**Risk capital constraints to innovation in services**

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**Abstract**

**Purpose**

This paper aims to understand the factors associated with perceptions of venture capital as a barrier to innovation in an important subset of knowledge-intensive service firms – technology-based business services. A general and longstanding neglect of services in studies of innovation and a common focus of innovation studies on the availability of, and demand for, risk capital has been noted.

**Design/methodology/approach**

In exploring these issues, the authors draw on survey data collected from 264 technology-based service firms located in Scotland and Northern England. The data are subjected to bivariate and multivariate statistical analyses to help explore the extent of demand-side risk capital concerns.

**Findings**

It was found that smaller, faster growing and R&D-intensive firms perception greater equity barriers. Moreover, firms who are relatively happy about the managerial competencies available to them, but who identify deficiencies in marketing skills and the availability of external debt finance (which may say something broadly about their financial neediness), are shown to be “needy”.

**Originality/value**

Studies of venture capital demand are relatively rare. Studies involving innovative service firms are rarer still. Given the prominent role of service firms in advanced economies and the changing perspective of the role of services in innovation, studies of financial constraints to innovation in services are timely. Innovation policy in advanced economies continues to be premised on patterns identified in manufacturing industries. This paper contributes to a broader perspective that views [technology-based] business services as dynamic innovation actors.

Keywords: Innovation, Small Enterprises, Service Industries

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**1. Introduction**

The paper represents an empirical exploration of the extent to which a particular type of small firm (technology-based knowledge-intensive business services – t-KIBS) views access to equity funding as a barrier to innovation and, within this group, the factors that are associated with greater “neediness” (i.e. stronger perceptions of inadequate access to equity). To this end, the paper is driven by two common observations: Firstly, access to finance generally, and equity specifically, is a considerable impediment to innovation in small firms. Secondly, the (occasionally ambivalent) evidence to support this supposition has been derived, in the main, from studies of manufacturing firms generally, and high-technology manufacturing firms specifically. The following two sections review the bases for these observations and seek to underline certain limits in our knowledge. Thereafter, subsequent sections outline the dataset and explore the substantive empirical question implied in the paper’s title.

Beforehand, a point of clarification seems in order: As noted above, this paper is concerned with a particular subset of firms – i.e. “KIBS”. In Europe, at least, this is a fairly common, and apparently well-understood, term. However, a general appreciation of the concept does not appear to go hand-in-hand with a settled definition for empirical purposes, and a variety of, more or less, operational working definitions have been used in the academic literature ([Wong and He, 2005](javascript:popRef2('b75')); [Muller and Doloreux, 2009](javascript:popRef2('b41'))). Accordingly, there is merit in a brief account of the definition adopted here – although the wider debate on fundamentals is beyond our scope. To this end, the most common starting point is provided by an early report to the European Commission ([Miles et al., 1995](javascript:popRef2('b39'))). Although the term “KIBS” may have been around longer ([Miles, 2001](javascript:popRef2('b38'))), this report is generally considered something of a touchstone, and it sought to explicitly set out the defining characteristics of KIBS, as follows: they rely heavily upon professional knowledge; they either are themselves primary sources of information and knowledge; or they use their knowledge to produce intermediary services for their clients’ production processes; and they are of competitive importance and supplied primarily to business.

Crucially for current purposes, within this broad category, [Miles et al. (1995)](javascript:popRef2('b39')) distinguished between “traditional professional services” (p-KIBS) and “new technology-based services” (t-KIBS), whilst p-KIBS are liable to be intensive users of new technology, t-KIBS are more active in shaping new technologies (the latter are of concern here). Significantly, identification of core characteristics allows the authors to list a number of specific services which exemplify the various “types” (including non-KIBS – [Miles et al., 1995](javascript:popRef2('b39')), pp. 29-31). Whilst the “lists” still admit some ambiguity and interpretive subjectivity, they provide the inspiration for the development of a more consistent and transparent operationalisation accordingly to standard industrial classifications. Subsequently, identifying KIBS sectors by means of industrial classifications (such as nomenclature statistique des activités économiques dans la communauté européenne (NACE) or international standard industrial classification (ISIC)) has proven increasingly popular. Although industrial classifications may be, more or less, sensitive to between-country differences in application or to wrongly classified firms ([Hipp, 1999](javascript:popRef2('b25'))), these disadvantages are outweighed by the manifold benefits. Not least amongst these advantages is the extent to which the ability to clearly define KIBS populations facilitates cross-study and cross-country comparability. This holds even where local partiality limits general consistency. In such circumstances, recognising exactly how working definitions differ should be relatively straightforward. Moreover, and perhaps most importantly, it should be “possible to distinguish which types of firms are included in the definition without merely exemplifying” ([Nählinder, 2002](javascript:popRef2('b44')), p. 15). This, then, is the approach adopted in the current study, and Section 4 details the sample distribution using four-digit ISIC codes.

**2. Innovation and venture capital in small firms**

Returning to the first of our two “observations”: a common caricature sees small, would-be, innovators as behaviourally advantaged yet materially constrained ([Madrid-Guijarro et al., 2009](javascript:popRef2('b34'))). Although flat management structures, effective internal communications and nearness to customers promote flexibility, these are often set against a lack of technical and managerial expertise, limited information processing capacity and an inability to hedge risk through portfolio investments. This final point may be of a particular concern. Whilst large firms may diversify their innovative projects to obtain more stable cash flows ([Stoneman and Canepa, 2002](javascript:popRef2('b59'))), small firms are, more often, constrained to “put all their eggs in one basket”, developing single research projects that require considerable funding relative to the turnover base ([Giudici and Paleari, 2000](javascript:popRef2('b22'))). Importantly, innovation is an essentially speculative process. In the main, resources must be committed prior to the (uncertain) receipt of revenues that these resources hope to generate ([Brophy and Shulman, 1993](javascript:popRef2('b7')); [Hall, 2005](javascript:popRef2('b23'))). Capital expended is capital risked, and the risks are likely to be greater for the smallest firms.

