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**Thin Markets and Innovative  
SMEs: the Demand and  
Supply of Bank Funding in  
UK Peripheral Regions**

*By Neil Lee and Ross Brown*

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**WP N° 15-011**

4<sup>th</sup> Quarter 2015



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# Thin markets and innovative SMEs: The demand and supply of bank funding in UK peripheral regions

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## Abstract

This paper considers geographical variations in the demand and supply of bank finance for innovative firms in the UK. It uses a detailed survey on the finances of almost 40,000 UK Small and Medium Sized Enterprises for 2011 – 2013 to investigate both the extent and type of finance for innovative firms in peripheral regions, whether funders accept their applications and whether acceptance rates reflect objective criteria, such as credit scores, or their location. The paper finds evidence of higher demand for bank finance for innovative firms in peripheral areas, but that these firms are also more likely to be discouraged from applying. However, there is strong evidence that innovative firms in peripheral regions are more likely to have their applications for finance rejected, even when controlling for factors such as credit score. These findings suggest that geography does matter in the financing of innovative firms.

**Keywords:** Finance; SMEs; Innovation; Thin Markets; Peripheral Regions

**JEL:** M13; O31; R30

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## Introduction

There is increasing interest in the relationship between innovation, the financial system and economic growth (King and Levine, 1993; Mazzucato, 2013). A number of studies have considered whether the financial system properly supports innovative firms (Freel, 2007; Lee, Sameen, & Cowling, 2014; Mina, Lahr, & Hughes, 2013). Information asymmetries, the cost and difficulty of valuing intellectual property (IP), or the erratic returns to innovation may all discourage potential investors and make innovative firms reliant on a smaller number of financial providers. At the same time, the financial system is increasingly geographically concentrated in the London and a few secondary cities of the UK (Wójcik & MacDonald Korth, 2015). Firms in peripheral regions face a challenge in accessing finance which is often located in core regions. Yet relatively little research has considered the relationship between these two issues: does geography matter for the financing of innovative firms?

The standard position from banking and finance is that that geography will not matter for firm finance. According to this view, technological change has reduced the importance of geography, with finance increasingly allocated on objective factors such as credit scores and balance sheet information, rather than personal relationships (Petersen and Rajan, 2002). But the other position – held by many economic geographers – is that distance will influence access to finance (Alessandrini et al., 2009; Özyildirim & Önder, 2008; Martin and Sunley, 2015). Regular contact between financier and entrepreneur may reduce transaction costs and allow better valuations to be made (Martin, et al. 2005; Martin, Sunley, & Turner, 2002). The stereotypical Silicon Valley Venture Capitalist is said to follow a ‘one-hour-rule’ where they are unwilling to invest in a firm more than an hour’s drive away (Griffith, Yam, & Subramaniam, 2007). These ‘distance effects’ seem at play in the UK where venture capital (VC) is highly spatially concentrated in London and the south east (Powell et al, 2002). Nightingale et al. (2009) argue that ‘thin-markets’ might develop in peripheral areas, with too few specialist firms and specialist financiers to allow the successful matching of innovative growth-oriented firms to providers of finance.

Most SMEs use bank finance, rather than the specialist financing on which research has focused. Yet little research has considered the availability of bank finance for innovative firms in peripheral regions. This paper addresses this gap with an analysis of the demand and supply of finance for innovative SMEs in peripheral areas of the UK. Strong spatial imbalances in the country’s economy and financial system make the UK a suitable location for this research (Martin et al, 2005; Gardiner et al, 2013), particularly given evidence that the spatial concentration has been increasing since the financial crisis of 2007/8 (Wójcik & MacDonald Korth, 2015). We use a large, high quality dataset on the finances of almost 40,000 SMEs which contains excellent firm level information, including credit scores and postcode areas in which the

firm is based. We then use a series of regression models, controlling for selection effects where appropriate, to address the following research questions:

- (1) Are there differences in the *demand* for finance, measured either through (i) applications or (ii) discouragement, for innovative firms in peripheral regions?
- (2) Are there differences in the *supply* of finance for innovative firms in peripheral and non-peripheral regions?

These questions have important implications for government policy. Following the recent establishment of the British Business Bank some policy makers have proposed a network of regional banks as a solution to the presumed lack of finance in peripheral regions (van der Schans, 2015). The Scottish Government is already establishing a Scottish Business Development Bank to support innovative SMEs with high growth potential (Scottish Government, 2015). Yet the evidence base for such interventions is weak and past efforts to increase the supply of specialised finance in peripheral regions have typically resulted in limited success (Mason and Harrison, 2003; Martin et al., 2005; Nightingale et al., 2009; Lerner, 2010; Grilli and Murtini, 2014).

This study makes a number of contributions to the literature on the geography of banking and finance. Studies have considered regional variations in demand and supply of VC (Martin et al., 2005; Sunley, Klagge, Berndt, & Martin, 2005). Using the concept of ‘thin markets’ this study extends the analysis to bank finance. This is important for policy as, despite risk capital being closely associated with innovative start-ups and SMEs (North et al, 2013), research for the British Business Bank found that only 1% of SMEs used equity finance over the last three years (van der Schans, 2015). This is similar to most European countries with limited risk capital markets (Colombo and Grilli, 2007). Therefore, by examining the demand and supply for bank finance this work extends our knowledge of the funding requirements within a much wider range of SMEs. The paper is also among the first to consider the financing of innovative firms in the regional context (Coronado, Acosta, & Fernández, 2008). In so doing, it begins to address concerns that the geography of finance has been under-researched (Wójcik & MacDonald Korth, 2015).

The paper is structured as follows. Section two reviews the literature and develops a set of hypotheses to test. Section three describes the dataset and presents an empirical model to test. Section four considers both demand for finance and rejection rates, a measure of supply. Section five tests whether our results apply to lagging regions. Section six concludes with a discussion of the implications for theory and policy.

