Peripheries in peripheries – within-region differences in financial constraints

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Abstract

Earlier literature has analysed regional finance gaps by comparing metropolitan areas with peripheral areas on a relatively high level of aggregation and most often in a U.S. or U.K. venture capital context. Financial capital has been found to be concentrated in metropolitan areas and access to capital easier because entrepreneurs leverage on proximity to capital providers. However, regardless of whether it is metropoles, when there is an urban centre of a certain size or relative dominance in a region, it can be hypothesized that financial capital is likely to be attracted to this urban centre even within a peripheral region. The literature has been silent regarding financial ‘centres’ within peripheral areas. Survey responses from managers in 834 firms are used in the empirical analyses. We find indications of differences in whether firms are financially constrained depending on the levels and types of geographical aggregation that are used in the models. In other words, even within the periphery there is a periphery-core difference. Intra-regional differences accentuate the need for considering the appropriate regional level of policy making and the policy instruments. The paper contributes specifically to the analysis of geographical scale in regional financial constraints. The issue of scale is in the core of economic geography yet often disregarded both in research and in the process of designing regional policies. On a general level of aggregation it contributes to a better understanding of regional policies for financing entrepreneurship and innovation.
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1. **Introduction**

Both in academia and among policy makers, it has for decades been discussed whether firms are excessively hindered in their development by a lack of financing and whether there is a rationale for government intervention to alleviate some of the financial constraints that firms encounter. Traditional arguments why firms often are financially constrained on their innovation investments evolves around the asymmetric information between investor and investee (Stiglitz and Weiss, 1981), the nature of investing in knowledge and innovation (Hall, 2010), and firms’ characteristics (Storey, 1994). Regarding the latter the literature on financial constraints has primarily focused on characteristics and behaviour of firms pertaining to their liabilities of smallness and newness, or to their risk profile stemming from their industry, market, or innovativeness. However, additional characteristic of financially constrained firms concerns their location. In addition to small, new and innovative firms, firms in peripheral areas are also claimed to be particularly financially constrained, as further argued in section two. Regional innovation policies at super-national, national, and regional levels of aggregation have therefore introduced an array of regional innovation financing instruments and –institutions such as regional venture capital funds, Regional Development Agencies, regional loan funds, ERD funding etc. Despite the policy interest, we know relatively little on this aspect of financial constraints, and the studies we do have suffer from fundamental limitations. Generally, the approach adopted in the literature consists of analysing regional disparities with respect to financial capital between prosperous and peripheral regions, where regions are most often defined as political-administrative regions, or between a major metropolitan area and other parts of a country. For example, Zhao and Jones-Evans (2017) study differences in access to finance in Nuts1 regions in the UK. Pre-determined regions on a high level of aggregation is the point of departure for studying regional disparities in the access to finance. Although briefly discussing such disparities between regions, the present paper adopts a novel approach by exploring whether there are intra-regional differences in the financial gaps between firms in urban areas and firms in peripheral areas even within a peripheral region. Hence, when Zhao and Jones-Evans find that access to finance is difficult in Wales compared to other regions in the UK it would perhaps be more interesting to know if there are e.g. differences between Cardiff in Wales and the rest of Wales, or if the patterns found for e.g. Scotland hide within-Scotland differences.\(^1\)

Therefore, the core research question and hypothesis tested in this paper is that in the context of an urban centre of a certain size or relative dominance, financial capital is likely to be attracted to such an urban centre despite the general tendency for the capital in a country to be clustered in the major national city. If this hypothesis holds true, then the use of only averages to compare regions defined at a high level of aggregation, and possible by political-administrative boundaries may be misleading or may render incomplete results and lead to inexpedient policy conclusions. This accentuates the present research, which ultimately sets a research agenda about defining the appropriate geographical scale for discussing potential funding gaps. Generally the literature has neglected this problem area despite the fact that it is important to not only research, but also policy. Several earlier studies have called for research along these lines (Lee and Drever, 2014, Zhao and Jones-Evans, 2017), however, most data sources do not allow a sufficient geographical break down.