The extent to which small firm innovation is speculative (and the nature of the accompanying risk) clearly has implications for the sorts of funding which may be more or less appropriate. In the case of high-technology small firms (HTSFs), for example, it has been suggested that the cyclical nature of R&D expenditure and sales is likely to be accompanied by a lack of uniformity in profits, raising questions about the innovative firm’s ability to repay debt ([Oakey, 2003](javascript:popRef2('b47')), [2007](javascript:popRef2('b48'))). This is over and above the recent evidence pointing to the existence of credit rationing (or adverse loan scaling) affecting the most innovative small firms ([Freel, 2007](javascript:popRef2('b19'))). Accordingly, what such firms require, we are told, is true “risk” capital (i.e. venture capital) – the returns to which are contingent upon the success of the venture, and “pay-back” [[1]](#footnote-1) may, more realistically, be judged in terms of a five to ten year period ([Cumming and Johan, 2010](javascript:popRef2('b14'))). From the firm’s perspective, and given limited early cash flows, the availability of equity may stimulate technological innovation, as owners are only likely to engage in such activities if their capital base is sufficient to sustain projects until returns materialise ([Müller and Zimmerman, 2009](javascript:popRef2('b42'))). Indeed, a belief in the importance of venture capital as a stimulus to small firm innovation is an important component of innovation policy in most developed economies ([Bottazzi and Da Rin, 2002](javascript:popRef2('b5'))).

Unfortunately, perhaps, and regardless of policy measures to increase the *supply* of early-stage venture capital, empirical evidence suggests that very few small firms appear either willing or able to access sources of genuine risk capital. Evidence from the US national survey of small business finances, for instance, suggests that < 1 per cent of SMEs used external equity ([Ou and Haynes, 2006](javascript:popRef2('b49'))). Moreover, even where studies are specifically concerned with technology-based small firms, the proportion of venture capital backed firms is rarely > 5 per cent ([Revest and Sapio, 2012](javascript:popRef2('b53'))). [Giudici and Paleari (2000)](javascript:popRef2('b22')), for example, investigating a sample of Italian HTSFs, record a clear preference pecking-order, running from self-financing (including retained profits and internal equity), through short-term debt (bank overdrafts and trade credit) and long-term debt. These authors note that “external equity is almost never issued” (p. 46). It would appear that, irrespective of presumptions of the relative merits of debt and equity, small firms are more likely to borrow capital than sell equity at ratios of between five and ten to one.

To date, most of the policy debate and associated academic literature have been concerned with supply-side considerations – with the availability of venture capital and with venture capitalists’ decision-making processes. However, it is unlikely that patterns of venture capital usage can be explained by supply-side factors alone. Indeed, there is a growing body of literature which now recognises the existence of *demand-side* financial constraints in small firms ([Berggren et al., 2000](javascript:popRef2('b3'))). By and large this has been concerned with the extent of “control aversion” (i.e. the reluctance of entrepreneurs, even those wishing to grow, to sell equity). However, whilst willingness to share ownership is undoubtedly a necessary demand-side condition, it is unlikely to be sufficient. Rather, one might anticipate that characteristics of the firm, its strategies and resources and its competitive environment will also influence the extent to which venture capital is “needed” or demanded. To the extent that these factors have been studied, the tendency has been to draw comparisons between venture capital users and non-users, and to record group differences ([Hogan and Hutson, 2005](javascript:popRef2('b27'))). Unfortunately, the use of venture capital is a poor proxy for latent demand, and the studies are forced to grapple with, often intractable, issues of causation.

**3. Technology-based knowledge-intensive business services**

Turning to our second observation: studies of innovation in services frequently bemoan the implicit (and ongoing) manufacturing bias in innovation studies in both developed ([Drejer, 2004](javascript:popRef2('b15'))) and developing nations ([Ndubisi and Iftikhar, 2012](javascript:popRef2('b46'))). The relative neglect of services should give cause for concern. As [Gallouj (2002](javascript:popRef2('b21')), p. 144) notes, such a position may: Preclude serious thought (particularly on the part of the public authorities) about ways of energising an area of activity of great importance for the future of firms, industries and nations. At least for the industrialised economies of Western Europe and North America, the past 35 years have seen a dramatic shift in economic activity from manufacturing towards services ([Acs and Audretsch, 1993](javascript:popRef2('b1'))). Since 1980, the service sector has “overwhelmingly predominated” ([Jorgenson and Timmer, 2011](javascript:popRef2('b31'))) in the economic activity of the world’s advanced economies, accounting for around 70 per cent of total value added and about 70 per cent of total employment in most organisation for economic cooperation and development (OECD) economies ([Wölfl, 2005](javascript:popRef2('b63'))). Importantly, a key characteristic of the services sector is its diversity ([Tether et al., 2001](javascript:popRef2('b74'))). Whilst many services may conform to the traditional caricature of “innovation laggards” (or “supplier dominated” in terms of [Pavitt’s (1984)](javascript:popRef2('b50')) classic taxonomy), KIBS, in contrast, are generally regarded as amongst the most dynamic components at the core of structural changes ([Evangelista and Sirilli, 1998](javascript:popRef2('b16')); [Strambach, 2001](javascript:popRef2('b60'))). They are the drivers at the heart of knowledge-based, entrepreneurial economies. Indeed, some commentators have suggested “an ongoing redistribution of knowledge in favour of KIBS and away from traditional producers and service providers” ([Tether and Hipp, 2002](javascript:popRef2('b62')), p. 166). Thus, although KIBS constitute only a small proportion of all services, researchers frequently accord them a significance beyond that indicated by their share in employment or value added ([Tether and Hipp, 2002](javascript:popRef2('b62')); [Gallouj, 2002](javascript:popRef2('b21'))) as sources of important new technologies, high-quality, high-wage employment and wealth creation ([Tether, 2004](javascript:popRef2('b61'))).

