Credit Management Research Centre

EQUITY FINANCE AND THE UK REGIONS

Understanding Regional Variations in the Supply and Demand of Equity and Growth Finance for Business

CMRC Research Paper

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Key Findings/ results

Analysis of the regional distribution of equity finance

Our descriptive analysis of the equity investment activity in the UK from 2011 to 2017 confirms results of previous studies in that London, the South East and East of England regions received in that period 67% of all equity deals and 75% of all invested funds in the UK. The concentration in London has increased over time since it has the highest average annual growth rate in equity investments (in both number of deals and invested amounts).

The three regions (London, South East and East of England) received higher proportions of equity investments in the UK than expected based on the number of high-growth firms (HGFs) and small and medium-sized enterprises (SMEs) in 2011-2017. Scotland received higher than expected number of deals but not invested amounts.

The detailed econometric analysis of firm-level data explaining the determinants of equity funding revealed that, after controlling for a wide range of firm and industry specific variables, the probability of a firm getting funded (any equity funding) is up to 50% lower in nearly all regions outside London. More specifically, in the period 2011-2017, the odds ratios that an identical company in a given region will get equity funding compared to London are the following (in descending order): Scotland (1.24), , East of England (0.80), South East (0.77), South West (0.70), North West (0.65), West Midlands (0.54), Yorkshire and Humberside (0.53), East Midlands (0.51). The results for the North East (1.01), Northern Ireland (0.96), Wales (0.85) are not statistically significant[1].

Firms able to communicate to outside investors attributes of the entrepreneurial and management team such as commitment, entrepreneurial experience, knowledge and management industry and technical know-how, and relevant networks increase their likelihood of accessing finance. Thus, the experience and composition of the board is important factor in gaining finance and venture success. Firms seeking equity investment are likely to compile larger initial boards aimed at capturing and signaling to potential investors these range of skills, business experience and evidence of networks. Moreover, the analysis showed that directors' previous experience of equity finance is associated with significantly higher odds of obtaining equity finance after controlling for a wide range of variables related to the financial and non-financial situation of a company (financial ratios, size, age, charges on assets), directors' characteristics, industry sectors' failure rate and macroeconomic environment, directors' previous experience of equity finance is

[1] Not significantly different from unity on the significance level 5%. It means that after controlling for a wide range of firm characteristics the odds of obtaining equity funding was not distinguishable from London.

associated with significantly higher odds of obtaining equity finance. By contrast, family firms have on average smaller odds of obtaining equity finance.

The econometric analysis of individual equity deal size (deal value) showed that all else equal, compared to London, in other regions the deal values are lower by up to 41%: East of England (-9% - but not significantly different from London), South East (-14%), Northern Ireland (-16% - but not significant), Scotland (-20%), Wales (-20%), South West (-25%), North West (-27%), East Midlands (-27%), West Midlands (-29%), Yorkshire and Humberside (-35%), North East (-41%). The models controlled for a range of variables related to the financial and non-financial situation of a company (financial ratios, size, age), deal characteristics (announcement, government involvement, stage), industry sector and macroeconomic environment.

In conclusion the differences in the probability of obtaining equity finance provision between London and other regions are magnified by the differences in deal values.

Analysis of equity finance supply in the regions

An analysis of investor-investee pairs[2] revealed that investors located in Northern Ireland, North West, Wales, North East and London invest most of their funds in their home region. The percentages of funds invested in the head office region (in descending order) are: Northern Ireland (93%), North West (70%), Wales (66%), North East (52%), London (52%), South East (49%), Scotland (45%), East of England (45%), Yorkshire and Humberside (24%), West Midlands (21%), East Midlands (19%), and South West (14%).

Overseas investors invest about 84% of their funds into companies located in London, East of England and South East. The percentages (in descending order) of overseas funds invested into companies with a primary trading address in particular regions are: London (60%), East of England (13%), South East (11%), South West (4%), North West (3%), Scotland (3%), North East (2%), West Midlands (2%), Yorkshire and Humberside (1%), Wales (1%), East Midlands (1%), and Northern Ireland (0.2%).

The proportions of company-investor pairs involving government (local, regional, devolved, or central) are the following (in descending order): North East (53.4%), Wales (39%), North West (34.6%), Yorkshire and Humberside (33.9%), Scotland (33.4%), Northern Ireland (28.4%), West Midlands (27.5%), East Midlands (9.3%), East of England (7.3%), London (5.1%), South East (8.3%) and the South West (5.1%).

Analysing distances between investor and invested company we find support for the spatial proximity hypothesis that the number of equity investments decreases with the distance from the investor. The frequency of equity deals decreases with the distance

[2] Analysis of company-investor pairs involves analysis of deals so that companies are matched with their investors.

between the invested company and the nearest investor's office. The exceptions to this rule are investors headquartered in Yorkshire and Humberside, West Midlands and East Midlands since they fund a relatively large number of deals further from their nearest offices. The pattern persists also after excluding government-backed funds.

Private investors are more likely to fund an equity deal outside their head office or branch office region if government is involved as a syndicated investor or if a director has past experiences with equity finance. In both cases the odds of equity investment from private investors located outside a focal firm's region increases by about 20%, after controlling for deal value, investor type, announcement, stage and macroeconomic environment.

Analysis of the demand for equity finance in the regions

Using the propensity score matching methodology we identified companies that share similar characteristics to those that have received equity finance. These firms are potential targets for equity investors. Then for these targeted companies we imputed deal values based on the characteristics of known deals. The sum of the deal values forms the estimate of the potential additional demand for equity finance (i.e. the 'equity gap') and is compared with actual stock of equity investments in regions.

The ranking of regions in terms of the potential demand for equity finance in 2011-2017 shows that the highest potential additional demand for equity finance was in Yorkshire and Humberside, followed by East Midlands, West Midlands, Northern Ireland, South West, North West, Wales, Scotland, South East, East of England, London and North East. (The presented order is on the basis of the potentially invested amounts imputed by the regression approach per one million pounds of actual equity investment, but the order remains virtually unchanged if other measures are used).

Using the plausible parameters to account for proportion of companies seeking expansion, willingness to take equity investor and the acceptance rate of equity funders we provide estimates of the aggregate 'equity gap' i.e. the total shortfall of equity funding in the economy. Analysis from alternative methods of estimation suggests that the size of the aggregate 'equity gap' is of the order of £6.5bn - £12bn.

Breaking this estimate down, the greatest additional demand in absolute terms seems to be in London (£1.9bn - £3.6bn), followed by the South East (£1bn- £1.8bn), the East of England and North West (£0.6bn - £0.86bn), and the South West (£0.5bn - £0.93bn). The West Midlands, Yorkshire and Humberside and East Midlands have a similar situation in that the potential 'equity gap' is approximately in the range £0.4bn - £0.7bn. Scotland follows closely after them (£0.3bn - £0.6bn). The lowest volumes of potential additional demand for equity funding seem to be in Wales (£0.16 - £0.3bn), the North East (£0.1bn - £0.17bn) and Northern Ireland (£0.06bn - £0.16bn).

In relative terms, the highest relative demand for additional equity funding in relation to the actual stock is in the East Midlands, followed by Yorkshire and Humberside, the West

Midlands and Northern Ireland. At the other end of the spectrum, there is London and the North East [3].

[3] We suggest that the effect in the North East may in part be because while there has been a recent increase in tech start-ups in the region and many start-ups since the 1980s involved low growth ventures created by individuals made redundant following the demise of traditional industries (Green et al., 2004). On the other hand, there has been a concerted effort to bring funding for start-ups to the North East region, notably from governmental and EU sources.

Executive Summary

Background

Equity finance investment in the corporate sector (venture capital, private equity, business angels, crowd funding) is important for funding firm level innovation and growth and hence for economic development. There have been persistent concerns of market failure in the provision of equity finance in the UK for high technology, knowledge intensive and high growth firms (see below). That is, there is insufficient capital supplied to match entrepreneurial demand and therefore many potential high growth and technically innovative businesses are under-capitalised or unfunded (i.e. an equity-gap exists because of lack of supply). Policy interventions such as tax-advantaged venture capital schemes, the Enterprise Investment Scheme and Venture Capital Trusts, provide incentives for investors and the establishment of the Business Bank, the Northern Powerhouse Investment Fund (£400m) and the Midlands Engine Investment Fund (£250m) aim to address the issue of regional imbalances in VC activity. Nonetheless recent research has identified the existence of both 'equity gaps' and regional imbalances in the provision of equity finance in the UK.

Recent reports by the British Business Bank, BEIS and the HM Treasury's Patient Capital Review (British Business Bank, 2017, 2018b; Patient Capital Review: Industry Response, 2017) point to a decline in equity investment in 2016 relative to previous years, although this appeared to have been reversed in 2017 with the increase in the average size of investment for growth stage ventures being notable. Investment activity is especially skewed towards two sectors, technology and IP based businesses as well as business and professional services (British Business Bank, 2018b).

Moreover, these studies suggest regional disparities in the provision of equity finance in favour of London, East and South East and report a marked increase in the concentration of equity deals by volume in 2017 (52% of the total) and by value (65% of the total) in the London region. The London region has witnessed the most growth in equity finance in recent years. The Patient Capital Review identified gaps relating to follow-on investment, particularly in moving beyond the seed stage to scale up for innovative firms with high growth potential in the investment size range from £5-50 million. The problem was deemed to be particularly acute for early stage investment outside London and the 'golden triangle' as well as Scotland in creative industries, digital technology sectors, and life sciences.

Objectives of the study and the datasets used

With the aim to understand further the extent, nature and possible reasons for the regional imbalance in equity finance investments we perform a range of analyses using comprehensive datasets on private companies and individual equity finance deals

covering the UK company sector in the period 2011-2017. The detailed longitudinal database of UK business characteristics and funding was compiled in order to estimate the extent of the regional equity finance gap in the UK. The data includes 10.6 million company year observations, more than 17,400 individual equity deal records and over 40 variables capturing firm-level, sector and regional characteristics for inclusion in the estimated models.

Descriptive analysis

As a starting point, we conduct a descriptive analysis of the database of equity finance deals in this period. We confirm the results of earlier studies and surveys that have identified regional disparities in equity finance provision and we document the increasing concentration of equity investment activity in the London region. Thus, our data shows that London, South East and East of England regions received from 2011 to 2017 about 70% of all equity investments in the UK (67% of all equity deals and 75% of all invested funds). The concentration in London has increased over time with an annual growth rate of over 40% in equity finance deals in London during this period (see Table 4). It is important to note however, that this descriptive information is not necessarily evidence per se of a market failure and may, in fact, reflect the level of business (investment) opportunities in London compared to other regions.

The analysis of location quotients extends the descriptive analysis. The location quotients compare the regional proportions of equity investments (number of deals or volume of invested amounts) with the regional proportions of individual measures of corporate demographics. The results show that the London, South East and Eastern regions receive more equity investments than might be expected based on the number of high-growth firms and small and medium-sized enterprises in their regions. In contrast The East Midlands, West Midlands, Yorkshire and Humberside and North West appear to have fewer deals than expected (see Table 5).

This initial analysis is refined further by investigating the aggregate number of regional deals per year in the context of a multivariate analysis. Here we control for several variables related to regional corporate demographics at once (see Table 6 for examples). The models provided mixed evidence regarding the imbalance in favour of London. Namely, if we attempt to explain the number of equity deals per region and year using current regional characteristics only, companies in the London region seem to receive more equity deals than expected. Once lagged variables (a proxy for momentum or repeat investment and the existing ecosystem of equity providers i.e. supply-side) were included in the models, London is no longer an outlier, the higher number of equity deals is explained by the relative concentration of funds located in the region. In contrast, regardless of model specification,

- Scotland and the East of England receive more equity deals than would be predicted by the corporate sector demography in these regions over the whole

period from 2011 to 2016. (Unlike the analysis using the location quotients which used just a single corporate demography characteristic, these models used several characteristics at once)

- The East Midlands and Yorkshire/Humberside regions received a smaller number of equity deals than predicted by the model in the whole observation period
- The North East and West Midlands received fewer deals in the last two years of our study (2015 and 2016)

In the next step we carried out an investigation of individual deals using firm-level data. While the previous models attempted to model the aggregate number of equity deals per region and year, the units of analysis in the firm-level data are company-year observations. Firstly, we built models explaining the probability of obtaining equity funding. The models controlled for a wide range of variables related to the financial and non-financial situation of companies (financial ratios, size, age, charges on assets), directors' characteristics, industry sectors' failure rate and macroeconomic environment.

Controlling for all these characteristics the models allowed us to calculate the odds ratios of a firm getting funded in all regions compared to London. We find that with the exception of Scotland and the North East, the odds of obtaining equity funding in 2011-2017 are on average smaller when compared to London. For example, the same company in the East Midlands, West Midlands or Yorkshire and Humberside has about 50% smaller odds of being funded. However, the results show that all else equal, a company in Scotland has 24% higher odds of being funded than the same company located in London (see Table 7 for details). Along with the findings related to regional differences, of particular interest we find that director experience of equity finance is an important factor in gaining equity finance. On the other hand, family firms have smaller odds of obtaining equity finance when controlled for all other characteristics.

Secondly, we estimated firm-level models explaining the deal value. Similar to the previous models, we controlled for a wide range of variables related to a company, industry sector and macroeconomic environment but were interested in regional differences. The results suggest that all else equal, compared to London, in other regions the deal values are lower by from 9% to 41% (see Table 8). Hence the differences in equity finance deals between London and other regions are further deepened by the differences in firm-level deal values.

Supply-side analysis

Our second stage analysis focused on the location of the funders (supply-side) and their investees (demand-side). We explore the colocation of 9,899 individual investor-investee pairs. The analysis shows that investors located in Northern Ireland, North West, Wales, North East and London invest most of their funds in their home region. On the other hand, investors located in the East Midlands, West Midlands and Yorkshire and Humberside have a portfolio of investments that are geographically more dispersed than investors in

other regions and these funds invest outside their regions, i.e. in London. Overseas investors fund about 15% of all equity deals that corresponds to about 33% of the invested amounts. Again, about 84% of these investments are focused mainly in London, the South East and East of England (see Table 9).

Looking at the investor type and the number of company-investor pairs involving government funds, the analysis shows that the highest proportion of deals that involve government (local, regional, devolved, or central) is in the North East region – more than 50%. On the other hand, the regions with the lowest proportions are East Midlands (9.3%), East of England (7.3%), London (5.1%), South East (8.3%) and the South West (5.1%) (see Figure 5). The government investments form a relatively smaller share of the invested amounts than of the number of deals.

By analysing geographical distances between the investor and investee we find support for the spatial proximity hypothesis, which is the number of equity investments decreases with the distance from the head or branch office of the investor. The regions with relatively high investment activity over greater distances than expected by the hypothesis are East Midlands, West Midlands and Yorkshire and Humberside. The pattern persists also after controlling for the location of branch offices and excluding the equity deals involving government funds (see Figure A1 and Figure A2 in the Appendix).

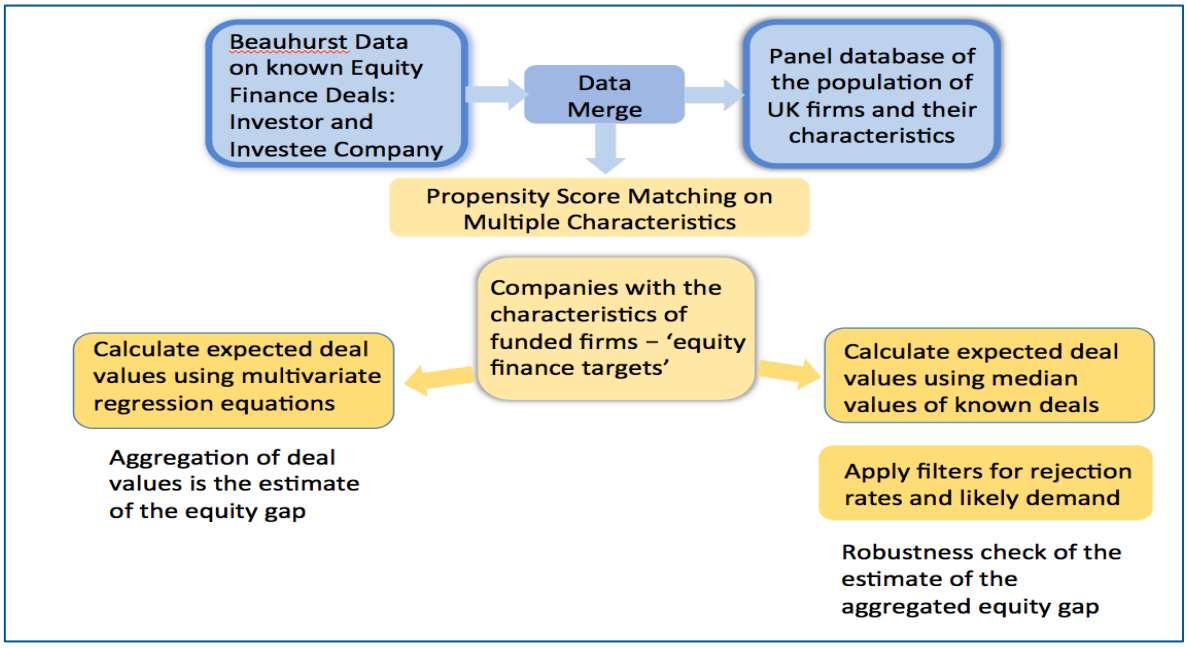
Looking at the determinants of cross-region investments using a multivariate logistic regression framework there is some evidence that government involvement as a syndicated investor (i.e. participating in an equity deal along with private investors) and involving directors that have previous experience in raising equity finance, and negotiating deals, is associated with a higher propensity of investing outside the investors' head or branch office region. Both government involvement and past experiences with equity finance increased the odds of receiving equity investment by about 20% after controlling for deal value, investor type, announcement, stage and macroeconomic environment.

Demand-side analysis

To evaluate the potential unmet demand for equity finance we identify companies that share similar characteristics to those that have received equity finance. This investigation utilises a propensity score matching methodology to profile the characteristics of firms that have been successful in accessing equity finance. We then use these identified characteristics to identify potential targets of equity investors in the company population. Having identified the target firms, we can then impute potential deal values for each of these targets, again basing our estimates on the characteristics of known deals. The sum of the deal values forms the estimate of the potential additional demand for equity finance (i.e. the 'equity gap') when compared with actual investments in each region. Regions are then ranked according to the size of the potential equity gap. The ranking uses metrics such as the number of potential deals per actual deal in the region and the potential

amount of investment per million £ of actual investment in the region. The methodology for arriving at the equity gap estimates is summarised in the flow chart (Chart 1).

Chart 1 Method for estimating the potential equity gap



Our analysis of regional ranking shows that overall Yorkshire and Humberside, the East Midlands, West Midlands and North West seem to receive much smaller amounts of equity investments than warranted by the quality of potential demand in these regions. In contrast, London and the North East receive relatively higher actual equity investments by value when compared to potential demand (see Table 11, Table 13 and Table 14). The results of the regional ranking were confirmed by an alternative matching methodology – the threshold matching (see Figure 8). . In the analysis we incorporate all the Business Angel deals that are part of a syndicate or network, identified by Beauhurst but this does not include investments by individual Business Angels. . Moreover the British Business Bank often provides investment through private investment vehicles and therefore BBB investment is not always classified as 'Government'. Consequently we may underestimate the proportion of government investment in the regions and in our findings related to cross regional investments.

Our more detailed analysis, based on a disaggregation of investor types and stages of investment, indicates that regional gaps in equity provision cannot be characterised as a simple 'north-south' divide but there is heterogeneity in equity provision across the different regions outside London and the South East.

In the final part of the analysis, we estimated the aggregate size of the potential equity gap. To arrive at realistic estimates, we used the results of a survey (British Business Bank, 2018a) that found about 5% of SMEs looked for finance to fund expansion. Thus, we started with the result of the matching which has similar proportion of potential equity

targets among company population. The initial estimates can be adjusted for the proportion of firms willing to use equity (17%) and the rejection rate of venture capitalists (54%). However, this parameter may be an overestimate since the rejection rate referred to the whole spectrum of companies without any prior screening. The fact that a company has been matched may be considered as an initial screening and thus the rejection rate applied on a pre-screened population of potential targets would likely be smaller. That is why we present two adjustments of the equity gap estimates (Table 1).

Table 1: Estimates of the potential 'equity gap' for 2017

	Actual stock	Regression approach		Median approach			
		Unadjusted estimates		Adjusted estimates Unwillingness		Adjusted estimates Unwillingness + Rejection	
	£ mil	£ mil	% of actual	£ mil	% of actual	£ mil	% of actual
East Midlands	59	511	863%	689	1165%	372	629%
Yorkshire/ Humber	96	565	588%	736	767%	398	414%
West Midlands	126	635	502%	798	631%	431	341%
Northern Ireland	28	114	408%	160	571%	86	308%
South East	671	1,612	240%	1,869	278%	1,009	150%
Wales	101	219	217%	299	298%	162	161%
South West	370	763	206%	932	252%	503	136%
Scotland	267	516	193%	616	231%	333	125%
North West	454	861	190%	1,009	222%	545	120%
East of England	561	861	153%	1,154	206%	623	111%
North East	139	136	98%	174	125%	94	67%
London	4,578	3,675	80%	3,618	79%	1,954	43%
Total	7,450	10,466	140%	12,055	162%	6,510	87%

Notes: The table presents estimates of the potential 'equity gap' for 2017. The second column shows the actual volume of equity investments in 2017. The third and the fourth columns show the estimates of 'equity gap' obtained using regression approach, the volume in £ mil (third column) and percentage of actual stock (fourth column). The fifth column shows the figures from median approach adjusted for the unwillingness of SMEs to apply for the equity finance. The sixth column shows the percentage of the former column in relation to the actual stock of equity investments. The seventh column shows the estimates of the 'equity gap' from median approach adjusted for both the unwillingness of some SMEs to receive external investors and rejection rate of equity investors. The last column shows the percentage of the former column in relation to the actual stock of equity investments. The regions are sorted in descending order based on the fourth column (relative size of 'equity gap' obtained using regression approach). Also, the fourth and the last columns are coloured based on the relative size of the 'equity gap'. . Analysis that breaks down the total equity gap by investment stage suggests £3.1bn is required at seed stage; £2.6bn at venture stage and £4.8bn for growth finance. The breakdown by investment stage and region is presented in Table A4.

