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**UNIVERSITIES AND KNOWLEDGE-BASED VENTURING:
Finance, Management and Networks in London**

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Abstract

This article seeks to measure and understand the prevalence of, and barriers to, university knowledge-based venturing and commercialisation in London. It finds that many of the key resources associated with successful commercialisation are skewed towards larger and more prestigious universities. Substantial spin-off and other commercialisation activities are restricted to a small number of universities in the region. It is concluded that although London has a higher concentration of higher education and finance institutions than other UK regions, there is no evidence that as a whole they are better connected or create and contribute to higher levels of university knowledge-based venturing.

Key words: universities; venturing; commercialisation; finance; seed.

Introduction

Knowledge is now recognised as a key ingredient underlying 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 value and wealth (Huggins and Izushi, 2002). In recent years, the commercialisation of the knowledge and research residing and undertaken in universities and higher education institutions (HEIs) has come to be viewed as an increasingly important stimulant of economic growth (Etzkowitz, 1998; Bok, 2003), and in particular for improving the development capabilities and economic performance of regions (Kukliński, 2001; Lawton Smith, 2003; Feldman and Desrochers, 2003; Goldstein and Renault, 2004; Wolfe, 2004; Shane, 2004; Braunerhjelm, 2005). This has occurred as regional variations in underlying levels of knowledge and creative-based entrepreneurship are further understood to be important aspects of future economic development potential (Dill, 1995; Nijkamp, 2003; Audretsch, 2004).

These developments have been coupled with notions of ‘entrepreneurial universities’ (Smilor et al., 1993; Slaughter and Leslie, 1997; Etzkowitz et al., 2000; Powers, 2004) and ‘academic entrepreneurs’ (Meyer, 2003; Shane, 2004) that are highly involved in venturing and commercialisation activities such as the establishment of spin-off firms, the exploitation of intellectual property rights through the licensing of technology and patent registration (D’Este and Patel, 2005). Such activities are typically seen as the key forms of technology transfer from universities. This article makes use of the term *knowledge transfer* (Agrawal, 2001) as a means of representing the growing transfer of activities that are not necessarily technology specific, such as those involving the creative industries (Hearn et al., 2004).

In their competitiveness analysis of the UK, Porter and Ketels (2003) recommend a requirement for further research and understanding of how to create effective commercialisation among the UK’s universities, and the role of regions as the platform for policy intervention. The aim of this article is to measure and understand the prevalence of, and barriers to, HEI knowledge-based venturing and commercialisation in London, the UK’s capital region. The article focuses on the key role of finance, and the interface between the academic and finance communities, as

an enabler of knowledge-based venturing. This area of analysis is particularly pertinent, as it has been found that an inability to obtain finance capital is a key reason why many university knowledge-based ventures are abandoned (Shane, 2004). This focus widens to cover the interlinked factors of access to management resources and academic-finance community networks. London is of particular interest as it is the location for almost one-quarter of the HEIs in the UK (39 out of 164) and is also one of the world's leading financial and business centres. Therefore, it is both a key location for the generation of knowledge and of the potential finance to commercialise it, and is crucial to the overall national economic development of the UK.

Within London, the higher education sector is a significant area of economic activity, with a research income far greater than any other region in the UK, and a research expenditure level per capita that is more than twice the UK average. Overall, London's HEIs employ about 58,000 academic and supporting staff and spend a total of £3.1bn per year (LDA, 2004). This significance has been recognised by the London's regional policymakers, which aim to promote London's universities and higher education institutions as one of its key global strengths. However, it remains imperative that to capitalise on the growth of the global knowledge economy, London's policymakers ensure that the region's knowledge-base is fully developed and exploited. This is particularly so given that recent evidence indicates that London's traditional economic competitive advantage has been shrinking in recent years (Huggins and Day, 2005). Therefore, the main thrust of the article is to explore the processes of HEI knowledge-based venturing in London within an underlying context of the region being of vital importance to the international performance and competitiveness of the UK as a whole. The result of this exploration is to elucidate particular forms of policy actions that could act as a lever for more effective forms of knowledge venturing and commercialisation by London's higher education sector. This is achieved through a methodological approach based on the triangulation of data obtained from a questionnaire survey of HEIs, a series of in-depth interviews with key actors, and an analysis of existing sources – in particular the annual UK higher education-business interaction survey (HEBI, 2004).

This article is structured as follows. It initially explores the context surrounding the provision of finance and university knowledge-based venturing at a regional level in

the UK. It then analyses the extent of knowledge-based venturing across London's HEIs, and assesses the key barriers hindering its further development. This is followed by an analysis of three factors influencing development: finance; management resources and networks. The article concludes with some thoughts on recommendations for future policy intervention.

Context

Within the UK, it is argued that government has failed to fully realise the significant direct and indirect contribution the UK's HEIs make to its local, regional and national economies (Kelly et al., 2002). On the other hand, it is also argued that the performance of many UK HEIs in the area of knowledge-based venturing activities has not matched their overall potential, partly due to the relatively low level of internal resources that are being devoted to such activities (Charles and Conway, 2001; Charles, 2003). This lack of supply-side resources has been coupled with issues concerning the constraining characteristics of HEI knowledge-based venturing, particularly the creation of spin-off firms, whereby their value is primarily linked to the longer-term growth potential derived from scientific knowledge and intellectual property. In their early stages, such ventures lack tangible assets to use as collateral, while their products initially have little or no track record, and are largely untested in markets or subject to high rates of obsolescence (Bank of England, 2002).

These characteristics are seen as making HEI knowledge-based venturing, along with other new knowledge-based start-up ventures, a relatively high-risk proposition for those investors who could potentially finance their future development and growth (Harding, 2000; Oakey, 2003). This has led many to argue - including the UK government - that a gap, or a bias against, exists for the type of seed, early-stage and other finance required by such ventures if they are to become commercially viable and sustainable (Murray and Lott, 1995; Murray, 1999; HM Treasury, 1999; Lockett et al., 2002). Seed finance can be defined as relatively small amounts of equity (i.e. risk capital) available to test the feasibility of a commercial concept or a product prototype to market exposure, with investments typically being less than £250,000, while early-stage finance mainly relates to the initial start-up phase post successful testing or prototyping (Murray, 1999; McGlue, 2002).

In order to more fully understand the role of seed financing in early stage commercial and business development it is useful to set it within the overall framework of venture capital financing in the UK. In an overall sense, the UK venture capital sector is Europe's most developed, accounting for the largest share in terms of the destination of investments – with 25.3% - and more than one-half (55.5%) of the funds raised in 2003 (EVCA, 2004). Furthermore, venture capital investment, as a proportion of gross domestic product, is far higher in the UK than all other European nations, which at 62.6% is significantly above the European average of 27.7%.