Unfortunately, however, whilst the picture is improving, we still know relatively little about the nature of innovation within KIBS. Much of the work, to date, has either been case study-based and conceptual or has been concerned with drawing broad patterns ([Freel, 2006](javascript:popRef2('b18'))). The former has tended to emphasise the uniqueness of services innovation. The latter, in contrast, although largely limited to description, has identified more similarities than differences between manufacturing and services along a number of innovation dimensions. A key finding amongst this second strand of research has been the resemblance between t-KIBS and high-technology manufacturing. [Howells (2000](javascript:popRef2('b28')); see also [Hipp et al., 2000](javascript:popRef2('b26'))), for instance, noted similarities between t-KIBS and high-technology manufacturing in relation to R&D effort and technology intensity. Here an important distinction is made between KIBS “types”. On the one hand, whilst p-KIBS are likely to be intensive users of new technology, t-KIBS are more likely to be actively involved in the development of new technology ([Miles et al., 1995](javascript:popRef2('b39'))). The characteristics of the innovation process in t-KIBS are likely to result in greater risk in much the same way as it does in high-technology manufacturing. This, in turn, it may influence the sorts of funding that are more or less appropriate and demanded. Specifically, if innovation in t-KIBS is similar to innovation in high-technology manufacturing, one might speculate that the availability of (and access to) venture capital would play an important stimulating or constraining role – for many of the reasons outlined in the previous section.

Of course, whilst one might anticipate *similarities* between the innovation processes of t-KIBS and high-technology manufacturing, differences (at least of emphases) are likely to remain. These differences, in turn, will bear upon both the demand for and supply of external finance. Two key, and related, differences involve the specificity of investments and the appropriability of returns. In the first instance, research points to the tendency for innovation to be “project-based” in services ([Salter and Tether, 2006](javascript:popRef2('b54'))). In most industries, the wages of scientists and engineers account for a large component of innovation expenditures ([Müller and Zimmerman, 2009](javascript:popRef2('b42'))) and, in consequence, such expenditures exhibit limited scrap or resale value. However, where innovation endeavours are linked and continuous learning across projects is likely, investments may be thought to make a more general contribution. In contrast, the episodic and ad hoc nature of innovation in knowledge-intensive services more frequently results in knowledge creation that is highly specific and localised to the given customer ([Gann and Salter, 2000](javascript:popRef2('b76'))). Moreover, in firms that rely, to a greater extent, on people-embodied knowledge, inter-project learning is often limited ([Prencipe and Tell, 2001](javascript:popRef2('b52'))). Given these constraints on the “cumulativeness” of returns to innovation investments in project-based services, there is a clear danger that equity providers will assess investments on the basis of projects rather than firms. The impact on the probability of funding is, more often, likely to be negative.

Relatedly, it is common practice to point to relatively weak intellectual property rights (IPR) protection and general appropriability concerns in service firms ([Gallouj, 2002](javascript:popRef2('b21')); [Howells, 2000](javascript:popRef2('b28')); [Tether and Hipp, 2002](javascript:popRef2('b62'))). Clearly, the firm’s ability to profit from innovation is a strong (if partial) function of the appropriability regime it faces ([Teece, 1986](javascript:popRef2('b77'))). If, as [Gallouj (2002](javascript:popRef2('b21')), p. 35) remarks: “[…] *the fact that services are not necessarily embodied in technological systems that can be readily appropriated gives them a certain degree of volatility that means they can be more easily imitated by competitors”,* then one might anticipate limitations in their ability to profit from innovation. Clearly, in such circumstances, they are likely to be less attractive to both debt providers and venture capitalists. However, whilst it is clear that disembodied or people-embodied technologies are generally less easy to protect through standard appropriability mechanisms such as patents, it is less immediately apparent why imitability should be correspondingly high. Rather, it seems reasonable to argue that knowledge embodied in individuals may be less imitable than knowledge embodied in physical artefacts – related, in part, to issues of observability and codifiability. In general, the evidence suggests that informal means of appropriability (such as secrecy) are more important than formal means (such as patents) in all but a small number of industries ([Cohen et al., 2000](javascript:popRef2('b12')); [Leiponen and Byma, 2009](javascript:popRef2('b33'))). Again, differences in the use of various appropriation mechanisms in services and manufacturing are likely to be of emphases rather than kind. Nonetheless, to the extent that formal appropriation mechanism provides some sort of “tangibility”, they are likely to be more attractive to venture capitalists. It is surely no coincidence that the sorts of industries where patenting “matters” (e.g. biotechnology, information technology and medical equipment) are also those which attract most venture capital.

Regardless, issues of both cumulativeness and appropriability are likely to speak to constraints in the supply of external equity, rather than its demand. Although peculiarities in the innovation processes of t-KIBS firms may make them less attractive to venture capitalists, there are less obviously likely to make them less “needy”. Whether these supply-side effects are reasonable or remediable is clearly of interest, but it is also beyond the immediate scope of this paper. Rather, the inspiration for the current paper is provided by the confluence of the two broader arguments: on the one hand, given risk (and cost/revenue flow) considerations, equity funding may be the most appropriate source of finance for innovation in technology-intensive small firms (though the evidence largely suggests that use is limited), while on the other, the rationale for believing this is drawn from studies of high-technology manufacturing, although the innovation process in technology-based business services is thought to be broadly analogous. These may be the sorts of “non-traditional” firms in greatest need of, and offering the greatest scope for, venture capital investment. Following this, our analysis is concerned with two issues: firstly, the extent to which a sample of t-KIBS firms perception of equity funding as an important barrier to innovation (amongst a cafeteria of possible barriers); and secondly the firm-level factors which predict perceptions of greater need.