## 1. Finance, geography and innovative firms

### *Financing innovative firms*

Since Schumpeter highlighted the role of finance in innovation (Schumpeter 1959), researchers have considered the importance of the supply and demand of finance in enabling innovative firms to grow (e.g. Freel, 2007; Mazzucato, 2013; Mina et al., 2013). Research suggests a number of reasons why innovative firms may find it harder to access finance than less innovative firms. Innovation is “essentially a speculative process” (Freel, 2007, p. 23) which involves “a bet on the future, and most attempts fail” (Mazzucato, 2013, p. 851). While some firms achieve large returns from innovation, many others fail to benefit (Coad & Rao, 2008). As a result, financiers may be reluctant to invest, particularly those who are dependent on debt repayment rather than equity stakes. In addition, there may be information asymmetries between providers of finance and firms (Mina et al. 2013). Finally, innovations can often involve expenditure on unrecoverable sunk costs, reducing the collateral required by some lenders (O’Brien and Folta, 2009). The result may be that innovative small firms cannot obtain the external finance they need. Yet the counter argument is that innovative firms will offer greater returns, be more attractive to specialist VC funders and so find it easier to find finance.

Unsurprisingly, given these counter arguments, the evidence on whether a finance gap exists specifically for innovative firms is quite mixed. Freel (2007) finds small innovative firms who apply for finance are less likely to receive it than others. Lee et al. (2014) similarly finds that innovative SMEs in the UK are more likely to be turned down for finance but, while their chances of rejection worsened in the recession, it improved relative to other firms. In contrast, in a nuanced, comparative study of larger firms Mina et al. (2013) found that innovative firms find it no harder to access finance in the UK than other firms, but actually easier in the US. Their results differ according to the measure of innovation used. Hain & Christensen (2013) find that incremental innovators are able to access the finance they need, yet firms which introduce radical innovations or technology-based innovations are often credit rationed. However, process innovation often requires substantial levels of capital investment which will also require recourse to external finance (Hall and Khan, 2003).

### *Demand and supply of finance in peripheral regions*

Despite a vast literature on access to finance for small firms, relatively little research has considered how it varies regionally. Regional economists have tended to assume no friction of distance between places and so no spatial variation in access to finance (Dow & Rodríguez-Fuentes, 1997). Indeed, when contextualising firm finance all too often the literature treats firms as “placeless entities” (Pollard, 2003, p. 440) despite the fact that “financial systems are inherently

spatial” (Mason, 2010, p. 167). Economic geographers on the other hand have highlighted the potential problem of the UK’s highly spatially concentrated markets for small firm equity, and suggested that this may lead to a problem for firms seeking external finance (Klagge and Martin 2005). A number of commentators have suggested that firms outside London and the South East of England may find it harder to obtain finance and that this problem, in turn, exacerbates regional disparities (Cox and Schmueker 2013).

There are essentially two positions on the existence of regional finance gaps. The first is the view that location will not matter. In this view, technology will have rendered location unimportant (Petersen and Rajan, 2002). Lending technologies such as computerised credit scoring and other automated systems may make face-to-face contact a less significant part of the financing decision (Beck and Demirguc-Kunt, 2006; Berger and Udell, 2006). Banks will see geography as unimportant and focus only on apparently objective balance sheet activity. ‘Mundane’ finance from banks is, if this view is correct, unlikely to vary spatially. In some studies of SME finance variables for geography are also included whether in the form of geographical variables such as the number of bank branches (e.g. Alessandrini et al. 2009) or simple regional dummies (e.g. Armstrong et al. 2013). Yet these studies do not tend to show a consistent picture of geographical variation in either the demand or supply of finance.

A second view is that geography will shape the financing of innovative firms. Nightingale et al. (2009) show that these problems seem particularly acute in spatial environments characterised by ‘thin markets’. These arise when “limited numbers of investors and entrepreneurial growth firms within the economy have difficulty finding and contracting with each other at reasonable costs” (Nightingale et al, 2009, p. 5). The authors highlight this problem with regard to public VC investments in peripheral regions of the UK. In these environments ‘thin-markets’ make it expensive for specialist investors and entrepreneurs to find each other outside of the core regions of the UK. The process can be cumulative: search costs are higher outside core areas, and so financiers are discouraged from looking; those providers of finance in peripheral areas which remain are less likely to specialise in financing innovative firms; they tend to focus on less resource-intensive early stage finance; and do not develop the appropriate specialisms to fund them. Analytically, the concept of ‘thin markets’ highlights how demand and supply-side issues coalesce to shape funding issues within innovative SMEs. However, to date research has yet to examine this concept in relation to bank finance.

### *Hypothesis Development*

Building on the concept of ‘thin markets’ a set of testable hypotheses can be developed. The first is that innovative firms in peripheral regions may be discouraged from applying for finance. In their classic paper on discouragement, Kon & Storey (2003: 38) develop a model where there are

good and bad firms and there is a cost (financial, time or “psychic”) which dissuades firms from seeking external sources of funding. In the context of asymmetric information, some firms will be discouraged from borrowing. However, Freel et al. (2012) use a large sample of over 9,000 firms but find no statistically significant evidence that innovative firms are more likely to be discouraged. Innovative firms in peripheral regions may be less likely to be aware of specialised financiers or financial alternative (Seghers, Manigart, & Vanacker, 2012) and will have fewer innovative peers who have accessed finance. They may also have less contact with financiers and so believe it harder to obtain. This corresponds with the ‘embeddedness’ view of finance where these kind of social relations and networks heavily shape “who gets credit and what that credit costs” (Uzzi, 1990, p. 502). From this the first hypothesis is:

H<sub>1</sub> Innovative firms in peripheral regions are more likely to be *discouraged* from applying for finance than other firms

Second, bank finance may become even more important for innovative firms in peripheral regions than those elsewhere due to supply-side issues (Klagge and Martin 2005). The classic explanation of the firm financing decision is the ‘pecking-order’ theory of finance (Myers and Majluf, 1984). To avoid losing control of a business, this theory suggests firms will choose first to use internal finance, then debt finance and will only reluctantly use equity finance as a last resort (Frank and Goyal, 2003). While this principle seems to hold for larger firms it doesn’t always apply to smaller firms. Due to information asymmetries, small firms “do not seem to follow a pecking order” of preferences (Vanacker and Manigart, 2010, p. 55). This is linked to the informational opacity previously noted within these firms for investors who perceive them as ‘riskier bets’. This will be particularly true for small firms who are untested technologies or IP as their core source of competitive advantage. In these particular cases, the pecking order may be reversed with firm’s firstly first seeking equity funding and then seeking other forms of funding. In the absence of VC funding firms may turn to general lenders such as banks. Therefore, innovative firms in peripheral regions faced with ‘thin markets’ for equity funding may thus be pushed towards bank finance even if other forms of finance are more suitable. This is the second hypothesis:

H<sub>2</sub> Innovative firms in peripheral regions are more likely to *apply* for bank finance than firms elsewhere

The third potential effect is that it may be harder for innovative firms in peripheral regions to access bank finance – a case of regional finance gaps. This might be because of a lack of specialist financiers and banking organisations lacking the knowledge of how to value innovations. The value of specialist IP and/or business models may not be immediately obvious to these providers of finance, a problem exacerbated by a lack of deal flow from innovative

firms. It might also be the result of banks having a focus on repayment of loans, rather than firm growth, and so being less willing to lend to companies introducing new innovations. Evidence from Italy suggests that firms which are geographically further from banking provision may face greater financing constraints (Alessandrini et al. 2009). Building on this, a third hypothesis suggests that innovative firms in peripheral regions may face particular credit constraints:

H<sub>3</sub> Innovative firms in peripheral regions face higher *rejection rates* than other firms

## 2. Data and methodology

### Data

To investigate geographical variations in financing patterns for innovative firms this paper uses the UK Small and Medium Sized Enterprise Finance monitor survey (UKSMEF) from Q1 2011 – Q3 2013. This is a cross sectional survey which gives comprehensive information on firms, their balance sheets and financial history, applications for finance, and the success of these applications and costs of financing. It is conducted by BDRC Continental and the data is made available through the UK Data Archive. The survey had a quota for size, sector and region. Enterprises needed to have a turnover of less than £25million, be a for-profit enterprise and not be more than 50% owned by another country. To focus on established firms we exclude firms with zero employees. The turnover of £25 million is slightly smaller than the EU’s definition of SME (Verheugen, 2005), but weights are used to make the results representative of the business stock of this size.

### Model and estimation strategy

#### *Demand for finance*

Following Mina et al. (2013) we investigate both the demand and supply of finance for innovative firms using a probit model and, where appropriate, a Heckman correction for selection effects. Our approach begins with an investigation into the demand for finance (for similar applications see Fraser 2009; Lee & Drever 2014). The basic model here is one where DFIN is a measure of whether a firm applies for finance in a given period:

$$DFIN_i = \alpha + \beta_1 FIRM_i + \beta_2 FINANCE_i + \beta_3 GEOGRAPHY_i + \beta_4 WAVE_i + \varphi + \varepsilon \quad (1)$$

Where FIRM is a set of variables for the characteristics of the firm, such as size, sector and age. FINANCE controls for the credit score and balance sheet of the firms and whether they have had issues paying previous debt. GEOGRAPHY is one of two variables for the location of the firm. WAVE is a control for the survey wave in which the firm was sampled. “ $\varphi$ ” is a sectoral dummy variable. The constant is “ $\alpha$ ” and “ $\varepsilon$ ” is the error term.



The UKSMEF has data on two sources of finance: loans and overdraft. It also gives information on discouragement, and whether firms do not apply because they believe applications will not be successful (Han et al., 2009; Kon & Storey, 2003). In this case, we follow the official statistics and define those who are discouraged as those who do not apply for finance because they do not trust banks or think they will be turned down (BDRC, 2014). These three variables – applications for loans, overdrafts and discouragement – are the key measures of demand for finance.

### *Supply of finance*

While equation 1 gives an indicator of the demand for finance, the second question is the extent to which the supply of finance differs across geographical locations. This is given as equation 2.

$$SFIN_i = \alpha + \beta_1 FIRM_i + \beta_2 FINANCE_i + \beta_3 GEOGRAPHY_i + \beta_4 WAVE_i + \varphi + \varepsilon \quad (2)$$

Controls are as before. The basic indicator of supply of finance is whether firms are successful in the applications for either bank loans or overdrafts. However, the likelihood of a firm being rejected for finance is conditional on their probability of applying for it. Because of this, we also estimate this model using the common Heckman selection approach (for applications see Fraser, 2009; Mina et al., 2013; Lee & Drever, 2014).

## **Variables and definitions**

### *Defining innovative firms*

Studies suggest that the success of firms in accessing finance depends on the type of innovation (Hain and Christensen, 2013). Our definition of innovation is whether firms have introduced a new product or service in the past 3 years. This is similar to the measure used by Lee et al (2014) in their study of access to finance in the recession and one incorporated in the study of Mina et al. (2013). This is also broadly consistent with the definition of product innovation used within the Community Innovation Survey (Hashi, & Stojcic, 2013).<sup>3</sup>

### *Defining ‘peripheral regions’*

Our measure of peripheral regions is developed from the European Spatial Planning and Observation Network (ESPON) Multimodal accessibility statistics (ESPON, 2009). We use the multimodal accessibility index, calculated using the total population across Europe and weighted according to travel time using road, rail and air. The statistic is indexed relative to the EU average with 100 being the average level of accessibility. These are defined as NUTS regions, whereas the UK SME Finance Monitor contains data at a postcode area level. To address this,

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<sup>3</sup> Note that we also experiment with an alternative, broader measure of innovation: “Whether firms have significantly improved an aspect of the business” with broadly similar results.

we calculate a weighted average accessibility index for each postcode area, based on share of postcode units (a good proxy for population size) across each area. We then define ‘peripheral regions’ as those in bottom ten percent in the UK. This methodology gives us a sub-set of areas mainly in the South West of England, Northern Scotland the Islands and North Wales (see Figure 1 below).<sup>4</sup> Note that one limitation of this is that it is based on 2006 data, although it is highly unlikely that significant changes will affect the results. We consider an alternative measure of peripherality in the robustness tests.

*Insert figure 1 around here*

#### *Control variables*

A series of controls are used to account for other factors which may influence both demand and success of finance. Summary statistics and variable definitions are given in table 1.