Within Europe, seed stage investment accounts for only 0.6% of total venture capital investment, with the biggest investment stages concerning buyouts (63.3%) and expansion (21.4%) – start-up stage financing also only accounts for 6.8%. Within the UK, seed financing plays an even lesser role within the venture capital system, accounting for only 0.2% of total venture capital investment in the UK, compared with 1.1% in Germany and 0.7% in France (EVCA, 2004). Even if seed and early stage investments are aggregated, the UK continues to invest a lower proportion of its venture capital in these ventures than its competitor nations. For example, while the UK invests 8% of its venture capital at seed and early stages, Germany invests 24%, and the US 31% (Harding, 2002).

In general, it is only small specialist venture capitalists that are prepared to invest in seed and very early stage ventures (Murray, 1999). This venture capital antipathy towards seed financing modes are linked to the varying levels of risk associated with differing stages of venture capital investment. Reid and Smith (2001) find that seed, followed by start-up and turnaround financing, are the three most risky potential investments from the perception of UK investors. They argue that this perception of ventures requiring seed financing is due to a lack of evidence on the 'fitness' of the investee and the very high levels of agency risk. Such risk occurs due to the incomplete alignment of investor and investee interests, and is notable in the financing of technology-based ventures (Reid and Smith, 2001).

Table 1 shows a breakdown of the total amount of venture capital and early stage investments by region across the UK for the period 1998-2001. The location quotients indicate the amount of investment compared with the stock of VAT registered

businesses, with a quotient of 1 representing the UK average. It is clear that over the period London is the dominant region for both the total amount of venture capital invested (29.5% of the UK total) and also for early stage investments (31.8%). The location quotients above 2 for London indicates that the region has more than double the amount of both venture capital and early stage investment that would be expected given an even spread of such investment across the UK. This is perhaps unsurprising since approximately 75% of UK venture capitalists are located in London (Martin et al., 2003).

Table 1 About Here

In order to assess regional involvement of HEIs in both venture capital and seed investment provision, it is possible to draw on data collected by the annual UK higher education-business interaction survey (HEBI, 2004), which is undertaken for a range of government departments and the UK's higher education funding councils. Table 2 highlights the proportion of HEIs in each region providing venture capital and seed investment either directly or through partner institutions during 2001-2002. Only 41% of London's HEIs make any provision for seed investment and only 28% for more general venture capital provision – significantly below the UK all institution average. This suggests the possibility that many HEIs in London are not as connected to regional networks of venture capital and finance, based on personal networks and face-to-face contacts (Martin et al., 2003), as their counterpart institutions in other regions.

Table 2 About Here

Does this lack of engagement and access to seed investment and venture capital appear to have any association with the extent of knowledge-based venturing activities undertaken by London's HEIs? The data collected for the HEBI (2004) survey can once again be utilised to provide a range of indicators on the scale of knowledge-based venturing activities for HEIs in each of the UK's regions. Table 3 provides a list and regional rankings of mean average outputs per institution for the following variables by region in during 2001-2002: value of business contracts; number of invention disclosures; cumulative number of patent actions (filed or granted); number of licences granted; revenues generated through intellectual property; and the total number of spin-off companies generated. It is clear that the

extent and scale of knowledge-based venturing activities across all of London's HEIs is in most instances mediocre and below par when compared with the majority of other UK regions. This suggests that there is a gap between the creativity and knowledge generated by London's higher education sector and the translation this creativity and knowledge into commercial ventures. To further understand why London generally underperforms a UK-wide baseline it is necessary to disaggregate overall regional activity to a more specific institutional level.

Table 3 About Here

Methodology

As London has significantly more HEIs than all other UK regions, it is important to analyse the spread and concentration patterns of both knowledge-based venturing and finance provision across the region's HEIs, in order to understand the reasons underlying the region's relatively poor performance when compared with these other regions. The published HEBI (2004) survey does not allow such analysis, as all data are aggregated at the regional level. The study outlined in this article incorporates a further survey of London's HEIs that enables a more detailed measure of the spread and extent of both the aspects to be undertaken. The objective of the survey was not to directly mirror the questions and data collected by the HEBI (2004) survey, but to gather data that could be interpreted in tandem with a series of face-to-face interviews, as well as allowing the construction of a knowledge-based venturing index ranking each of the responding HEIs.

Overall, the methodology adopted by the study involves the triangulation of quantitative and qualitative research techniques (Sechrest and Sidani, 1995), primarily through a questionnaire survey of London's HEIs, and in-depth face-to-face interviews with a cross-section of relevant key actors and stakeholders in the region. The questionnaire survey of HEIs was directed at those individuals responsible for commercialisation and venturing activities within their respective institutions, which broadly consists of the directors or managers of industrial liaison offices, technology transfer offices or university commercialisation companies. These individuals were identified through telephone calls and were then posted a copy of the questionnaire to allow them time to collect the relevant data and information before the questionnaire

was administered by telephone. A follow-up telephone call was then made to set a time and date to undertake administration of the questionnaire by telephone.

Telephone administration of the questionnaire took place between one and three weeks after the questionnaire had been received by the relevant individuals. The key areas of data collection covered by the questionnaire consisted of: the current extent of knowledge commercialisation activities within their institution; attitude and approach of their institution to knowledge commercialisation; the management and financing of the knowledge commercialisation process; and the barriers to knowledge commercialisation faced by their institution.

Of the 39 HEIs in London, 25 questionnaires were completed, representing a response rate of 64.1%. These responding HEIs account for 18 of the top twenty HEIs in London ranked by total income received, and in total account for 87.7% of the income received annually by London's higher education sector. Of the fourteen HEIs for which there was no response, identified individuals claimed in the follow-up call that their institution had little or no involvement in activities related to the commercialisation of research and did not therefore consider that it was appropriate for them to complete questionnaire.

In total 30 in-depth interviews were undertaken by the author, each with a research assistant in attendance, and which generally lasted between 90 minutes and two hours. A semi-structured interview pro-forma was constructed, which enabled the acquisition of common information from the interviewees, as well as allowing them to express views and provide further evidence contextualising their views and opinions. The interviewees were identified through three pilot interviews with individuals whom existing secondary documentation had highlighted to be key actors with relevance to one of the following areas of activity in London: university fund managers; venture capitalists; business angels; public and private sector business intermediaries and finance network managers; and the innovation departments of major banks.