The results are presented below.

**4. Data**

The data presented here were collected as part of a wide-ranging “Survey of Enterprise in Northern Britain”. For the present purposes “Northern Britain” encompasses Scotland and the Northern English counties of Northumberland, County Durham, Tyne and Wear, Teesside and Cumbria. Details of this project and dataset can be found elsewhere. In style and substance, it followed the model established by the successful Cambridge studies of UK SMEs (beginning with [SBRC, 1992](javascript:popRef2('b55'))) and was driven, in a large part, by concerns over inadequate regional coverage in these earlier studies [[2]](#footnote-2). Again, in common with the Cambridge studies, the sample frame used in constructing the database was the Dun and Bradstreet UK Marketing Database. This database has its origins in the credit-rating business and, as such, it is likely that it over-represents expanding firms in search of finance. It is also known to under-represent single-person self-employed, sole proprietors and partnerships in comparison to the overall enterprise sector ([Bullock and Hughes, 2000](javascript:popRef2('b8'))). In the context of the current paper, the principal consequence of these biases is likely to be an overestimation of population levels of R&D expenditure, exporting and so on. However, when this caveat is borne in mind (i.e. that the survey did not seek to represent, in any isomorphic manner, the notional population), then the legitimacy of the subsequent analyses should not be compromised.

For present purposes, the analyses draw on the questionnaire sections relating to general business characteristics and innovation. Importantly, although this larger project addressed small manufacturing and business service firms in general, our current interest is only with a particular subset –t-KIBS. That is, of the 1,347 respondents to the larger survey (a response rate of around 11 per cent), we are interested in the 264 t-KIBS. For the reasons outlined previously, the concerns of this subset may be particularly urgent.

As outlined in the introduction to the paper, our conceptual definition of t-KIBS follows that of [Miles et al. (1995)](javascript:popRef2('b39')). Operationally, we follow [Nählinder (2002)](javascript:popRef2('b44')) ([Nählinder and Hommen, 2002](javascript:popRef2('b45'))) and identify t-KIBS sectors using four-digit ISIC codes (revision 3). Whilst some studies operationalise KIBS at the division (i.e. two-digit) level – to include ISIC 72-74 – these authors more precisely discriminate KIBS by class (i.e. four-digit). This level of disaggregation allows one to better distinguish between t-KIBS and p-KIBS. [Figure 1](javascript:popRef('F_JBIM-08-2013-0175001')) illustrates the distribution of sample firms across recognised t-KIBS classes. Architectural and engineering activities and related technical consultancy (ISIC 7,421) dominate, and this is consistent with the population at large (although, in the UK as a whole, one might anticipate a higher proportion of software consultancy and supply firms). An appreciation of this sectoral profile should facilitate interpretation of the analyses that follow. Importantly, the bulk of our firms is not in information and communication technology-related sectors. Whilst one might anticipate that firms in those sectors would benefit from the broader technological specialisation of venture capitalists ([Petit and Quéré, 2006](javascript:popRef2('b51'))), our current sample is less likely to be so well placed.

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Insert Figure 1 Here

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**5. Model and preliminary analysis**

As noted, a preliminary concern is with the relative perceptions of access to venture capital (or, strictly, external equity) as a barrier to innovation. Relative, that is, to other possible constraints, knowing the extent to which equity access is a more or less pressing obstacle (at least from the perspective of sample firms) provides important context for the inferential analysis that follows and for the debate on the exigencies of equity funding for small firm innovation more generally. These data are presented in [Figure 2](javascript:popRef('F_JBIM-08-2013-0175002')).

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Insert Figure 2 Here

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In more detail: firms were asked to rank the various barriers on a scale of 1-5, where 1 signified “not important” and 5 signified “crucial”. The data in [Figure 2](javascript:popRef('F_JBIM-08-2013-0175002')) are ordered by proportions recording “not important”. On this basis (and in aggregate), access to equity is perceived to be the least important barrier to innovation (and access to information and advice is the most important). One could, of course, order the data in a number of ways. However, any sensible ranking of perceived barriers puts financial considerations generally and equity specifically at the bottom of the list. There is plenty of precedent for this in the recent literature ([Freel, 2000](javascript:popRef2('b17')); [Hewitt-Dundas, 2006](javascript:popRef2('b24'))). Although, by and large, these studies have been based on samples of manufacturing firms, the lower capitalisation and greater reliance on human resources in services would lead one to expect a similar observation here. Indeed, in absolute terms, our data are broadly in line with observations from a recent UK community innovation survey (CIS). The fourth UK CIS does not ask a direct question on equity as a barrier to innovation. Rather, it asks more generally about the “availability of finance”. Respondents may answer: “not experienced”, “low”, “medium” or “high” importance. This final response category seems semantically equivalent to the “very important” and “crucial” categories reported in [Figure 2](javascript:popRef('F_JBIM-08-2013-0175002')). In the CIS, 10.5 per cent of all firms responded “high” (9.9 per cent of services) [[3]](#footnote-3). Given the broader scope of the CIS response item, one should not be surprised that the numbers are a little higher. Beyond this, it is difficult to make a relative comparison (on the ranking of barriers), as the factors listed in the CIS are very different from those used here. However, it is worth noting that a more detailed analysis of the UK CIS ([Freel and Harrison, 2007](javascript:popRef2('b20')), p. 72) ranks “access to finance” as the eighth most pressing barrier facing t-KIBS (out of 11 possible choices).