*Insert table 1 around here*

First we consider firm size and age. Size can be measured in a number of ways, but in an effort to avoid endogeneity with loan size, total employment is used here. This is given in six categories: 0 employees; 1 - 9 ; 10-49, 50 – 99, 100 – 199 employees and 200 – 249 employees. Age is also considered. An unweighted 10 percent of the sample are ‘start-ups’ defined here as being two years old or younger. The other categories are 2 – 5 years old, 6 – 9 years, 10 – 15 years with the largest category being older than 15 years. Categories are used in this case for two reasons: to identify potential non-linearities and to avoid collinearity with other variables.

Legal structure may determine the extent to which banks are willing to lend. We control for four types of structure: sole proprietorship, partnership, limited liability partnership and limited liability company. Note that “not for profits” are not included in the survey.

Finally, we include a variable for the growth ambition of the firm. This takes the value one if respondents say they want to grow substantially or moderately when asked about their ambitions for the firm. Firms which aim to grow will be more likely to be applying for finance for growth, rather than working capital. They may also be more likely to be innovative.

Four variables are included for the finance of the firm. The first two are dummy variables for whether the firm has made a profit or a loss in their most recent trading period (the reference category is whether firms have broken even). A control is also used for past financial problem

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<sup>4</sup> The postcode areas included are: Carlisle (CA), Dumfries and Galloway (DG), Dorchester (DT), Exeter, the Outer Hebrides (HS), Inverness (IV), Kilmarnock (KA), Orkney (KW), Northern Lancashire (LA), Llandudno (LL), Perth (PH), Plymouth (PL), Taunton (TA), Galashiels (TD), Torquay (TQ), Truro (TR) and Shetland (ZE).

(Armstrong et al. 2013). This takes the value 1 if a firm has missed a loan repayment, an unauthorised overdraft, bounced cheques or used the government’s “Time to Pay Scheme” which is for insolvent firms.

In addition, a set of controls are used for the risk rating of the firm. One problem is that credit score is likely to be endogenous with the decision to apply for finance. As is now standard in the literature using these surveys, following authors such as Han et al. (2009), an instrumented credit score is used to address this problem. The credit score of each firm is predicted using an ordinal logit model and the base characteristics of the firm.

Two additional variables control for the firms activities. The first of these is whether a firm exports. The second is whether a firm has a business plan. Firms with business plans will be more able to access finance as this can be a requirement of some financiers. It will also signal a better-managed firm (Smith, 1998). Sector will also be important and seven dummy variables are used to control for this.

As the period in question is one in which lending to small firms fluctuated significantly, dummy variables are also included for the quarter of the survey in which the firm was sampled (e.g. Q1 2013; Q2 2014 etc).<sup>5</sup> These dummy variables will account for aggregate changes in the supply of finance.

### **3. Demand and supply of finance in peripheral regions**

#### *Demand for finance*

The first research question is whether innovative firms in peripheral regions have a lower demand for finance than firms elsewhere. Table 2 gives simple cross tabulations related to the financing variables according to whether firms are innovators and their location. Significance tests are given in parentheses (to accommodate weights, these are the result of a probit regression with column 4 as the reference category).

*Insert table 2 around here*

Relative to normal firms (non-innovative firms in the periphery), innovative firms are more likely to apply for finance. The difference is relatively small, but statistically significant and it applies for both loans and overdrafts. “Normal” firms in peripheral regions are also particularly likely to apply for both loans, although not overdrafts. Innovative firms in core regions are also more likely to apply for both loans and overdrafts.

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<sup>5</sup> Note that the first two waves (Q1 2011 and Q2 2011) are amalgamated in the data file. This small issue is unlikely to significantly affect the results.

*Insert table 3 around here*

The basic regression results for these three measures of demand for finance - loan applications, overdraft applications and discouraged borrowers - are given in table 3. Models are estimated at probit regressions with weights. For each of the three dependent variables, models are first given with simple variables for peripheral firms and innovators but no controls, then with interactions between the periphery/innovation variables but no controls, and then for both basic variables and interactions but with full controls.<sup>6</sup>

The first hypothesis is the extent to which these firms are discouraged from borrowing. There is no evidence that peripherality matters here, although innovators are certainly more likely to be discouraged than other firms. When considering interaction effects (columns 3 and 4), the results suggest non-peripheral innovators are more likely to be discouraged from borrowing than firms elsewhere, even when controlling for other characteristics such as their risk profiles. The effect is, if anything, even more pronounced for innovative firms in peripheral regions (the coefficient is more than double). We find both that innovative firms are particularly likely to be discouraged from borrowing but also that the effect is even larger in peripheral regions. There is no grounds to reject our first hypothesis, that innovative firms in peripheral regions are more likely to be discouraged from seeking finance.

Considering next loan applications (columns 5 – 8), peripheral firms make more applications as do innovative firms. These results are hold when interactions are included and are robust to controls. Innovative firms outside of peripheral regions are more likely to apply for loans even when controlling for their other characteristics. This ‘demand’ effect seems, if anything, to be greater for innovative firms in peripheral regions where the coefficient is slightly larger. Similarly, ‘normal’ firms in peripheral regions have higher loan application rates. Considering overdraft applications (columns 9 – 12) provides more nuance to this story. As with loans, innovative firms are more likely to apply for overdrafts than other firms – but in this case, there is no effect from being in a peripheral region. As with loans, the effect is larger for peripheral innovators than those in non-peripheral areas.

In short, the results show higher demand for external finance for both innovative and peripheral firms – and innovative firms in the periphery are more likely to apply for both overdrafts and loans than normal firms. Given that we also find evidence of discouragement, this provides no grounds to reject our hypotheses related to increased demand for finance amongst peripheral innovators.

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<sup>6</sup> As is standard, models are run with robust standard errors. There is some evidence of collinearity – as might be expected - between the instrumented credit scores and other controls. Yet removing the collinear variables makes no difference to the main results.

### *Rejection rates and the supply of finance*

Next we consider the extent to which firms who apply for loans or overdrafts are able to successfully obtain them. We estimate these models using two types of regression. In the basic regressions (columns 1 – 4) these are simple probit regressions where the dependent variable is whether a firm is rejected for a loan or overdraft. Yet these regressions will suffer from selection bias: as certain types of firm are more likely to apply for finance, we need to control for this when estimating regression equations. To address this, we use the common two-step Heckman selection equation (see Fraser, 2009; Armstrong, Davis, Liadze, & Rienzo, 2013; Lee & Drever, 2014). The exclusion criteria for these models are legal status and age (for loan rejections) or whether firms have a business plan (for overdraft rejections). We do not report the first stage equation as these will be very similar to those given in table 3.

