universities viewed as important actors within networks of regional clusters of knowledge-based activities or systems of regional innovation (Saxenian, 1996; Porter, 1998; Cooke et al., 2004).

As the role of universities in bolstering technology communities and shaping innovation cultures has become more widely recognized, regional engagement and innovation capacity have become core themes in university mission statements (Lawton Smith, 2007). The triple helix model formalizes this role and views universities as increasingly 'entrepreneurial' or 'generative' institutions where the spillover of knowledge is the result of strategic internal reorganization that facilitates the development of infrastructure such as incubators or science parks as well as human capital development programmes (Etzkowitz, 2006; Etzkowitz & Zhou, 2006; Gunasekara, 2006). Scholars have also identified a new type university that is even more entrenched in regional economic and social development. They argue that the 'engaged' university is one that is not only entrepreneurial in technology development but is also adaptive and responsive to the needs of its region and plays a wider role in building social and civic capital through community service and leadership in regional social and civic structures (Chatterton & Goddard, 2000; Benneworth & Hospers, 2007).

'Engaged' universities play a 'developmental' role in learning regions by establishing programmes, building institutions and facilitating networks that are tailored to the needs of the regions they serve (Keane & Allison, 1999; Gunasekara, 2006). These developments are not only confined to advanced economies; newly-developing national and regional economies are also seeking to mobilize the knowledge contributions of their universities to develop their innovation systems and stimulate further growth. In Beijing, Shanghai and Shenzhen in China there are efforts to integrate universities into city-region innovation systems and clusters (Chen & Kenney, 2007; Wu, 2007), along with similar efforts in Banaglore and Pune in India (Basant & Chandra, 2007), Seoul (Sohn & Kenney, 2007) and Bangkok (Schiller, 2006). As in Europe, developments in more advanced Asian regions, such as those in Japan, as well as Singapore, are more established and often seek to emulate US modes of engagement (Kodama & Suzuki, 2007; Wong et al., 2007). This global trend demonstrates the extent to which universities are increasingly judged by how effectively they generate ad disseminate knowledge to firms.

Organizational Learning and Absorptive Capacity

The focus of this paper is on innovative small firms, as they are increasingly portrayed as significant to economic development, as in case of academic ventures (Lambert, 2003; Shane, 2004; Huggins et al., 2008). In order to remain competitive, innovative small firmsare often involved in knowledge sourcing because they lack the capacity to perform internal R&D (Huggins et al., 2010). The innovation activity of small firms is not necessarily hindered by their size, as small firms have been reported to experience lower market failures (Cefis & Marsili, 2003) and better rates of innovation than their larger counterparts (Gellman Research Associates, 1976; The Futures Group, 1984; Audretsch, 1991; Chakrabarti, 1991; Audretsch, 1995). This suggests a greater innovative potential associated with traditionally less resource-intensive small firms as compared to the better-resourced large firms.

As the way mean by which firms innovate has evolved into a more open system (Chesbrough, 2003), the internal knowledge development has been expanded into and partially substituted with external knowledge sourcing. This has specifically had an effect on how firms approach research and development, and how the externally sourced knowledge influences innovative activities of firms. As March (1991) suggested, there is a dichotomy in how organizations learn, some focusing on exploring knowledge, whilst others directing their attention to exploiting knowledge. The explorative knowledge sourcing is associated with discoveries, new undeveloped ideas, with little emphasis on improving internal competencies. On the other hand, exploitative knowledge sourcing is focused on improvements in knowledge by means of organic growth.