In short, firms appear to identify “know-how” barriers, rather than financial barriers to innovation. This should be an important caveat to the many discussions of financial constraints, which often generate great heat without a corresponding amount of light. However, notwithstanding its relative (un)importance as a barrier to innovation for the sample of t-KIBS as a whole, it is also clear that for some firms, unsatisfactory access to external equity is a non-trivial constraint. Indeed, around 8 per cent of sample firms identify access to equity as either a “very important” or “crucial” constraint, and > 30 per cent consider it to be of some importance. In other words, and regardless of the foregoing qualifications, access to equity was identified as a barrier to innovation (of varying intensity) by almost one-third of the sample. Given the prominence of innovation, of t-KIBS and of equity in policy pronouncements (and academic discussions), understanding what makes firms more “needy”, or identifying those who perceive inadequate access to equity funding as a barrier to innovation, is clearly of some merit. We turn to this later in the text.

Identifying the characteristics of our “needy” firms takes the form of an ordered logit model (with perceptions of the availability of equity finance as a barrier to innovation acting as the dependent variable). In exploring the firm-level characteristics associated with higher perceptions of equity finance as an innovation constraint, we are somewhat limited by the lack of information on internal capital structure. However, we are fortunate to have data on a number of factors which (by extrapolation) previous research suggests may influence the requirement for, or use of, external funding. These are listed below, with a brief rationalisation for their inclusion in the model and description of the manner in which they were operationalised:

*Age*. Our concern is with whether younger firms are needier than older firms. In many respects, this is a standard control variable in models of this type. However, it may also be argued that younger technology-based firms, with fewer reserves (and the greater risk associated with a shorter track record–associated with information opacity), are more likely candidates for equity funding. Indeed, this is a clear presupposition in much of the literature ([Muller and Zimmermann, 2009](javascript:popRef2('b42')); [Schafer and Shilder, 2009](javascript:popRef2('frd9'))). In a similar vein, [Westhead and Storey (1997)](javascript:popRef2('b78')) noted that younger high-technology small firms were more likely to report a financial constraint to growth. Certainly, recent evidence suggests that the first round of venture capital financing happens early rather than later ([Bertoni et al., 2011](javascript:popRef2('frd2'))). Accordingly, we expect younger firms to record higher perceptions of access to equity as a constraint to innovation. In the current model, age is represented by two binary dummy variables: up to 3 years (to control for the period covered by the survey and an obvious sampling artefact); and, 4-9 years. The reference group being > 10 years.

*Size*. Again, firm size is often a standard control in models exploring issues of small firm finance and innovation. Beyond this, however, one may argue that fewer resources lead smaller firms to perceive greater financial “neediness” and that the greater risk attendant on smaller size is more likely to require equity than debt ([Revest and Sapio, 2012](javascript:popRef2('b53'))). In light of this, we would hypothesise that larger firms will be less “needy”. Following standard practice, firm size is proxied by the log of employment.

*R&D intensity*. The presence and volume of dedicated R&D expenditure is often given among the primary reasons that equity is preferable to debt as a funding source for technology-based small firms ([Hogan and Hutson, 2005](javascript:popRef2('b27'))). The argument is commonly presented in terms of the firm’s (or product’s) life cycle: R&D is a sunk cost, incurred at the outset of the project and prior to the receipt of any revenues the project hopes to generate. Accordingly, R&D generally requires funds from outside the project and, in the case of small firms, frequently outside the firm ([Stoneman and Canepa, 2002](javascript:popRef2('b59'))). Moreover, the uncertainty of returns and the generally low levels of scrap or resale value are likely to be unattractive to standard financial intermediaries (i.e. banks). Rather, capital that shares the risk (i.e. equity) may be a more appropriate means of funding significant R&D expenditures. Accordingly, we anticipate that higher levels or R&D expenditure predict greater levels of perceived need. To this end, the model contains three binary variables addressing R&D expenditure as a proportion of sales. Firms are recorded as having spent 1-5, 6-10 or > 10 per cent of turnover on R&D, with no R&D expenditure acting as the reference group.

*Growth*. Growing firms are often argued to be the most attractive and the most needy–relating, in part, to the cash flow implications of high growth but also to the sunk costs often required to stimulate and sustain growth ([Beck and Demirguc-Kunt, 2006](javascript:popRef2('frd1'))). Indeed, UK policy experience seems to see technology-based firms as particular exemplars of high-growth potential firms ([Mason and Brown, 2013](javascript:popRef2('frd8'))); with an attendant emphasis on providing adequate amounts of risk capital, as problems of collateral are likely to be particularly acute for these firms. The consequence is difficulties in accessing bank debt, and recent evidence ([Freel, 2007](javascript:popRef2('b19'))) points to adverse loan scaling for small firms experiencing significant growth. In light of the conjectured financial “neediness” of growth firms and the presumed difficulties in debt markets, we anticipate that higher levels of growth will be associated with higher perceptions of inadequate equity access for innovation. In the current model, growth is represented by the annualised change in turnover from 2001-2003.

*Changing products*. Whilst R&D expenditure says something about technical uncertainty (as an input to the innovation process), it says relatively little about target (or market) uncertainty. Yet the uncertainties surrounding technology-based businesses relate to both technical feasibility and market acceptance ([Sjögren and Zackrisson, 2005](javascript:popRef2('frd10'))). In this sense, we would anticipate that firms regularly introducing new products or services to the market (an innovation output measure) would represent greater risk to standard financial intermediaries and, correspondingly, be more likely to identify inadequate external equity funding as a barrier to innovation.mHere we record two binary dummy variables, relating to the extent to which the composition of a firm’s products or services has changed. Firms were asked about the extent to which their product and service offerings had changed over the previous three years. Response options were: “greatly changed”; “slightly changed”; and “not changed”. Firms whose product or services were “not changed” provide the reference group.