The validity of the hypothesis that there is likely to be centre-periphery dynamics also within peripheries may be contested if there is a pre-selection of firms through the location, i.e. certain firms who typically experience financing constraints may be attracted to peripheral areas regardless their perception of financing constraints, thus their characteristics other than the regional location are the primary explanatory factors (Lee and Drever, 2014). Earlier research (Lee and Cowling, 2012) look into if obstacles as perceived by firms in deprived areas of the UK differ from other firms, or if they are explained by their characteristics. Whereas different perceptions

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\(^1\) It should be recognized that these authors themselves point to this limitation of their study and they call for further studies on a more disaggregated level.
of the majority (8 of 9) of obstacles to SMEs' development are not explained by the location of the firm, access to finance stand out in their study as being related to the location in deprived areas. Contrary, Lee and Brown (2017) find that innovative firms in peripheries find it harder to obtain finance and that firms in these areas also are more likely to be discouraged from applying.

A large share of the earlier studies of access to finance in a geographical perspective have studied venture capital finance, and often the case regions have been either Boston and Silicon Valley in the U.S. or Cambridge and the Southeast region in the U.K. These are places in which industrial evolution and finance functions well, and they are not representative for the vast majority of regions. Our study goes beyond these areas hence contributes to extending our knowledge of the geography of financial constraints. Moreover, even if specialised forms of finance like venture capital may be important to industrial evolution the broad majority of firms do not access venture capital rather relies on bank finance. By incorporating all types of finance for investment purposes, we obtain more complete information on the access to finance landscape. The study is focused on cities that in an international context are relatively small, which in itself is novel in this literature. Finally, our data allows a geographical break down that entail small areas.

This paper specifically focuses on whether there is a financing gap within a peripheral area, North Jutland, Denmark. Our case region is well suited for answering the question of a potential ‘second-order’ periphery, as it is a peripheral area in Denmark but has a clear urban centre, Aalborg. Much of the region’s economic activity and many of its high-tech industries are located in this city. Firms in this centre could be expected to attract the attention of financiers away from firms in more peripheral areas potentially causing these firms to be deprived of financing. Denmark is said to have relatively small regional differences, which makes it an expedient context to study these problems in because potential problems, if identified in this context, are likely to be exagrebated in other countries.

The analysis is based on data from surveys of 834 private firms in North Jutland covering different aspects of access to capital. To control for possible variance over time data cover four years, 2010-2013 with yearly, consistent surveys. The time period analysed is focused on when the financial crisis is expected to have the hardest negative consequences for access to finance. This provides additional insight into financial constraints during tight credit conditions.

In section two, the paper provides a discussion of theories and earlier studies that may render a justification for the hypothesis that is tested in the paper. Moreover, it provides a conceptual background for financial constraints from a geographical perspective. While providing the broad conceptualisation on geographies of finance we realise that we embark on such geographies that are not tested in our empirical analyses. The third section presents the data and methodology as well as the case region, North Jutland. The results concerning potential intra-regional differences are presented in section four, and the conclusion and discussion of policy implications are presented in section five.

2. Earlier literature on the geography of financial constraints

2.1. Financial gaps

Whether firms are excessively constrained on access to finance has been a persistent and recurrent topic throughout the history of both academic and policy debates. Although the lack of financing appears to have been an enduring theme, the discussion intensified as a result of the financial crisis and the subsequent increase in financial constraints that are imposed on a broad range of firms (North et al., 2013, Cowling et al., 2012, Vermoesen et al., 2013, Appleyard, 2013, Ningh et al., 2015, Cowling, 2018). As a result the public sector has gained increased importance as an investor and co-investor (Mason and Pierrakis, 2013). It has, though, also been contested if there is a finance gap and if there is, how severe it really is (deMeza and Webb, 1987), and if policy intervention to alleviate constraints for entrepreneurs is at all justified (Nightingale and Coad, 2013, Acs et al., 2017).
The above-mentioned studies and several other studies have primarily focused on differences between firms of different size classes, age, and industries in terms of the extent to which such firms are financially constrained. In particular, small and new firms appear to experience more financial obstacles as a result of severe problems with liabilities of newness and smallness, asymmetric information, agency problems and the high fixed costs of screening and monitoring such firms compared with the potential for profit for financing institutions (Murray, 1999, Gertler, 1988, Fazzari et al., 1988, Beck et al., 2006, Canepa and Stoneman, 2008, Carreira and Silva, 2010, Hall, 2010, Canton et al., 2013, Mina et al., 2013). Research also finds that firms who display fast growth see finance as a barrier (Lee, 2014). The common belief that innovation financing and funding of ‘gazelles’ enhances growth and employment (Commission of European Communities, 1998, Mason and Harrison, 2002, 2003, Sunley et al, 2005, Mason and Brown, 2013) but that market failure exists regarding the financing of these types of firms has encouraged policymakers to initiate regional, national and supranational programmes to support innovation and high-growth firms financing (European Commission/JRC, 2016).