The estimates provided using the regression approach has two levels of screening of the target population, that is multivariate models that determine both the probability of the firm requiring equity funds and the potential demand (value) of funds required. Therefore we apply no further adjustments to these estimates. To the estimates from the median approach to demand estimation we apply discount factors based on the likely willingness to use equity finance and/or industry rejection rate. Firstly, we apply the discount factor of 17% corresponding to the average willingness of surveyed SMEs to use equity investors to the results of Matching 2. Secondly, we apply the overall discount factor of 9.18% (17% * 54% = 9.18%) corresponding to both the willingness to use equity investors and the

rejection rate of equity investors. We report a plausible range of the potential equity gap utilizing two methods for estimating potential individual equity deals (regression and median approach).

Using our most robust regression model estimate, the total potential unmet demand for SME equity financing in the UK is estimated at around £10.5bn, or 140% of the actual flow of SME equity finance in 2017. We corroborate the regression result with "median" approach. The median approach is an important "sense-check" on the more advanced results coming out of the regression predictions. The "median approach" imputes the likely value of a firms' equity deal by analysing the ratio of deal value to total assets for the sample of known deals and calculating the median value for four company size bands. The median value is then used as the estimated deal value for the target firms within each size band. The resulting estimate of potential unmet demand for equity financing in the UK comes out in a range from £6.5bn to £12bn. The greatest additional demand in absolute terms seems to be in London (£1.9bn - £3.6bn), followed by the South East (£1bn-£1.8bn), the East of England and North West (£0.6bn - £0.86bn), and the South West (£0.5bn - £0.93bn). The West Midlands, Yorkshire and Humberside and East Midlands have a similar situation in that the potential 'equity gap' is approximately in the range £0.4bn - £0.7bn. Scotland follows closely after them (£0.3bn - £0.6bn). The lowest volumes of potential additional demand for equity funding seem to be in Wales (£0.16 - £0.3bn), the North East (£0.1bn - £0.17bn) and Northern Ireland (£0.06bn - £0.16bn). In relative terms, the highest relative demand for additional equity funding in relation to the actual stock is in the East Midlands, followed by Yorkshire and Humberside, the West Midlands and Northern Ireland. At the other end of the spectrum, there is London and the North East (Table 1).

Recommendations

Clearly, our estimates of the potential demand for equity finance do not provide direct evidence that the companies not currently financed by equity investors are in search of equity finance or that they are particularly attractive for the investors. However, the results suggest that based on the observed company characteristics there exists substantial additional demand across the UK. Thus the existence of the equity gap seems to be driven either by a differential regional distribution of companies' characteristics that are causal but unobserved to us (e.g. ambition of the owner) or more likely by supply side issues.

Our finding of regional differences in the extent to which family firms are significantly less likely to have external equity funding also has implications for policy. There may be opportunities as part of scale-up policies to engage with family business organizations and advisors to promote the attractions of taking on external equity in family businesses and to devise innovative ways to maintain family control. For example, the development of group structures might be a way to ring fence overall family control while enabling external equity to be raised for subsidiaries with unrealised growth opportunities. Many family firms also

face a succession challenge, with management buyouts and buyins being an important solution where there is a lack of next generation family members to take over the business – private equity can potentially play a role here. Further work might identify the financing requirements of employee-owned firms.

An important ingredient of success in the acquisition of equity finance is the firms' engagement, at an early stage, with networks of potential investors (VC's, Business Angel networks) and/or with individuals (directors) who have had experience of raising equity finance in the past. Our proxy for this type of activity in our analysis is the firms' appointment of directors with equity finance experience. Policies that are geared to incentivise such individuals to offer their experience and policies to help firms to attract and retain key employees could be beneficial. For instance, schemes such as the Enterprise Management Incentive (EMI), a tax-advantaged share option scheme, could be a relevant policy instrument. Board experience and compostion is an important facet of success in funding acquisition. It is in the interest of companies keen on receiving VC funding to take on board directors with necessary contacts and networks, thus bringing extended experience to the team and possibly the positive relationships with the VCs.

Our analysis indicates that action to incentivise investors to locate branches within the regions could stimulate regional investment. The issue of 'information asymmetry' is often cited as a cause of the equity gap, i.e. investors find it difficult to find and assess investable opportunities and investees lack both awareness of the equity financing options and the experience to structure and negotiate deals. The provision of information for both investors (business intelligence on opportunities or targets) and potential investees (information on available schemes, director mentoring, legal advice, VC and Angel networks) could stimulate investment activity. For instance, matching methods, used for screening the corporate population with at least initial financial statements, could be a useful tool for equity fund managers seeking to identify potential opportunities prior to their more detailed investigation and due diligence relating to managerial capabilities, products, market potential, etc. Efficient and consistent screening of potential investees may help alleviate the funding gap. Such an approach is less applicable to very early stage ventures because of a lack of financial information from past financial statements needed for the suggested matching method.

Introduction

This report aims to improve our understanding of the regional distribution of equity finance or equity investments in small and medium sized enterprises[4] in the UK. Equity investment includes any form of external equity finance[5] provided to private companies by, typically, venture capital and private equity funds, corporate venturing, business angels[6] and equity crowd funding. Approximately 40% of such investment deals are announced via government regulatory organisations or investee/investor news and press releases and the remaining deals can be tracked via changes in the share ownership certificates of private companies filed[7] at Companies House, as required by company law. Data on finance deals for individual companies, deal types, and therefore, aggregates of deal volumes and values by sector and region can be compiled to facilitate an analysis of the trends in and distribution of equity finance across the UK regions.

Equity investors provide finance, in return for shares, to companies at the various phases of evolution from start-up (seed-stage) to development (venture-stage) and in order to facilitate commercialisation and growth (growth-stage). Equity investment is important in the transformational development of start-ups into large-scale businesses and is often associated with high technology and knowledge intensive ventures where the risk and the timing and scale of the returns of the business are difficult to assess for lenders. Of course equity investors, in addition to providing finance, are able to offer expertise to guide companies through their growth phases. Equity finance is seen as a vital ingredient for innovation, productivity and growth in the SME sector. As the Business Bank report, “the provision of funding at the right time, combined with the expertise that outside equity investors bring, can fuel rapid growth when companies are starting up, expanding, diversifying or entering new markets” (British Business Bank, 2018b, p. 4).

Equity Gaps, Policy and Regional Finance

However there have been persistent concerns of *market failure* in the provision of equity finance in the UK and it is suggested that: 1) there is insufficient capital supplied to match entrepreneurial demand. In consequence there may be many potential high growth and

[4] The EC defines a SME as a business with less than 250 employees and either a turnover of less than €50m or balance sheet total of less than €43m.
[5] Equity finance is often referred to as ‘Entrepreneurial Finance’ or ‘Patient Capital’ reflecting its use in funding new and innovative ventures and the longer-term returns for this type of financing, in contrast to loan and other debt finance.
[6] In the analysis we do not have data on individual Business Angel deals but can only identify Angel investments when part of a network or syndicate
[7] Document SH01 filed at Companies House.

technically innovative businesses that are under-capitalised on unfunded (i.e. an equity-gap exists). 2) Moreover there exist regional disparities in the provision equity finance with access to such capital being more difficult for firms outside of London, the South East or outside of the clusters of the entrepreneurial eco-systems e.g. Oxford and Cambridge. 3) Further it has been suggested that there is a particular shortage of capital or larger long-term investments to fund growth or scale-ups, i.e. firms at the venture or growth phase of commercialisation.

Recent reports by the British Business Banks, BEIS and the HM Treasury's Patient Capital Review (British Business Bank, 2017, 2018b; HM Treasury and BEIS, 2017) point to a decline in equity investment in 2016 relative to previous years, although this appears to have been reversed in 2017, with the increase in the average size of investment for growth stage ventures being notable. Investment activity is especially skewed towards two sectors, technology and IP based businesses as well as business and professional services (British Business Bank, 2018b). Moreover, these studies report a marked increase in the concentration of equity deals by volume in 2017 (52% of the total) and by value (65% of the total) in the London region. The London region has also witnessed the most growth in equity finance in recent years and clusters of deal activity. This can be explained in part by a concentration of funders located in London (the number of venture funds located in London appears disproportionately high) and because of the sector composition of London i.e. high technology and IP-based business sectors attract the greatest amount of investment (in 2017, 36% of total deal value, a decline from 49% the previous year as the business and professional services sector recorded a sharp rise). In consequence the financing needs of high growth potential small businesses in the other UK regions may not be being met with consequences for regional investment, productivity, growth and prosperity. Figure 1 taken from the Small Business Equity Tracker, 2018 (British Business Bank, 2018b) shows the regional trends in the number of deals and investment value.

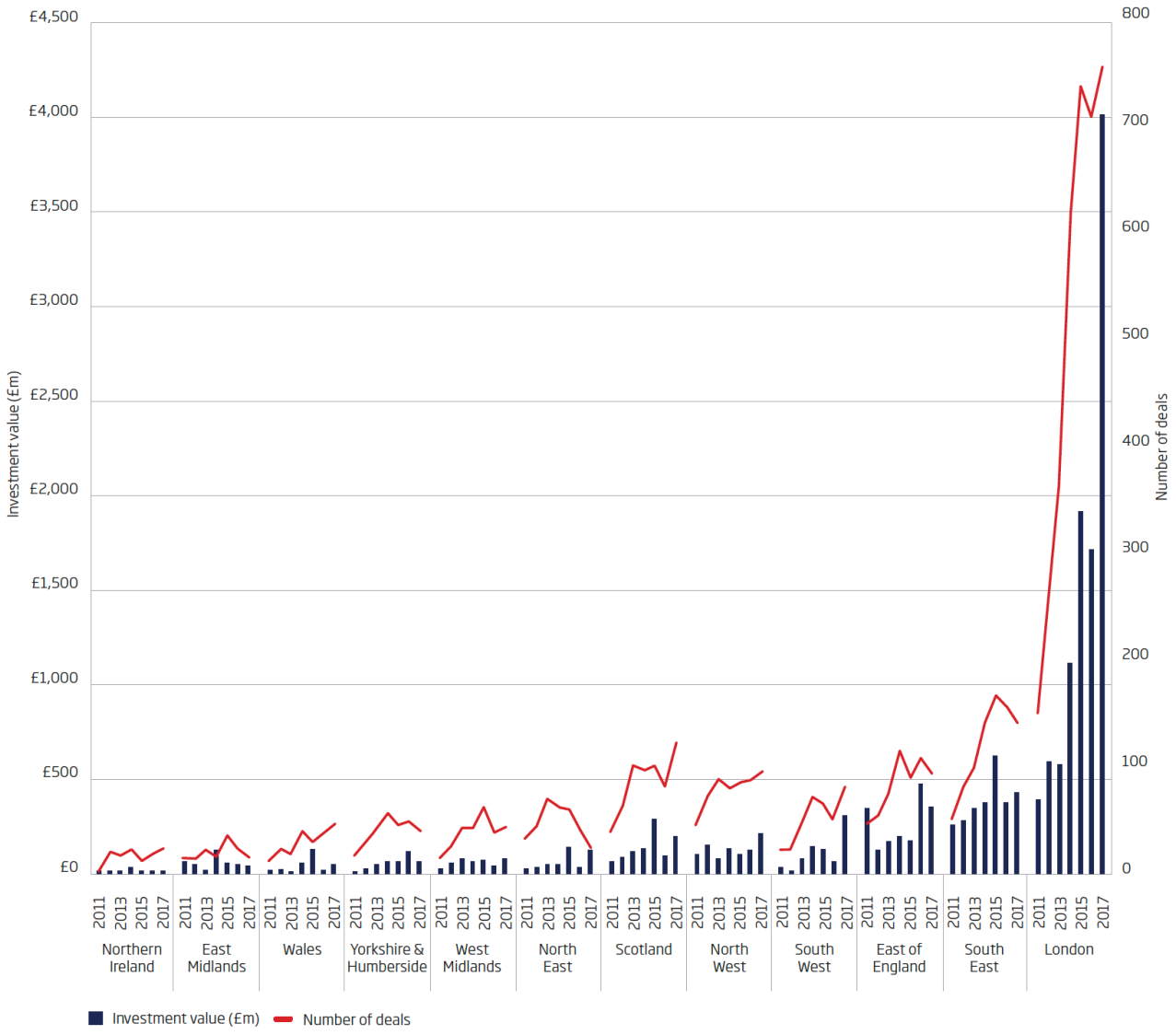


Figure 1: Number and Value of Equity Deals by English Region and Devolved Administration (source: British Business Bank, 2018b, p. 19, fig. 1.11)

Policy interventions have attempted to address the supply-side problem of new and growing businesses being unable to access the capital they require to develop and grow. The Enterprise Investment Scheme and Venture Capital Trusts provide tax incentives for investors and the establishments of the Business Bank, the Northern Powerhouse Investment Fund (£400m) and the Midlands Engine Investment Fund (£250m) have been raised to address the issue of regional imbalances in venture capital activity and other aspects of business finance.

However, although observing that there are regional variations in equity finance provision and a concentration in the South is informative understanding why these potential regional imbalances in equity finance provision exist is a more complex issue. Addressing the problem involves considering both the supply (activity and location of funders) and the demand side issues (the finance needs of companies and the distribution of investable

opportunities) within the regions. In seeking to inform policy we analyse all known equity finance deals in the UK in relation to the private company population, and over a long period, in order to ascertain the potential scale of unmet demand for equity finance (the 'equity gap'), and its regional distribution. This report summarises the results of an in-depth study of funding activity and the potential demand for all types of equity finance, by UK companies, across the regions (Wilson et al., 2018a).

Public policy makers and academic researchers acknowledge the importance of growth in the private company sector in the UK and the role of SMEs. The concerns that there is an unmet demand for 'growth capital' in both traditional bank credit and alternative sources of finance (such as venture capital) have persisted over a long period. A lack of access to appropriate funding may be limiting firm growth and constraining economic recovery and economic growth (Rowlands, 2009; BIS, 2012; Fraser et al., 2015). There is some evidence, on the supply side, that regional disparities in equity finance provision exist (British Business Bank, 2017, 2018b) and that the scale of the 'equity gap' varies regionally. The latter, of course, implies regional imbalances in both economic performance and long-term prosperity.

Academic studies and surveys (e.g. Rowlands, 2009; BIS 2009; BIS 2012) have sought to assess the nature and scale of equity and loan funding gaps for Small and Medium Sized Firms (SMEs). Early work had a focus on the provision of loan and debt finance for SME's and found evidence of both transitory and persistent 'funding gaps', that is, growing and creditworthy SME's are/were unable to access the financial resource, loan and working capital, required to place them on a trajectory of development and growth. This lack of finance provision can be attributed to market disequilibrium and/or 'informational asymmetries' in that lenders have insufficient information to be able to assess the lending risks to this particular sector of firms.

The problem of funding gaps has been addressed in numerous inquiries (Breedon, 2012) and to some extent redressed by policy interventions (e.g. loan guarantee schemes; tax advantaged enterprise investment schemes). However, assessing the prospects and risks of new, innovative, high technology and knowledge intensive firms is particularly problematic. Uncertainties relating to estimating the time period from development to the achievement of commercial viability and consequently the timing of cash inflows is particularly difficult for ventures that are competing to develop new technologies, products and new markets (e.g. knowledge intensive and high technology firms). Such firms need longer-term investment, in the form of equity finance, to fund their evolution through the various stages of product/service development to commercialisation and profitability. Academic studies now distinguish between first and second funding and equity gaps with knowledge intensive firms most likely to face later stage financing issues. Practitioners and policy-makers are beginning to recognize the existence of a 'second equity gap' involving somewhat older and larger firms beyond the initial startup revenue generation phase. The British Business Bank reports that UK businesses receive less follow on funding (1.9

rounds) compared to US businesses (2.7 rounds) that suggests there are fewer businesses scaling up.

Equity finance is often referred to as 'Entrepreneurial Finance' or 'Patient Capital' reflecting its use in funding new and innovative ventures. For equity investors the returns rely on increases in company (and share) value as the firm develops, and the investee does not have the immediate servicing requirement (repayment schedules) associated with debt finance. Equity finance is categorised as non-bank finance, and typically provided specialist by Venture Capital funds, Venture Capital Trusts, Private Equity Firms, Business Angels and online Crowdfunding platforms. Recent studies have highlighted a gap in the provision of equity finance and have estimated the scale of the equity gap (Harding and Cowling, 2006; Wilson et al., 2018b). Although policy interventions have stimulated the supply of equity finance[8] by providing tax advantages for investors, evidence on the existence and nature of an 'equity-gap' suggests that there is a problem of access to finance among existing smaller firms (particularly high technology and knowledge intensive firms) beyond start-up, the constraints of which could prevent firms from reaching their growth potential and necessitating further support and policy intervention[9]. Thus, the provision of equity finance to fund firms through the development phase to commercialisation and growth is particularly important and is of policy concern. Studies have debated whether the equity gap is spatially related in that both funders and investees may be regionally or locally clustered. There is some evidence that the gap appears to vary across regions and consequently a need to decentralize financial provision for entrepreneurial firms (British Business Bank, 2017, 2018b). These studies confirm a concentration of equity finance deals in London and the South East.

Equity Finance in the UK: Academic Studies

This section reviews recent academic studies on the provision of equity finance in the UK, organised by funding type: venture capital, business angels, private equity and crowdfunding.

Studies by Mason and Harrison (2002) and Martin et al, (2005) identify that the formal ***Venture Capital*** (VC) market in the United Kingdom is concentrated in the most economically developed region with regard to the location of fund managers and investments made. Babcock-Lumish (2009) identified a spatial mismatch between investors and investees in the United Kingdom, with a thriving formal and informal VC funder cluster in London but innovative firms (i.e. deals) scattered throughout the country. The implication is that the equity gap is more a supply-side than demand-side issue.

[8] Enterprise Investment Scheme (EIS); Seed Enterprise Investment Scheme (SEIS); Venture Capital Trusts (VCT)
[9] see Patient Capital Review

Further there is a pronounced distance-decay effect relating to the formal VC investment behaviour of London-based offices, with over 90% of investments made to firms located within the South-East of England. The geographical bias, which Martin et al, 2005 term 'spatial proximity effects', is shaped by the interaction between the supply and demand for formal VC. However, specifically in the case of VC investment in 'spin-outs' from universities, Mueller et al. (2012) show that in cases located outside the so-called 'golden triangle' of London, Oxford and Cambridge, VC could be attracted but only where the entrepreneurs had some prior entrepreneurial experience. Of course, the funders' evaluation of the composition, quality and experience of the management team and directors is, an important factor in the funding decision alongside their appraisal of the business proposition.

Indeed rejection rates for venture capital are much higher than for bank or non-bank debt reflecting the complexity of the investment decisions. For example, a UK study published in 2009 found that 46% of respondents approaching VCs and 24% of those approaching private individuals, i.e. business angels, had experienced rejection (Cosh et al., 2009). Studies that have attempted to assess the size of the potential equity gap have found that the actual amounts funded by venture capital in health, pharmaceuticals, household products, insurance, information technology, investment companies and speciality finance were significantly below expectations (Wilson and Wright, 2011) but regional imbalances existed in the provision of equity finance with the East of England, London and South East regions receiving higher than expected levels of funding. Of course it is important to evaluate the impact of VC investment on the invested firms but also in relation to economic activity and innovation. A synthesis of the evidence from several countries generally shows a positive relationship between VC backing and firm performance (Manigart and Wright, 2013; Manigart et al., 2002). Portfolio firms backed by *experienced* government-related VC firms have higher survival rates compared to those backed by independent VC firms, mainly because government VC firms often have a regional economic development goal and hence, prefer to keep the "living dead" alive (Manigart and Wright, 2013; Manigart et al., 2002). Portfolio firms backed by inexperienced government-related VCs have higher failure rates. Evidence on the post investment growth and productivity of VC backed firms could be used to infer the employment and growth impact of policies designed to close the equity gap, generally and across regions.

More firms receive financing from ***Business Angels*** than is the case for venture capital. A recent large survey (Wright et al., 2015) of business angels shows that two-thirds of angels responding to the survey were located in London and the South East for the purposes of making investments, with the remaining third covering the rest of the UK. Angels located in London and the South East tended to have more years of experience in investing than angels from other regions. There is some debate relating to whether business angels mainly invest locally due to personal networks and greater possibilities for 'hands-on' involvement. While some 86% of business angels do invest in their home region, some 58% of angels invest outside their home region in the UK (that is, many angels are investing both in their home region and outside it). These findings stand in some contrast

to other evidence that suggests that distance is an important constraint on the likelihood of a business angel investing in a particular business. Further evidence (Harrison et al., 2010) indicates that a significant minority of angel investments are in businesses a relatively 'long distance' from their home location defined simply as not in their home county and indeed beyond immediately adjacent counties. Indeed, the business angel market in the United Kingdom is associated with overlapping local / regional markets rather than a national market. There are marked regional differences in the relative importance of industrial sectors for angel investment, with over three quarters of investments in the gaming, fashion and design, film, security, social media, and digital media sectors being located in London and the South East, while a majority of investments in consumer electronics are located in the rest of the UK.