*Exporting*. A general premise is that exporting manufacturing firms are likely to exhibit higher levels of technological and managerial sophistication ([Braunerhjelm, 1996](javascript:popRef2('frd3'))). If this holds for service firms, then one might view venture capital as a means of sharing technology risk and supplementing managerial expertise. Moreover, there is longstanding evidence of greater perceived uncertainty and risk with international business decisions compared with home market operations ([Lautanen, 2000](javascript:popRef2('frd5')); [Cavusgil, 1984](javascript:popRef2('frd4'))). And here, firm perceptions may be more important than any objective measure of risk. If firms perceive their activities to involve greater risk, then they may be more inclined to seek “risk capital”, and this drives our presupposition. That is, higher levels of export activity will be associated with greater “neediness”. In the current model, exporting is represented by the proportion of exporting sales to total sales.

*Management skills and marketing skills*. Venture capital (in both its formal and informal guises) is often presented as “smart money” ([Sjögren and Zackrisson, 2005](javascript:popRef2('frd10'))). Indeed, this is the great claim of the venture capital literature ([Sorheim, 2012](javascript:popRef2('frd11'))). The “real” value-added brought by venture capitalists and business angels relates to the expertise that they bring–their commercial skills, entrepreneurial experience, business know-how and contacts. If there is validity to this claim–and, as [Sorheim (2012)](javascript:popRef2('frd11')) notes, the evidence is inconclusive–one might expect (ceteris paribus) firms with identified management deficiencies to be more disposed to seek external equity as means to alleviating internal managerial and administrative shortfalls. Logically, this argument may reasonably be extended to marketing skills. And this drives our presuppositions that perceptions of limitations in both internal managerial and marketing skills will increase the “neediness” of sample firms.

In the current model, perceptions of managerial and marketing skill deficiencies are estimated from responses to questions relating to the extent to which firms view these as barriers to innovation. Two binary variables are used as proxies: if the firm responds “4” or “5” (“very important” or “crucial”) it is coded as 1; otherwise 0.

*Debt*. We include in the model a measure of the extent to which firms view access to debt as a barrier to innovation. Here our intention is to control for general financial “neediness”. That is, the extent to which the observed concern with equity is merely symptomatic of a general concern over access to finance. In the model, this is represented by a binary variable for perceptions of debt as a barrier: if the firm responds “4” or “5” (“very important” or “crucial”) it is coded as 1; otherwise 0.

**6. Multivariate analysis**

Logistic regression, in common with all varieties of multiple regression, is sensitive to high correlation among the independent variables. However, various tests for multicollinearity (using correlation matrices and multiway frequency analysis) suggest little problem in this respect. [Table I](javascript:popRef('F_JBIM-08-2013-0175003')) details the simple bivariate correlations between the independent variables used in our regressions equation. From this, there appear to be few collinearity concerns. Only in the case of the correlation between perceived managerial and marketing constraints to innovation is the coefficient higher than one might like. However, this is to be expected and it equates to a variance inflation factor of 1.89, substantially below 10 that is normally taken to indicate collinearity. Moreover, as the data in [Table II](javascript:popRef('F_JBIM-08-2013-0175004')) indicate, the model appears to be a reasonable predictor of “neediness” – significantly improving upon “constant only” prediction at the 1 per cent level and explaining around 43 per cent of the variance. On the whole, the model seems to have a number of satisfactory properties.

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Insert Table 1 Here

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Insert Table 2 Here

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In terms of the detailed data in [Table II](javascript:popRef('F_JBIM-08-2013-0175004')), and with reference to research and development in the first instance, it is clear, and emphatic, that any (and increasing) levels of R&D expenditure are associated with higher perceptions of access to external equity as a barrier to innovation in t-KIBS. From other analyses ([Freel, 2007](javascript:popRef2('b19'))), we also know that R&D-intensive small firms (including services) encounter greater difficulties in accessing bank debt. In both cases, these difficulties are exacerbated by smaller size. Given European Governments’ determination to increase levels of business expenditure on R&D, this should give cause for concern and provide further stimulus to welcome efforts to direct a greater proportion of venture capital (and business angel) funding towards early-stage technology investments (such as the recent university challenge funds in the UK, and the activities of the European Investment Fund in the European Union). Importantly, and given the current focus on t-KIBS, it may also caution against treating access to equity as a peculiar problem of high-technology manufacturing firms. For neither technology-based manufacturing nor services in venture capital is likely to be a majority concern. For instance, in a survey of > 500 Anglo-German new-technology-based-firms, [Burgel and Murray (1998)](javascript:popRef2('b9')) reported only 11 per cent as having venture capital. In a later study, [Murray (1999](javascript:popRef2('b43')), p. 380) notes that “For 9 in 10 enterprises of this sample of exclusively high tech young firms, venture capital was either not offered or not sought”. Accordingly, the 8 per cent of this sample of t-KIBS identifying access to external equity as a significant barrier to innovation is broadly in line with the orders of magnitude one would expect from previous studies of high-technology manufacturing. Of course, the relatively small numbers perceiving a need for (or, indeed, using) external equity should suggests cautions of another sort – i.e. the dangers of overplaying the significance of (formal or informal) venture capital. However, we return to this issue in the conclusions.

The current study also confirms the difficulties (or, more accurately, the perceived difficulties) growth firms face in accessing finance. It appears to be precisely the type of firms that are the focus of much policy rhetoric that are most “needy”. Similarly, “needy” firms are more likely to perceive external finance, in general (in the form of debt), as a barrier to innovation, and one wonders about the extent to which this reflects an attitude of “We need more money, and it doesn’t matter where it comes from!”. Regardless, it is clear that higher perceptions of inadequate debt availability help predict higher perceptions of inadequate access to equity finance. Importantly, this variable was included in the model largely to *control* for general financial “neediness”. Accordingly, other observed effects are additional.