The two aspects of the study facilitate an analysis that allows the demand and supply-side factors, relating to knowledge-based venturing and commercialisation among London's HEIs, to be incorporated in a balanced manner. Furthermore, an

interpretation of the data collected through each aspect meant that relevant issues emerged and were interpreted that may not have become visible if they were undertaken independently.

University Knowledge-Based Venturing and Commercialisation in London

In terms of overall propensity to engage in knowledge-based venturing and commercialisation activities, 80% of the responding HEIs in London stated that they have a strategic plan in place to develop these activities. This is below the 91% of all UK HEIs that the HEBI (2004) survey found to possess some form of strategic plan for commercialisation activities. In general, the objective of these strategic plans is to exploit or develop commercial expertise through the formation of new companies and/or to increase revenue from other commercialisation activities.

Most respondents (84%) stated that senior management within their HEI are generally positive towards the commercialisation of research, but could also do more to encourage it. The key types of knowledge commercialisation activities undertaken by the HEIs during the three years from 2000 to 2002 were: collaborative research with businesses (100% of respondents); creation or support of spin-off companies (84%); licensing of technology (68%); and the patenting of inventions (64%). Almost one-third (32%) of responding HEIs had registered twenty or more patents in the last three years. However, an equivalent percentage (36%) had filed no patents during this period – indicating a significant disparity in knowledge commercialisation activities across London's HEIs.

Similarly, while 32% of HEIs had granted twenty or more licenses during the last three years, a further 32% had also not granted any licenses, and 24% had granted less than five during this period. In terms of spin-off activity, 44% of HEIs had evolved less than five new firms during the last three years, with a further 16% creating no spin-off companies during this period. Only 16% of respondents reported the generation of 10 new firms during this period, followed by a middle tier that had established between five and nine spin-offs.

Using the key results from the questionnaire survey it is possible to rank the twenty-five responding HEIs in terms of their overall level of knowledge-based venturing and

commercialisation activities, based on allocating scores for their performance and involvement in these activities. Five factors were given an equal weighting in generating an index of knowledge commercialisation, consisting of: the number of patents registered; the number of licenses granted; number of spin-offs created; the number of projects requiring seed funding; and the overall demand for seed funds (details of responses on seed funding can be found later).

Once the index was constructed, the HEIs were placed into three groups: top ranked; middle ranked and bottom ranked, by order of their commercial activities, with the possibility of achieving a score between 0 and 100 (see Table 4). The top ranked HEI scored 90.0 and the lowest a mere 2.5, with the mean average score being 39.5. This ranking system enables further analysis and differentiation of the issues and requirements appropriate to each 'group'.

Table 4 About Here

It is evident from the range of index scores that there is a large divide across London's HE sector in terms of the depth, breadth and success of their knowledge-based venturing commercialisation activities. This finding was echoed by many of the interviewees who expressed the view that a 'premier league' of universities has formed in London, which runs the risk of ignoring the commercial exploitation value of innovations and ideas emerging from universities ranked in London's 'lower divisions'. Interviewees were further generally of the view that although commercialisation activities have increased considerably in London's HEIs in recent years, these activities have often been skewed towards the larger and more prestigious universities. For example, one financier stated that:

“We cannot just have a premier league of universities. We must also have a good '1st division' who are well developed. We will miss out [economically] if these universities are ignored.”

The variation in the propensity to engage, and intensity of involvement, in knowledge commercialisation processes in London's higher education sector can be categorised by the existence of a three-tier system: an upper-tier of HEIs that are intensively involved in knowledge commercialisation processes – often at a global level - through licensing, patenting and spinout activities; a middle-tier of HEIs that are seeking to

intensify their knowledge commercialisation activities, but which at present are failing to fulfil their potential due to both internal and external restrictions; and a lower-tier of HEIs that do not appear to have prioritised knowledge commercialisation activities, and do not view them as core to their overall strategic vision. In general, these HEIs lack awareness of the potential gains from such activities and have adopted few measures aimed at addressing commercialisation barriers.

In terms of the differing approach adopted by London's universities towards knowledge commercialisation across the three ranked groups, one of the key differences is the presence within each university of unit, office or company dedicated to the management of knowledge-based venturing. Of the top-ranked universities on the index of knowledge commercialisation, 80% have established a specific entity aimed at managing the commercialisation of research, compared with only 25% of the bottom ranked universities. Although this does not necessarily imply that such entities have been underlying cause of higher levels of knowledge commercialisation, since they may be more the result of the extant success of such activities, the findings are in line with those found at a UK-wide level, which suggest that the most successful universities in the field of knowledge commercialisation are those with clear strategies usually managed through entities possessing personnel with significant and relevant expertise in the field (Lockett et al., 2003).

Barriers

The differential in knowledge commercialisation performance across London's universities suggests that the poorer performing universities may have more barriers to navigate. According to the survey respondents, the most significant perceived problem to knowledge commercialisation activities is the of lack of time that academics are able to contribute to such activities (68% of respondents), followed by: a lack of the management acumen and skills within HEIs to develop efficient and effective knowledge commercialisation systems (64%); difficulties in accessing relevant finance and funding relating to proof of concept and early stage development (44%); accessibility of the appropriate space and physical infrastructure necessary to establish new spinout firms (36%); and difficulties in undertaking market research (36%).

It is important to interpret the lack of time factor highlighted by London's HEI respondents as a barrier to involvement in knowledge commercialisation processes. This apparent lack of time can be taken as a measure of the significance that most HEIs and their academics currently place (or are able to place) on commercialisation activities, compared to their more traditional pursuits. In other words, it can be argued that the higher education structure in the UK still works against the adoption of knowledge commercialisation activities within the value and rewards structure in which HEIs operate, and to a large extent are a reflection of the lack of development towards alleviating the key barriers highlighted above.

For the HEIs ranked at top of the knowledge commercialisation index the most significant constraint is a lack of management skills (80%). This suggests that these HEIs have much of the infrastructure requirements for knowledge commercialisation already in place, and are now in a position where it is human capital factors that are the focus of continuing and improving their knowledge commercialisation capabilities. The most significant barrier among the middle-ranked universities is a difficulty in accessing seed funding (63%). This indicates that the middle-ranked universities are unable to compete with their top-ranked counterparts in obtaining a significant slice of the finite amount of seed funds available to HEIs in London - a difficulty in accessing seed funding was only seen as a significant problem by 20% of top-ranked HEIs. Amongst the bottom-ranked HEIs the most important barriers were the lack of time (83%) and management skills.