If we consider the innovation path of each of the approaches, the first mode (i.e. explorative) would present itself as non-linear, whilst the other (i.e. exploitative) would picture a straight line. The adoption of one of the two approaches may be resource-based; however, it is important to note that the highest levels of effectiveness in knowledge sourcing are observed when the two approaches are combined rather than followed separately (Gupta et al., 2006; March & Levinthal, 1993; March, 1991). Therefore, it is necessary to consider the relational assets, specifically the network capital in the form of inter-organizational networks, underpinning the processes through which either form of learning occur in an externalized environment (Huggins, 2010; Huggins & Johnston, 2010). Since firms innovate through more collaborative means (Chesbrough, 2003), they participate in innovation networks (Vonortas, 2009; Morone & Taylor, 2010), where the sole value of knowledge received is strengthened by the value of relationships created in the knowledge sourcing process. Being better linked and thus participating in denser networks is related to increased performance of firms (Fleming et al., 2007; Hochberg et al., 2007; Schilling & Phelps, 2007). This is an important aspect in the context of the small firm knowledge sourcing considered in this paper.

The utility of knowledge as a driver of competitiveness rests on the capacity of firms to not only access new knowledge but also to exploit it. Knowledge acts as a competitive advantage only when it is embedded in the members, tools, and tasks of an organization (Argote & McGrath, 1993). In other words, organizational learning serves as the bedrock of innovation because it denotes a process by which knowledge is integrated into product and process development. One way that organizational learning is demonstrated is through the 'absorptive capacity' of firms, or the ways in which they are able to identify, assimilate and apply external knowledge to commercial ends (March & Levinthal, 1993).

The capacity of firms to absorb knowledge is determined in part by their existing knowledge. Boschma (2004) contends that cognitive proximity or a common knowledge base is necessary for interactive learning to take place. For Cohen and Levinthal (1989; 1990) it is experiential learning that increases the absorptive capacity of firms. They argue that prior knowledge obtained though previous learning and problem solving experiences is what determines how well firms will assimilate new knowledge. There are, however, limits to experiential learning. Levinthal and March (1993) note that learning myopias make it difficult for firms to continue to absorb knowledge as they gain competencies. These myopias occur when firms overlook distant times (temporal myopia), distant places (the spatial myopia) and the lessons from negative learning (the failure myopia). They argue that firms must find the appropriate balance between explorative and exploitative learning in order to survive (Levinthal & March, 1993).

Knowledge Networks and Spatial Proximity

The absorptive capacity of firms must be considered in relation to the proximity of knowledge transfers and the shifting dynamics of industrial R&D. Many studies have found that geographic proximity of knowledge transfer does matter, and in particular that knowledge flow increases with closer proximity to universities (Adams & Jaffe, 1996; Audretsch, 1998; Phan & Siegel, 2006). University spin outs tend to have a direct economic impact on their home regions and universities may factor into firm location (Lund, 1986; Malecki & Bradbury, 1992). Early life cycle stage industries which are dependent on rapidly advancing technology are more likely to rely on collaboration between professors and firms (Jensen & Thursby, 2004) and are especially dependent on the tacit knowledge generated by universities (Audretsch & Feldman, 1996).

Small firms are more likely to rely on external, public, and local sources of knowledge because they lack the resources to conduct R&D in house or to source it from further afield (Acs & Audretsch, 1994; Markiewicz, 2004; Cohen et al., 2002). However, these localised effects could migrate outside if the resources to support the innovative firms are not adequately developed (Christopherson & Clark, 2010). In fact to remain competitive, Levinthal and March (1993) argue that firms need to avoid the

spatial myopia. Indeed most competitive firms are increasingly restructuring their R&D chains to take advantage of global collaboration networks (MacCormack et al., 2007).

Is the proximity of knowledge generators and knowledge recipients more or less important given the rise of international knowledge sourcing? Florida (1999) argued more than a decade ago that the increased mobility of technology based firms was a reflection of corporate efforts to harness external technological capabilities. Firms expand abroad to access unique sources of knowledge and to take advantage of lower costs. (Chung & Yeaple, 2008). Although greenfield investment is less common than acquisitions, universities may serve as anchors of FDI as well as regional economic development. While SMEs are unlikely to physically expand abroad, many are seeking specialized knowledge abroad. Global competition between universities has increased as the R&D networks of firms have expanded. Chatterton (1999) notes that 'the territorial monopoly of universities is being eroded by the internationalization of education and that these institutions are mechanism by which universities, exerting a cultural role, contribute to the formation of a public sphere on multiple geographic levels.'