In contrast, and counter to expectations, firm age, exporting propensity or innovativeness (as an output phenomenon) appear to have limited influence on the likelihood of having higher perceptions of inadequate equity funding for innovation. In the case of innovativeness and age, the signs on the coefficients are in the anticipated direction (younger and more innovative firms record higher perceptions); for exporters the opposite is true (non-exporters who appear to have higher perceptions). Regardless, for all these variables, the observations are not statistically significant.

More remarkable are the mixed results relating to management and marketing skills. As noted earlier, one of the great claims of venture capital research relates to non-pecuniary value-added one. Indeed, from a demand-side perspective, [Cressy and Olofsson (1997)](javascript:popRef2('b13')), although noting a general “control aversion”, identify a significant minority of firms that recognise the potential contribution from outside investors in the form of additional and valuable expertise. [Mason and Harrison (1999,](javascript:popRef2('frd7')) p. 30) suggest that this conclusion implies that “small firms view equity finance as a ‘package’: loss of control is more acceptable if is it accompanied by compensating gains in terms of much needed management skills”. The current results appear to suggest that it is not management deficiencies but rather marketing deficiencies that matter. Firms that perceive inadequate marketing skills are more likely to also perceive inadequate access to external equity. The reverse is true for management skills. That is, it is firms who are relatively content with the management skills available to them, which appear to be more likely to perceive access to external equity as an innovation barrier. Of course, interpreting this result is not unproblematic. Strictly, we are identifying a positive (negative) correlation between *perceptions* of inadequate marketing (management) skills for innovation and *perceptions* of inadequate equity access for innovation. That is, our concern is with perceptions and with innovation, and we are limited in what we can objectively say about skills, both for innovation and more generally. However, the finding is suggestive: one might speculate that technology-based service firms, faced with unfamiliar and uncertain market environments (manifest in inadequate internal marketing expertise), will encounter the greatest difficulties in accessing external finance. This seems a fairly comfortable rationalisation and speaks to the risk profile of enterprises and their likely risk capital “neediness”.

Unfortunately, the relationship between perceptions of management skill (in)adequacies and equity does not lends itself to as comfortable a rationalisation. Perhaps, it may suggest that competent managerial resource may assist “needy” firms in exploring alternative, and arguably more appropriate, sources of finance – in this way explaining the negative relationship between the perceived adequacy of management skills and equity[[4]](#footnote-4). That they continue to perceive equity access as a barrier to innovation may indicate failure to either gain outside investment or to gain investment at “reasonable” terms. Perhaps reflecting the “expectations gap” long-recognised between entrepreneurs and venture capitalists ([Moore and Garnsey, 1993](javascript:popRef2('b40'))), although this is beyond the scope of the current study. On the whole, however, this explanation seems a little simplistic and trite and, in the absence of richer data, we are content to merely note the association.

**7. Concluding remarks**

Drawing on data from a sample of 264 t-KIBS, the paper was concerned with identifying the perceived relative importance of access to external equity as a barrier to innovation (for the sample as a whole) and, within the sample, the characteristics of firms recording the highest perceptions of equity as a barrier. In this sense, the paper presents a relatively uncommon demand-side perspective. With respect to the former issue, and relative to a cafeteria of resource choices, it is clear that access to external equity figures low on the list of impediments for most firms. In general, sample firms are more likely to identify skill and knowledge constraints than financial constraints. There is plenty of empirical precedent for this finding in the innovation studies literature (albeit largely relating to manufacturing firms – for example [Freel, 2000](javascript:popRef2('b17')); [Hewitt-Dundas, 2006](javascript:popRef2('b24'))) and noting it here may be considered unremarkable. However, that a similar pattern is evident in a particular set of service firms is more noteworthy, further underscoring presumed similarities between t-KIBS and high-technology manufacturing ([Howells, 2000](javascript:popRef2('b28'))) and raising concerns over the relative neglect of the former in academic studies and policy discussions.

With regards to the second research issue, and notwithstanding its low relative importance, access to equity was viewed as a non-trivial barrier to innovation by around one-third of firms. Clearly, for a small proportion of firms (of a similar magnitude identified in studies of small high-technology manufacturing), inadequate access to equity is a pressing concern (or, at least, perceived to be so). Identifying the characteristics of these firms was the primary aim of the paper. Following the earlier analysis, and in short, one might be tempted to summarise the characteristics of “neediness” as follows.

Small, fast growing and R&D-intensive firms, who are relatively sanguine about the managerial competencies available to them, but who identify deficiencies in marketing skills and the availability of external finance generally (which may say something broadly about their financial neediness), are most likely to perceive the availability of external equity as a barrier to innovation. With respect to the title of the paper, these are our “needy” firms.

Given the importance of services generally, and business services, particularly to developed economies, appreciating the existence of equity-related constraints to innovation in services is important. By and large, services have not been the focus of much venture capital or business angel activity. This may relate to presumptions of lower rates of return, to the inability to appropriately value intangible assets, to misconceptions surrounding the levels of innovativeness, to shorter product (or service) cycles which militate against cost recovery through high volume sales of standardised products or to weaknesses in the intellectual property regimes. In the main, these caricatures apply inconsistently across the service sector. A growing body of empirical work is establishing the similarities between technology-based services and, as a more natural target of equity funding (at least rhetorically), high-technology manufacturing – in terms of both innovation processes and firm performance ([Sirilli and Evangelista, 1998](javascript:popRef2('b16')); [Hughes and Wood, 2000](javascript:popRef2('b30')); [Wong and He, 2005](javascript:popRef2('b75'))). Importantly, the growth of the KIBS sector – and the growth of innovative firms within the sector ([Mansury and Love, 2008](javascript:popRef2('b36'))) – should be generating more interest (from policymakers and equity providers). Yet, even state-supported venture capital agencies are reticent in relation to services. The current analysis points to a small, but significant, group of t-KIBS that perceive equity funding as a barrier to innovation. Identifying the existence of a problem is not remarkable. In a recent commentary, [Howells (2003](javascript:popRef2('b29')), p. 31) notes that: “Service firms commonly blame their inability to innovate on an absence of venture capital and the unsympathetic attitude of financial organisations and banks towards service-based firms”. Rather, in providing greater detail of who is “needy”, the paper may help to further focus discussions.