In discussing further these perceived barriers through the face-to-face interviews it became apparent that a key factor underpinning these issues is often the lack of transparent and visible networks and communication channels linking the academic, financial and business intermediary sectors, resulting in the existence of information asymmetries and an inability to externally access relevant resources. Therefore, we now focus on the issue of finance and human (management) resources in tandem with the network factors regarding their accessibility.

Finance

The main and secondary sources of seed financing accessed by HEIs in London responding to the survey are shown in Table 5, which indicates that finance is drawn

from a variety of internal and external sources, with many institutions accessing funds from several different sources. The most important funding source are specialist funds created and funded within HEIs. The University Challenge Fund (UCF) was the next most important source, and was the main source of funding for one-fifth of all HEIs. The UCF is the most important UK national policy development relating to seed financing university knowledge commercialisation. The purpose of the UCF is to enable universities to establish seed funds for proof-of-concept and early-stage knowledge-based venturing. The UCF has recently been incorporated within a wider Higher Education Innovation Fund (HEIF) - £185 million allocated in 2004 - aimed at supporting knowledge transfer from universities through a number of channels and to a range of communities. The amount funding received by London's HEIs is broadly in line with their representation among the total number of UK HEIs.

These public sector developments underline the furthering of the 'triple helix' model of university-industry-government interactions in the field of innovation and commercialisation within the UK, with the government increasingly acting as a public entrepreneur and venture capitalist (Etzkowitz and Leydesdorff, 2000; Etzkowitz, 2003). Overall, public sector seed funds have been skewed in London towards the top-ranked universities, all of which had accessed seed funding from at least two public sector funds. Less than two-thirds (63%) of the middle-ranked HEIs and only 33% of the bottom-ranked HEIs had accessed two or more funds. This suggests that London's triple helix does not fully intertwine the breadth of the region's higher education sector.

Table 5 About Here

Private sector seed or venture sector capital is the main source of finance for only 8% of HEIs in London and a secondary source for 36%. Almost two thirds (64%) of responding HEIs stated they had no experience of private sector involvement in gaining seed financing for their knowledge commercialisation activities. Private sector involvement was most commonly through the provision of equity in return for seed financing. This was most prevalent among the top-ranked universities, with 60% being involved in seed financing through private equity staking. However, only one institution had experience of gaining finance through corporate venturing – a very low figure given the strength of the region's business sector.

More surprisingly, perhaps, is the finding that 50% of the middle-ranked HEIs have also had involvement in this mode of seed financing, highlighting their increasing willingness to undertake knowledge-based venturing of this kind. However, none of the bottom-ranked universities surveyed had accessed any form of private seed funding. The private sector financiers interviewed stated that if they consider investing in the higher education sector, they only seek ‘low hanging fruit’, and the relative concentration upon the top-ranked universities is evidence of such a focus.

The relationship between private funding and public seed financing can be analysed by attributing scores for public and private funding for each institution, and then testing the hypothesis that private sector seed funding for knowledge commercialisation is more likely to be accessed if public funding is already in place. The survey data reveals that those universities gaining significant amounts of public funding are more likely to also access private funding, with a very high correlation between the two across institutions. The relationship between the two modes of financing substantiates the views obtained through the qualitative research. There was considerable agreement among interviewees that public sector funding acts as a signal for private sector involvement, i.e. the probability of investment from the private sector rises with the amount of public funding secured, as explained by one interviewee:

“Matched funding is used as a signal – with investors much more likely to become involved in a project that is backed by government money, as the risks of involvement are reduced.”

Although public sector financing could have the effect of crowding out private investment, a pan-European analysis finds that public investment acts as a signaller to private investors primarily through the demonstration of legitimacy (Leleux and Surlemont, 2003). In his review of the funding of new technology-based firms in the UK, Oakey (2003) argues for the better integration of public and private sector funding, which as he says should not be seen as ‘oil’ and ‘water’. In general, such private sector investment in London comes either from venture capitalists or business angels; major banks are very unlikely to invest in university ventures, and will only lend money once significant equity is in place. In a study of high-technology start-ups

in Belgium, it was found that although banks do provide some finance, it is venture capitalists and private investors that are the source of the largest amounts of finance to these firms (Manigart and Struyf, 1997). Alongside public sector money, so-called 'hurt money' - representing the academic entrepreneur's own money or money from friends and family - can also act as a signal for potential investors.

According to those university fund managers interviewed in London, potential private sector investors in HEI spin-offs rarely understand the technology underpinning a proposed project, and often make an incorrect as to the level of risk involved. Other interviewees also considered that potential academic entrepreneurs are rarely able to effectively and fully demonstrate their ideas. Public sector financing is seen as being able to play an important role in alleviating these information asymmetries, by facilitating the effective demonstration of the technology and ensuring a realistic risk assessment is undertaken.

It is suggested that the role of the public sector is to either put in place structures that either directly alleviate this risk – if it exists at all – or dispel fears of risk that maybe misconceived (Lawton, 2002). All interviewees were of the view that any public sector investment in higher education knowledge commercialisation should retain a 'private sector dimension'. In other words, public sector financing must not subsidise research activities, but be solely directed towards dismantling the barriers to knowledge commercialisation activities. When probed, interviewees generally stated that seed funding does not appeal to the majority of London's venture capitalists and business angels unless there is a level of public sector involvement. However, only the top-ranked HEIs in London are able to lever any significant funding for pre-revenue business development. According to one finance intermediary:

“Most business angels and venture capitalists do not want to touch equity seed funding...the problem cannot be dealt with totally commercially, there has to be some involvement of public money.”

Apart from one university, all respondents of the HEI survey (96%) stated that there is a project being undertaken in their institution for which there was a requirement for seed funds. This requirement varied significantly across institutions: 52% HEIs had demand from 1-5 projects; 28% had demand from 5-19 projects; and 16% had demand from twenty or more projects. In general, it is clear that whether or not

institutions are able to access seed funds, there is some demand across institutions. However, this demand is not always being met. In total, 28% of respondents stated that there is strong unmet demand for seed financing within their institution. This rises to 40% for the top-ranked group and 50% in the case of the middle-ranked HEIs – indicating that many of these institutions are seeking, yet not always finding, seed funds. The lack of unmet demand amongst the lower ranked universities (only 8% of respondents) is indicative of their relatively low involvement in knowledge commercialisation processes.

The finance community within London generally perceived the University Challenge Fund (now HEIF) initiative to be a success, as it not only provided valuable funds for the commercialisation of knowledge, but has also gone some way to addressing the lack of commercial skills and acumen shown by academics, albeit within a limited number of HEIs. However, there were concerns regarding the UCF format from a number of operators within HEIs. In particular, there was a consideration that the UCF would have difficulty in creating university seed funds that are ‘evergreen’, i.e. self-sustainable, especially when serving the biotechnology and medical sectors.