Methodology

For the purpose of this study 16 UK and US SMEs (8 in the UK, and 8 in the US) were selected, each representing different market sectors: engineering, biotechnology, pharmaceuticals, IT, business consultancy. The UK sample was identified from a survey conducted for the study of knowledge sourcing practices (Huggins et al., 2010), whilst the US sample was identified from the business collaborations of the Northern Illinois University and the tenant companies of the Chicago Technology Park. The criteria of inclusion in the sample framework were based on four key premises: 1) the firm sourced university knowledge, 2) the firm was located within the geographical scope of the study, being the UK and primarily Illinois in the US, for respective national contexts, 3) the firm was categorised as a small firms, and 4) the firm was active during the studied period. The comparison between the US and UK is made at a firm level, and therefore the paper utilizes a firm level case study approach. This ensures that the unique stories behind each firm are maintained, whilst comparing them against a set of themes. Each case study was prepared from data gathered through semi-structured interviews with the senior executives from the firms, in many instances – the CEOs (Chief Executive Officers). The data collection involved face to face and telephone interviews, which were recorded, and subsequently transcribed. Additionally, the interviewees were offered the copy of the recording to review their case studies in order to ensure an accurate portrayal of their activities and firm structure. The data collection process benefited from the involvement of the researchers based both in the US and the UK, which bridged the distances in accessing the firms. For the data collection an interview pro-forma was designed, which set out the key structure and questions for the interviews, allowing flexibility for the researchers to tailor the discussion. However, each case study concentrated on exploring the knowledge sourced from universities, the nature of this process, and the lessons firms gained from interacting with the universities.

Findings

The sample of case-study firms are presented in Table 1, which provides an overview of the firms. We can observe that the UK and the US firms share certain general characteristics. Regardless of the size, the majority of the UK and the US firms sell their products/ services globally, though their key markets are the US and Europe. Furthermore, the majority of the firms are less than 10 years old, which together with their global customer base indicates how quickly the innovative firms start exporting their products contributing to the regional economies, what adds to the empirical evidence on the innovative firms' significance in economic development (Siegel et al., 2003). However, this also

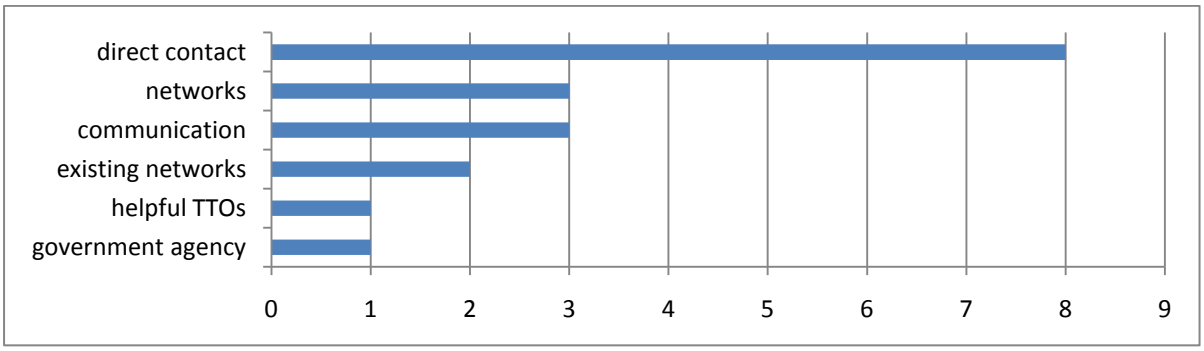
indicates their niche markets and limited local customer bases. Furthermore, the firms' sectors represent the key sectors of many innovative firms, with a majority of them being technology-based (Granstrand, 1998), confirming traditional image of an innovative firm.