Innovative firms are also believed to experience financial constraints. This belief may be explained by the intrinsic uncertainty and increased problems with asymmetric information related to innovation that may result in credit rationing or excess interest rate premiums. Financial constraints can be assumed to increase with the rate and radicalness of the firm’s innovation activities. This is because the information required to correctly assess innovative ventures is usually (i) private, and thus only given voluntarily since firms may fear misuse and be reluctant to share it; (ii) complex, thus requiring in-depth knowledge regarding applied technologies or market circumstances; (iii) to a large extent tacit, thus requiring spatial proximity and face-to-face contact with financiers in order to be transferred and (iv) innovation processes are reliant upon and embedded in human capital, which is often volatile and not easily maintained in the firm. The intangible nature of many innovation processes, and the fact that they have long time lags from initiation to returns, means that financiers are faced with projects for which they have little possibility of estimating the returns, as well as poor options to cover the risk by way of collateral (Hall, 2010). As discussed more below, it is clear that several of the arguments pertaining to financial constraints involves geographical elements.

2.2. Concentration of financial capital

The economic geography literature on financial constraints has generally been relatively scarce (Pollard, 2003). Likewise, the entrepreneurial finance literature has not sufficiently examined the geographical aspects of finance (Mason, 2010). Two decades ago, a body of literature that could be termed the ‘geography of money’ highlighted the skewed spatial distribution of the supply of financial capital (Florida and Kenney, 1988, Martin, 1989, 1999, Mason and Harrison, 2002, Zook, 2002, Powell et al., 2002). A vast body of literature has followed these contributions, also focused on a broader array of types of finance than entrepreneurial finance such as housing finance, financial centres, pension funds, retail banking etc. Rather than spanning this rather diverse literature the geographical perspectives on money and finance is below focused on entrepreneurial finance and primarily exemplified by the literature on the concentration of formal venture capital as a reference point. Venture capital is often referred to as an important driver for entrepreneurship and economic evolution (Chen et al., 2010, Peneder, 2010) and has been subject to many empirical studies, also of the geography of venture capital (Mason, 2007, 2010). Venture capital funding make up a very small proportion of the external financing for firms, however, the principles and conceptual considerations in this section apply to other types of financing as well. Even within this category of entrepreneurial finance complexity and heterogeneity prevails. Informal venture capital, institutional venture capital, corporate venture capital, and private equity have different geographies (Mason, 2007). It is nevertheless illustrative for our point.

One of the conclusions from studies of the geography of venture capital is that a disproportionate share of financial capital is managed and invested in metropolitan areas (Martin et al., 2002, 2003; Mason and Harrison, 2002,), and the location of venture capital firms has typically been in metropoles. In the U.S., California (especially Silicon Valley) and Boston (especially the Route 128 area) attract a large share of U.S. venture capital; for example, California accounts for at least one-third of the total sum of venture capital investments in the U.S. (Powell et al., 2002, Zook, 2002, Mason, 2007). In the U.K., venture capital investment remains highly.

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2 Reviews are in Hall (2011, 2012, 2013). See also Sokol (2013) for an overview.

3 In fact, this effect is sometimes overstated considering the small share that actually receives venture capital funding. However, venture capital may have catalytic effects beyond the immediate effect on individual firms.
concentrated in the London and Southeast regions (Mason and Harrison, 2002). The concentration of finance in the venture capital market is moderated when the data are weighted with GDP shares. However, not only quantitative, also qualitative differences persist; the venture capital funds in more peripheral areas involve public funds to a greater extent, and (related) the differences in amounts invested persist to a larger extent than the number of investments (Mason and Pierrakis, 2013). The informal venture capital market is generally regarded as more evenly dispersed (Gaston, 1989, Harrison et al., 2010), but there is also a concentration of this type of finance, again in the UK in the London and Southeast regions (Jones-Evans and Thomson, 2009). Similarly, Avdeitchova (2009) shows that also in Sweden the informal venture capital is concentrated in metropolitan areas and university cities, hence, cannot live up to the expectations some policy makers have regarding the potential role of this type of finance in bridging the regional equity gap as argued in early literature on business angels (Mason and Harrison, 1995). In fact, her findings regarding the flows of capital indicate that informal venture capital is reallocated from peripheral areas to metropolitan areas and university cities where the concentration already is high. This was earlier studied for other types of finance. Martin and Minns (1995) point out that the UK pension funds stem from British savers dispersed throughout the UK, but the funds are invested in a few, urban areas. On a general level Myrdal (1957) denoted these mechanisms 'regional drainage'. Even if the economic geography literature has pointed out that capital flows change and impact substantially on regional development there has not been similar efforts to provide sufficient and precise explanations why these capital flows emerge and what their magnitude and implications are.