In terms of sector and academic discipline, biological sciences and subjects allied to medicine and dentistry account for the most significant proportion of demand for seed funding. In total, 40% of HEIs claimed these disciplines to be their main sources of demand for seed finance. Other significant demand for seed funding comes from the computer science, creative arts and design, and engineering and technology disciplines. The highest level of secondary demand – i.e. demand for generally smaller amounts of finance than required by main source disciplines – emanates from computer science, followed by subjects allied to medicine (Table 6). The HEBI (2004) survey similarly finds that key target sectors for business interaction by London’s HEIs consist of ICT, biotechnology, medical and the creative industries.

Table 6 Here

When probed about the nature of any future public sector involvement in seed financing for HEIs in London, interviewees were generally of the view that funds should contain some form of intra-fund stream relating to specific disciplines and sectors, since their requirements are often varied in terms of: the amount of

investment required; the level of investor patience required; and the necessary management skills required – both current and future. Biotechnology, for instance, has a far greater time-span between early/start-up and revenue generating stages. In general, this timeframe is often far shorter for computer science related projects. Therefore, if seed funds are to become ‘evergreen’ they must factor in the sector/discipline differentials between start-up and revenue generating stages. Hall (2002) has rightly called for further study of the impact of public sector seed funds to be undertaken. However, for many funds there is a lack of clarity as to whether their objective should be to become ‘evergreen’ or whether they are purely a pump-prime mechanism for signalling to and attracting private investment.

Overall, there is a requirement in London to broaden the focus of financing university knowledge commercialisation activities beyond the upper tier of HEIs if the region is to fulfil its economic objectives, particularly as a key driver of the UK’s knowledge economy. This is significant to the extent that much of the existing research points to the relative abundance of private and venture capital investment in London, but does not capture the extent to which this regional supply has been able to serve differing channels of regional demand, such as the higher education sector (Mason and Harrison, 2003; Martin et al., 2003). However, the existing research does show that the mismatch between demand and supply in most regions is at the seed, start-up and early-stage end of the market, and even within the relatively strong US market significant regional gaps have been found to exist for seed and early-stage capital required by new knowledge-based ventures (Murray, 1999; Carayannis et al., 2000). However, what remains a relatively unexplored area is the extent to which matching supply and demand is concomitant on other factors, such as the suitability of existing human capital and the effectiveness of the interface between demand and supply-side actors.

Management Resources

At a European level, studies indicate that successful knowledge-based ventures are more likely to emanate from individuals with a commercial background than an academic one, primarily due to the managerial competencies and market know-how they already possess (Bower, 2003). In the UK, university spin-offs typically lack the financial means and managerial expertise to acquire the resources and develop the

capabilities they need to fully exploit the commercial potential of their technologies, with accessing suitable management being the most significant factor inhibiting university spin-off activities (Bank of England, 2002; Wright et al., 2004).

Interviews with the members of London's finance community revealed that an apparent lack of managerial skills within London's HEIs are a deterrent to business angels and venture capitalists investing in university knowledge-based venturing, and in particular spin-off companies. Furthermore, there is a consideration that poor managerial skills are a critical barrier holding back the progression of London's higher education commercialisation activities. As one interviewee put it:

“Forget the finance gap, there is a management chasm.”

Another argued:

“A lot of scientists will have good ideas, but will have no business acumen at all. There is a big need for skills on the management side...the quality of business plans is absolutely grotesque - below that of someone studying a business studies course.”

One financier suggested that on the whole there is a critical divide between the UK and the US:

“Even basic financial management skills are often lacking amongst [UK] academics that seek to commercialise their ideas... There is still a staggering ignorance amongst intellectuals. For example, a lot of academics don't know what equity is. This is one cultural difference that exists between the US and the UK. Academics in the UK desperately need to be trained in the workings of the commercial world if they are to be successful in any commercialisation of their work.”

One of the key explanations for this UK-US differential is experience and accumulated knowledge, since the US has been involved in public sector knowledge transfer activities significantly longer than the UK (Franklin et al., 2001). Although the opinions of the interviewees allows us to speculate on the relatively low the quality of managerial skills possessed by many of those undertaking HEI knowledge commercialisation in London, further research on the precise nature of these skills and any deficiencies is necessary to facilitate an understanding of the requirement for any future intervention. However, according to interviewees a key deficiency lies in the quality and range of skills contained within the Technology Transfer Offices (TTOs)

in many of London's HEIs. Interviewees often stated that TTOs lack the degree of professionalism required when dealing with the private sector. In particular, the relative 'quality of personnel' is seen as leading to a structural failure of the commercialisation process in many HEIs, with one financier stating:

“The TTO is part of the university, and as such is often underpaid. They are often the wrong individuals, will have poor business sense and be far from impartial. We often find that professors will not like to go to someone that they believe are their juniors to look for advice. TTOs are often left out of the loop, and it is imperative for them to become more involved if they are to become more effective.”

One university-based fund manager similarly argued:

“It is a matter of the quality of the Technology Transfer Officers – there is no commercial realisation in many universities. They need to be educated in the ways of business.”

This observation is highly pertinent as it ties with a plethora of studies; for instance, Chapple et al. (2005) find evidence of a need for the upgrading of the business skills and capabilities of TTO managers in the UK, while studies in the US show that the quality of TTO support is based on the level of embeddedness of relationships with the business community (Friedman and Silberman, 2003; Owen-Smith and Powell, 2003; Markman et al, 2005; Powers and McDougall; 2005). Furthermore, TTO personnel that have pre-existing business or financial experience are often better positioned to provide stronger support (Markman et al., 2005).

In the US, there is evidence that the compensation received by TTO personnel has an impact on the effectiveness of the office (Siegel et al., 2004). Within the confines of London's economy, with a large and generally well remunerated private business and financial sector, it is likely that HEI technology transfer officers will be less well remunerated in comparison with someone undertaking a similar role in the private sector. Furthermore, it can be hypothesised that such is the global prominence of London's financial and business sector, that the level and speed of engagement required by those operating in this sector is at a pace that is out of step with the more long-term process of engagement undertaken by many HEIs. Indeed, a number of interviewees argued there is often a wide cultural divide between the operation of most universities and businesses in London, which has led to 'deal breakdown'.

While interviewee responses suggest there may be a deficiency of management skills in many of London's HEIs, it is also important to recognise that there should not be a dilution of technical expertise by making academics concentrate their efforts upon managerial issues, and as one interviewee put it:

“We don't want to make the world's best scientists mediocre businessmen.”