Private equity (PE), specifically funding for management buyouts and buyins, has been a major player in the provision of growth finance and finance for restructuring in the UK over a long period (Toms et al., 2015). There are major regional differences in the extent of PE investment in management buyouts and buyins. While management buyouts and buyins may be headquartered in a particular region, PE firms based in London may often provide the funding. PE investor experience gives them superior selection and value-adding abilities through better monitoring and encouragement of entrepreneurial activities compared to other private investors. Private equity investors seek targets in sectors and with financial characteristics that have potential for performance improvements and which are able to service the debt and equity structures associated with such investment. Analysis of the population of UK firms over the period 1995-2012 finds a consistent pattern of PE backed buyouts with higher growth rates than non-PE backed buyouts for the first four years post buyout, especially in terms of value added (Wilson et al., 2012).

Crowdfunding and peer to peer lending platforms have developed into an important mechanism for attracting funding for entrepreneurial ventures. Crowdfunding has been particularly important for seed stage funding. There are several types of crowdfunding mechanisms. Donation crowdfunding platforms finance projects by securing small donations from a large number of donors. Reward platforms source small amounts of money from individuals in exchange for rewards. Equity crowdfunding platforms seek investment from the crowd in exchange for a share in the entrepreneur's business or project. The rapid growth in crowdfunding is reflected by estimates from the UK that suggests that the amounts raised rose by 43% between 2015 and 2016 to reach £4.6bn. Of this total, peer to peer lending accounted for £3.55bn (of which £1.23bn was peer to peer business lending), equity crowdfunding was £272 million, reward-based crowdfunding £48 million, property crowdfunding £71 million, invoice trading £452 million. Data suggests that 62% of crowdfunding platforms were based in London in 2015 (Baeck, 2017).

In contrast to other forms of crowdfunding, equity crowdfunding investments tend to be somewhat larger, with a smaller set of investors. Of the different forms, equity crowdfunding has grown the most rapidly in recent years and now accounts for an estimated 17% of total UK seed and venture-stage equity investment and peer-to-peer

business lending provides the equivalent of 15% of all new loans lent to small businesses by UK banks (Cambridge Centre for Alternative Finance, 2017).

As a rapidly diffusing sector, crowdfunding displays significant entry of new types of providers as well as exit of others. Different models of equity crowdfunding have emerged involving nominee (Seedrs), individual (Crowdcube), syndicated shareholdings (Syndicateroom) and fund structure approaches. These different platforms introduce different roles for individual retail investors compared with more 'sophisticated' angel investors and angel syndicates. Recent evidence indicates that some 45% of business angels are now investing alongside crowdfunding platforms (Wright et al., 2015). Business angels are themselves providing increased amounts of funding and following ventures across different stages of development as a result of the growth in syndicates of angels. With respect to exits, it is estimated that in the UK 35 platforms closed or merged between 2015 and 2016 and that the five largest platforms account for 64% of the market.

London and the South East dominate in the provision of equity crowdfunding with suggestions that this dominance was increasing. The South West initially showed a high incidence of equity crowdfunding in large part due to the location there of Crowdcube. Evidence also indicated that the West Midlands performed relatively strongly in terms of equity crowdfunding compared to its share of other equity funding, while the North East, North West and Yorkshire and Humberside were initially under-performing.

Analysis of evidence from Funding Circle, one of the leading peer-to-peer lenders shows marked differences in the distribution of loans by region of origin. The South East dominates, accounting for 24.2% of all loans granted by Funding Circle, while loans obtained by firms in London and Midlands account for 14.6% and 13.6% of all funded loans respectively. On the other hand, Northern Ireland, Wales and East Anglia are the least represented in the market. They also find that the demand for peer-to-peer lending to fund growth (as opposed to funding working capital) is more likely to be higher in firms in their early stages of growth than younger firms less than 5 years, consistent with the notion of a "finance gap" for growth firms seeking risk capital for expansion beyond the start-up phase. However, apart from in Scotland, regional location is not significantly associated with the demand for peer-to-peer lending to fund growth. Given data limitations, it is not clear whether those firms demanding peer to peer lending for growth purposes are discouraged borrowers who have been unable to obtain secured loans from traditional lenders and/or whether they are unwilling to see equity dilution in raising funds to fulfil their growth ambitions.

Further analysis shows that in terms of regional distribution of default risk, Scotland (5.5%), Wales (5.3%) and the North East (5.3%) have the highest rates of loan default, while East Anglia (2.8%), the South East (3.8%) and London (4%) have the lowest rates of default (Ekpu and Wright, 2018). Controlling for other factors, three regions are significant in explaining the risk of non-performing loans relative to East Anglia as the base level - Scotland, Wales and North East. This is in line with the view that loans to businesses

operating in regions with greater level of economic activity are relatively more likely to perform better than loans to businesses operating in regions with lower level of commercial activity. However, when late payment loans are excluded in order to focus on loans that have defaulted, all regional categories become significant in explaining the risk of default compared to the lowest defaulting region.

Equity Finance in the UK: Policy

Strong, sustainable and well-balanced growth of businesses has become a top priority of government economic policy. Several key initiatives and programmes have been launched in an attempt to remove barriers to growth as well as to provide conditions to stimulate and sustain high growth in the private sector over the long term. These support measures are seeking to address the regional imbalances in the economy.

Governmental funding initiatives have traditionally tended to address the equity gap for seed and start-up stage ventures requiring funding for the development of proof of concept and prototypes. However, these sources oftentimes provide little opportunity for the follow-on funding needed for these firms to grow beyond start-up. Government interventions, through the Enterprise Investment Scheme (EIS) and recent amendments in 2015, to stimulate investment in innovative business have been successful in attracting angel and syndicate investment through, for example, venture capital trusts but, here too there is evidence of regional imbalance in the allocation of this type of funding across the corporate sector and particularly for later stage ventures (Wright et al., 2015).

Recent attempts to redress the north/south divide have gained impetus through the notion of the “Northern Powerhouse’ which, articulated in a number of policy statements and reports, has the ambitious aim “to transform Northern growth, rebalance the country’s economy and establish the North as a global powerhouse”. A major element of the Northern Powerhouse policy focus concerns the provision of finance to enable existing private companies to realise growth opportunities. The sub optimal provision of funding to firms with growth potential provides a rationale for government intervention in venture financing.

Similarly, the recently introduced £400m Northern Powerhouse Investment Fund, launched in February 2017 by the British Business Bank, supports smaller businesses across the Northern Powerhouse region by providing funding only to fund managers who offer microfinance (£25,000 – £100,000), business loans (£100,000 – £750,000) and equity finance (up to £2m). A report provided by industry in response to the Patient Capital Review outlined a number of potential policy interventions that might improve the flow of finance to growth ventures. These included changing the limits for EIS and VCT schemes; establishing a development fund (Patient Capital Investment Vehicle) for scale-ups and science-based start-ups; “*the PCIV would enable the aggregation and deployment of both retail and institutional capital for investment in UK scale-up businesses and capital-intensive R&D-based businesses”*.

Part 1 – Descriptive Analysis of Equity Finance Provision

In this report we seek to inform the continuing development of government equity finance policy. We undertake descriptive and multivariate analysis, using firm-level data, on individual equity finance deals. We seek to understand further the supply and demand side issues of equity finance provision across the UK and the data aggregated by regions.

Company Level Data and Equity Finance Deals

In this section we outline the data sources used in the analysis and discuss the variable constructions and selection. We then provide a descriptive overview of the equity finance deals identified amongst the UK corporate population and their regional distribution. Our core database consists of a panel dataset of all private limited companies (the active population) in the UK covering the period 1998-2017. The panel has been constructed over a long period by the researchers using bulk data feeds from Companies House via credit reference agencies, subscribed hand collected databases and online sources. The full panel has over 34 million company years and covers, for each company, financial statements, directors and shareholder information, company location, industry sector, technology and the firm specific characteristics of individual companies. Within the corporate population, we can identify sub-samples of the panel i.e. active firms and firms within various age and size bands, specifically SMEs. To this data we have matched known equity finance deals within the corporate population using a combination of data from Beauhurst (2011-2018), NESTA (2007-2011) and Zephyr (1998-2017). In addition, we have matched firm-level data on Private Equity backed buyouts using data compiled by the Centre for Management Buyout Research (CMBOR) data from 1998 onwards. Thus, within the limited company population (demand-side) we can identify the sub-population of those firms (investees) that have received various rounds of equity finance along with deal dates and deal size (amounts invested). The Beauhurst hand collected data provides information on the investor (supply-side), their office location(s) and information on the nature of individual deal.

Table 2: Accounts data - company-year observations

Year	All companies	Real Total Assets £10k to £40m
2010	1,987,167	1,181,023
2011	2,083,160	1,233,486
2012	2,216,196	1,302,081
2013	2,367,788	1,378,820
2014	2,534,728	1,474,179
2015	2,736,003	1,581,538
2016	2,898,449	1,664,362
2017	1,349,173	782,620
Total	**18,172,664**	**10,598,109**

Notes: The table shows the number of company-year observations for the initial dataset compiled from data companies submit to Companies House. The second column shows the observations for all companies and the last column shows the subsample of the active companies actually used for the analysis.

Using a definition of 'active company' real total assets over £10k – and taking into account the target population of the study – real total assets less than £40m – the panel used for most of our analysis amounts to around 10.5 million company-year observations for the purposes of the analysis (see Table 2). The data fields include statutory accounts (abridged or full accounts) inclusive of financial performance information, from which we construct financial ratios); non- financial information (age, size, industry and technology classification, auditors, audit qualifications, changes in auditor, parent-subsidiary structure, foreign ownership, firm location); other documents filed (insolvency events, creditor charges on assets, changes in board or shareholders). The location of each company is identified by registered and trading address postcode. The postcode data can be matched to various levels of geography including NUTS regions and UK output area classifications.

Companies that seek venture capital may have characteristics that provide a credible signal to the investors about the otherwise unobservable viability of the business and management team, especially in its early stage. Firms able to communicate to outside investors attributes of the entrepreneurial and management team such as commitment, entrepreneurial experience, knowledge and management industry and technical know-how, and relevant networks increase their likelihood of accessing finance. Thus, the experience and composition of the board is important factor in gaining finance and venture success. Firms seeking equity investment are likely to compile larger initial boards aimed at capturing and signaling to potential investors these range of skills, business experience and evidence of networks. We construct for each company in our database variables on individual company directors and board composition and experience. We analyse over 60 million records of directors including the recorded date of birth (age), director name and title (gender), appointment date (and resignation date), tenure with a given company directorship (tenure), nationality of each director, and geographic location of the directorship (company address, postcode). Company directors have a unique identification number that can be used to identify their involvement with all current and previous directorships. We measure **director experience** by the number of years since their first appointment as a director (for each company-year). We construct a variable measuring **founding experience** that calculates the time period between a directors' first ever

appointment as a director and the appointments at a particular company i.e. the directors' experience at the time of appointment. For each director we can calculate their **tenure** with a particular company at the end of each accounting year. Analysis of director names allows us to identify the gender of a director and thus we can construct variables reflecting gender diversity (**female directors %**) along with **age diversity** (average age and the coefficient of variation). We are able to calculate **board size** in any company-year, the percentage of **foreign nationals** of company boards of directors. As directors may have multiple directorships, we calculate the number of directorships that each director on the board of a company has (**multiple directorships**). For each firm we can identify if there are directors with a common surname and use this to proxy **family firms**. Finally, we identify directors that have been involved in equity finance deals. We identify all firms that have received equity finance and identify directors that were on the board at the time of the deal. For each director we identify their first equity finance deal. We code these directors as **equity-finance directors** since they have experience of raising equity finance. We then track their involvement with other companies after their first deal. The idea is that firms with directors that already have experience of equity finance are more likely to attract further deals.

We used datasets about company-level equity deals from three providers – Zephyr, NESTA and Beauhurst. The details about the period covered, number of deals and number of individual companies after removing duplicates are presented in Table 3.

Table 3: Coverage of the equity deals from three data providers

Provider	Zephyr	NESTA	Beauhurst
Date from	14 April 1997	1 January 2007	1 January 2011
Date to	30 December 2017	21 April 2011	20 March 2018
Equity deals	5,626	1,733	24,125
Companies	3,911	1,274	11,355

After merging datasets to remove deals included in more than one dataset we ended up with 29,321 deals about 14,240 individual companies covering the time period from 14/4/1997 to 20/3/2018. The information from this dataset was used for the construction of indicators of experience with equity finance. However, the merged dataset was not always suitable for further analyses since the three data sources differ significantly in terms of covered deals and reported variables. For this reason we used data from the Beauhurst dataset for our main analyses. However, the information from the merged dataset was used for identifying directors that have been involved in equity finance deals.

Beauhurst data covers over 90% of equity deals in the UK after 1 January 2015, both publically announced and unannounced. Before 1 January 2015, the coverage of unannounced deals is not comprehensive. The data on unannounced deals is obtained from SH01 forms (The Return of Allotment of Shares) submitted by companies to Companies House. The remaining, less than 10%, is not covered due to incorrect filings in

Companies House, etc. Information for the population data set is used for the construction of our indicator of individual directors' experience with equity finance.

Descriptive Analysis of Equity Finance Deals

As outlined above, recent studies have identified a concentration of equity finance deals in London and the South East. Using our comprehensive dataset of equity finance deals and individual data on the population of UK companies we provide an update on the actual distribution of firms that have received equity finance. In this section we undertake various descriptive analyses of this firm level data on equity finance deals. The analysis seeks to determine not just the distribution of equity finance deals and deal values across the UK regions but also in relation to regional corporate demographics.

For the descriptive analysis we apply some restrictions to our selection of firms. Thus, to the Beauhurst data on UK equity deals we applied the following restrictions: known deal value; available accounts submitted to Companies House before the deal date; Invested company fulfils SME criteria at the time of last accounts date; and deals occurred in the period from 2011 to 2017. The resulting dataset of equity deals contains 17,431 equity deals on 8,624 individual companies.

The descriptive analysis is the first stage of our empirical research and it starts simply with an examination of the number of equity deals, the value of invested amounts and the growth rate in equity finance provision by region and by year. The analysis proceeds by analysing these numbers in relation to the number of SMEs in each region and the number of high growth firms (HGFs) in the region. The number of SMEs and HGFs can be aggregated from our firm level database but we supplement this data with information from the Office of National Statistics (ONS) on the number of active companies, the number of new company registrations, the number of high growth firms and firm failures (exits/survivors). Using this database we calculate location quotients and undertake multivariate regressions aimed at explaining the number of equity deals in each region/year by a range of variables capturing regional corporate demographics. Further analysis utilises the firm level population data and the data on invested firms to estimate a multivariate profile of the firms that receive finance compared to those that do not. Essentially the modelling technique provides a score for all firms that indicates the probability of their receiving equity finance based on the firms' financial and non-financial characteristics. Finally, we use the firm level deal data to model average deal values for invested firms in relation to both firm level characteristics (financial, sector, board) and regional and macroeconomic indicators.

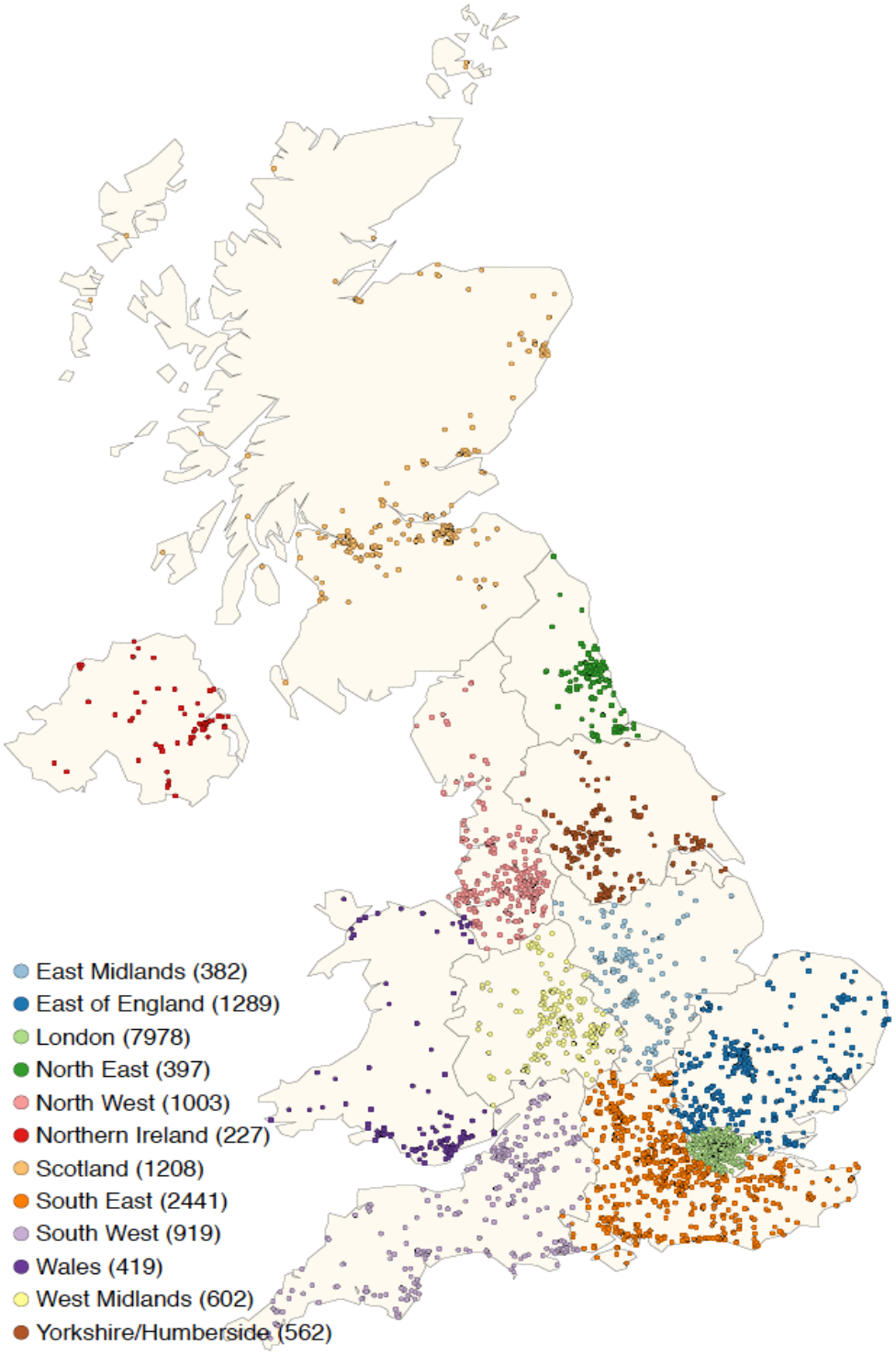


Figure 2: Equity Finance Deals by Company Location

Figure 2 presents a map of the UK regions and the location of companies that have received equity finance during 2011-17 and reveals a relative concentration in London and the South East.

Table 4 presents the proportions of the total number of UK equity finance deals allocated to each region by number of deals, the value of deals and the compound annual growth

rates in deals and amounts over the period 2011-17. The table shows that 46% of all equity deals were invested into companies located in the London region (51% of all invested funds)[10]. However, these are average figures for the time period 2011-2017. Moreover, our data show that London, the South East and the East of England regions received from 2011 to 2017 67% of all equity deals in the UK (East of England 7%, London 46%, South East 14%). This represents 75% of all invested amounts (East of England 9%, London 51%, South East 15%). At the same time the concentration in London seems to increase in time with an average annual growth rate of 41% in equity finance deals and 48% in investment volume during the analysis period[11].

Table 4: Regional shares of the number of equity deals and value of equity investments in 2011-2017

	Number of deals			Invested amounts		
	Deals	Regional share	Growth rate	Amount (£ mil.)	Regional share	Growth rate
East Midlands	382	2%	19%	469	2%	11%
East of England	1,289	7%	26%	2,345	9%	19%
London	7,978	46%	41%	12,921	51%	48%
North East	397	2%	8%	519	2%	37%
North West	1,003	6%	23%	1,398	6%	23%
Northern Ireland	227	1%	22%	124	0%	40%
Scotland	1,208	7%	17%	1,244	5%	15%
South East	2,441	14%	28%	3,772	15%	21%
South West	919	5%	36%	1,030	4%	37%
Wales	419	2%	31%	420	2%	25%
West Midlands	602	3%	27%	655	3%	7%
Yorkshire/Humber	562	3%	21%	509	2%	23%
Total	17,427	100%	31%	25,406	100%	33%

Notes: The table summarises number and value of equity deals in 2011-2017. The second column shows the number of equity deals, the third column shows the regional proportions of the number of equity deals, and the fourth column shows the average regional year-on-year growth rate in the number of equity deals. The fifth column shows the total funds invested in equity deals, the sixth column shows the regional proportions of total invested amounts and the last column shows the average regional year-on-year growth rate of total invested amounts. The figures are rounded to whole numbers.

[10] The regional shares are calculated as a ratio of the number of equity deals in a given region and the number of equity deals in the whole UK. For example, in London the number of equity deals was 7,978 and the number of equity deals in the whole UK was 17,427. That is why the regional share of the number of equity deals in the London region is 7,978/17,427 = 46% (rounded to the whole number).

[11] The comprehensive table and analysis including the annual figures can be found in Wilson et al. (2018a).