The concentration of financial capital in prosperous, urban areas is found in virtually all countries but to a varying degree. Comparing concentrations of financial capital in the U.K. and Germany, Martin et al. (2003) found that German financial capital is less concentrated and involves a greater number of financial centres. This finding may relate to differences in political-administrative structures and to different city structures, as there are relatively many larger cities dispersed throughout Germany. Therefore, the supply of financial capital, such as venture capital, has been argued to be more evenly dispersed in Germany than in the U.S. and the U.K. (Fritsch and Schilder, 2011). Based on interviews with German venture capital firms Fritsch and Schilder (2008) report that the respondents do not consider spatial distance a problem for investment in new ventures. In contrast, Lutz et al. (2013) find that the likelihood of obtaining external finance in Germany decreases with travel distance between investor and investee. The spatial distance is particular important to less experienced and lead investors, according to these authors.

2.3. Space and a distance decay: an hour-long drive and other transaction costs

Several studies of the geography of entrepreneurial finance have found that investors prefer investing in firms that are not excessively distant from their own locations. With some variance, the distance threshold of business angels’ investments is often referred to as an hour-long drive (Zook, 2002). Preference for proximity to investee firms stem from the fact that transaction costs and search costs are reduced with close spatial proximity. Investors monitor their portfolio firms by providing guidance and act as a sounding board to the management of a firm. Some of the information in this interaction, such as budgets, progress reports and similar codified information can be transferred across distance by mail. However, to build a business relationship with a portfolio firm, investors engage in personal interactions with the portfolio firm to facilitate the transfer of another type of

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1 Mason and Pierrakis (2013) find that the difference in access to finance between the South East of UK and the North England and Midlands has narrowed during the financial crisis, however, it still exists and the partly closing of the gap is due to an increase in publicly funded financing.

2 Other studies refer to slightly longer travel times, such as Sapienza et al. (1996), who refer to 1.5 hours for U.K. venture capital investors, Mason and Harrison (2002) who refer to 2 hours travel times for most (three-quarters) UK business angels, and Florida and Kenney (1988), who refer to 150-250 miles. Fritsch and Schilder (2011) found that 44% of venture capital investments in Germany are within 100 kilometres and that the median distance is 148 kilometres. Landström (1998) found that investors had 60% of investments within a 80 kilometer radius, and Christensen (2007) found a mean distance of 70-100 kilometres for Danish investors in most of the years studied. Note that the numbers for actual average distances do not necessarily reflect preferences or thresholds. These two types of numbers may deviate for several reasons. Avdeitchova (2009) found that despite the fact that the majority of investors have preferences for close proximity to portfolio firms in fact a non-negligible share of business angels invest across distance (operationalized as cross-border investments).
information, tacit knowledge. Because tacit knowledge is dependent on the building of common means of understanding, communication and, above all, personal trust, tacit knowledge is often spatially grounded (Gertler et al., 2000; Zook, 2002, 2004). Such personal interactions require a certain frequency of face-to-face interaction, which adds to transaction costs.

Furthermore, transaction costs are relatively higher in small firm investments. Such investments often lack managerial skills and organisational capabilities, which may require greater guidance, hence spatial proximity may be relatively more important for small investments. A similar argument applies to the case of highly innovative firms, which may represent greater uncertainty and thus require more intense monitoring. This argument may in turn suggest that financial institutions balance the geographical scope of their investments against specialization in other dimensions (Christensen, 2007). A more densely located cohort of portfolio firms reduces agency and transaction costs, and has been mentioned as an important factor in early stage VC investments (Cumming and Dai, 2010). Additionally, during crisis periods, spatial proximity tends to become even more important because much of the interaction with portfolio firms consists of problem-solving tasks, which often require rapid actions (Harrison et al., 2010).