Another stating:

“The inventor is not necessarily the manager – usually they will not be the right person for the job. Finding the right management is the key.”

At a wider UK-level, Lockett et al. (2003) observed that the long-term management role of academics in successful projects is more likely to be advisory than integral at the top level. Interviewees in London argued that there is a key requirement to import strong management skills from the private sector, with one finance intermediary suggesting that:

“Academics will not entirely change – a large proportion of academics never touch life outside academia. It is better to bring in managerial expertise rather than expect academics to change.”

It was considered that 'surrogate' or 'interim' management' will not only give a project the commercial acumen required to progress it, but will also facilitate academics in their long-term approach to commercialisation activities. It was further suggested that interim management should have a degree of investment in the project, ensuring that they not only have an incentive to make the project successful but also that they become involved with projects that best suit their particular managerial skills and field of specialisation. Within the UK university sector the use of surrogate or interim managers and entrepreneurs has been relatively limited, although those universities that have shown a higher propensity to engage such managers have created more successful ventures (Franklin et al. 2001; Lockett et al. 2003).

A number of mechanisms were suggested by interviewees for further developing interim management, including: 'parachuting' in managerial expertise or mentoring; using managerial networks for academics seeking managerial skills to augment their commercialisation activities; and utilising business angels as a managerial resource.

These mechanisms are primarily based on building management teams through ‘importing’ management skills from the private sector. However, an issue that emerged from the study is that there is only fragmented knowledge of those managers and mentors in London who are available, and best suited to working with the academic community on knowledge commercialisation projects. Indeed, existing intelligence appears to be largely confined to members of London’s business angel networks, with one business angel suggesting that:

“Although business angels are one source of management expertise, it is still difficult to put together a full management team in London.”

The fact that such a focus is put on business angels at all is interesting, and is most likely due to the lack of venture capital engagement, with business angels seen as a way of plugging the gap. The relative success of the US compared with most parts of Europe has relied far more on the development of strong networks of the venture capital, as opposed to the angel, community with knowledge-based ventures, which are often facilitated through a rich infrastructure of intermediary organisations (Sapienza, 1992; Prevezer 2001; Çetindamar and Laage-Hellman, 2003).

In the US, a key role of these intermediary organisations is to make spin-offs and start-ups ‘investment ready’, i.e. to have in place the managerial and technological framework and plans that allows them to negotiate with venture capitalists and business angels on a level playing field. In the UK, there is evidence of significant deficiencies in the investment readiness of many knowledge-based ventures that are either tabled or have the potential to be tabled to financiers (Mason and Harrison, 2001; Mason and Harrison, 2004).

Furthermore, there are often significant variations in knowledge commercialisation patterns depending on the technology applied, which in particular impact upon the timing of revenue streams (Powell and Moris, 2004). The fact that there are different timelines for different technologies means that the type of managerial skills required by commercialisation projects will often depend upon the field of research, and the stage of development. For example, the managerial requirements of a biotechnology spin-off will differ from the needs of a civil engineering project, with one interviewee in London commenting:

“It is common that a potential spinout company will not have the right kind of management for progressing the project. A particular problem is that the [biotechnology] industry is a young industry, and there is a shortfall in relevant management experience, as there is simply not enough expertise relevant to the industry.”

Ensuring the quality and visibility of managerial skills for those undertaking HEI knowledge commercialisation, as well as generally raising awareness of the skills relevant to the commercialisation process, is clearly necessary if there is to be improvement in the performance of the wider system of higher education knowledge commercialisation in London. One aspect that has been identified as a route for potential development in the UK is the furthering of university-industry joint ventures as a means of overcoming managing resource weaknesses (Wright et al. 2004). However, as we will see, the networkability of many of London’s HEIs in searching and accessing such partners appears to be limited.

Networks

Networks play an important role in controlling access to finance and have been said to act as the ‘pipes and prisms of the market’ (Podolny, 2001; Garmaise and Moskowitz, 2003). From a venturing perspective, networks are seen as being integral to securing resources and obtaining legitimacy, with the ability to access external finance through networks an important predictor of the performance of start-up firms (Lee et al., 2001; Elfring and Hulsink, 2003). Throughout the interviewing process it became highly abundant that the networks between and within the academic and finance and communities in London appear to generally lack either visibility or transparency. The following quotes provide a snap-shot of the perceptions of interviewees:

“There is little connection between actors in London. There is confusion and the match-up [between potential investors and investees] is atrocious.”

“London is a bit like a fog – the challenge for the region is to exploit the capacity and break down insularity ...we need to increase [regional] institution to institution dealings.”

“The whole system is fairly uncoordinated. The various actors and agents have grown organically and hence there is a lack of co-ordination...there is no one who is actually championing the interaction between higher education institutions and the business community. There is a definite need for strategic influence in this sphere.”

“London is poorly served by its [intermediaries], with very little visibility or focused attention.”

These statements suggest that poor underlying network conditions in London makes accessing finance for those academics seeking to commercialise their research and knowledge problematic. Other research similarly finds that poor network conditions, manifested by a lack of social ties, between entrepreneurs and venture financiers results in the existence of information asymmetries between both parties (Shane and Cable, 2002; Shane, 2004). The lack of effective interaction networks between the HEIs and the business community in London appears to have a negative effect on the commercialisation of knowledge not just in terms of financing, but also in terms of exchanging expertise and experience. This supports Lockett et al.’s (2003) finding that the more successful universities in the UK generally possess greater networks with external organisations, although in general these are not particularly strong even in leading universities.

Harding (2002) has argued that the equity gap is itself a manifestation of the existence of information asymmetry. From the views provided by interviewees, it can be suggested that information asymmetry and a resulting lack of suitable risk intelligence among potential private sector investors are having a negative effect on knowledge commercialisation processes in London’s higher education sector. Similarly, potential investees do not have access to the relevant networks and intelligence needed to make an effective case for financing, and therefore cannot effectively demonstrate their ideas. This equates with evidence from the US showing that new ventures with founders that already have direct and indirect relationships with venture investors are most likely to receive venture funding and are less likely to fail (Shane and Stuart, 2002). A number of interviewees in London provided evidence of HEI projects that should have been able to attract private sector financing, but were instead ‘put-on-the-shelf’ due to a lack of effective engagement with those financiers capable of making a significant investment.