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Figure 1: Sectoral distribution of sample t-KIBS (ISIC in parenthesis)

t-kibs-sample

Figure 2. Perceptions of barriers to innovation in technology-based knowledge-intensive business services

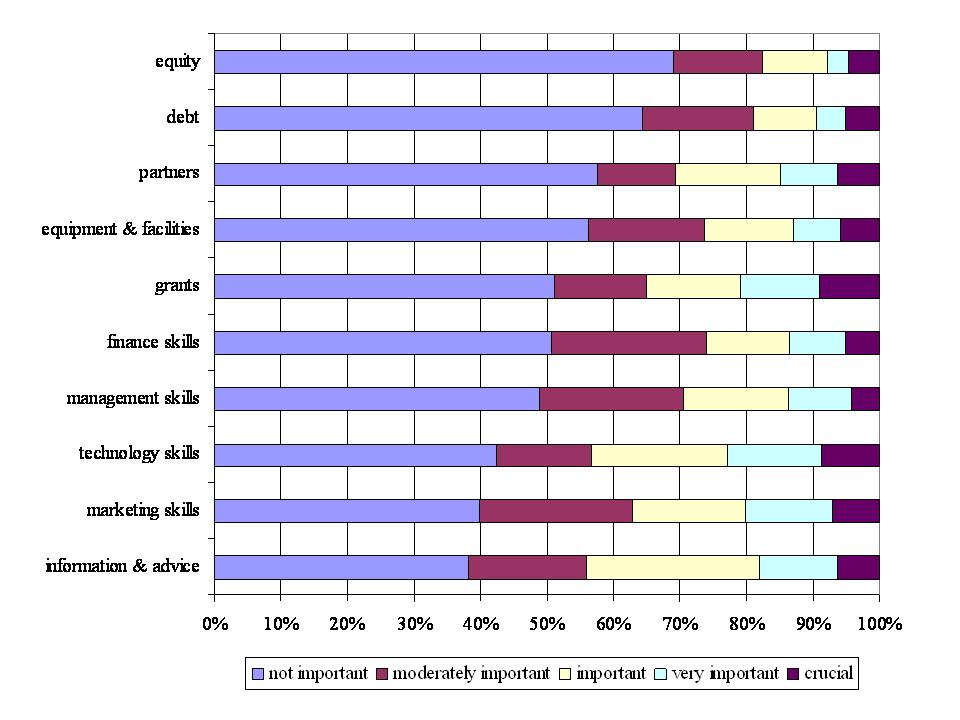


Table 1. Correlation matrix of independent variables used in regression analysis (Spearman’s ρ and Pearson’s r where applicable)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Log size | . |  |  |  |  |  |  |  |  |
| Age | 0.222 | . |  |  |  |  |  |  |  |
| R&D intensity | 0.164 | -0.040 | . |  |  |  |  |  |  |
| Sales growth | 0.070 | -0.069 | -0.003 | . |  |  |  |  |  |
| Export intensity | 0.133 | 0.062 | 0.249 | -0.018 | . |  |  |  |  |
| Service volatility | 0.119 | -0.112 | 0.192 | 0.014 | 0.192 | . |  |  |  |
| Marketing constraints | 0.102 | 0.028 | 0.126 | 0.032 | 0.046 | 0.111 | . |  |  |
| Management constraints | 0.168 | 0.072 | 0.192 | 0.077 | 0.101 | 0.088 | 0.687 | . |  |
| Debt constraints | 0.107 | 0.069 | 0.108 | -0.004 | -0.038 | 0.143 | 0.269 | 0.365 | . |

Table 2. Ordered Logit of perceptions of access to equity finance as a barrier to innovation

|  |  |
| --- | --- |
| Independent | Perceptions of equity funding as a barrier to innovation |
| Variables |
|  |  |
| Log Size | **-0.316 (3.611)b** |
| Age (0-3 years) | -0.426 (0.375) |
| Age (4-9 years) | 0.717 (2.111) |
| R&D (>10% turnover) | **1.264 (3.419)c** |
| R&D (6-10% turnover) | **1.524 (3.240)c** |
| R&D (1-5% turnover) | **0.906 (3.881)b** |
| Growth | **0.460 (3.144)c** |
| Exporting | -0.015 (1.037) |
| High product/service volatility | 0.760 (1.541) |
| Medium product/service volatility | 0.816 (2.310) |
| Managerial constraints | **-1.428 (5.060)b** |
| Marketing constraints | **1.363 (4.773)b** |
| Debt constraints | **3.002 (36.169)a** |
|  |  |
| Nagelkerke R2 | 0.434 |
| -2 Log-likelihood | 261.579 |
| dχ2 (16 df) | **80.23a** |
| N | 170 |

d full model *versus* constant only model

Figures in parenthesis are Wald χ2 test statistics

a significant at 1% level; b significant at 5% level; c significant at 10% level

1. Clearly, venture capital is not “paid back”. Rather, venture capitalists hope to make a capital gain realised through the sale of their equity holding. [↑](#footnote-ref-1)
2. For instance, data from the 1997 Cambridge survey included only 146 Scottish firms [↑](#footnote-ref-2)
3. Based on the authors’ own calculations on the UK CIS dataset. [↑](#footnote-ref-3)
4. The (flippant) flip-side of this line of argument would be to suggest that, where management deficiencies are identified and equity is not considered a barrier, the former implies that existing managers are simply not smart enough to identify the value of the latter (ceteris paribus!). [↑](#footnote-ref-4)