Equity investment activity and corporate demographics

Table 5: Location quotients analysis of equity investments using the number of high-growth firms and number of active small and medium-sized enterprises

	Time-period 2011-2017				Time-period 2015-2017			
	Number of deals		Invested amounts		Number of deals		Invested amounts	
	HGFs	SMEs	HGFs	SMEs	HGFs	SMEs	HGFs	SMEs
East Midlands	0.41	0.36	0.35	0.30	0.33	0.32	0.19	0.19
East of England	0.85	0.74	1.06	0.92	0.74	0.70	0.85	0.80
London	1.57	2.07	1.75	2.30	1.80	2.19	2.07	2.53
North East	0.80	0.99	0.72	0.89	0.53	0.76	0.63	0.91
North West	0.64	0.57	0.61	0.55	0.62	0.54	0.62	0.54
Northern Ireland	0.71	0.82	0.27	0.31	0.64	0.72	0.26	0.29
Scotland	1.13	1.16	0.80	0.82	1.14	1.03	0.76	0.69
South East	1.04	0.85	1.10	0.91	1.04	0.82	1.01	0.80
South West	0.71	0.65	0.55	0.50	0.65	0.68	0.47	0.50
Wales	1.01	0.81	0.69	0.56	1.15	0.81	0.76	0.53
West Midlands	0.52	0.44	0.39	0.33	0.45	0.42	0.26	0.24
Yorkshire/Humber	0.46	0.50	0.28	0.31	0.40	0.45	0.24	0.27

Notes: The location quotients are calculated for two time periods – 2011-2017 and 2015-2017. The first part of the table shows the location quotients for the whole time-period, i.e. 2011-2017. The second column shows the location quotients for the number of equity deals in relation to the number of high-growth firms (HGFs) and the third column shows the location quotients in relation to the number of small and medium-sized enterprises (SMEs). The fourth column show the location quotients of the volume of equity investments in relation to the number of HGFs and the fifth column in relation to SMEs. The second part of the table shows the location quotients for the time-period 2015-2017. The cells are shaded to facilitate visual comparison – the cells in red show regions with a low level of funding, those in green (and especially above the value of one) show regions getting more funding than expected.

Table 5 shows a comparison of equity investment activity with the regional corporate demographics – the number of high-growth firms (HGFs) and the number of small and medium-sized enterprises (SMEs)[12] – using location quotients. The location quotient is calculated as a ratio of the proportion of equity investments (either number of deals or invested amounts) and the proportion of either high-growth firms (HGFs) or small and medium-sized enterprises (SMEs) in a region[13]. The location quotient higher than one means that a region received more equity investments than expected based on the number of high-growth firms and small and medium-sized enterprises in their regions. If the number is small, the companies in a region are not getting as much equity funding relative to the number of firms that are available.

[12] The high-growth firms (HGFs) are defined as companies with average annual growth in employment of 20% or more over three-year period and initial employment of ten or more employees. The small and medium-sized companies (SMEs) are identified using European Commission definition, i.e. companies with less than 250 employees and either a turnover of less than €50m or balance sheet total of less than €43m. Both measures (HGFs and SMEs) were calculated using the dataset of active companies (see Table 1 for the size of the sample).

[13] For example, the share of all equity deals in 2011-2017 in the London region was 45.78%, whereas the share of high-growth firms was just 29.09%. That is why the location quotient of the number of equity deals in relation to the number of high-growth firms was 45.78/29.09 = 1.57.

The results suggest that the companies located in the London region receive higher amounts of equity funding than the share of high-growth firms (HGFs) or small and medium-sized enterprises (SMEs). Partially it is true for the South East when compared with the HGFs. Scotland and Wales seem to receive a higher number of equity deals but it is not the case for invested amounts. The companies in the East of England receive relatively higher volumes of equity investments. In contrast, the East Midlands, the West Midlands, Yorkshire and Humberside, Northern Ireland and the North West appear to have fewer deals and lower investments than expected (red shades). The analysis was replicated using several measures of corporate demographics coming from the Office of National Statistics (ONS) data – the number of active companies, the number of new firms (births), the number of high-growth firms and the number of surviving companies. The results confirmed the above figures to large extent[14].

Table 6: The most important drivers of the number of equity deals in a given region and year.

Explanatory variables	Model 1	Model 2	Model 3	Model 4	Model 5
The number of SMEs	yes	yes	yes	yes	yes
The proportion of HGFs		yes	yes	yes	yes
The proportion of HTKIs			yes	yes	yes
The proportion of new firms				yes	
Indicators of years					yes
Explanatory power (R^2)	0.547	0.763	0.814	0.819	0.898

Notes: The table shows five model specifications explaining the number of equity deals in a given region and year. In each model, the dependent variable is the logarithm of number of equity deals in a given region and year (in logarithms), i.e. the unit of analysis is region and year. The full estimation results are presented in Table A1 in Annex B. SME stands for number of active small and medium-sized enterprises. HGF stands for high-growth firm (more than 10 employees and average annual growth in employment during 3-year period over 20%). HTKI stands for high-technology manufacturing or knowledge-intensive company (Eurostat definition, source http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf). The proportion of new firms is calculated with respect to number of active small and medium-sized enterprises.

This analysis using the location quotients is univariate in nature in that it compares the equity investment activity with a single measure of corporate demographics. That is why it is refined in the next step by investigating the aggregate number of regional deals per year within a multivariate analysis, i.e. taking into account several measures of corporate demographics at once (similar to Avdeitchikova, 2009). This was done using the regression analysis where the dependent variable is the aggregate number of equity deals in a given region and year in logarithm.

Table 6 shows the explanatory variables in five model specifications. The idea was to explain what seems to determine the number of equity deals[15] and then to look at the regions in terms of the difference between the actual and predicted aggregate number of equity deals (i.e. compare the residuals from the model). The last model in Table 6 (the preferred specification) explains nearly 90% of variability in the aggregate number of

[14] The results are not shown in this report for the sake of brevity. The full results are reported in the analytical report (Wilson et al., 2018a).

[15] It needs to be stressed at this point that the models show statistical associations, i.e. they are not causal.

equity deals across regions and years. The significant predictors in this model are the number of small and medium-sized companies, the proportion of high-growth firms and the proportion of high-technology manufacturing or knowledge-intensive services firms. The changes in macroeconomic conditions are represented by indicators of years.

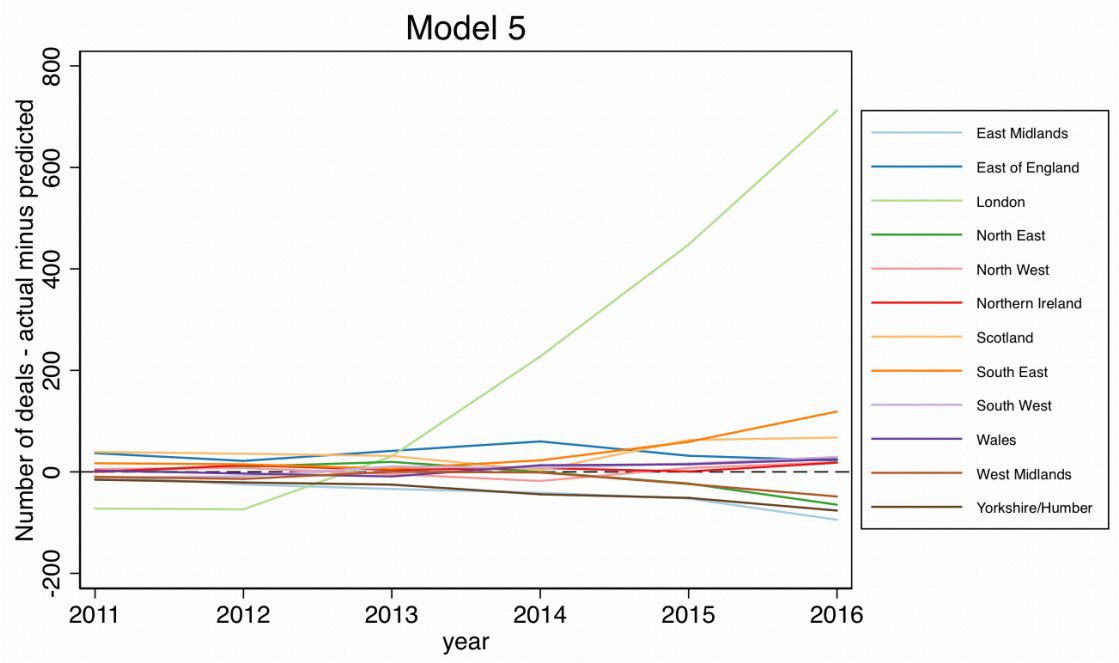


Figure 3: Difference between actual and predicted number of equity deals

Figure 3 shows the residuals from the model 5 in Table 6. If a residual is positive, it implies that there were more equity deals in the given region and year than justified based on the corporate population, if it is negative, the actual number of deals in the region is smaller. The London region seems to be an outlier here showing a large positive residual in the period 2014-2016.

However, after experimenting with additional model specifications, including lagged variables, the models provided somewhat contradictory evidence regarding the imbalance in favour of London. When the lagged number of funders was included among the explanatory variables, the predicted aggregate numbers of deals from these models were smaller than predicted with exception of 2011 and 2016. This result supports the importance of established eco-system and infrastructure of funders (or simply momentum) in explaining the number of equity deals in regions i.e. the higher number of equity deals is explained by the higher relative concentration of funds located in the region. Table A2 in Annex shows the frequencies of investors broken down by region and year.

Looking at the remaining regions, all model specifications suggest that Scotland and the East of England receive more equity deals than would be predicted by the corporate sector demography in these regions. The East Midlands and Yorkshire and Humberside regions received a smaller number of equity deals than predicted by the model in the whole

observation period, whereas the North East and West Midlands received less in the last two years of the study (2015 and 2016)[16].

Multivariate analysis of firm-level data

Models explaining the probability of obtaining equity funding

Our multivariate analysis extends to an investigation of individual deals using firm-level data. The unit of analysis here is the company-year observation and firstly we estimated firm-level models explaining the probability of a firm obtaining equity funding. The variables of interest are the regional indicators (the reference category is London). We include a range of control variables – the variables related to the situation of the firms (logarithm of total assets, ratio of intangible assets to fixed assets, profit and loss account reserve to total assets, cash to total assets, bank overdraft and long-term liabilities to total assets, trade creditors to total liabilities and net worth to total assets, number of charges on assets, age), directors-related variables (board size, directors' age, directors' age diversity, directors' tenure, directors' experience, founding directors' experience, proportion of female directors, proportion of foreign directors, number of directorships, proportion of non-institutional directors, indicator of family firm and indicator of previous experience with equity funding), variables related to industry sector (21 industry sectors based on SIC 2007 – Hirsch-Herfindahl competition index and indicators of industry sectors) and variables representing macroeconomic changes (year indicators).

We follow earlier empirical work as far as the control variables set is concerned. In general, our interest is primarily in the indicators of regions, but we explain the motivation and the expectations about the signs of the coefficients of some of the control variables. Puri and Zarutskie (2012) argue that 'In the general population of firms, VC-financed firms are an order of magnitude larger than non-VC-financed firms, as measured by employment and sales.' (Puri and Zarutskie, 2012, p. 2248). Since employment and sales are not reported for companies submitting abridged or abbreviated accounts, we use total assets instead and expect the size measure to be positively related to the probability of obtaining equity funding. The competitive advantage of knowledge-intensive companies is their knowledge and technology base. That is why the companies looking for equity funding are expected to increase the value of intangible rather than tangible assets well before the actual revenue generation (Wilson et al., 2018). The level of intangible assets is expected to be positively related to probability of equity funding, too. In general, potential investees and knowledge-intensive companies tend to be loss-making for extended periods of time after start up. Also, an under-performing company may an attractive target for equity investors with the expectation of improving its performance (Wright and Robbie, 1998). We assume the probability of getting funded may be negatively related to

[16] All model specifications along with the corresponding charts of residuals are reported in the analytical report (Wilson et al., 2018a).

accumulated profits (profit and loss accounts reserve to total assets). The equity funded companies, because of higher level of intangibility, need to provide collateral to their creditors through floating charges on assets. Charges on assets signal that these companies underwent creditors' screening process but are unlikely to attract additional debt finance. The floating charges on assets are expected to be positively related to probability of equity funding. Also, these companies have higher level of leverage and measures of leverage such as bank overdraft and long-term liabilities to total assets and trade creditors to total liabilities are expected to be higher. Croce et al. (2013) report pre-investment statistically significant differences in age between the VC-backed and non-VC-backed companies in that the invested companies were younger. This is in line with an assumption that when compared to their non-financed counterparts, younger firms apply for equity funding and this is what we expect for our sample. Board size may be an additional measure of size, besides total assets and it is expected to be positively correlated with probability of equity funding and may proxy a wider range of skills and experience. Industry effects and differences are important in differentiating the companies with regard to equity funding. For example, Masulis and Nahata (2011) report that 72% of VC-backed targets belong to technology-intensive industries in their sample of the US incorporated companies. We include control variables related to industry sectors, such as a measure of concentration (HHI – total assets) and industry sector indicators. As for the estimation method, the models are estimated using logistic regression and allow us to calculate the probability that a firm will be funded based on its characteristics (i.e. the explanatory variables included in the model).

Table 7 reports the estimated coefficients of the regional indicators for the preferred demand-side[17] model estimated for the whole period 2011-17 (see Wilson et al., 2018a for full model specification of this model and also the alternative specifications). The exponentiated coefficients[18] are instrumental in understanding the regional differences in the probability of being funded – these are the odds ratios. The odds ratios represent the odds that an otherwise identical company (in terms of all other explanatory variables) will obtain equity funding if it is located in a given region to the odds if it would be located in the London region[19]. The odds ratios are shown in the last column of Table 7.

[17] A further means of investigating demand and supply-side would be to estimate the demand-supply system as disequilibrium models but this is outside the scope of the current analysis but an area for further research.

[18] In logistic regression, the estimated coefficients of the regional indicators tell us by how much the natural logarithm of odds of obtaining the equity financing differs between the given region and the reference category (i.e. the London region). That is why we need to exponentiate the estimated coefficients to get the odds ratio, where values greater than one indicate an increase in likelihood for changes in the independent variable and less than one a decrease.

[19] For example, the odds that a company located in East Midlands will get funding is 49% smaller (100%-51% = 49%) than odds of the identical company located in the London region. Similarly, a company located in Scotland has 24% higher odds of obtaining equity funding when compared to an identical company located in London.

We find that compared to London, the same company in most of the regions have lower probabilities of being funded. Based on the magnitude of the differences from London, we may divide the regions with a lower probability of being financed with respect to London into two groups. The first group includes the East Midlands, Yorkshire and Humberside and West Midlands. The companies with primary trading address in these regions have about 47% smaller odds of getting equity funding (the exact figures are 49%, 47% and 46%, respectively). The second group includes the North West, South West, South East and East of England, with the odds of being financed about 27% smaller than that of London (the exact figures are 35%, 30%, 23% and 20%, respectively). The odds for being funded are not significantly different for companies located in Wales, Northern Ireland or the North East, when compared to London. However, the results show that all else equal, a company in Scotland has 24% higher odds of being funded than the same company located in London.

Table 7: Estimated coefficients for regional indicators from models of equity financing probability and their transformation to odds ratios of obtaining equity funding compared to London for identical companies (i.e. controlling for firm characteristics)

	Estimated coefficient	Odds ratio
Scotland	0.214***	**1.24**
North East	0.00512	1.01
Northern Ireland	-0.0383	0.96
Wales	-0.162	0.85
East of England	-0.227***	**0.80**
South East	-0.265***	**0.77**
South West	-0.351***	**0.70**
North West	-0.428***	**0.65**
West Midlands	-0.623***	**0.54**
Yorkshire Humber	-0.644***	**0.53**
East Midlands	-0.665***	**0.51**

Notes: The second column shows the estimated coefficients for the regional indicators from the model explaining the probability of equity financing of individual firms. The statistical significance of the coefficients is denoted with asterisks (* p<10%, ** p<5%, *** p<1%). The coefficients of the remaining explanatory variables included in the model are not reported for the sake of brevity, see Wilson et al. (2018a) for full model specification. The last column shows the odds ratios of a firm located in a given region obtaining equity funding compared to a company with the same characteristics located in London. The figures in bold are statistically significant at 1% significance level.

Figure 4 plots the trends in values of odds ratios in time. The values of the estimated coefficients (exponentiated) come from cross-sectional probability models[20] of obtaining equity finance reported in Wilson et al. (2018a). The shift downwards in the values of odds ratios from 2011 to 2017 is clearly visible, confirming different dynamics of equity investments in the London region when compared to other ones. Moreover, with the exception of Scotland, the trajectories of the odds ratios of other regions show some signs

[20] The model reported earlier was the pooled model, i.e. for the whole time-period 2011-2017. Thus, we get just one constant odds ratio for each region. To see evolution of the odds ratios in time, we re-estimated the same model separately for each year.

of convergence in that towards the end of the analysed period the odds ratios are becoming smaller than one for all regions implying the smaller odds of getting equity finance when compared to London. Scotland remains the only region with consistently higher odds of obtaining equity funding for an identical company.[21] It should be noted that our data is more comprehensive and, therefore, reliable from 2012 onwards.

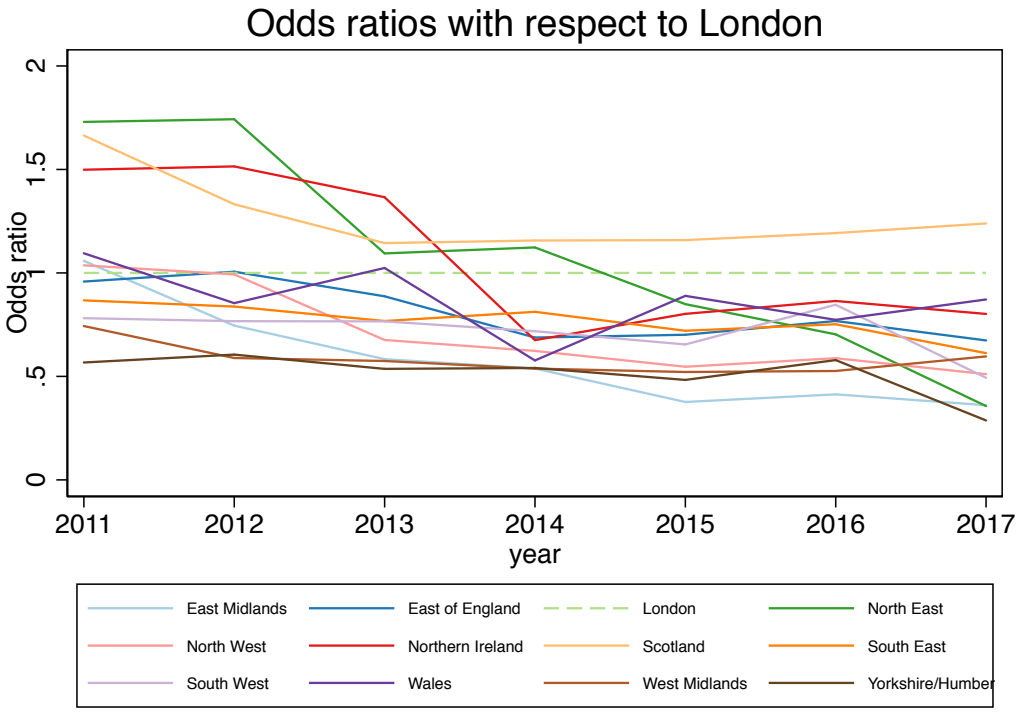


Figure 4: Plot of odds ratios of an individual firm being funded with respect to London over time

Quantification of impact of the control variables related to directors on the probability of obtaining equity funding

The multivariate models determining deal probability control for a wide range of firm level characteristics. An important ingredient of success in the acquisition of equity finance is the firms' engagement, at an early stage, with networks of potential investors (VC's, Business Angel networks) and/or with individuals (directors) who have had experience of raising equity finance in the past. Our proxy for this type of activity in our analysis is the firms' appointment of directors with equity finance experience. Of particular interest we find that director experience of equity finance is an important factor in gaining equity finance (odds ratio higher 24 times[22] compared to companies without directors' experience with

[21] After running the cross-sectional models (i.e. for each year) without control variables (i.e. just with the regional indicators) the convergence was even stronger. All odds ratios were below unity after 2013 signifying lower probability of equity investments in all other regions when compared to London. The odds ratios were higher than unity in 2011 and 2012 for the North East and in 2011 for Scotland.

[22] The impact of equity finance experience seems to be very strong. To rule out a potential explanation that the strong association is driven by the second and higher rounds of equity financing, we ran separate

equity finance) along with other aspects of board composition (size, age diversity, experience, founding director experience). The companies with larger boards (increase of odds by about 19% for each additional director) and younger directors are associated with a higher probability of getting equity funding (the odds of a company being financed decrease by about 5% with each additional year of average age of directors). At the same time, these companies have higher diversity in terms of age[23]. Since the companies are younger (the odds of a company being financed decrease by about 11% with each additional year of the company age), directors' tenures are also shorter on average in the financed companies (the odds are lower by about 10% with each additional year of directors' tenure). On the other hand, the directors are relatively experienced – both the current ones and also those at the time of founding, even though the effect of these variables is relatively weaker (the corresponding increase in odds by 2% and 1% for an additional year of experience for the current and founding directors, respectively). The incidence of female or foreign directors is smaller and the same holds for multiple directorships (both are associated with about 0.5% decrease in odds of being financed per additional percentage point increase in the proportion of female or foreign directors). The multiple directorships are associated with lower probability of equity funding (decrease in odds by about 6% for an additional directorship). The equity funded companies are associated with higher proportions of non-institutional directors (the odds are higher by about 0.9% per additional percentage point increase in proportion of non-institutional directors). Companies that seek venture capital may have characteristics that provide a credible signal to the investors about the otherwise unobservable viability of the business and management team, especially in its early stage. Family firms are less likely to have equity finance (odds lower by 30% compared to other firms). This may be a function of the preference of family owners to use finance that does not dilute the family equity stake or perhaps due to a lack of awareness of the availability and nature of equity finance deals. Of course firms located in regions or local areas where there are no active VC funders may be less informed about the potential and availability of equity finance.

regressions excluding the observations for companies that obtained the second or higher rounds of funding. The coefficient decreased somewhat but remained relatively high (the odds ratio of about 20).