Fully understanding the nature of information asymmetries and measuring the impact on ‘deal flow’ is difficult. Venture capital firm investors consult formal network sources more frequently than do business angels. For instance, business angels often

suffer from far less efficient flows of information from their informants than venture capitalists (Fiet, 1995). Further research finds that only 20% of business angels are active investors, with there being little information on the channels through which they source deals (Freear et al., 2002). Mason and Harrison (2002) suggest that information asymmetry is a particular problem for the engagement of the UK's business angel community, many of whom have large stocks of capital they are seeking to invest. This also appears true for London, but overcoming existing hurdles is no easy matter, as outlined by a university-based fund manager:

“It is very difficult for business angels, they would sometimes like to become involved, but as they don't understand technology they don't touch it with a barge pole. Angels also want revenue quickly, but there isn't really anything that can be done to change this. There is a large amount of private equity, but it is hard to get them to invest.”

To a large extent, the poor networkability of the London region is related to the sheer size and number of players in its financial community, leading to networks between actors that are at best disjointed, and at worst disconnected. Many of the interviewees – who can be considered as key players in the region - stated that they do not have a complete view of all the relevant actors, and that much of the total London network remains uncharted. As one venture capitalist noted:

“The downside [to London] is that the market is much more diffused. For example, in Manchester everyone knows each other and the networks are clear. The same cannot be said for London where the networks are much cloudier.”

Indeed, for the most important players – both financial and academic – the level of diffusion is global, with many of London venture capitalists dealing purely at an international level, and the leading universities establishing commercial alliances with other leading universities and multinationals from around the world. However, as we have already seen, London's higher education sector has a long tail with a lack of strength in depth concerning successful involvement in knowledge-based venturing.

The international nature of London's venture capital community is somewhat contrary to those who argue that venture capital investments are usually made locally and are reliant on a network of local contacts (Di Gregorio and Shane, 2003). However, others have found that while finance and knowledge-based activities are often spatially

clustered, older and larger venture capital firms tend to make more non-local investments in more commercially advanced projects, although early stage biotechnology ventures still tend to be more reliant on local finance sources (Powell et al., 2002). This is supported by Sorenson and Stuart (2001) who find that venture capitalists involved in axial positions with large scale syndicated projects are more likely to invest in spatially distant companies. It can therefore be suggested that London's venture capitalists conform to these wider spatial investment patterns.

The majority of universities in London are not integrated into these international networks, and due to the issues highlighted above are also unable to enter functioning regional networks. In many ways, they are more disadvantaged than institutions located in more peripheral regions, where more identifiable and functioning networks already exist, and where there is not such a plethora of competing higher education institutions and internationally-facing finance institutions.

However, there are clearly more potential opportunities for London's universities than in most regions, and many HEIs in London are attempting to untangle the complex web of actors. This responsibility has largely fallen to the TTOs, which in a number of institutions are still embryonic. As we have already seen, the capability of these offices to operate effectively within a highly commercial environment is often considered to be below the level required by the finance community, which within London can be assumed to be even more demanding in less finance-centric cities and regions. One banker interviewed, who had experience of trying to broker deals in the region, explained:

“Evidence from our dealings show that venture capitalists consider the timescales of the decision-making within universities to be too slow...Both VCs and the universities indicate that the Technology Transfer Offices are under-resourced and can do very little for both sides of the fence.”

Carlsson and Fridh (2002) argue that this divide between the TTOs and financiers is the result of the diversity of objectives set for TTOs, whereby knowledge-based venturing is only one of a range of endeavours related to assisting researchers in disseminating research results for the public good.

Conclusions

This article has identified and analysed the processes of knowledge venturing and commercialisation activities across London's HEIs. It finds that many of the key resources – finance, management and networks - associated with successful knowledge commercialisation are skewed towards London's larger and more prestigious universities, such as that identified by Birley (2002) in connection with London's Imperial College. Substantial spin-off and other commercialisation activities are restricted to only a small number of HEIs, highlighting the existence of a large knowledge commercialisation divide across London's higher education sector. Despite the density of both higher education and finance institutions in London, the interface between the two is fragmented and limited in its depth.

It is often assumed that core economic regions possess an advantage over their more peripheral counterparts due to the existing and embedded intra-regional networks and interdependencies between economic and knowledge creating actors. With regard to university-finance networks in London, this does not appear to be the case. Although London has a higher concentration of higher education and finance institutions than other UK regions, there is no evidence that as a whole they are better connected or create and contribute to higher levels of knowledge-based venturing. This suggests that the growing plethora of literature concerning regional knowledge and innovation systems must be careful and clear as to the specific actors and context that is being analysed. This is particularly true of the literature relating to regional networks and 'clusters', which tends to make non-specific and often generic and ubiquitous assumptions across a wide range of distinct actors and institutions whose only visible commonality is their regional proximity. This may be of particular relevance to cluster development in London, with research on the region's media cluster finding that non-regional linkages are at least of equal importance as more localised linkages in ensuring competitiveness (Nachum and Keeble, 2003).

In terms of potential regional policy intervention in London, it is noticeable that the region currently lacks any form of knowledge commercialisation 'champion' that is enabled to strategically influence the interaction between HEIs and the finance/business community. Such a strategic 'champion' could not only act as the key facilitator of interaction between the business community and HEIs, but also map

potential financing routes, co-ordinate university processes, and raise awareness of higher education knowledge commercialisation activities. The key feature of such a champion would be to work on behalf of all HEIs, both through and across existing networks and routes of interactions. In other words, the role of the champion would not be to displace or duplicate existing networks, actors/stakeholders, or initiatives/programmes, but to work effectively with them in a complementary and supporting manner. This could be achieved through the establishment of a regional academic-finance network co-ordinated by the champion.

This network should operate as a means of introducing potential academic entrepreneurs and their technology transfer officers to investors, business intermediaries (both public and private sector), as well as to other academic entrepreneurs and institutions. The key roles of the network would be to: (1) increase academic-business interaction; (2) enable more efficient access to finance; and (3) create a fulcrum for raising market intelligence. In order to improve the management of commercialisation processes, the network could be mobilised to create a far more co-ordinated approach for identifying and promoting suitable managers and mentors. Furthermore, the development of databases drawing together a range of intelligence on the managers and mentors capable of working with academic entrepreneurs would reduce the search and transaction costs of accessing managerial expertise and increase the probability of acquiring appropriate type of expertise.

Although the above may begin to provide part of a future remedy, given the ingrained barriers working against the creation of non-exclusive finance routes in London it may be necessary for regional public sector authorities to act as the catalysts of finance routes that seek and facilitate the engagement of private sector finance to a far wider range HEIs than is currently the case. Such activities could be best leveraged through a higher education seed fund aimed at financing those proof of concept and very early stage ventures that are able to show the necessary criteria to warrant funding, but which have been ‘overlooked’ by other financing channels.