Table 1 Characteristics of the studied firms

	Firm	size	latest turnover	Year of incorporation	sector/activity	Geographical market/customers
UK	A1	12	1.5-2m	1982	software & consultancy, structural geology	global
	A2	30	5m	1983	enzyme manufacturing	global
	A3	17	n/a	2006	pharmaceuticals, technology engineering	US, Europe
	A4	5	n/a	2005	biotechnology	global; key: US, Europe
	A5	14	1m	2006	clinical trial management	global; key: US, Europe
	A6	22	1m	1989	software, web content management systems	global; key: US, Europe
	A7	7	n/a	2004	scientific equipment manufacturing	global, key: US, Far East, Europe
	A8	16	1m	2003	industrial biotechnology	global; key: US, Europe
US	B1	15	1.5m	1999	biotechnology	global; key: US
	B2	5	none	2008	mechanical engineering	not selling yet; in plans: US, Canada, South America, Europe
	B3	n/a	n/a	1914	mechanical engineering	global; key: US, Africa, Middle East
	B4	2	n/a	2009	nanotechnology	key: US
	B5	2	0.5m	1991	biotechnology	global; key: India, China, Eastern Europe
	B6	5	1.3m	2006	engineering	global; key: North America
	B7	3	0.1m	2007	pharmaceuticals	n/a
	B8	10	n/a	2002	biotechnology	global; key: Europe, Asia, North America

Across the firm in both nations, the key to successful collaboration is the direct contact with academics (Figure 1). As indicated by company B6, the less rigid and developed university commercialisation structure (including technology transfer offices) the easier it was for the firm to work with the academics, thus enabling the knowledge spill-over (Chesbrough, 2003). Furthermore, the importance of networks and good communication are found to be stimulating the knowledge sourcing of the small firms. This seems to confirm the importance of networks in the literature on innovation (Morone & Taylor, 2010), whilst the communication is both related here to networks – as a stimulus for knowledge flow, and bureaucracy – as an efficiency driver.

Figure 1 Supply side: network stimuli (counts)



The similarity of knowledge supply-related issues proves how uneasy it is for firms in both national contexts to source university knowledge. Clearly, the preferred by companies direct contact is the alleviation of university institutional bureaucracy and IP issues. This presents how well the innovative SMEs have installed the open innovation approach into their business models. Furthermore, as presented in the following sections, although the knowledge supply side of the studied firms shares common characteristics, there is a clear distinction at the knowledge demand side. The importance of this supply – demand controversy is one that should not be neglected, as what we observe is that the public policies (related to higher education) have shaped a certain common ground for knowledge transfer. Contrary to this, firms (private markets) appear to operate more independently, and consequently, differ on national contexts.

In order to establish the differences between the knowledge demand of the UK and the US firms, we discuss them under two key themes: the means through which knowledge is sourced, and the location of this knowledge. The UK and US firms differ in the means through which knowledge is sourced, as depicted in Table 2, with the UK firms focused mainly on the collaborative and/ or contract research (firms: A1, A2, A3, A6, A8) and consultancy (firms: A1, A2, A4, A6, A7) with very minor deviation from these key types, as for example observed in the case of company A5, which accesses knowledge through networking with key academics at international conferences, where it recognises where the latest research in its field is being conducted.

The US firms access knowledge through a more diverse range of types, with collaborative research sourced by 4 firms (firms: B4, B5, B6, B8), contract research sourced by 2 firms (firms: B5, B6), and lab space sourced by 2 firms (firms: B6, B7). Firm B6 is an illustrative example of the range of knowledge types sourced: lab space, expertise, collaborative research, contract research, and student hire. The types of knowledge transfer and the difference in the variation of the range of knowledge transfer indicates a distinction between the UK and US firms, with the UK firms rather exploring knowledge, and, to a lesser degree, using a wide range of types in their innovative processes. On the other hand, the US firms appear more comfortable at sourcing knowledge, exploiting many types at the same time.