[23] The higher diversity in terms of age means that the company directors' ages are more dispersed, i.e. there are younger and also older directors, not directors of similar age. Since the variable represents the coefficient of variation of directors' age, the quantitative interpretation of the coefficient is not very intuitive.

Models explaining the individual equity deal value

Table 8: Estimated coefficients for regional indicators from equity deal value models and their transformation to percentage differences with respect to London

	Estimated coefficient	Percentage difference
North East	-0.525***	**-41%**
Yorkshire Humber	-0.428***	**-35%**
West Midlands	-0.339***	**-29%**
East Midlands	-0.319***	**-27%**
North West	-0.309***	**-27%**
South West	-0.284***	**-25%**
Wales	-0.229***	**-20%**
Scotland	-0.217***	**-20%**
Northern Ireland	-0.176*	-16%
South East	-0.148***	**-14%**
East of England	-0.0929*	-9%

Notes: The second column shows the estimated coefficients for the regional indicators from the model explaining the deal value of individual equity deal during whole analysed period 2011-2017. The statistical significance of the coefficients is denoted with asterisks (* p<10%, ** p<5%, *** p<1%). The coefficients of the remaining explanatory variables included in the model are not reported for the sake of brevity, see Wilson et al. (2018a) for full model specification. The last column shows the percentage difference in the deal value for a firm located in a given region compared to a company with the same characteristics located in London. The figures in bold are statistically significant at 1% significance level.

To explain the differences between the equity investments (deal size) in the regions we have further estimated firm level equity deal value models with indicators of regions (London is the reference category). The set of control variables includes size (logarithm of total assets), financial variables (ratio of intangible assets to fixed assets, profit and loss account reserve to total assets, cash to total assets, bank overdraft and long-term liabilities to total assets, net worth to total assets), non-financial variables (indicator of being audited and company age), macro-economic variables (GDP growth), variables related to equity deal (indicator of an announced deal, indicator of the government involvement in the deal and company evolution stage), time indicators and industry indicators (21 industry sectors based on SIC 2007). The dependent variable is the logarithm of firm-level deal value and the parameters are estimated using the least squares method.

The coefficients for our variables of interest, the regional indicators, along with their transformation to relative percentage differences[24] from London region, are reported in Table 8. The deal values in other regions are on average lower by from 9% to 41% compared to London. The largest differences in relation to London are in the North East (41%), Yorkshire and Humberside (35%), the West Midlands (29%), the East Midlands (27%) and the North West (27%). Then follow the South West (25%), Scotland (20%), Wales (20%) and the South East (14%). The differences in equity deals for Northern Ireland and the East of England are negative, too, but they are not statistically significant.

[24] The estimated coefficients are transformed to percentage differences in deal values using the following formula: *percentage difference* = (exp(*estimated coefficient*) – 1)*100%

As far as the impact of control variables on deal value is concerned, the company size is unsurprisingly positively related to deal value (the increase in size by one percent is associated with 0.4% increase in deal value). From among the financial ratios intangibility, profit and loss account reserve to total assets, bank overdraft and long-term liabilities to total assets and net worth to total assets are associated negatively with deal value (the one percentage point increase in these financial ratios is on average associated with lower deal value by 0.18%, 0.73%, 1.46% and 0.09% respectively). On the other hand, cash to total assets is associated with deal value positively (one percentage point increase in the cash to total assets is associated with 0.25% increase in equity deal value). Audited companies receive equity deals higher by 21%. Age of the invested company is negatively related to deal value (an additional year of age is associated with equity deal value lower by about 5%). Deal values are procyclical in that an additional percentage point in GDP growth is associated with nearly 9% increase in average deal value. Announced deals have on average 3.6 times higher value than unannounced ones. Government involvement is associated negatively with average deal values (the average deal value is lower by 14% if government is one of the syndicated investors).[25] Finally, the company stage of evolution affects the average deal values, too (when compared to seed stage, companies in venture stage get on average deal values higher by 58% and those in growth stage by 65%).

Overall, the multivariate analysis of deal values leads to the conclusion that the differences in invested amounts remain even after controlling for other relevant predictors of deal values. Partially, the differences in individual deal values across regions as captured by regional indicators may reflect regional variations in prices, especially in relation to London, but it is not clear at this stage whether they are related to unobserved determinants of equity deals or are unique to the provision of equity finance in the regions. However, coupled with the conclusions from the models explaining the probability of equity funding ~~the previous part~~, the differences in firm-level deal values further deepen the regional imbalance in favour of London region.

Conclusion from the descriptive analysis

Based on simple descriptive analysis we find that the London region attracts the highest proportion of number of deals (46%) and invested amounts (51%), followed by the South East (14% and 15%, respectively) and the East of England (7% and 9%, respectively). Moreover, the imbalance in favour of the London region is increasing in time because of the highest annual growth rate (41% and 48%, respectively).

[25] This is not to say that the government "causes" small deal values. Perhaps without the government participation these companies would not be financed at all.

When compared to dimensions of business populations (number of high-growth firms and SMEs), we find that London attracts a higher than warranted number and volume of equity investments (with location quotients for 2011-2017 ranging from 1.57 to 2.3). Other regions with at least one location quotient higher than unity signifying a relatively higher share of equity investment are Scotland (location quotients from 0.80 to 1.13), the South East (0.85-1.10) and the East of England (0.74-1.06). After taking into account several measures of corporate population at once, Scotland and the East of England received indeed higher number of equity deal in 2011-2017. As far as the London region is concerned, the results of multivariate models taking into account several measures of corporate demographics seem to suggest that the number of investors located in London helps to explain the number of equity deals there.

After controlling for financial and non-financial variables the probability of getting funded is lower in other regions than in London. The regions with the highest differences are the East Midlands, Yorkshire and Humberside and West Midlands (with odds of obtaining equity funding when compared to London lower by 49%, 47% and 46%, respectively), followed by the North West, the South West, the South East and the East of England (odds lower by 35%, 30%, 23% and 20%). In some regions, the propensity is not statistically different (the North East, Northern Ireland and Wales). In Scotland, on the other hand, the odds of obtaining the equity funding are higher by 24%. However, time trends indicate that the propensity of equity investments in other regions is decreasing with respect to London. While in 2011 the average odds ratio of getting funded in other regions compared to London was 1.09, it decreased gradually down to only 0.62 in 2017. The differences in number of equity deals are further aggravated by the differences in individual deal values since in all regions the firm-level deal values are smaller than in London on average with the differences ranging from 9% in the East of England (albeit not statistically significant) to 41% in the North East.

Part 2 – Funding Activity in the UK Regions: Supply-side

The purpose of this part of the analysis is to understand how supply-side factors may influence the regional disparities in the provision of equity financing. The analysis focuses on several approaches: 1) an analysis of amounts invested across regions (and time) using the information about the region of an invested company and the region of the investor, 2) analysis based on investor type i.e. venture capital & private equity, business angels, crowd funding and government, 3) an analysis of the spatial proximity effects i.e. distances between the geographical location of investor and investee and finally 4) a multivariate analysis of the actual deals completed by individual investors that are outside of the investor's head office or branch office regions.

Regional distribution of equity investors

Thus our interest is in the location of the funders (supply-side) and their investees (demand-side). We explore the colocation of 9,899 individual investor-investee pairs. The analysis shows that investors located in the East Midlands, West Midlands and Yorkshire and Humberside have a portfolio of investments that are geographically more dispersed than investors in other regions and these funds invest outside their regions i.e. in London. Overseas investors fund about 15% of all equity deals that corresponds to about 33% of the invested amounts. Again, these investments are focused mainly in London, the South East and East of England. Looking at the investor type, the analysis shows that the government is more active in regions with a proportionately lower provision of equity finance from private investors, although the government investments form a relatively smaller share of the invested amounts than of the number of deals.

In Table 9 the percentages show investment behaviour based on the head office of the investor: Investors located in Northern Ireland, Scotland, Wales, the North West, the North East and London invest primarily in their home region. Investors located in the South West, the East Midlands, the West Midlands and Yorkshire and Humberside have more geographically dispersed portfolios (mainly due to private equity activity). Overseas investors (USA, EEA and other) invest relatively higher proportions of their funds in London (61% of deals and 60% by value), the East of England (10% and 13%) and the South East (9% and 11%). Overall, the overseas investors fund about 15% of all equity deals that corresponds to about 33% of the invested amounts in the UK.

Table 9: Equity investments in home regions, London, South East and East of England by region (or country) of investor

Region/Country of investor	Number of deals				Invested amounts			
	Home	London	South East	East of England	Home	London	South East	East of England
East Midlands	35%	7%	12%	7%	19%	6%	40%	5%
East of England	41%	28%	11%	--	45%	26%	10%	--
London	56%	--	11%	9%	52%	--	14%	8%
North East	70%	9%	3%	1%	52%	13%	4%	1%
North West	72%	4%	6%	2%	70%	5%	4%	4%
Northern Ireland	94%	0%	6%	0%	93%	0%	7%	0%
Scotland	86%	5%	2%	1%	45%	16%	4%	6%
South East	36%	33%	--	7%	49%	28%	--	3%
South West	15%	48%	13%	5%	14%	54%	11%	6%
Wales	74%	6%	5%	3%	66%	15%	6%	1%
West Midlands	37%	13%	18%	4%	21%	9%	17%	2%
Yorkshire/Humber	36%	20%	6%	8%	24%	38%	6%	9%
UK unknown region	-	40%	9%	11%	-	45%	27%	7%
USA	-	64%	10%	11%	-	61%	12%	12%
EEA	-	58%	8%	9%	-	57%	12%	11%
Other country	-	58%	12%	7%	-	62%	7%	18%
Total	-	44%	10%	9%	-	49%	15%	10%

Notes: The first half of the table shows what proportion of the equity deals of an investor located in a given region goes into companies located in the same region (the second column), the London region (the third column), the South East (the fourth column) and the East of England (the fifth column). The second half of the table shows what proportion of the invested amounts (volume of equity investments) of an investor located in a given region goes into companies located in the same region (the sixth column), the London region (the seventh column), the South East (the eighth column) and the East of England (the last column). See the analytical report for the comprehensive table (Wilson et al., 2018a).

Analysis of most frequent investor types

Beauhurst data enable analysis of individual deal-investor pairs based on investor type. In terms of the number of company-investor pairs, the most frequent types of investors are private equity and venture capital (3,435 company-investor pairs), private investment vehicles (1,265), crowd funding (1,103), angel network (859) and government (local and regional – 697, devolved – 484 and central – 134).

Table 10: Equity investors activity by most frequent investor types (row percentages)

Panel A. Row percentages for number of deals

Type of investor	Company primary address region												
	EM	EE	Lo	NE	NW	NI	Sc	SE	SW	Wa	WM	YH	Total
Private Equity and Venture Capital	2%	8%	52%	1%	5%	1%	7%	12%	4%	2%	3%	2%	100%
Private Investment Vehicle	1%	8%	55%	3%	5%	1%	8%	8%	3%	4%	2%	2%	100%
Crowd funding	1%	7%	53%	1%	3%	1%	3%	13%	8%	2%	5%	2%	100%
Angel Network	1%	11%	31%	2%	3%	1%	30%	9%	3%	2%	4%	1%	100%
Local and Regional Government	2%	4%	16%	21%	25%	0%	2%	7%	1%	1%	10%	11%	100%
Devolved Government	0%	1%	4%	0%	1%	6%	66%	1%	1%	20%	0%	0%	100%
Central Government	1%	16%	33%	4%	10%	1%	1%	13%	4%	4%	7%	7%	100%

Panel B. Row percentages for invested amount

Type of investor	Company primary address region												
	EM	EE	Lo	NE	NW	NI	Sc	SE	SW	Wa	WM	YH	Total
Private Equity and Venture Capital	2%	11%	53%	1%	5%	0%	5%	14%	4%	1%	3%	2%	100%
Private Investment Vehicle	0%	6%	69%	2%	4%	0%	4%	8%	3%	2%	1%	1%	100%
Crowd funding	1%	7%	53%	0%	3%	1%	4%	12%	10%	3%	4%	2%	100%

Angel Network	1%	13%	35%	2%	3%	1%	28%	10%	2%	2%	3%	1%	100%
Local and Regional Government	1%	4%	16%	14%	22%	0%	2%	21%	1%	0%	7%	11%	100%
Devolved Government	0%	0%	6%	0%	1%	4%	65%	2%	1%	21%	0%	0%	100%
Central Government	0%	13%	43%	1%	5%	1%	1%	20%	3%	6%	3%	2%	100%

Notes: The table shows the proportions of equity investments carried out by the most frequent investor types broken down by region of primary trading address region of invested companies. The upper panel shows the figures related to number of deals and the lower panel shows the figures related to invested amounts. EM – East Midlands, EE – East of England, Lo – London, NE – North East, NW – North West, NI – Northern Ireland, Sc – Scotland, SE – South East, SW – South West, Wa – Wales, WM – West Midlands, YH – Yorkshire and the Humber.

Table 10 shows the proportions of equity investments carried out by the most frequent investor types broken down by the region of the primary trading address of invested companies, i.e. into which regions the given investor type invests the most. It seems that the most frequent types of private investors are investing predominantly in London. The angel networks are more active in Scotland and the East of England, too. The local and regional government funds are invested mostly into the North East and North West, but significant proportion goes to London, as well. The devolved government not surprisingly invest the most into Scotland and Wales, while the central government invests most in London, South East and East of England.

Table 10b: Equity investors activity by most frequent investor types (column percentages)

Panel A. Column percentages for number of deals

Type of investor	**Company primary address region**												
	EM	**EE**	**Lo**	**NE**	**NW**	**NI**	**Sc**	**SE**	**SW**	**Wa**	**WM**	**YH**	**Total**
Private Equity and Venture Capital	49%	33%	41%	14%	32%	32%	21%	41%	36%	20%	27%	22%	35%
Private Investment Vehicle	11%	12%	16%	12%	11%	8%	9%	10%	9%	14%	10%	8%	13%
Crowd funding	8%	9%	13%	3%	6%	10%	3%	13%	21%	8%	16%	9%	11%
Angel Network	6%	11%	6%	5%	5%	9%	23%	8%	7%	6%	11%	2%	9%
Local and Regional Government	8%	3%	3%	49%	30%	1%	1%	5%	2%	3%	23%	27%	7%
Devolved Government	0%	0%	0%	0%	1%	24%	28%	1%	2%	30%	1%	0%	5%
Central Government	1%	3%	1%	2%	2%	2%	0%	2%	1%	2%	3%	3%	1%
Other types or unknown	17%	29%	20%	15%	13%	14%	15%	20%	22%	17%	9%	29%	19%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Panel B. Column percentages for invested amount

Type of investor	**Company primary address region**												
	EM	**EE**	**Lo**	**NE**	**NW**	**NI**	**Sc**	**SE**	**SW**	**Wa**	**WM**	**YH**	**Total**
Private Equity and Venture Capital	53%	57%	55%	30%	45%	40%	46%	47%	47%	40%	52%	49%	51%
Private Investment Vehicle	1%	5%	11%	7%	6%	7%	6%	4%	5%	10%	4%	4%	8%
Crowd funding	2%	2%	3%	0%	2%	5%	2%	2%	7%	7%	4%	3%	3%
Angel Network	2%	2%	1%	1%	1%	5%	10%	1%	1%	2%	2%	1%	2%
Local and Regional Government	1%	1%	1%	11%	7%	0%	1%	3%	0%	1%	5%	10%	2%
Devolved Government	0%	0%	0%	0%	0%	14%	14%	0%	0%	17%	0%	0%	1%
Central Government	0%	1%	1%	0%	1%	2%	0%	1%	1%	3%	1%	1%	1%
Other types or unknown	41%	32%	28%	49%	38%	27%	21%	41%	39%	20%	32%	32%	32%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Notes: The table shows the proportions of equity investments in regions broken down by investor type and invested companies primary trading address region. The upper panel (Panel A) shows the figures related to number of deals and the lower panel (Panel B) shows the figures related to invested amounts. EM – East Midlands, EE – East of England, Lo – London, NE – North East, NW – North West, NI – Northern Ireland, Sc – Scotland, SE – South East, SW – South West, Wa – Wales, WM – West Midlands, YH – Yorkshire and the Humber.

Table 10b shows shares of the equity investments within regions attributed to most frequent investor types. In terms of number of equity deals (Panel A), the regions with relatively lower provision of equity finance from the private sector (mostly represented by private equity and venture capital, and private investment vehicles) are the North East

(26%), Scotland (30%), Yorkshire and Humberside (30%) and Wales (34%). However, the figures representing the invested amounts (Panel B) suggest that in total the private equity and venture capital funds are financing higher proportions of invested sums (51%) than proportions of the total number of deals (35%). On the other hand, the government investments (devolved, local and regional government) form a smaller proportion of invested sums (1%, resp. 2%) than number of equity deals (5%, resp. 7%).

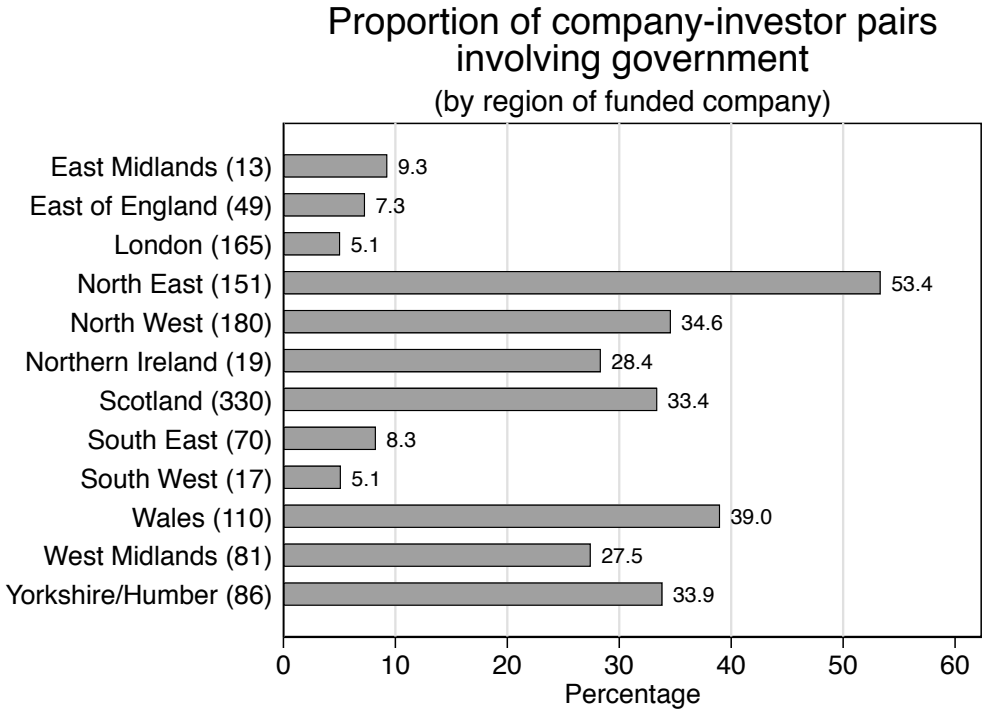


Figure 5: Proportion of company-investor pairs involving government funds (local, regional, devolved or central government) by funded company primary trading address region

Notes: The number of company-investor pairs involving government, for each region, are displayed in the parenthesis.

Figure 5 shows the proportion of company-investor pairs involving government funds (local, regional, devolved or central government) in each region. The highest proportion is in the North East region – more than 50%. On the other end of the spectrum, the regions with the proportions lower than 10% are the East Midlands (9.3%), the East of England (7.3%), London (5.1%), the South East (8.3%) and the South West (5.1%). The cases of the East Midlands and the South West are noteworthy given the relatively low investment activity of equity investors there with respect to corporate demographics measured either

by high-growth firms or SMEs, as reported earlier in the study (see Table 5). The proportion of government funded deals is higher in regions with similar location quotients[26].

Spatial proximity analysis

By analysing geographical distances between the investor and investee we find support for the spatial proximity hypothesis – the number of equity investments decreases with the distance from the head or branch office of the investor. Figure 6 charts the distance between investor and investee in 50km bands and shows that largest frequency of investments is within the first 50km band for most investors/regions. In general, the frequency of equity deals decreases with the distance between the invested company and the nearest investor's office. If the investors with head offices in London are excluded (upper right chart of Figure 6, below), the picture is even clearer. The relatively high bars in the chart for investors with a head office in London (lower left chart) are for the distance band of 250-300 km (North West – 145 deals, Yorkshire and Humberside – 53 deals) and 500-550 km (Scotland).[27]

The interesting case is the Yorkshire and Humberside region since there is a relatively high bar for the distance band of 200-250 km, corresponding mainly to investments in the London region (40). It is interesting since over 70% of company-investor pairs involve government-backed funds (e.g. Angel CoFund or funds related to the South Yorkshire Investment Fund)[28] and one would expect the government funds support investments in the home region. However, the contradiction is only apparent[29] and the bimodal distribution (i.e. two equally high spikes, one for 0-50 km and another for the 200-250 km distance band) remain also after excluding government-backed funds. Investors based in the West Midlands are also investing significantly outside their region. If we consider investments within 100-150 km distance, a relatively large share goes into London (19), South East (19) and North West (11). The charts for all regions for the whole analysis period 2011-2017 and also for the last three-year period (2015-2017) are in Annex A (Figure A1 and Figure A2).