*Insert table 4 around here*

The basic results are given in columns 1 – 4. These show that being located in a peripheral region seems to have no impact on loan or overdraft rejection – in this respect, the dominant narrative that geography is unimportant seems correct. Innovation, in contrast, does seem to matter both without considering geography and – for loans – when considering interactions with peripherality. There is no effect when considering overdrafts.

The results when controlling for selection are more definitive: while we continue to find no effect on non-innovative peripheral firms, we find that innovative firms in peripheral regions find it harder to access both loans and overdrafts. In short, there seems to be a penalty for firms located in peripheral regions, but this only applies to innovative firms. We find no reason to reject our third hypothesis, that innovative firms in peripheral regions will have higher rejection rates.

The control variables also yield some insights. Firms making losses are particularly likely to find it hard to access loan finance, but not overdrafts when controlling for selection. Profitable firms are particularly likely to be turned down for loans, once selection is controlled for. This may simply be because of the reasons they are seeking finance. Firms with finance find it harder to access finance, but we find no evidence of discrimination about female owned firms (if anything, the reverse) which may suggest they apply for less. Similarly, firms seeking business plans are more likely to be rejected, perhaps because they are making more ambitious requests.

#### **4. Lagging regions**

To test the robustness of our results to our indicator of ‘peripherality’ we also use an indicator of whether firms are located in lagging regions. We use European regional policy to define these.

Firms are aggregated into two groups to match EU regional policy: (1) Less developed regions – these are regions with less than 75% of the EU average GDP.<sup>7</sup> (2) Transition regions – these are those with GDP between 75 and 90 percent of the EU average GDP. For clarity of interpretation and to avoid small sample sizes both sets of regions are included in a single variable. These are defined according to NUTS regions, however, and these do not perfectly overlap with postcode areas. All postcode areas which overlap with the relevant NUTS areas are used.

The results for ‘lagging regions’ are broadly similar to those for peripheral regions. Table 5 shows the results for demand, discouragement and supply of finance. All regressions include full controls as in tables 3 and 4. Innovative firms, as before, seem to have higher demand for external finance but also find it harder to access. They are more likely to apply for finance, yet no more or less likely to be discouraged. They are more likely to be rejected regardless of whether we correct for selection.

## 5. Discussion and Conclusions

This paper has considered the demand and supply of finance for innovative firms and how this varies in peripheral versus core regions. Using detailed firm-level data, it has focused on the demand and supply of loans and overdrafts. To the best of our knowledge, this is the first attempt to investigate the geography of both demand and supply of bank finance for innovative firms in a single paper. By examining access to bank finance it also extends the more extensive body of work on spatial variations in the demand and supply of VC for SMEs, enabling us to extend the analytical concept of ‘thin markets’.

Our first question related to the demand for finance. We find that innovative firms are more likely to be discouraged from applying for finance, but that innovative firms in peripheral regions are particularly so. In some respects, this is consistent with the idea of thin markets developing in peripheral regions as firms do not believe they will be funded. Yet demand is actually higher for innovative firms in peripheral regions – as shown by higher probabilities of loan or overdraft applications. One potential explanation for this is the pecking order hypothesis. Peripheral innovators may be forced to seek bank loans or overdraft funding as they lack internal capital (e.g. through higher house values in core regions) or access to specialised equity finance.

Our second finding relates to supply: innovative firms in peripheral regions are more likely to have their applications for finance rejected, even when controlling for selection effects and a

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<sup>7</sup> The regions in category 1 are: Cornwall and the Isles of Scilly (postcode areas: TR, PL), West Wales and the Valleys (LL, SY, SA, LD) (note we exclude Cardiff and Newport from this definition). The UK regions in category 2 are: Cumbria (CA, LA), Devon (EX, TQ, TA), East Yorkshire and North Lincolnshire (YO, HU), Highlands and Islands (KW, IV, PH, PA, ZE), Lancashire (LA, PR, BB, BD, FY – note exclude Manchester, Oldham, Wigan and Blackburn), Lincolnshire (LN, DN), Merseyside (L, CH, WA), Northern Ireland (BT), Shropshire and Staffordshire (ST, TR), South Yorkshire (YO, S), Tees Valley and Durham (DH, TS, DL).

wide set of firm-level variables such as credit score. This suggests that the idea that geography does not matter for firm financing is mistaken. On the contrary, firms located in remote regions seem to suffer a ‘liability of distance’ in terms of accessing funding, providing further evidence for claims that lending practices by banks and other funders “can be spatially discriminatory” (Martin and Sunley, 2015, p. 32). Meanwhile, it also supports some other research in this area (Alessandrini et al., 2009; Alessandrini et al, 2010; Özyildirim & Önder, 2008), but adding the nuance that it is innovative firms which are particularly affected. While their lack of finance could just indicate an efficient market mechanism preventing weak innovators from obtaining funding (Lockett et al, 2002), it could also be signal that firms in some regions are disadvantaged. Credit markets are not perfect allocators of capital (Cowling & Siepel, 2014), and the geographical dimension may be one aspect of this. Further work is needed to probe the quality of loan applications from innovative firms in peripheral regions to examine this issue in greater depth.

What these findings suggest is the existence of an additional dimension to the thin market hypothesis. Higher loan rejection levels suggest that mainstream lending may also feature thin markets in some spatial locations. The tighter financing constraints facing innovative firms experience in some regions often dovetails with a strong presence of branches of large non-local banks. This lack of local decision making autonomy or “functional distance between bank decisional centers and local branches” therefore may be hindering the innovation process in some regions (Alessandrini et al, 2010, p. 874). These institutional factors also seem to mediate thin markets. Overcoming the existence of thin markets is not just a question of supply of funding but rather about building a vibrant funding ecosystem of many “complex component parts” (Nightingale et al, 2009, p. 28) which covers a range of different types of finance for innovative SMEs. It will also require developing a strong pool of innovative high growth firms who have the capacity to optimise lending opportunities wherever these may arise.