Table 2 Types of knowledge transfer

		Types of knowledge sourced
UK	A1	collaborative research / consultancy
	A2	contract research / consultancy
	A3	collaborative research / research
	A4	contract research / consultancy / spinout
	A5	expertise
	A6	consultancy / collaborative research / PhD studentship
	A7	license / consultancy
	A8	collaborative research / spinout
US	B1	license / spinout
	B2	consultancy / student-rent projects / graduate internships
	B3	consultancy
	B4	collaborations with researchers / spinoff creation / collaborative research
	B5	collaborative research / contract research / student hire
	B6	lab space / expertise / student hire / collaborative research / contract research
	B7	lab space / specialist equipment / expertise / student hire
	B8	collaborative research

Furthermore, the form of knowledge transfer is a very good reflection of the type of knowledge sourced (Table 3). The UK firms focus on the research (all firms) or the latest research (firms: A3, A4, A5, A6, A8), as presented by the example of firm A3 focusing on the latest research in the therapeutic effects of crystals in pharmaceuticals, which reflects its business model – developing new technologies and licensing them to other businesses. Conversely, the US firms are more diverse in the knowledge they source, with just 3 firms focused on the latest research (firms: B1, B4, B5) and 3 firms concentrated on accessing expertise (firms: B6, B7, B8). This wide range of knowledge is portrayed by firm B2, which unlike other firms in the sample required market intelligence, which it largely gained through a mix of consultancy, student-rent projects, and graduate internships.

The empirical evidence suggests there is a different approach in sourcing knowledge among the UK and the US firms, with the UK firms clearly using a narrower base of knowledge, yet of a very specific character – leading to radical innovations (i.e. latest research). The US firms present a different approach to knowledge sourcing, with it covering more than just the latest research aspects, through what seems a more extensive use of universities. These two divergent approaches reveal elements of March's (1991) explorative – exploitative dichotomy, with the UK firms identified here as explorative, whilst the US firms as exploitative.

Table 3 Type of knowledge sourced

		Type of knowledge sourced
UK	A1	Theory (ideas), research, prototype
	A2	research
	A3	latest research, knowledge
	A4	latest research, knowledge
	A5	latest knowledge, research, experts that could help interpret regulations
	A6	latest research, expertise
	A7	technology, research
	A8	latest research, knowledge (expertise), feedback
US	B1	latest research, technology
	B2	market intelligence
	B3	designs, technology, prototypes
	B4	latest research
	B5	latest research, testing, analysis
	B6	expertise, lab space, new ideas, research, customer leads
	B7	lab equipment, technical expertise, graduate students
	B8	research expertise, improving production process, developing products

The types of knowledge sourced and the modes of knowledge transfer discussed above revealed difference among the UK and US firms from the sample. When looking at the reasons behind accessing university knowledge (Table 4), the dichotomy between the two groups of firms appears even more clearly. The UK firms are mainly focused on knowledge related to the need for radical innovation For example, of firm A6 relies heavily on research, stressing that it needs to lead through the excellence in innovation, being at the top of the next generation software and technology, with the sourcing of university knowledge playing a very important role in this mission. The US firms appear to be less focused on remaining competitive through sourcing university knowledge, instead they reveal a different picture on the rationale for accessing the university knowledge. All firms, except one (firm B1), stated their key reason for sourcing university knowledge to be related to resource limitations, with universities often being a lower-price (firm: B2, B7, B8) well-equipped (firms: B3, B5, B6) supplier of knowledge compared to other organizations. This could be observed from the example of company B7, which required a specialist equipment for own research; however due to related high cost, it found it easier and more affordable to use the university's equipment. The cost issue is also well pictured in the case of company B2, which stated that for any of the knowledge sourced from the university it would need to pay at least three times more in the private industry.