[26] The location quotients in East Midlands are similar to those in West Midlands and Yorkshire and Humberside. And the South West is similar to the North West and Northern Ireland (see Table 5).

[27] The figures come from additional analysis of invested companies primary trading address regions for these distance bands.

[28] Out of 242 investor-investee pairs with investors headquartered in Yorkshire and Humberside, 71 involve local and regional government (funds related to South Yorkshire Investment Fund) and 107 central government (mostly Angel CoFund – 99 investments).

[29] As far as their regional investment pattern of the government funds is concerned, local and regional government funds indeed invested mostly in the home region (65 out of 71 investments, whereas the central government funds made only 7 out of 107 investments in the region where the fund is located (Angel CoFund 4 out of 99).

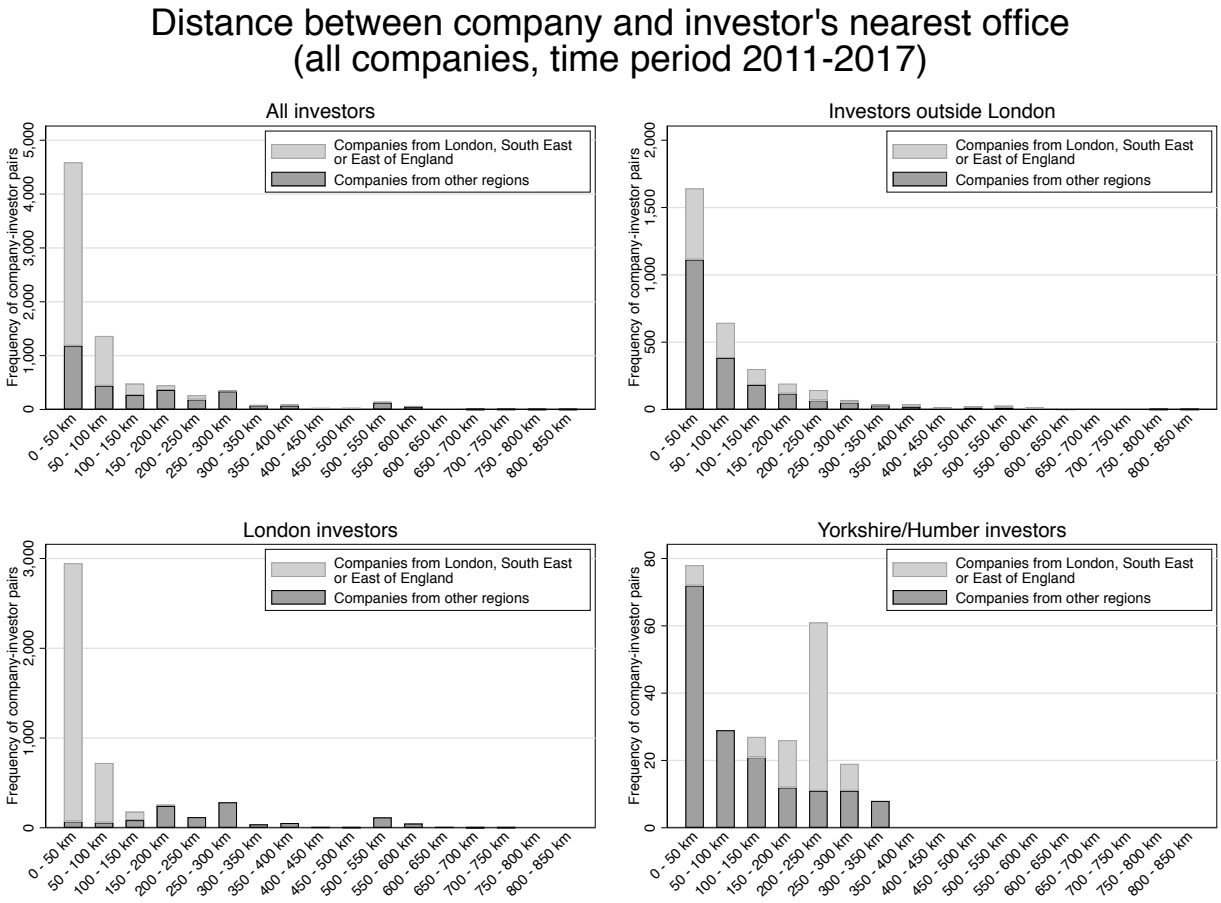


Figure 6: Spatial Proximity – frequencies of investor-company pairs by distance bands

Notes: The bars in the charts show the frequencies of equity deals where the distance between the invested company and the nearest office of the investor is from a given size-band. The upper left chart shows the frequencies of the company-investor combinations for all investors. The upper right chart shows the frequencies for investors with head office outside the London region. The lower left chart shows the frequencies for investors with head office in the London region. And the lower right chart shows the frequencies of company-investor pairs for investors with head office in Yorkshire and Humberside. The bars are split to show the proportion of companies from London, South East and East of England as opposed to companies from other regions (the region of the company is determined on the basis of primary trading address).

Analysis of cross-regional investments

To gain a better insight into what drives investments outside the regions of investors' head office or branch office, we have estimated several model specifications where the dependent variable is the indicator of this kind of investment (i.e. an investment where the investor invested into a company located in a region where there is neither headquarter nor a branch office of the investor). The set of control explanatory variables includes those variables where we expect a significant association with the cross-regional investment. We include deal value where we expect a positive association with the probability of investment outside the home region. Then we include the indicators of investor type. Here,

the expected direction of statistical association differs for each type of investor but we consider important to control for it nevertheless.[30] Further we control for deal stage and we expect the probability of a cross-regional investment to increase with higher stages (venture, growth).[31] The same is expected for publicly announced deals. Finally, the set of control variables includes indicators of years to control for macroeconomic changes and other time-changing factors impacting all equity investments.

We are interested in answering two questions – firstly, whether the involvement of government[32] increases the probability of investment outside the investor's head office or branch office regions and secondly what the impact of the presence of directors with previous equity funding experience is. In both cases we expect a positive association.

Looking at the results of the estimated models of cross-region investments there is some evidence that government involvement as a syndicated investor and involving directors that have previous experience in raising equity finance, and negotiating deals, is associated with a higher propensity of investing outside the investors' head or branch office region. Thus the government involvement is associated with increased odds of investment outside home region by about 17% with respect to deals when the government is not among the syndicated investors.[33] Similarly, the presence of directors with past equity experience is associated with increased odds of investment outside the home region[34] by about 20% when compared to companies where none of the directors had past experience with equity finance (see the estimation results presented in Table A3 in Annex).

Conclusion from the supply side analysis

In summary, the analysis of individual deal-investor pairs show that investors located in the East Midlands, the West Midlands and Yorkshire and Humberside invest relatively low proportions in their home region and invest outside their regions, e.g. in London or the South East. This finding is supported by analysis of spatial proximity, too. Investors from

[30] Fritsch and Schilder (2008) used the indicators of investor type as control variables in models explaining the distance between the investor and an invested company.

[31] Lutz et al. (2013) used the deal value and company stage as control variables in a model explaining the spatial behaviour of venture capitalists.

[32] Here, the involvement of government refers to the situation when the government is one of the syndicated investors. It does not refer to British Business Bank schemes where the government funds are delivered by private sector fund managers.

[33] The finding does not mean that the government has a negative impact on its regional intervention. This finding means that the government involvement increases the probability that a private investor will make a cross-region investment, i.e. an investment outside the region where it is headquartered or where its branch is located. The government as a syndicated investor may signal the quality of the invested company beyond the due diligence conducted by the private investor.

[34] Similar to the government involvement, invested companies with directors on board who have previous experiences with the equity funding seem to be perceived as relatively safer to invest in even over longer distances.

other countries invest predominantly in London, the South East and the East of England. This point was highlighted also in a recent Beauhurst analysis of foreign equity investments (Beauhurst, 2018). In comparison with regions with similar activity of private investors, the South West and the East Midlands receive relatively lower proportion of deals involving the government funds. Government involvement and the experience of directors with equity finance in the past are associated with higher propensity of investing outside investors' head or branch office region.

Part 3 – Determining the Relative Demand for Equity Finance ('equity gap analysis')

Methodology description

To evaluate the potential demand for equity finance we identify companies that share similar characteristics to those that have received equity finance. This investigation utilises a propensity score matching methodology to profile the characteristics of firms that have been successful in accessing equity finance. We then use these identified characteristics to screen for firms in the company population that are potential targets for receiving equity finance but which have not yet received such funding[35]. More specifically, for each company that received equity finance, we match companies from the whole of the UK that have the same age (14 categories of age), operate in the same sector defined by high-technology manufacturing or knowledge-intensive services (7 categories of sector[36]), reside in the same type of area (output area classification – 7 categories)[37], has the same financial year-end and finally have propensity scores that fall within a pre-defined calliper[38]. The propensity scores are calculated based on multivariate logistic regression with the explanatory variables related to company[39], directors[40], industry sector[41] and

[35] A separate analysis of private equity targets, over a longer period, is summarised in Annex C.
[36] See http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf for details.
[37] Output area classifications are constructed from UK 2011 Census Data and a description of the method and classifications can be found at: https://www.ons.gov.uk/methodology/geography/geographicalproducts/areaclassifications/2011areaclassifications/aboutthareaclassifications#what-geographic-levels-are-available
[38] The calliper is a maximum absolute difference allowed between the estimated propensity score of an equity financed firm and that of a company matched to it. In the propensity score matching literature, the calliper is often derived from dispersion of the estimated propensity scores. In the study, we use four different calliper sizes: IQR (Matching 1), IQR /10 (Matching 2), IQR /100 (Matching 3) and IQR /1000 (Matching 4), where IQR is the interquartile range of the estimated propensity scores.
[39] The set of financial and non-financial company-related variables include logarithm of total assets, intangible assets to fixed assets, profit and loss account reserve to total assets, cash to total assets, bank overdraft and long-term liabilities to total assets, trade debtors to total assets, trade creditors to total liabilities, net worth to total assets, number of charges on assets, indicator of high-technology or knowledge-intensive company and indicator of LLP.
[40] The directors' characteristics used in the propensity score model include board size, directors' age, directors' age diversity, directors' tenure, directors' experience, founding directors' experience, proportion of female directors, proportion of foreign directors, number of directorships, proportion of non-institutional directors, indicator of family firm and indicator of previous experience with equity funding.
[41] The industry-specific variables comprise Hirsch-Herfindahl index of concentration calculated using total assets, industry weight of evidence – a measure of failure rate.

macroeconomic situation[42]. As a next step, we remove subsidiaries and any firms that have received equity funding in the past[43] from the group of matched companies.

Having identified the target firms we can impute potential deal values for each of these targets, again basing our estimates on the characteristics of known deals. We use two approaches to impute potential deal values – a regression approach and a median approach. The regression approach predicts deal values using a multivariate regression model with a similar specification to the model predicting target companies and utilises a wide range of company characteristics. In the median approach the predicted deal value is proportional to the size of a potential target company (total assets).[44] The sum of the deal values for the pool of potential target companies forms the initial estimate of the potential additional demand for equity finance (i.e. the 'equity gap') compared to actual investments in each region. Regions are then ranked according to the size of the potential 'equity gap' in relation to actual equity investments. The ranking uses metrics such as the number of potential deals per actual deal in the region and the potential amount of investment per million £ of actual investment in the region. Comparing the results for various matching procedures facilitates an assessment of the robustness of the ranking. Finally, using a set of plausible assumptions[45] about firm-level demand for equity finance we provide the figures for the aggregate demand of equity gap in the UK.

Results

Relative ranking

Table 11, below, shows the frequencies of matched companies broken down by year and type of matching. The trends in time are similar for all four types of matching. The number of matched companies decreases from 2011 to 2013 when it reaches its lowest point, though for the "Matching 1" the decrease is very small in percentage terms. After 2013, it increases in a relatively stable manner up to 2016 when the number of matched companies is higher than in 2011. The difference between the matching types lies solely in

[42] The set of macroeconomic variables includes growth in net lending and real interest rate.

[43] We are able to identify these companies using the records about shareholders and the past equity deals available in datasets at our disposition.

[44] In the median approach, firstly we calculate the ratio of deal value to total assets for the sample of known deals. Then we find medians of the ratios for four size bands (the thresholds between the bands are those used for distinction between micro, small, medium and large company in the UK). For each matched company the potential equity investment is calculated as a product of the median for the appropriate size group and total assets of the company. For example, the micro companies have total assets smaller than £312,000. For the micro companies, the median of the ratios of deal value to total assets for the sample of equity deals used in the study is 2.43. Thus, the potential deal value for a matched company from this size group will be equal to 2.43 times its total assets. See Wilson et al. (2018a) for further details.

[45] We recognise that some firms are not seeking finance for expansion or are not willing to accept equity dilution and therefore this form of finance. Also, venture capital investors reject a significant proportion of applications for venture funds. As discussed later, we use survey evidence to estimate these parameters.

the calliper size and thus comparison of results between types of matching is only a parametric exercise[46]. Since the results are qualitatively similar, in that the ranking of regions in terms of potential equity finance demand is not sensitive to the choice of matching process, we will discuss in greater detail the results obtained by the "Matching 3" results. Figure 7 maps the companies predicted as equity finance targets in 2016 using matching method 3.

Table 11: Number of matched companies by year and type of matching

Year	Matching 1	Matching 2	Matching 3	Matching 4
2010	139,369	40,331	4,980	506
2011	304,257	96,442	14,905	1,449
2012	295,309	79,846	12,254	1,196
2013	296,092	67,030	6,672	641
2014	347,858	82,326	9,554	1,008
2015	410,305	87,655	10,072	1,088
2016	478,950	128,854	16,037	1,775
2017	450,416	136,981	23,067	2,440
2018	20,577	6,001	1,510	143

Notes: The table reports the number of matched companies with the real total assets from £10k to £40m for each year[47] and matching strategy. The matching procedures differ in the calliper size, i.e. the maximum absolute difference allowed between the estimated propensity score of an equity financed firm and that of a company matched to it. The following calliper sizes are used: IQR (Matching 1), IQR /10 (Matching 2), IQR /100 (Matching 3) and IQR /1000 (Matching 4), where IQR stands for the interquartile range of the estimated propensity scores. The relatively large differences in the number of matched firms are the consequence of the differences in the calliper sizes.

[46] The parameter we refer to that differs for the matching procedures is the calliper size. The following calliper sizes are used: IQR (Matching 1), IQR /10 (Matching 2), IQR /100 (Matching 3) and IQR /1000 (Matching 4), where IQR stands for the interquartile range of the estimated propensity scores.

[47] The number of matched firms for 2010 and 2018 are not comparable to other years. Firstly, our database of equity deals contains deals after 1 January 2011 and consequently there is a relatively small number of equity deals for companies with last financial accounts before the deal submitted in 2010. Secondly, the database of financial accounts was extracted in January 2018 and therefore it contains a very small number of accounts for 2018 and the second half of 2017. The number of matched companies for 2017 is not significantly affected since the predicted date of a potential equity deal is 188 days after the last financial year end.

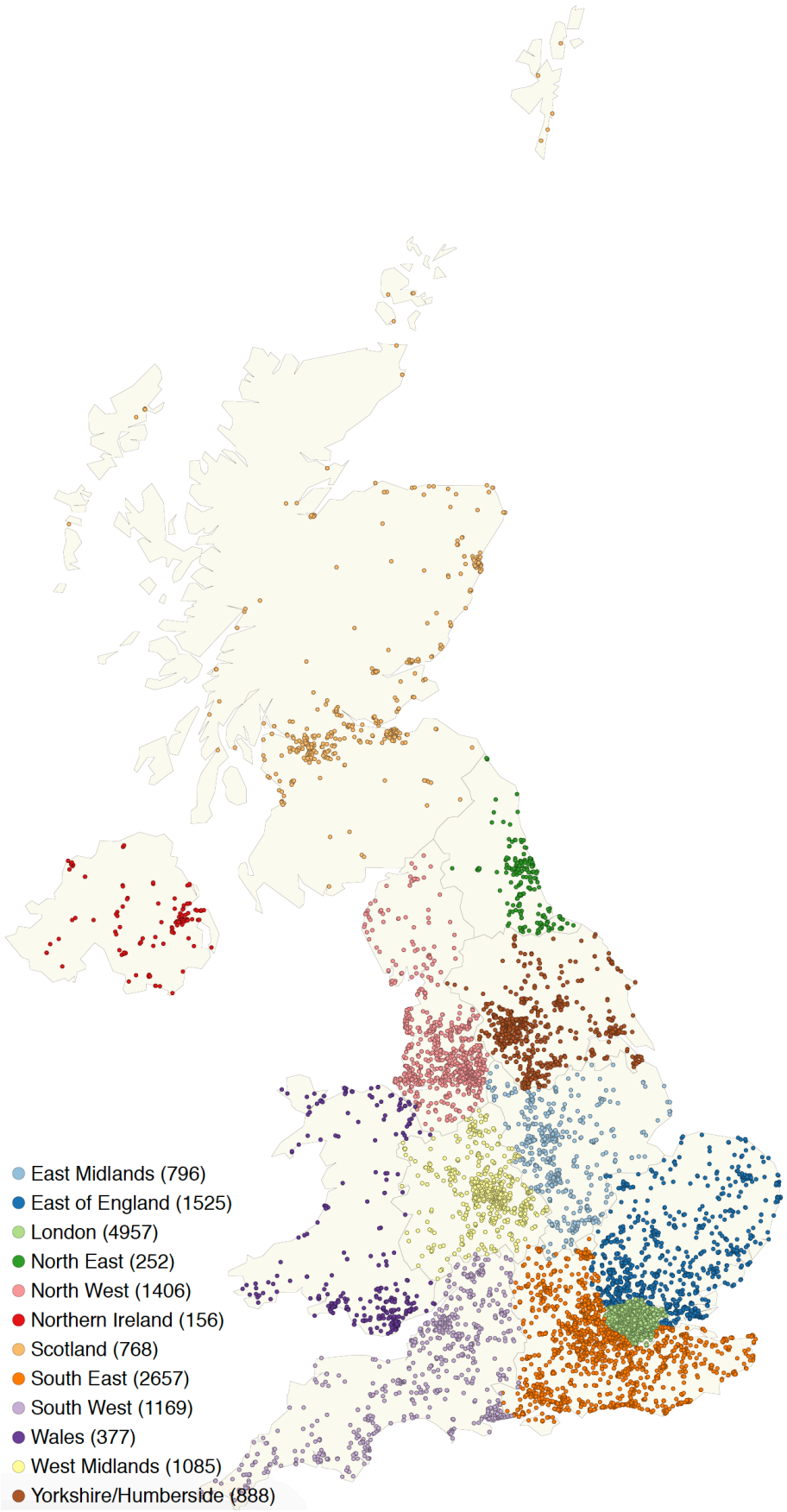


Figure 7: Regional Distribution of Potential Target Companies (Matching 3, year 2016)

Table 12 shows the number of potential targets for equity investments in 2016 for each matching procedure. It allows comparison with the number of active SMEs in each region. The results show that the highest proportions are in London, the South East and the East of England, i.e. the regions with the highest investment activity. On the other hand, the lowest proportions are in Northern Ireland, the North East and the East Midlands.

Table 12: Number of potential targets for equity investors in 2016 and proportions of active SMEs

	Matching 1		Matching 2		Matching 3		Matching 4	
	Number of firms	% of active SMEs	Number of firms	% of active SMEs	Number of firms	% of active SMEs	Number of firms	% of active SMEs
East Midlands	24,865	25%	6,648	6.7%	796	0.81%	76	0.077%
East of England	46,340	28%	12,802	7.8%	1,525	0.93%	156	0.095%
London	130,034	35%	36,054	9.6%	4,957	1.32%	589	0.157%
North East	8,826	24%	2,119	5.7%	252	0.67%	33	0.088%
North West	45,213	28%	11,378	6.9%	1,406	0.86%	160	0.098%
Northern Ireland	5,329	20%	1,192	4.4%	156	0.58%	19	0.071%
Scotland	26,229	27%	6,503	6.8%	768	0.80%	70	0.073%
South East	80,196	30%	22,306	8.4%	2,657	1.00%	285	0.107%
South West	37,681	28%	10,486	7.9%	1,169	0.88%	120	0.091%
Wales	12,137	25%	3,323	6.9%	377	0.79%	49	0.102%
West Midlands	33,809	27%	8,766	7.0%	1,085	0.86%	114	0.091%
Yorkshire/Humber	27,941	26%	7,241	6.9%	888	0.84%	104	0.099%
Total	478,950	29%	128,854	7.9%	16,037	0.98%	1,775	0.108%

Notes: The table reports the number of matched companies with real total assets from £10k to £40m for each region and the matching procedure for 2016. The matching procedures differ in the calliper size. For each matching procedure, the first column shows the number of potential equity investors targets and the second column shows the proportion from active SMEs in the given region. The shading of the percentages allows visual comparison – the green colour shows the regions with the highest proportions of potential equity targets relative to the number of active SMEs in our database. The red colour shows those with the lowest proportions.

Table 13, below, presents the potential demand for equity investments by comparing to the number of actual deals. The presented figures are averages for the time-period 2011-2017. The region with the greatest unsatisfied demand for equity investment is the East Midlands where there are potentially 11 equity targets per one company that actually received equity funding (Table 13, Matching 3). Similar situations are evident in the West Midlands (9.9), Yorkshire and Humberside (8.3), the North West (7.7) and the South West (7.5). At the other end of the spectrum are Northern Ireland (3.3), the North East (3.5), London (3.8), Scotland (4.3) and Wales (4.9). The ranking of the regions in terms of the potential equity deals relative to the actual number of deals is robust to the matching procedure and the choice of calliper.