The work raises important policy implications from both supply-side and demand-side issues. First and foremost, despite the huge focus on risk finance, banks matter for innovative SMEs. The research suggests that policy makers are right to consider the concept of regionalised networks of banks. This seems especially prescient for countries with highly centralised and monopolistic banks systems such as the UK. The design and construction of these banks needs to be very carefully considered so that these genuinely augment existing lending provision rather crowding it out as some government-funded VC programmes have done (Cumming & MacIntosh, 2006). In terms of the demand-side, the newly established British Business Bank should help tackle discouragement through various informational campaigns to help stimulate the demand for borrowing (van der Schans, 2015), including promoting the growing range of alternative forms of small business funding such as crowdfunding and peer-to-peer lending (Bruton et al, 2015). Enterprise policies designed to support high growth firms have been

criticised for being too narrowly focused (Mason and Brown, 2013), often omitting interventions to improve the financial acumen of these firms. Indeed, encouraging entrepreneurs to seek out more spatially extensive sources of credit from outside their own regional economies could help overcome some of the problems remote innovative firms face accessing finance.

Of course, there are potential methodological explanations for these results. The first is some sort of omitted variable bias and more information on balance sheets may be needed to address this problem. Alternatively, further consideration of the type of finance requested may further address this concern. The second is some sort of selection issue, with firms in peripheral areas introducing new products which are simply less commercially viable than in other areas. Regardless, it is a potentially troubling finding. There are a number of limitations to the paper as stands. It is hard to find appropriate measures of innovation and while those used here are inclusive, they are inevitably limited and may disguise sectoral variation and hide the significance or quality of any innovation. Future work may want to address this.



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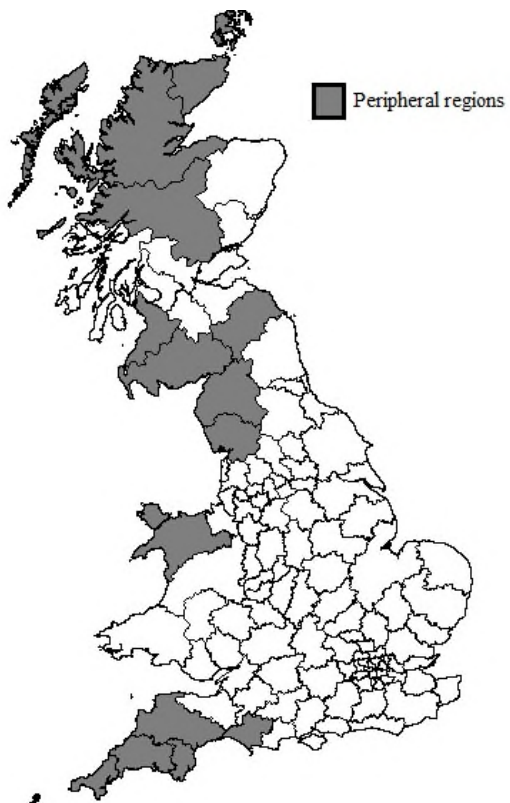
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## Tables & Figures

Figure 1. Peripheral postcode areas



Note: Also includes Shetland (ZE)

**Table 1. Variable descriptions and summary stats**

<b>Variable</b>	<b>Details</b>	<b>Obs</b>	<b>Mean</b>
Loan application	Firm has made new application for term loan in previous 12 months	39994	0.05
Overdraft application	Firm has made new application for overdraft in previous 12 months	39994	0.06
Loan rejection	Firm applied for loan but was rejected	39994	0.02
Overdraft application	Firm applied for overdraft but was rejected	39994	0.03
Discouraged	Discouraged	35970	0.03
Periphery	Firm located in peripheral postcode area	39994	0.09
Innovator	Firm has introduced a new product or service in past 36 months	39994	0.23
Profit	Firm made profit in last financial year	39994	0.68
Loss	Firm made loss in last financial year	39994	0.13
Aims to grow	Firm aims to grow	39994	0.52
Financial problem	Firm has experienced financial issues in past 3 years	39994	0.18
Women owned	Firm owned by a woman	39994	0.33
IV Credit risk 2	Instrumented credit score	39994	0.18
IV Credit risk 3	Instrumented credit score	39994	0.31
IV Credit risk 4	Instrumented credit score	39994	0.38
1 – 9 Emps	Employment size, 1 – 9	39994	0.86
10 – 49 Emps	Employment size, 10 - 49	39994	0.12
50 – 99 Emps	Employment size, 50 - 99	39994	0.01
100 – 199 Emps	Employment size, 100 – 199	39994	0.01
200 – 249 Emps	Employment size, 200 – 249	39994	0.01
0 – 5 years	Firm age, 2 – 5 years	39994	0.24
6 – 15 years	Firm age, 6 – 9 years	39994	0.29
15 + years	Firm age, 15 years +	39994	0.45
Sole Prop	Legal structure: Sole Prop	39994	0.26
Partnership	Legal structure: Partnership	39994	0.14
LLP	Legal structure: LLP	39994	0.03
LLC	Legal structure: LLC	39994	0.57
Exports	Firm exports	39994	0.12
Business plan	Firm has business plan	39994	0.43

**Table 2. Cross-tabulations: Applications by geography, firm type**

% of firms:	Peripheral		Non-peripheral	
	Product innovator	Not product innovator	Product innovator	Not product innovator
Applying for loans	7.7 (0.000)	5.4 (0.015)	6.6 (0.000)	4.0
Applying for overdraft	9.4 (0.000)	6.2 (0.244)	7.7 (0.000)	5.4

**Notes:** sample size 50,175. P-values in parentheses from simple probit regressions (with weights) with the reference category of column 4 – the ‘normal’ firm.