Table 4 Reasons for sourcing knowledge

		Reason for sourcing knowledge
UK	A1	continual development to maintain competitive edge
	A2	conducting basic research into new enzymes - leaving company scientists concentrate on working on customers' problems
	A3	continuous knowledge sourcing to maintain competitive edge
	A4	continuous knowledge sourcing to maintain competitive edge, and develop new products
	A5	continuous knowledge development to stay at the top of the game
	A6	excellence in innovation, being at the top of the next generation software and technology, gaining accreditation for proprietary software
	A7	to improve existing and develop new products - remain competitive
	A8	continuous development and innovation to offer best products, solutions, services
US	B1	to exploit a specific technology commercially
	B2	to concentrate on developing products (R&D; university was cheaper than private industry)
	B3	not having the expertise in a specific field; need to improve technology to make it more efficient and/or safer
	B4	sharing of discoveries in young and emerging technologies; to complete the value chain - connect basic research to commercialisation
	B5	insufficient resources - universities have more resources, expertise and facilities
	B6	originally lab space, then developing technology; giving access to own lab to university also provides opportunities for new technologies developed to be commercialised
	B7	high costs of specialist equipment
	B8	limited resources, need for knowledge to commercialise the research

The empirical evidence presented from the comparison of the reasons the UK and the US firms source university knowledge that for the UK firms horizontal relationships are of key importance (resembling alliance networks), whilst in the US more vertical relationships (resembling supply-chain networks) are paramount. In order to further confirm this, we further assessed the location of universities engaged with the small firms, hypothesising that supply-chain relations would be more local in character. Overall, UK firms seem less constrained in accessing distant knowledge, with 5 firms (firms: A1, A3, A5, A6, A7) stating to work or have worked with overseas universities, of which four firms (firms: A3, A5, A6, A7) sourced knowledge from a different continent(s), whilst only two accessed knowledge from the universities located within their region (firms: A4, A8). A different picture can be observed with the US firms, all of which access university knowledge from within their regions, with only three going beyond their locality and accessing knowledge from other US regions (companies: B5, B6) or other countries/continents (companies: B4, B5). These differences are depicted in Table 5.

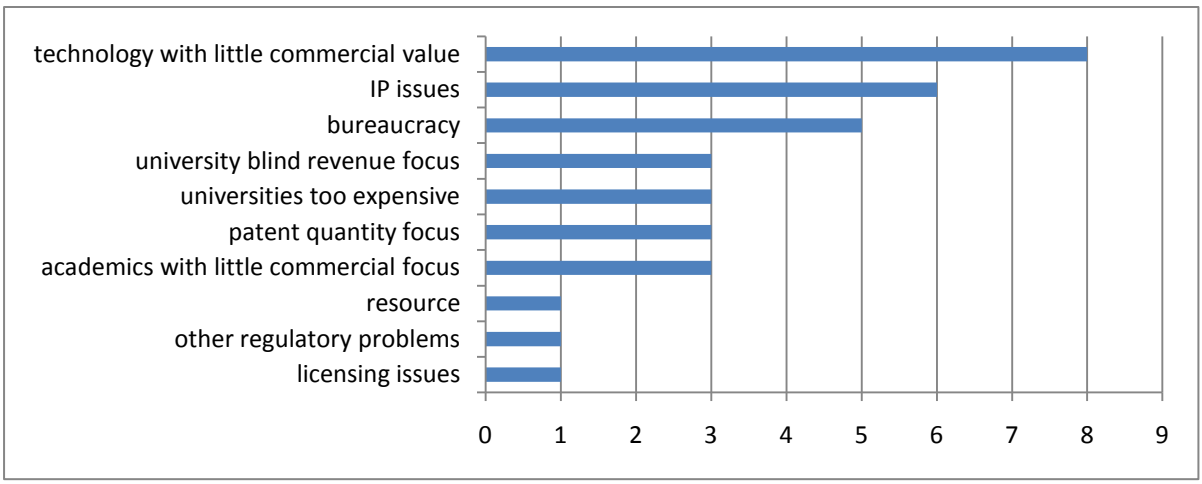
Table 5 Location of knowledge sources

		Knowledge location
UK	A1	UK, France
	A2	UK
	A3	mostly UK, but also US, and global
	A4	same region
	A5	global
	A6	Denmark, UK, US
	A7	global
	A8	same region
US	B1	same region
	B2	same region
	B3	same region
	B4	same region, Germany, Asia
	B5	same region, Arizona, Michigan, UK
	B6	same region, New Jersey
	B7	same region
	B8	same region

The different patterns observed among the UK and the US firms in relation to the location of the universities they work with strengthen the character of their relationships: horizontal – UK, and vertical – US. The proximity of the locations of the universities for the US firms is specifically related to the supply-chains, which are usually local, whilst the non-proximate locations of the universities the UK firms work with indicate a more collaborative quality of the relationships. This dichotomy confirms the explorative knowledge sourcing character of the UK firms, and the exploitative of the US firms.