Table 13: Number of matched companies per actual equity deal in each region

	Time period 2011 - 2017			
Region	**Matching 1**	**Matching 2**	**Matching 3**	**Matching 4**
East Midlands	332	83	11.0	1.08
East of England	188	50	6.6	0.65
London	94	26	3.8	0.40
North East	113	26	3.5	0.35
North West	241	60	7.7	0.80
Northern Ireland	102	25	3.3	0.35
Scotland	121	32	4.3	0.41
South East	173	47	6.2	0.65
South West	216	57	7.5	0.76
Wales	146	37	4.9	0.54
West Midlands	299	75	9.9	1.04
Yorkshire/Humber	254	64	8.3	0.88
Total	148	39	5.3	0.55

Notes: The tables report the number of matched companies (i.e. the number of potential equity targets) per one actually financed company. The figures correspond to average in the time period 2011-2017 and the shading emphasizes the regional differences – the green colour denotes regions with a relatively low potential demand for equity finance while the red colour means a relatively high demand for the equity finance.

Using the different approaches to estimate the likely deal value for each target company we aggregate by regions. Table 14 reports the relative size of the potential equity investment volume for each region and matching strategy using regression approach for the time-period 2011-2017. The figures can be interpreted as the aggregate value of potential demand in £million for each £1m of actual equity investments. The shading emphasizes the regional differences – the green colour denotes regions with a relatively low potential additional investment volume while the red colour shows regions with a relatively greater potential additional investment volume.

The greatest unmet potential demand for equity finance is in Yorkshire and Humberside, with £0.8million of potential volume of equity investment per £1million of actual investments (see Table 14, matching 3). The other regions in the same group are the West Midlands and East Midlands (0.7), Northern Ireland (0.6) and South West (0.5). The smallest unmet demand is in the North East and London (0.2), and East of England, Scotland and South East (0.3). The interesting difference when compared to the previous analysis is Northern Ireland – even though Northern Ireland had the smallest ratio of potential to actual number of deals, the unmet demand in terms of volume of investments is relatively larger.

Table 14: Potential demand in £million per £1m of actual investments – regression approach

	Time period 2011 - 2017			
Region	**Matching 1**	**Matching 2**	**Matching 3**	**Matching 4**
East Midlands	26	5	0.7	0.09
East of England	10	2	0.3	0.04
London	10	2	0.2	0.02
North East	10	2	0.2	0.02
North West	17	4	0.4	0.06
Northern Ireland	23	5	0.6	0.07
Scotland	11	3	0.3	0.03
South East	11	2	0.3	0.03
South West	19	4	0.5	0.07
Wales	13	3	0.4	0.06
West Midlands	27	6	0.7	0.08
Yorkshire/Humber	29	6	0.8	0.10
Total	12	2	0.3	0.04

Notes: The table reports the relative size of the potential equity investment volume for each region and matching strategy calculated using regression approach. The figures can be interpreted as number of million £ per one million of actual equity investments. The figures correspond to average in the given region for the whole time-period and the shading emphasizes the regional differences – the green colour denotes regions with a relatively low potential investment volume while the red colour show regions with a relatively greater potential investment volume.

Table 15 reports the relative size of the potential equity investment volume for each region and matching strategy when the potential deal values were imputed using the median approach. The results obtained using this approach in terms of ranking of the regions are virtually identical to those obtained using the regression approach. It confirms that Yorkshire and Humberside, the West Midlands, the East Midlands, Northern Ireland and the South West are the regions with the greatest unmet relative potential demand for equity finance.

Table 15: Potential demand in £million per £1m of actual investments – median approach

	Time period 2011 - 2017			
Region	**Matching 1**	**Matching 2**	**Matching 3**	**Matching 4**
East Midlands	115	34	4.6	0.44
East of England	40	12	1.7	0.18
London	27	8	1.3	0.14
North East	35	9	1.3	0.11
North West	66	19	2.7	0.31
Northern Ireland	115	31	4.3	0.46
Scotland	51	15	2.3	0.22
South East	42	13	1.8	0.18
South West	74	23	3.2	0.33
Wales	60	17	2.4	0.26
West Midlands	107	30	4.4	0.46
Yorkshire/Humber	120	35	5.0	0.50
Total	42	12	1.8	0.19

Notes: The table reports the relative size of the potential equity investment volume for each region and matching strategy calculated using median approach. The figures can be interpreted as number of million £ per one million of actual equity investments. The figures correspond to the average in the given region for the whole time-period and the shading emphasizes the regional differences – the green colour denotes regions with a relatively low potential investment volume while the red colour show regions with a relatively greater potential investment volume.

Sensitivity analysis – threshold matching

We repeat the calculations using a different matching procedure we call threshold matching[48]. This comparison is presented in graphical form in Figure 8. All the results give very similar outcomes: the East Midlands, the West Midlands and Yorkshire and Humberside seem to receive much smaller amounts of equity investments than warranted by the quality of demand. On the other hand, London and the North East received relatively higher number of deals and volume of equity investments than expected by the quality of demand. We suggest that the effect in the North East may in part be because while there has been a recent increase in tech start-ups in the region many start-ups since the 1980s involved low growth ventures created by individuals made redundant following the demise of traditional industries (Green et al., 2004). On the other hand, there has been a concerted effort to bring funding for start-ups to the North East region, notably from governmental and EU sources. Both methods also show that the next group of regions, in terms of lower provision of equity finance than justified, are the North West, South West and Northern Ireland. Finally, on the other end of the spectrum, both methods show that the London region receives much more than expected based on the company characteristics relative to the actual equity investments.

[48] The threshold matching procedure is similar to propensity score matching employed as a main method in that a logistic regression model is used to estimate the conditional probabilities of obtaining equity funding controlling for a wide range of company characteristics. Next a threshold (or cut-off point) is determined. Companies with a higher value of predicted conditional probability than the threshold are considered as potential targets of equity investors. More details are in the analytical report (Wilson et al., 2018a).

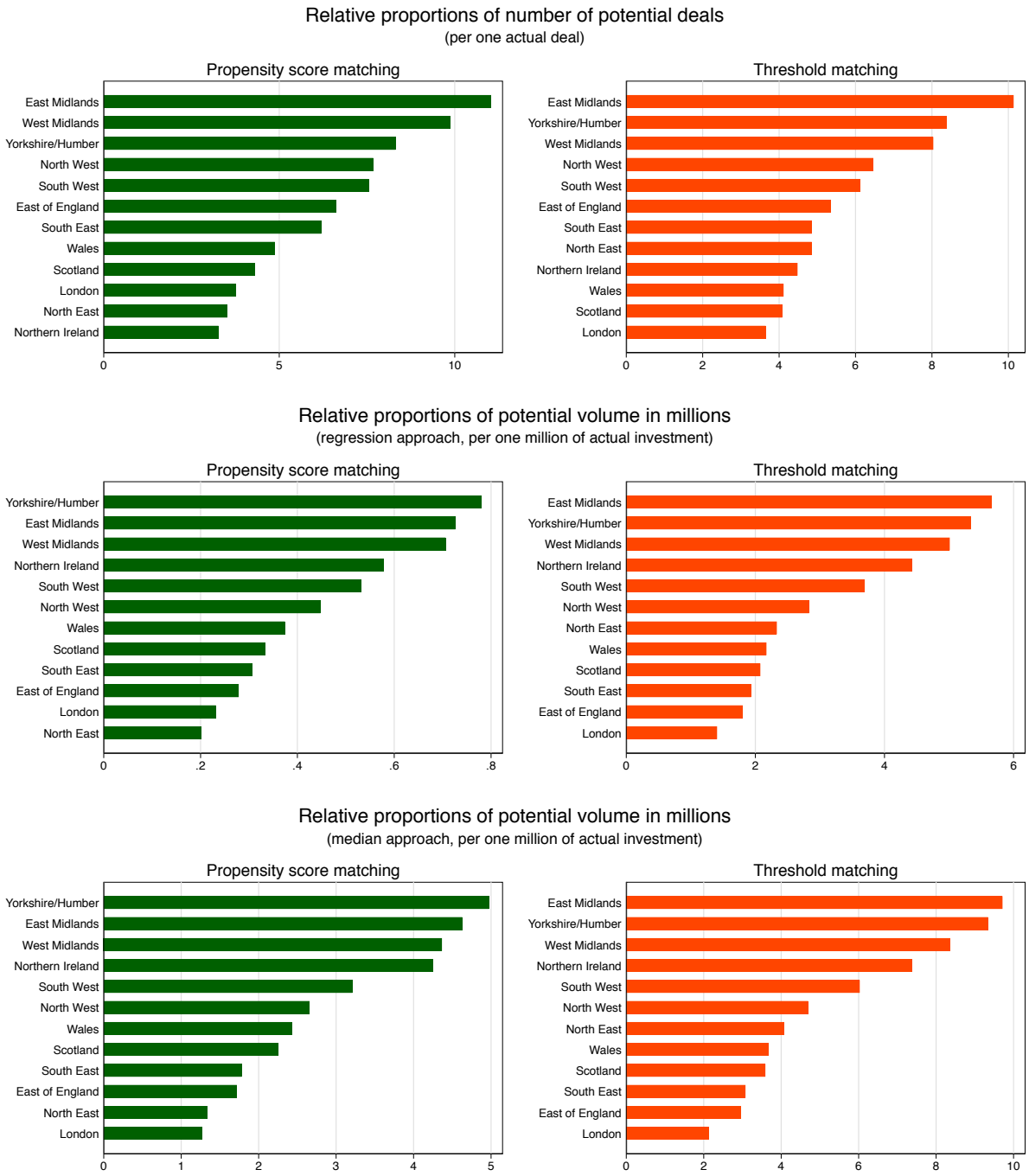


Figure 8: Regional rankings of equity finance demand using alternative methods

Results of matching based on company stage and investor type

Our more detailed analysis, based on a disaggregation of investor types and stages of investment, indicates that regional gaps in equity provision cannot be characterised as a simple 'north-south' divide but there is heterogeneity in equity provision across the different regions outside London and the South East.

There are some important variations when we look at specific investor types. Yorkshire and Humberside, the East Midlands, West Midlands and North West, with varying degree, seem to lack equity deals involving all types of the main four investor types. The North East seems to have relatively low levels of crowd funding investments. Crowdfunding investments seem to be concentrated in the South (urban clusters) when one would expect crowdfunding platforms to reach geographically distributed investors and entrepreneurs. Northern Ireland seems to have a relatively low volume of invested amounts involving private equity/venture capital and private investment vehicles. And the South West receives a relatively low amount of investments involving angel networks. When looking at the stage of equity investment at the deal date (seed, venture and growth stage), Yorkshire and Humberside, the East Midlands, the West Midlands and the North West seem to have the highest potentially unmet demand for equity investments into companies of any stages, even though the East Midlands and the North West appear to be relatively better off in terms of volume of invested amounts in growth stage deals. Regarding other regions, the South West seems to have relatively higher potential demand for seed stage deals while Northern Ireland and Wales seem to have a relatively high potential demand for later stage deals.

The analysis of the stages of company investment by region and the type of investors active in regions provides insights for policy relating to the type of VC investment that might be stimulated across regions. It is clear that the East Midlands, the West Midlands, Yorkshire and Humberside and the North West have demand for all types of equity finance investment although there is evidence that growth finance has relatively better provision in the East Midlands and the North West whereas Yorkshire and Humberside appears to have a requirement for growth finance (potential unsatisfied demand). The South West lacks seed and business angel investment with a potential high demand for this type of equity finance. Northern Ireland and Wales have a shortfall in later stage finance.

Estimates of the aggregate equity gap

The ranking of regions in terms of potential versus actual amounts of equity investments as a measure of potentially unsatisfied demand for equity funding is an important outcome of the demand side analysis. However, a more refined estimate of the aggregate ‘equity gap’ is interesting and useful as an input for policy makers or as a reference point for further discussions. The number of matched companies using the above propensity score matching methodology is simply a function of the chosen calliper size and thus in principle can produce a wide range of estimates based on the chosen parameter.

To arrive at estimates with more reliability and plausibility, we use the results of the recent Business Finance Survey conducted among SMEs (British Business Bank, 2018a) in order to set some parameters on the likely actual demand. The BBB study showed that between 5% and 7% of the surveyed companies stated that expansion is their main reason for

seeking finance in 2015-2017 (British Business Bank, 2018a, slide 17). These proportions are in line with the results of matching 2.

We use two approaches to arrive at possible deal values – regression approach and median approach. The results obtained using the regression approach are more conservative while results using the median approach point to a wider 'equity gap' and consequently to a higher additional demand for equity financing. Regression approach is much more conservative since the multivariate regression model explaining equity deal values takes into account a wide range of company characteristics. The results obtained using median approach are less restrictive since they take into account just total assets of potential equity targets.

The 'equity gap' calculations based on median approach are potentially an overestimate unless we take into account two other important factors: firstly, many businesses that are suitable for equity finance may not wish to apply for it and dilute their equity stake and secondly, equity investors have a relatively high rejection rate so the potential target pool would not all be funded in practice. Thus we apply two discounting factors to the preliminary estimates from median approach. The first parameter (the proportion of the companies willing to accept outside investors) is set to 17% since according to the survey about 17% of SMEs would consider applying for equity finance in future (British Business Bank, 2018a, slide 35). The second parameter is set to 54% since Cosh et al. (2009) found that 46% of respondents approaching VCs had experienced rejection (Cosh et al., 2009). However, this parameter may be an overestimate since the rejection rate refers to the whole spectrum of companies without any prior screening. The fact that a company has been matched may be considered as an initial screening and thus the rejection rate applied on a pre-screened population of potential targets would likely be smaller. That is why we present two adjustments of the equity gap estimates using the median approach. Firstly, we apply the discount factor of 17% corresponding to average willingness of surveyed SMEs to accept the equity investors to the results of Matching 2. Secondly, we apply the overall discount factor of 9.18% (17% * 54% = 9.18%) corresponding to both willingness to accept the equity investor and rejection rate of equity investors. This produces a range for a realistic estimate of the actual 'equity gap'.

The results of the aggregate 'equity gap' estimates for 2017[49] are shown in Table 16. The first part (the third and the fourth columns) shows the estimates using the regression approach and the second part (from the fifth column onwards) shows the results using the median approach adjusted for willingness of the SMEs accept equity funding and the rejection rate of venture capitalists.

[49] Presenting the figures for whole period of 2011-2017 would necessarily involve some double counting because some companies would be counted more than once. That is why we present figures for the last available year.

Table 16: Estimates of the potential 'equity gap' for 2017

	Actual stock	Regression approach		Median approach			
		Unadjusted estimates		Adjusted estimates Unwillingness		Adjusted estimates Unwillingness + Rejection	
	£ mil	£ mil	% of actual	£ mil	% of actual	£ mil	% of actual
East Midlands	59	511	863%	689	1165%	372	629%
Yorkshire/Humber	96	565	588%	736	767%	398	414%
West Midlands	126	635	502%	798	631%	431	341%
Northern Ireland	28	114	408%	160	571%	86	308%
South East	671	1,612	240%	1,869	278%	1,009	150%
Wales	101	219	217%	299	298%	162	161%
South West	370	763	206%	932	252%	503	136%
Scotland	267	516	193%	616	231%	333	125%
North West	454	861	190%	1,009	222%	545	120%
East of England	561	861	153%	1,154	206%	623	111%
North East	139	136	98%	174	125%	94	67%
London	4,578	3,675	80%	3,618	79%	1,954	43%
Total	7,450	10,466	140%	12,055	162%	6,510	87%

Notes: The table presents estimates of the potential 'equity gap' for 2017. The second column shows the actual volume of equity investments in 2017. The third and the fourth columns show the estimates of 'equity gap' obtained using regression approach, the volume in £ mil (third column) and percentage of actual stock (fourth column). The fifth column shows the figures from median approach adjusted for the unwillingness of SMEs to apply for the equity finance. The sixth column shows the percentage of the former column in relation to the actual stock of equity investments. The seventh column shows the estimates of the 'equity gap' from median approach adjusted for both the unwillingness of some SMEs to receive external investors and rejection rate of equity investors. The last column shows the percentage of the former column in relation to the actual stock of equity investments. The regions are sorted in descending order based on the fourth column (relative size of 'equity gap' obtained using regression approach). Also, the fourth and the last columns are coloured based on the relative size of the 'equity gap'.

Using the regression approach for imputing the equity deals, the total potential demand for equity financing in the UK is in the range of £10.47bn. The greatest additional demand in absolute terms seems to be in London (£3.68bn), followed by the South East (£1.61bn), the East of England and the North West (£861 mil each) and the South West (£763 mil). The West Midlands, Yorkshire and Humberside and the East Midlands have similar situation in that the potential 'equity gap' is approximately in the region of £511 mil - £635 mil. Scotland follows closely after them (£516 mil). The lowest volumes of potential additional demand for equity funding seem to be in Wales (£219 mil), the North East (£136 mil) and Northern Ireland (£114 mil). In relative terms, the highest relative demand for the additional equity funding in relation to the actual stock has the East Midlands (863%), followed by Yorkshire and Humberside (588%), the West Midlands (502%) and Northern Ireland (408%). At the other end of the spectrum, there is London (80%) and the North East (98%).

Using the median approach points to the potential additional demand for equity financing in the UK in the range from £6.5bn - £12bn. In absolute terms, the greatest demand is in the London region (£2bn - £3.6bn), followed by the South East (£1bn - £1.9bn). The next regions are the East of England (£0.6bn - £1.2bn), the North West (£0.5bn - £1bn), the

South West (£0.5bn - £0.9bn), the West Midlands (£431 mil. - £798 mil.), Yorkshire and Humberside (£398 mil. - £736 mil.), the East Midlands (£372 mil. - £689 mil.) and Scotland (£333 mil. - £616 mil.). The regions with the smallest levels of additional demand for equity funding are Wales (£162 mil. - £299 mil.), the North East (£94 mil. - £174 mil.) and Northern Ireland (£86 mil. - £160mil.). When we compare the estimates of the additional demand with the actual stock of equity investment, the regions with the highest relative demand are the East Midlands (691%-1165%), Yorkshire and Humberside (414%-767%), the West Midlands (341%-631%) and Northern Ireland (308%-571%). The London region (43%-79%) and the North East (67%-125%) are the regions with the lowest relative demand for equity funding.

Analysis that breaks down the total equity gap by investment stage suggests £3.1bn is required at seed stage; £2.6bn at venture stage and £4.8bn for growth finance. The breakdown by investment stage and region is presented in Table A4 in Appendix.

Conclusions from demand side analysis

In this part of the study, we analysed the potential additional demand for equity funding in the individual regions by predicting potential targets of equity investors. Firstly, we focused on the relative ranking of the regions. We found that the greatest unmet potential demand for equity finance is in Yorkshire and Humberside, followed by the West Midlands, the East Midlands and Northern Ireland. The smallest unmet demand is in the North East and London. Secondly, using a set of plausible assumptions we arrived at the figures of the potential ‘equity gap’. We take into account the proportion of companies seeking finance for expansion, the proportion of companies considering equity finance in the future and the acceptance rate of equity investors. We found that the overall additional demand for equity funding in the UK in 2017 is in the range of £1-6.5bn, corresponding to 13% to 87% of the actual stock of equity funding.

Conclusions and Recommendations

The results of this study provide a quantitative assessment of equity finance demand, the 'equity gap' and evidence of regional disparities in the provision of equity finance in the UK. The analysis confirms a rationale for government intervention to address the financing problems in the SME sector and to address the particular issues facing innovative and high technology new start-ups and growing ventures facing funding challenges the stages of commercialisation and growth. In the UK the Enterprise Investment Scheme and Venture Capital Trusts are long-standing tax incentives to encourage investment in small and growing businesses introduced in the mid 90's. Amendments to the legislation in 2015[50] attempted to tailor these schemes to focus investments on a subset of knowledge intensive companies falling within specific size and age bands. There is potential to further stimulate equity finance provision and to help to address the general issue of an unmet demand or equity gap and the regional imbalance.

Our analysis indicates that the regional imbalance in equity finance investments is not merely a demand side issue and action to incentivise investors to locate branches (or funds) within the regions could stimulate regional growth; this may involve a reversal of recent trends for investors to retreat from regional locations. The issue of 'information asymmetry' is often cited as a cause of the equity gap, i.e. investors find it difficult to find and assess investable opportunities and investees lack both awareness of the equity financing options and the experience to structure and negotiate deals. The provision of information for both investors (business intelligence) and potential investees (available schemes, director mentoring, legal advice) could stimulate investment activity. For instance, our methods, used for screening the corporate population, could be a useful tool for equity fund managers seeking to identify potential opportunities of later stage ventures prior to their more detailed investigation and due diligence. Efficient and consistent screening may help alleviate the funding gap.

An important ingredient of success in the acquisition of equity finance is the firms' engagement, at an early stage, with networks of potential investors (VC's, Business Angel networks) and/or with individuals (directors) who have had experience of raising equity finance in the past. Our proxy for this type of activity in our analysis is the firms' appointment of directors with equity finance experience. Policies that are geared to

[50] The aim of the amended EIS/VCT scheme is to support the growth of certain SMEs and knowledge-intensive SMEs and mid-caps which due to their early developments stage, would otherwise struggle to have access to finance due to an insufficient track record and/or poor collaterals. For this purpose, tax incentives are provided under the scheme to private individuals (natural persons) investing in qualifying companies (EIS), or in financial intermediaries (VCT), which carry out the eligible investments". *European Commission, Brussels, 09.10.2015 C(2015) 6841 final*

incentivise such individuals to offer their experience and policies to allow firms to attract and retain key employees could be beneficial. For instance, schemes such as the Enterprise Management Incentive (EMI), a tax-advantaged share option scheme, could be a relevant policy instrument.