Such a seed fund needs to be established and developed in accordance with a number intra-stream funds relating to the following key criteria: the type of seed and early-stage investment required; the post-seed requirement for financial support; and the

expected stages of revenue generation. If seed funds of this type are to become 'evergreen', they must take account of sector differentials between start-up and revenue generating stages, and will require a number of specific 'pots' based on the appropriate academic discipline. In the case of London's higher education sector, for instance, the most appropriate: life, biological and medical sciences; engineering, computer, mathematical and physical sciences; finance and business studies; and creative arts and design.

Overall, the aim of higher education seed funds should be to act as a catalyst for attracting commercial funding, and should be based on a form of 'matched-funding' to ensure that the fund is not used as a loop-hole to gain extra research funding or subsidise further 'academic' research, but to act as a signal for private sector investment. In other words, the objective would be to create new forms of risk syndication specifically for higher education projects at the proof of concept and very early stage development. Risk syndication should yield a higher return for such investments, due to the increased level of information and knowledge available and an expansion in the quality of deal flow.

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Table 1: Regional Distribution of Total Venture Capital Investment and Early Stage Investment across the UK, 1998-2001

Region	Total Amount (%)	Early Stage (%)	Location Quotient - Total	Location Quotient - Early Stage
London	29.5	31.8	2.02	2.07
South East	19.0	22.8	1.17	1.37
Eastern	6.8	11.5	0.70	1.18
South West	3.8	4.0	0.41	0.44
East Midlands	8.2	3.2	1.09	0.46
West Midlands	8.2	4.0	0.90	0.48
Yorkshire and the Humber	4.5	3.3	0.61	0.47
North West	10.1	7.3	0.83	0.75
North East	1.3	1.0	0.54	0.40
Wales	1.3	0.7	0.18	0.10
Scotland	7.8	9.0	1.02	1.24
Northern Ireland	0.5	1.3	0.15	0.39
UK Total	100.0	100.0	1.00	1.00

Source: Martin et al. (2003)

Table 2: UK Higher Education Institutions Providing Seed Investment and Venture Capital Either Themselves or Through a Partner by Region, 2001-2002

Region	Total Number of Institutions	% of Institutions Providing Seed Investment Either Themselves or Through a Partner	% of Institutions Providing Venture Capital Either Themselves or Through a Partner
North East	5	100.0	100.0
Northern Ireland	2	100.0	100.0
Scotland	19	78.9	68.4
East Midlands	9	77.8	44.4
Wales	13	76.9	69.2
West Midlands	11	72.7	72.7
Yorkshire and the Humber	11	63.6	54.5
South East	18	55.6	44.4
South West	13	53.8	23.1
North West	15	53.3	53.3
Eastern	9	44.4	33.3
London	39	41.0	28.2
UK Total	164	60.4	48.8

Source: Derived from HEBI (2004) Higher education-business interaction survey 2001-02

Table 3: Knowledge-Based Venturing Activities per Higher Education Institution (HEI) by Region, 2001-2002

Region	Number of Institutions	Total value of business contracts (£000s)	(Rank)	Invention Disclosures	(Rank)	Cumulative number of patent actions (filed or granted)	Rank	Total Licences Granted	Rank	IP Revenues (£000s)	Rank	Total Spin-offs (HEI & Non-HEI owned)	Rank
East Midlands	9	2,975	(1)	15.0	(9)	13.1	(6)	8.6	(2)	361	(3)	1.6	(6)
Eastern	9	2,965	(2)	19.2	(4)	18.4	(1)	4.3	(5)	210	(4)	1.2	(9)
London	39	2,273	(5)	11.7	(10)	11.7	(8)	2.9	(9)	126	(6)	1.0	(10)
North East	5	1,835	(8)	17.6	(6)	13.0	(7)	3.6	(7)	18	(12)	2.0	(2)
North West	15	1,328	(10)	16.2	(7)	9.5	(9)	2.1	(10)	26	(11)	1.8	(3)
Northern Ireland	2	2,448	(4)	23.0	(1)	15.5	(3)	9.5	(1)	115	(7)	4.0	(1)
Scotland	19	2,062	(6)	16.1	(8)	17.1	(2)	7.4	(3)	523	(2)	1.3	(8)
South East	18	1,822	(9)	21.9	(2)	15.0	(4)	6.0	(4)	158	(5)	0.7	(12)
South West	13	785	(12)	7.5	(12)	5.1	(11)	3.5	(8)	54	(10)	0.8	(11)
Wales	13	1,291	(11)	8.5	(11)	3.3	(12)	1.0	(12)	103	(8)	1.7	(5)
West Midlands	11	1,896	(7)	21.3	(3)	5.7	(10)	3.6	(6)	632	(1)	1.5	(7)
Yorkshire and the Humber	11	2,958	(3)	17.6	(5)	14.6	(5)	1.9	(11)	98	(9)	1.7	(4)
UK Average	164	2,003		15.1		11.6		5.6		205		1.3	

Source: Derived from HEBI (2004) Higher education-business interaction survey 2001-02

Table 4: Knowledge Commercialisation Ranking and Index Parameters for HEIs in London

Ranking Group	Ranks Covered	Mean Average Score	Index Score Range (%)
Top	1 to 5	76.5%	70-90%
Middle	6 to 13	50.9%	35-65%
Bottom	14 to 25	16.5%	2.5-32.5%
Overall	1 to 25	39.5%	0-100%

Table 5: Sources of Seed Financing for London's HEIs (% of Respondents)

Source of Finance	Main Source	Secondary Source
Specialist Funds Created by the HEI	36%	48%
University Challenge Funding	20%	32%
Higher Education Funding Council for England	12%	44%
Private Sector Seed or Venture Capital	8%	36%
DTI Grants or Loans	4%	44%
EU Programme Funds or Loans	0%	20%
Wellcome Trust	0%	16%
Other Charity, Trust or Research Foundation	0%	8%
Other	0%	4%

Source: Author's Survey

Table 6: Source of Demand for Seed Funding by Discipline among London's HEIs (% of Respondents)

Discipline	Main Source	Secondary Source
Biological Sciences	20%	52%
Subjects Allied to Medicine	12%	56%
Medicine and Dentistry	8%	28%
Computer Science	8%	76%
Engineering and Technology	8%	52%
Creative Arts & Design	8%	48%
Mathematical Sciences	8%	28%
Business & Administrative Studies	8%	20%

Source: Author's Survey