Of course, these relationships and are not without their problems and through a categorical exploration of the responses we identified 10 themes related to knowledge-sourcing problems, and 7 themes within stimuli. The problems related to the knowledge sourcing, as identified in Figure 2, are mostly related to three key aspects: a) technology developed by the universities having little commercial value (8 companies), b) intellectual property issues (6 respondents), related to contractual terms and university IP policies stifling the collaboration, c) bureaucracy (5 respondents) – reflected mainly through large amounts of paperwork, and problems associated with the internal university departments interpreting contracts differently. Additionally, there were other issues reported that provide an interesting insight into the experience of firms in collaborating with universities: high focus on exploiting the technologies financially regardless of the technology commercial potential, the cost of working with some universities preventing small firms from sourcing their knowledge, patenting quantity orientation regardless of the technology's little commercial value (i.e. unjustified costs), and the gap between the academia and the 'real world' – with little commercial understanding and focus of the academics. This experience in university knowledge transfer reported by the studied firms confirms the findings of others (Shane, 2004).

Figure 2 Supply side: barriers (counts)



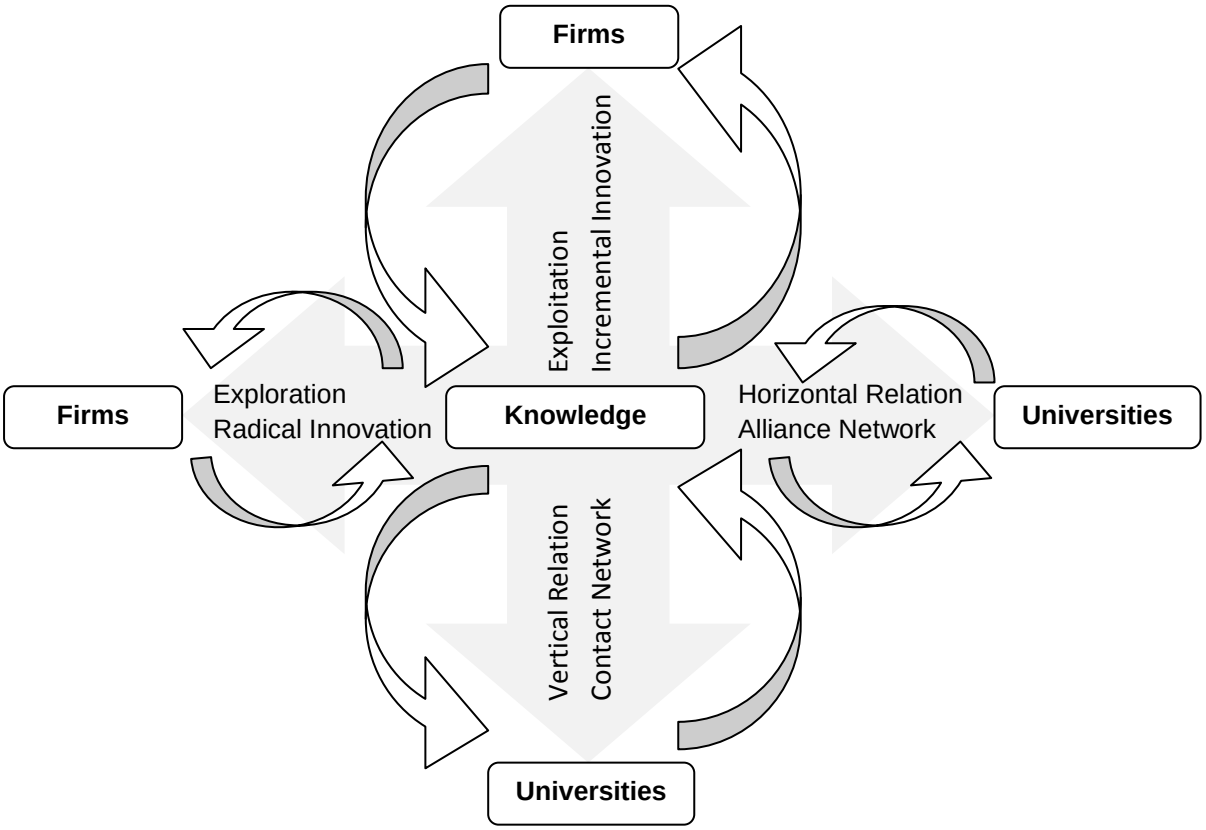
Discussion and Conclusion

When the nature of small firm sourcing of university knowledge is analysed, it is possible to delineate a range of types of sourcing and transfer from which we find distinct variations in innovation practices across the UK and the US firms. UK firms appear to be involved more explorative in sourcing knowledge – with their key interest being to seek the latest research which could lead to more radical innovation. The nature of knowledge among the US firms is often different, and is related more to accessing knowledge via exploitative means – with firms interacting with universities, more to improve their existing technologies or expertise. The more incremental nature of the knowledge sourced by the US firms, which often results from contracts to access equipment and labour, resembles the supply-chain type of knowledge access associated with contact network – with the university often being just one of many vendors used by the US firms. These vertical relationships are less prevalent in the UK context, whereby firms and universities engage more in horizontal relationships based on more collaborative network activities.

The results suggest that the nature of the networks and interactions small firms utilise to engage in knowledge sourcing from universities may differ across national boundaries. In the UK horizontal alliance networks focused on collaboration, while in the US contact networks are more prevalent, which is more than partly due to universities being a more embedded part of an SMEs existing supply-chain, compared with SMEs in the UK. These differences are synthesized in Figure 3.