Our finding of regional differences in the extent to which family firms are significantly less likely to have external equity funding also has implications for policy. Notwithstanding the general view of family firms, there is recognition that taking advantage of entrepreneurial and innovative opportunities may be important for their growth and survival and which may involve the taking on of external equity and expertise. There may be opportunities as part of scale-up policies to engage with family business organizations and advisors to promote the attractions of taking on external equity in family businesses and to devise innovative ways to maintain family control. Many family firms also face a succession challenge, with management buyouts and buy-ins being an important solution where there is a lack of next generation family members to take over the business. Closure of regional office networks by private equity firms like 3i and a lack of locally available finance to fund smaller deals may help explain the drop in volumes of this kind of deal. Recent years have seen the emergence of private equity firms targeting the smaller end of the market and there may be opportunities to develop initiatives to further encourage this development that may help provide equity funding in the regions where many of these deals are likely to be located.

In conclusion

- Demand:
  - Although insufficient demand does not seem to be the main problem (based on the estimates of the 'equity gap' provided), there appears to be scope to enhance support for family run businesses to encourage them and enable them to take more external equity. Further work might identify the financing requirements of employee-owned firms.
  - Awareness of equity finance options among firms is frequently cited as an important demand side factor. Government activities aimed at increasing the awareness, especially in areas without active equity investors, could play a significant role in promoting the attraction of the equity financing.
  - Government scale-up policies could do more to engage with family business organizations and advisors to promote the attractions of taking on external equity in family businesses and to devise innovative ways to maintain family control. For example, the development of group structures might be a way to ring fence overall family control while enabling external equity to be raised for subsidiaries with unrealised growth opportunities.
  - Family firms facing succession challenges with incumbents reluctant to cede control outside the family yet disengaging from the business may be foregoing growth opportunities that external equity can facilitate. Government policy might usefully introduce financial incentives and advisory support to encourage private equity backed management buyouts and buyins as an important solution in such cases.

- Supply:
  - Government policy could further stimulate equity finance provision by reviewing, refining and extending existing schemes to help address the general issue of a potential unmet demand or equity gap.
  - Government policy could also stimulate regional investment through incentives to encourage investors to locate branches or funds within the regions.
  - Policies designed to increase firm engagement with funding networks and individuals or directors with equity finance experience in their development phases could be beneficial along with the tailoring of share schemes designed to attract and retain key employees.
  - Greater scope for government involvement as a syndicated investor could be important in attracting private investment to the regions.
  - We have shown that it is possible for equity fund managers to identify potential opportunities in the regions among the population of firms, prior to their more detailed investigation and due diligence relating to managerial capabilities, products, market potential, etc. More efficient and consistent screening may help alleviate the funding gap.

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Annex A. Additional charts

Distance between company and investor's nearest office (all companies, time period 2011-2017)

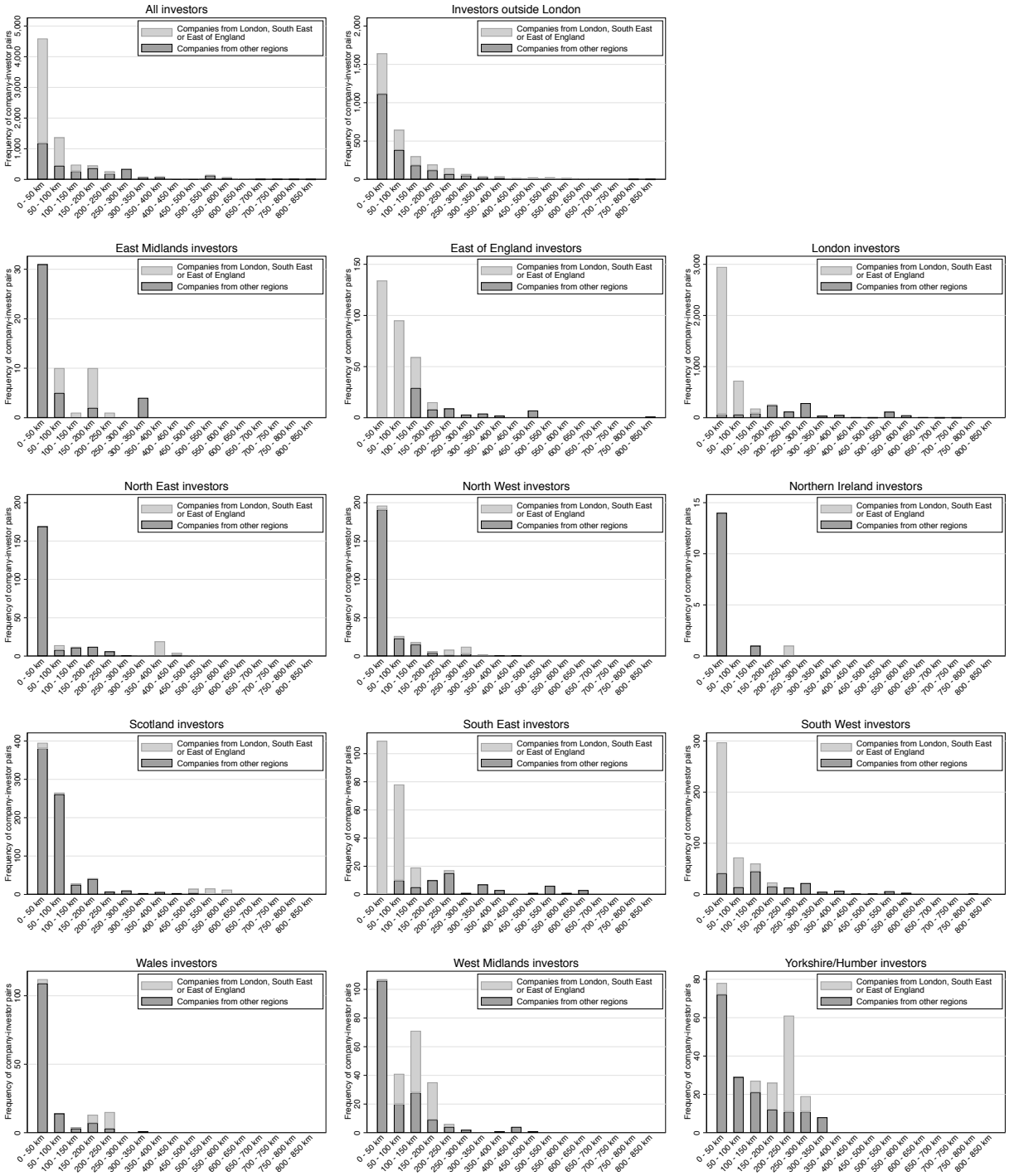

Figure A1: Spatial Proximity – frequencies of investor-company pairs by distance bands (2011-2017)

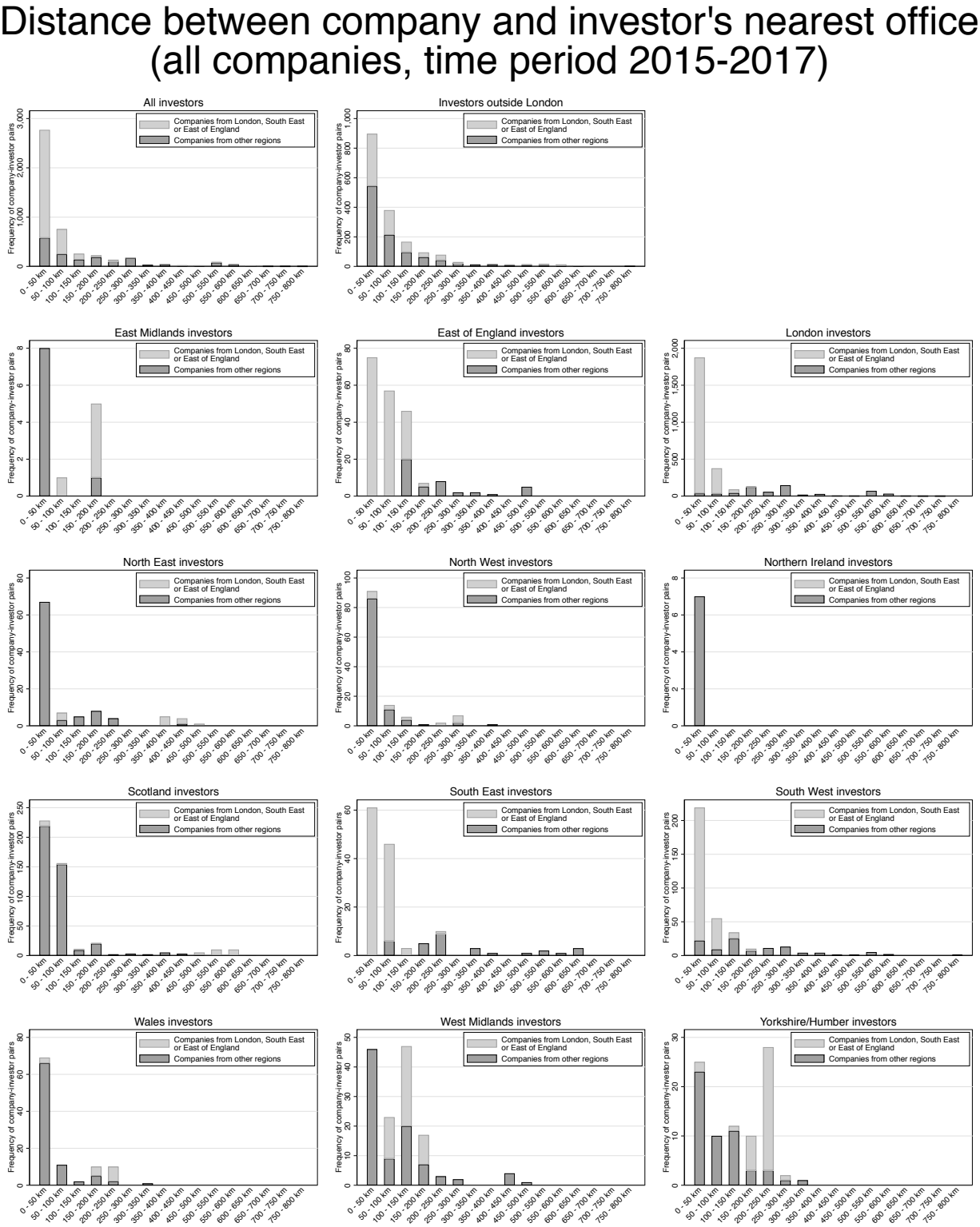

Figure A2: Spatial Proximity – frequencies of investor-company pairs by distance bands (2011-2017)

Annex B. Additional tables

Table A1 Multivariate models explaining the number of deals in each region

	Model specification				
Explanatory variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Number of SMEs (log)	0.954***	1.076***	0.724***	0.723***	0.752***
	(6.42)	(13.95)	(9.84)	(8.02)	(10.30)
Proportion of HGFs		890.8***	948.1***	782.7**	877.0***
		(3.98)	(4.56)	(2.88)	(5.05)
Proportion of HTKIs			8.542***	7.467**	6.688***
			(3.15)	(2.34)	(3.14)
Proportion of new firms				7.714*	
				(1.84)	
Year 2012					0.367***
					(3.82)
Year 2013					0.486***
					(4.73)
Year 2014					0.820***
					(7.81)
Year 2015					0.871***
					(9.40)
Year 2016					0.745***
					(5.22)
Intercept	-6.618***	-9.552***	-8.657***	-9.201***	-8.735***
	(-3.86)	(-8.93)	(-11.38)	(-10.21)	(-11.53)
Observations	84	72	72	72	72
R^2	0.547	0.763	0.814	0.819	0.898
St. errors	Robust	Robust	Robust	Robust	Robust

Notes: The table shows five model specifications explaining the number of equity deals in a given region and year. In each model, the dependent variable is the logarithm of number of equity deals per region and year (in logarithms), i.e. the unit of analysis is region and year. The models are estimated using ordinary least squares method. t-statistics are in parentheses and are calculated using the standard errors are adjusted for clusters in regions. Statistical significance of estimated coefficients is denoted with asterisks (* p<10%, ** p<5%, *** p<1%). SME stands for number of active small and medium-sized enterprises. HGF stands for high-growth firm (more than 10 employees and average annual growth in employment during 3-year period over 20%). HTKI stands for high-technology manufacturing or knowledge-intensive company (Eurostat definition, source http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf). The proportion of new firms is calculated with respect to number of active small and medium-sized enterprises. Variables Year 2012 to Year 2017 stand for indicators of those years.

Table A2 Presence of investors in regions

Panel A. Number of unique investors by head office and year

	2011	2012	2013	2014	2015	2016	2017
East Midlands	5	8	8	2	6	3	2
East of England	14	8	11	13	11	18	11
London	91	126	138	190	231	223	244
North East	10	9	7	8	12	10	8
North West	9	12	17	18	19	19	13
Northern Ireland	0	1	2	1	1	1	0
Scotland	22	21	28	27	35	30	35
South East	13	11	21	21	18	20	20
South West	2	3	6	8	10	8	8
Wales	3	3	4	6	10	7	9
West Midlands	9	10	17	12	10	11	13
Yorkshire/Humber	10	9	7	12	6	10	11

Panel B. Number of offices by region and year

	2015			2016			2017		
	head	**branch**	**total**	**head**	**branch**	**total**	**head**	**branch**	**total**
East Midlands	6	4	10	3	5	8	2	4	6
East of England	11	7	18	18	9	27	11	9	20
London	231	16	247	223	12	235	244	16	260
North East	12	3	15	10	4	14	8	4	12
North West	19	21	40	19	18	37	13	18	31
Northern Ireland	1	0	1	1	0	1	0	0	0
Scotland	35	18	53	30	16	46	35	19	54
South East	18	7	25	20	5	25	20	6	26
South West	10	6	16	8	6	14	8	6	14
Wales	10	7	17	7	7	14	9	5	14
West Midlands	10	9	19	11	8	19	13	10	23
Yorkshire/Humber	6	9	15	10	6	16	11	9	20

Notes: The table shows presence of equity investors in regions. Panel A shows the number of unique investors or funds that financed at least one company in our sample of equity deals broken by head office region of the investor and deal year. Panel B shows the number of unique offices by region and year. The information about the branches was as of June 2018 that is why only last three years are shown since going back further the information about the branches may not be reliable. Also, the identity of at least one investor was known only for about one third of equity deals and that is why the indicated numbers may not be representative of the population.

Table A3 Determinants of cross-region investments

	Model specification			
Explanatory variables	**(1)**	**(2)**	**(3)**	**(4)**
Deal value	1.34e-08***	1.40e-08***	1.30e-08***	1.35e-08***
Private_investment_vehicle	-0.258***	-0.268***	-0.255***	-0.264***
Crowd_funding	-0.265***	-0.246***	-0.260***	-0.244***
Angel_network	-0.521***	-0.570***	-0.538***	-0.580***
Local and Regional Government	-1.236***	-1.214***	-1.232***	-1.212***
Devolved Government	-2.221***	-2.196***	-2.239***	-2.216***
Corporate	1.034***	1.027***	1.038***	1.033***
Commercialisation Company	0.0372	0.0118	0.0182	-0.00302
Accelerator	-0.839***	-0.827***	-0.804***	-0.795***
Central Government	1.621***	1.614***	1.601***	1.596***
University	-0.0214	-0.0562	-0.0424	-0.0717
Charity/Not-for-profit company	0.463**	0.444**	0.462**	0.445**
Other/Unknown	1.022***	1.021***	1.031***	1.029***
Publicly announced deal	0.267**	0.279**	0.279**	0.289**
Venture	0.0386	0.0325	-0.0205	-0.0225
Growth	0.156**	0.159**	0.0915	0.0981
Government involvement		0.182**		0.159**
Equity finance experience			0.191***	0.181***
Time dummies	yes	yes	yes	yes
Constant	0.163	0.134	0.0540	0.0348
Observations	9899	9899	9899	9899
Pseudo-R^2	0.0929	0.0934	0.0939	0.0943
St. errors	Clustered	Clustered	Clustered	Clustered

Notes: The table shows four model specifications explaining the investments outside home or branch office regions of investor (cross-region investment). In each model, the dependent variable is the indicator of cross-region investment. The unit of analysis is investor-investee pair. The models are estimated using logistic regression. Statistical significance of estimated coefficients is denoted with asterisks (* p<10%, ** p<5%, *** p<1%), they are based on the standard errors adjusted for clusters in syndicated deals.

Table A4 Estimates of 'equity gap' by company stage for 2017

Panel A: Seed

	Actual stock	Regression approach		Median approach			
		Unadjusted estimates		Adjusted estimates Unwillingness		Adjusted estimates Unwillingness+Rejection	
	£ mil	£ mil	% of actual	£ mil	% of actual	£ mil	% of actual
East Midlands	4	135	3080%	65	1486%	35	803%
Yorkshire/ Humber	13	163	1248%	73	558%	39	301%
South West	33	224	679%	106	322%	57	174%
North West	51	280	544%	129	250%	70	135%
West Midlands	36	187	516%	85	235%	46	127%
North East	9	43	501%	21	248%	11	134%
Scotland	46	163	356%	82	178%	44	96%
South East	170	484	285%	218	128%	118	69%
Wales	25	60	242%	30	122%	16	66%
Northern Ireland	8	19	223%	11	126%	6	68%
East of England	118	260	221%	127	108%	69	58%
London	781	1,063	136%	457	58%	247	32%
Total	1,295	3,082	238%	1,404	108%	758	59%

Panel B. Venture

	Actual stock	Regression approach		Median approach			
		Unadjusted estimates		Adjusted estimates Unwillingness		Adjusted estimates Unwillingness+Rejection	
	£ mil	£ mil	% of actual	£ mil	% of actual	£ mil	% of actual
East Midlands	23	124	537%	120	517%	65	279%
North East	10	33	343%	32	333%	18	180%
Yorkshire/ Humber	47	144	304%	134	282%	72	152%
West Midlands	54	161	299%	151	280%	81	151%
Northern Ireland	12	30	247%	28	231%	15	125%
South East	220	419	190%	380	172%	205	93%
Wales	44	66	149%	59	132%	32	72%
North West	154	202	131%	189	122%	102	66%
Scotland	129	132	102%	126	98%	68	53%
South West	218	222	101%	181	83%	98	45%
East of England	253	221	88%	217	86%	117	46%
London	1,497	858	57%	641	43%	346	23%
Total	2,662	2,612	98%	2,255	85%	1,218	46%

Panel C. Growth

	Actual stock	Regression approach		Median approach			
		Unadjusted estimates		Adjusted estimates Unwillingness		Adjusted estimates Unwillingness+Rejection	
	£ mil	£ mil	% of actual	£ mil	% of actual	£ mil	% of actual
Northern Ireland	8	66	867%	122	1601%	66	865%
East Midlands	32	251	795%	504	1595%	272	861%
West Midlands	36	287	788%	563	1548%	304	836%
Yorkshire/ Humber	36	257	723%	530	1488%	286	804%
Wales	31	92	295%	210	671%	114	362%
South West	118	317	267%	645	544%	348	294%
South East	281	709	253%	1,271	453%	686	244%
Scotland	92	221	240%	409	444%	221	240%
East of England	190	379	199%	810	425%	437	230%
North West	248	379	153%	692	279%	373	151%
London	2,300	1,755	76%	2,520	110%	1,361	59%
North East	121	60	49%	120	99%	65	54%
Total	3,493	4,773	137%	8,395	240%	4,533	130%

Notes: The table presents estimates of the potential 'equity gap' for 2017 broken down by company stage. To obtain the results we firstly run the model (multinomial logit) explaining the company stage – seed, venture, growth – among the actual equity investments. Then the estimated coefficients were used to predict the company stage for potential equity investment targets. For each potential equity target, the deal value was predicted using either regression or median approach. In Panel A the results are aggregated for predicted seed stage companies, in Panel B for venture stage companies and in Panel C for growth stage companies. In each panel, the third and the fourth columns show the estimates of 'equity gap' obtained using regression approach, the volume in £ mil (third column) and percentage of actual stock (fourth column). The fifth column shows the figures from median approach adjusted for the unwillingness of SMEs to apply for the equity finance. The sixth column shows the percentage of the former column in relation to the actual stock of equity investments. The seventh column shows the estimates of the 'equity gap' from median approach adjusted for both the unwillingness of some SMEs to receive external investors and rejection rate of equity investors. The last column shows the percentage of the former column in relation to the actual stock of equity investments. The regions are sorted in descending order based on the fourth column (relative size of 'equity gap' obtained using regression approach). Also, the fourth and the last columns are coloured based on the relative size of the 'equity gap'.

Annex C. Private equity profile

PE investors focus on single product/service targets. This supports the hypothesis that PE tends to target companies with defined markets and uncomplicated product lines. The results support the notion that private equity investors have and continue to target companies outside of the knowledge intensive sector and choose targets that are more established, cash generative and profitable but can benefit from restructuring and further capital investment.

The profiling of private equity targets, using a multivariate technique that assesses all firm level characteristics simultaneously, generates a range of significant characteristics. Private equity targets tend to be established companies in terms of age and size and are more likely to have a higher proportion of tangible assets. The targets are in stable industry sectors with a lower than average failure rate and are less likely to be diversified (single product). Amongst the riskier sectors private equity investors have a preference for advanced manufacturing technologies and the high technology end of the services sector. The firms that private equity investors target are generally cash generative, profitable and have high interest coverage ratios on existing debt. The target firms are likely to have borrowed and have charges on assets. These firms have lower levels of equity and lower than average productivity thus providing opportunities for investors to realise performance improvement, and growth, post investment.

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