**Table 3. Regression: Demand for finance**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Discouraged		New loan application				New overdraft application					
Periphery	-0.0821	-0.0414			0.130**	0.118**			0.0725	0.0824		
	(0.0675)	(0.0704)			(0.0513)	(0.0523)			(0.0500)	(0.0510)		
Innovator	0.160***	0.170***			0.240***	0.162***			0.178***	0.117***		
	(0.0453)	(0.0509)			(0.0367)	(0.0392)			(0.0364)	(0.0407)		
Non-periph / Innov			0.136***	0.147***			0.245***	0.169***			0.175***	0.114***
			(0.0475)	(0.0532)			(0.0388)	(0.0411)			(0.0384)	(0.0427)
Periph / Non-innov			-0.172**	-0.131			0.145**	0.138**			0.0637	0.0756
			(0.0808)	(0.0826)			(0.0601)	(0.0610)			(0.0576)	(0.0582)
Periph / Innov			0.286**	0.328**			0.326***	0.223**			0.276***	0.219**
			(0.122)	(0.131)			(0.0920)	(0.0944)			(0.0977)	(0.101)
Profit		-0.0604		-0.0595		0.0908		0.0905		0.128**		0.128**
		(0.0708)		(0.0708)		(0.0561)		(0.0561)		(0.0551)		(0.0552)
Loss		0.298***		0.297***		0.226***		0.226***		0.189***		0.189***
		(0.0810)		(0.0811)		(0.0752)		(0.0752)		(0.0636)		(0.0636)
Aims to grow		0.0321		0.0311		0.204***		0.204***		0.107***		0.107***
		(0.0508)		(0.0508)		(0.0403)		(0.0403)		(0.0384)		(0.0384)
Financial problems		0.376***		0.376***		0.510***		0.510***		0.534***		0.534***
		(0.0888)		(0.0888)		(0.0702)		(0.0702)		(0.0650)		(0.0650)
Women owned		0.0161		0.0170		-0.0468		-0.0468		0.0377		0.0378
		(0.0501)		(0.0501)		(0.0387)		(0.0387)		(0.0376)		(0.0376)
Exports		-0.0753		-0.0752		-0.0296		-0.0298		0.0649		0.0649
		(0.0798)		(0.0798)		(0.0612)		(0.0612)		(0.0621)		(0.0621)
Business plan		0.0682		0.0669		0.181***		0.181***		0.122***		0.122***
		(0.0463)		(0.0463)		(0.0363)		(0.0363)		(0.0350)		(0.0350)
IV Credit risk 2		1.345		1.351		-0.102		-0.104		1.319		1.319

		(1.992)		(1.992)		(1.238)		(1.239)		(1.247)		(1.246)
IV Credit risk 3		1.442**		1.439**		-1.419***		-1.419***		0.303		0.303
		(0.690)		(0.690)		(0.452)		(0.452)		(0.459)		(0.459)
IV Credit risk 4		2.059		2.063		-1.068		-1.068		1.057		1.056
		(1.667)		(1.667)		(1.165)		(1.165)		(1.121)		(1.121)
10 – 49 employees		0.108		0.109		-0.180		-0.180		-0.0250		-0.0251
		(0.150)		(0.150)		(0.114)		(0.114)		(0.109)		(0.109)
50 – 99 employees		0.0869		0.0889		-0.271**		-0.271**		-0.157		-0.157
		(0.183)		(0.183)		(0.136)		(0.136)		(0.131)		(0.131)
100 – 199 Emps		-0.305		-0.306		-0.184		-0.184		-0.0125		-0.0130
		(0.224)		(0.224)		(0.154)		(0.154)		(0.151)		(0.150)
200 – 249 Emps		-0.261		-0.272		-0.138		-0.137		-0.171		-0.171
		(0.285)		(0.281)		(0.150)		(0.150)		(0.161)		(0.161)
6 – 15 years		-0.0122		-0.0126		0.00401		0.00413		-0.0267		-0.0267
		(0.0455)		(0.0455)		(0.0391)		(0.0391)		(0.0358)		(0.0358)
15 years +		0.0903		0.0911		-0.158**		-0.158**		0.0632		0.0633
		(0.0970)		(0.0969)		(0.0702)		(0.0702)		(0.0676)		(0.0676)
Constant	-1.825***	-3.526***	-1.818***	-3.518***	-1.543***	-0.789	-1.545***	-0.791	-1.414***	-2.495***	-1.413***	-2.494***
	(0.0586)	(1.363)	(0.0585)	(1.363)	(0.0477)	(0.923)	(0.0478)	(0.923)	(0.0442)	(0.907)	(0.0443)	(0.906)
Wave dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector & legal status controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	35,970	35,970	35,970	35,970	39,994	39,994	39,994	39,994	39,994	39,994	39,994	39,994
Pseudo R2	0.00723	0.0849	0.00806	0.0856	0.0126	0.0513	0.0126	0.0514	0.0117	0.0644	0.0117	0.0644

**Notes:** Estimated as probit regression. Unreported Controls: legal structure, sector and survey wave. Weights applied. Robust standard errors in parenthesis. Statistical significance: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 4. Supply of finance**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Rejection: Loan		Rejection: Overdraft		Rejection: Loan		Rejection: Overdraft	rej_ov
Estimation method	Probit	Probit	Probit	Probit	Heckman probit	Heckman probit	Heckman probit	Heckman probit
Periphery	-0.0118 (0.0702)		0.0517 (0.0585)		0.0433 (0.0509)		0.0956 (0.0629)	
Innovator	0.199*** (0.0492)		0.184*** (0.0485)		0.169*** (0.0341)		0.170*** (0.0435)	
Non-periph / Innov		0.191*** (0.0512)		0.194*** (0.0508)		0.150*** (0.0358)		0.172*** (0.0456)
Periph / Non-innov		-0.0421 (0.0881)		0.0851 (0.0668)		-0.0296 (0.0638)		0.102 (0.0729)
Periph / Innov		0.252** (0.113)		0.137 (0.114)		0.332*** (0.0829)		0.259** (0.110)
Profit	0.0683 (0.0671)	0.0687 (0.0671)	0.0642 (0.0669)	0.0633 (0.0668)	0.148*** (0.0456)	0.149*** (0.0455)	0.104 (0.0692)	0.104 (0.0688)
Loss	0.266*** (0.0848)	0.265*** (0.0848)	0.175** (0.0747)	0.175** (0.0747)	0.188*** (0.0566)	0.188*** (0.0565)	0.116 (0.0897)	0.117 (0.0886)
Aims to grow	0.168*** (0.0515)	0.168*** (0.0515)	0.0819* (0.0452)	0.0825* (0.0452)	0.175*** (0.0332)	0.176*** (0.0331)	0.0180 (0.0534)	0.0196 (0.0528)
Financial problems	0.485*** (0.0824)	0.484*** (0.0824)	0.532*** (0.0759)	0.532*** (0.0759)	0.396*** (0.0349)	0.397*** (0.0349)	0.378*** (0.0959)	0.380*** (0.0944)
Women owned	-0.116** (0.0500)	-0.116** (0.0500)	-0.0214 (0.0456)	-0.0217 (0.0456)	-0.0682* (0.0355)	-0.0697** (0.0355)	-0.0335 (0.0451)	-0.0333 (0.0447)
Exports	-0.0130 (0.0811)	-0.0124 (0.0811)	0.0397 (0.0737)	0.0393 (0.0738)	-0.0201 (0.0456)	-0.0201 (0.0455)	0.120 (0.0741)	0.118 (0.0735)
Business plan	0.203*** (0.0442)	0.203*** (0.0442)	0.0468 (0.0409)	0.0470 (0.0409)	0.131*** (0.0323)	0.130*** (0.0323)		
IV Credit risk 2	-0.584 (1.655)	-0.583 (1.655)	-0.0380 (1.423)	-0.0521 (1.424)	-0.953 (0.795)	-0.889 (0.796)	1.474 (1.376)	1.439 (1.366)
IV Credit risk 3	-0.732 (0.584)	-0.732 (0.584)	0.106 (0.537)	0.104 (0.537)	-0.0436 (0.237)	-0.0378 (0.237)	1.000* (0.554)	0.989* (0.550)