Knowledge sourcing is a very complex process, therefore there is no guarantee of achieving a commercial success. From the studied firms we have identified a number of lessons that could assist similar innovative small firms in sourcing university knowledge. From the UK firms we learn that there is often much value in the collaborative research projects, where the networks formed with other organizations both private and public, provide future opportunities. The US experiences also suggest the need for caution in engaging with the universities, with the need for university knowledge to be evaluated for commercial usefulness at the outset of engagement. Furthermore, the choice of university to engage with should not necessarily be based on spatial proximity or expertise, as the 'price tag' on knowledge does not follow any national standard, but is rather independently set by each of the institutions. From the university perspective, it is important that they take more account of the speed and effectiveness of the knowledge transfer process. This is especially significant, as the knowledge market appears to be controlled by the universities, which have the decision-making power on how fast and if at all the knowledge should be shared.

Figure 3 Modes of University Knowledge Transfer



Overall, it is clear that the competitiveness of small firms is increasingly dependent on their ability to innovate. However, the nature of sourcing knowledge through universities differs across national boundaries, based on a UK-US comparison. The knowledge sourced by the UK small firms is focused on radical innovation, converse to US firms, which appears to concentrate more on knowledge to achieve incremental improvement to their products and processes. UK firms tend to source university knowledge through collaborations and alliances, whilst the US firms have a supply-chain relationship with the universities. This difference points to the nature of accessing university knowledge, which for the UK firms becomes explorative as firms seek the latest research. In the case of US firms the knowledge sourcing is often related to a sub-contracting process as firms seek to resolve their internal resource-based incapacity to perform R&D activity.

The empirical evidence presented in this paper draws attention to the specificities of the university knowledge sourcing activities of the innovative small firms in the UK and the US. There appears to be a need for a review of the existing policies, which are often limited to a uniform, and in the case of the UK a ‘copy-cat’, approach. The study suggests that more research is required in order to understand cultural differences in small firms innovation practices across nations. In particular, further research should concentrate on the effects of different knowledge network practices on the innovation performance of firms.

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