IV Credit risk 4	-0.837 (1.473)	-0.837 (1.473)	0.730 (1.308)	0.720 (1.309)	0.123 (0.388)	0.151 (0.389)	2.792** (1.412)	2.755** (1.398)
10 – 49 employees	-0.162 (0.140)	-0.162 (0.140)	0.0141 (0.130)	0.0142 (0.130)	0.0106 (0.0485)	0.00777 (0.0485)	0.183 (0.136)	0.181 (0.135)
50 – 99 employees	-0.326* (0.167)	-0.326* (0.167)	-0.152 (0.157)	-0.152 (0.157)	-0.110 (0.0730)	-0.109 (0.0730)	0.0317 (0.168)	0.0292 (0.167)
100 – 199 Emps	-0.379* (0.195)	-0.380* (0.195)	-0.0681 (0.180)	-0.0661 (0.180)	-0.0971 (0.0943)	-0.0980 (0.0943)	0.0401 (0.198)	0.0396 (0.197)
200 – 249 Emps	-0.143 (0.189)	-0.145 (0.188)	-0.427* (0.221)	-0.429* (0.221)	0.0535 (0.127)	0.0458 (0.127)	-0.117 (0.247)	-0.115 (0.246)
6 – 15 years	-0.0313 (0.0462)	-0.0315 (0.0462)	-0.00945 (0.0424)	-0.00954 (0.0424)			0.00535 (0.0466)	0.00460 (0.0461)
15 years +	-0.0416 (0.0885)	-0.0414 (0.0885)	0.0692 (0.0813)	0.0686 (0.0813)			0.156* (0.0818)	0.155* (0.0812)
Partnership	-0.0203 (0.110)	-0.0192 (0.110)	0.0746 (0.0996)	0.0725 (0.0996)				
LLP	0.0848 (0.177)	0.0862 (0.177)	0.127 (0.164)	0.124 (0.164)				
LLC	-0.0157 (0.126)	-0.0150 (0.126)	0.176 (0.112)	0.175 (0.112)				
Constant	-1.550 (1.183)	-1.547 (1.182)	-2.470** (1.051)	-2.465** (1.052)	-2.189*** (0.310)	-2.203*** (0.311)	-3.881*** (1.053)	-3.861*** (1.046)

Wave & Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	39,994	39,994	39,994	39,994	39,994	39,994	39,994	39,994
Pseudo R2	0.0595	0.0596	0.0698	0.0700				
Wald Test					426.31	432.17	457.30	460.58
P-value					0.0000	0.0000	0.0000	0.0000
LR Test					4.46	3.82	5.46	5.56
p-value					0.0347	0.0508	0.0195	0.0184

**Notes:** Estimated as probit regression (columns 1 – 4) with Heckman correction (columns 5 – 8). First stage regressions for 5 – 8 not reported. Weights applied. Robust standard errors in parenthesis. Statistical significance: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 5. Demand and supply of finance: Lagging regions**

	(1)	(2)	(3)	(4)	(5)	(6)	(8)
Application for	Demand			Rejection		Loans	Overdraft
	Loan	Overdraft	Discouragement	Loans	Overdraft	Rejection rate	Rejection rate
Non-lagging / Innovator	0.147*** (0.0417)	0.131*** (0.0403)	0.0996* (0.0536)	0.146*** (0.0531)	0.189*** (0.0481)	0.201*** (0.0365)	0.199*** (0.0243)
Lagging / Non-innov	-0.0228 (0.0568)	0.0223 (0.0531)	-0.180 (0.249)	0.0507 (0.0690)	0.0769 (0.0651)	0.0752* (0.0442)	0.141*** (0.0466)
Lagging / Innovator	0.185*** (0.0540)	0.154*** (0.0512)	0.0945 (0.244)	0.164** (0.0658)	0.170*** (0.0590)	0.264*** (0.0416)	0.282*** (0.0417)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimation method	Probit	Probit	Probit	Probit	Probit	Heckman probit	Heckman probit
Obs	40,115	40,115	36,086	40,115	40,115	39,994	39,994
Pseudo R <sup>2</sup>	0.0519	0.0657	0.0881	0.0581	0.0717		
Wald Test						438.74	673.51
P-value						0.0000	0.0000
LR Test						5.92	11.31
p-value						0.0150	0.0008

**Notes:** Estimated as probit regression. Regressions 6 – 9 use Heckman correction. Controls: Size, age, sector, growth ambitions, exports, business plan, profits, loss, financial problems, risk rating, survey wave and legal structure (used as selection variables for regressions 6 & 8). Robust standard errors in parenthesis. Statistical significance: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .



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