Transaction costs related to post-investment monitoring may be reduced by spatial proximity, geographical proximity is also important prior to the investment process. Because investors use referrals and their networks to both generate a deal flow and assist the due diligence process, local informants reduce search costs. Information on the potential of investment opportunities is not publicly available and is often spatially bounded (Sorensen and Stuart, 2001, Powell et al., 2002, Florida and Kenney, 1988, Zook, 2004, Kolymphiris et al., 2017) and interpreted by actors in the same socio-economic context (Allessandrini et al., 2010). Moreover, as shown in the new economic geography literature, interactions between parties (i.e., a financier and a firm in this case) are also affected by social, institutional, organisational and cognitive proximity (Boschma, 2005), not only spatial. Strong proximity in one of these dimensions may alleviate or even eliminate the hindrances that are imposed by spatial distance.

Related, it may be argued that operational distances are not the only relevant aspects of distance. Agarwal and Hauswald (2010) point out that the trend has been towards that the information base for lending decisions increasingly is based on hard factors, often computerized, expert system based decisions making, rather than soft, intangible, local factors (see also Udell, 2015). In turn, this can have dual effects on access to finance for firms in peripheries. Decreased relative importance of information that is difficult to transfer over distance can be argued to increase the access for firms to financing sources further away as information and capital flows become less context-dependent. Contrasting this argument, Lee and Brown (2017) argue that this trend divert attention of bankers to financial factors rather than development potentials and innovative abilities of firms. Hence, in particular innovative and peripheral firms risk being worse off regarding access to finance. Also Alessandrini et al. (2009) argue that the functional distance, in the majority of earlier studies operationalised as the distance between headquarters and branches of e.g. banks (e.g. Zhao and Jones-Evans, 2017)^{6}, has changed (increased) in many countries and that this particularly has a negative effect on the likelihood of innovative firms in peripheries to obtain finance.

2.4. Networks and intermediaries

Depending on the extensiveness of networks of financial community, intermediaries and firms, the pure awareness of sources of capital may also differ (Mason and Harrison, 1998, Mason, 2007). Thus, building on innovation system literature, Pierrakis and Saridakis (2018) maintain that the entrepreneurial eco-system consists of three pillars; the knowledge creating community, the business support community, and the entrepreneurial finance community. The specific configurations and interactions between these actors are decisive for an innovation system to work effectively. In turn, this has a bearing on networks in relation to finance and hence access to finance.

Along these lines Wray (2012) provided a theoretical argument and empirical evidence that shows how knowledge migrates among the members of the financial community and that there is great heterogeneity in the density of the

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^6 Another functional distance could be the cap of loan amounts that sub-branches are allowed to decide on autonomously.
relational geographies of finance. Her cases are the East Midlands and Northeast areas of the U.K., which are regarded as having less developed venture capital markets. The author reported that investors use networks differently and that the localised characters of networks are not always decisive for reaching objectives. The intersection of territories, networks and institutional structures produces a complex structural context in which interactions unfold. Local factors influence the manner in which networks are used. Hence, as emphasized by Wray (2012), how networks function depends upon specific local and socio-institutional contexts in various ways. In addition to knowledge flows, space-specific factors may influence the opportunities that are available to firms seeking financing (e.g., by providing collateral). Buildings and houses are often used as collateral and are intrinsically spatially bounded. Although their use value may be relatively constant, their exchange value may be heavily affected by ups and downs of business cycles, as has been visible in the recent period of financial turbulence. The decreasing prices in the housing market and the downswing of business cycles reduced the value of these assets as collateral but with profound regional variations (Becicová and Blazek, 2015).

A virtuous circle may be initiated because regions with high-growth, high-technology environments attract not only other such firms but also venture capital and business services, such as technology experts, head hunters, access to qualified staff, and access to syndication partners. This contributes to agglomeration economies and enhanced efficiency in the innovation investment process, for example, by facilitating the screening and monitoring process and reducing transaction costs in the use of intermediaries, but it also contributes to inducing synergies both among businesses and among investors themselves, for example by being mediators of other, additional types of funding. Thus, the agglomeration of investors may increase the use of networking, which may in turn influence performance of investment funds (Zook, 2004, Holbeck et al., 2007, Samila and Sorensen, 2011).

2.5. Demand variations in peripheries and core

Demand for finance may differ between localities, as business activities are often unevenly distributed (Davidsson et al., 1994, Powell et al., 2002, Mason 2007, Lee and Drever, 2014, Lee and Brown, 2017). Demand variations may be related to varying degrees of entrepreneurship, technological development, clusters and other factors (Florida and Kenney, 1988).

Demand may also be related to the decisions made in firms on whether to apply for external funding or not. If there is a need, and no alternative, application for external finance is natural. However, in some cases firms abstain from applying, despite a need, in the anticipation that their application will be turned down, what is termed discouraged borrowers (Kon and Storey, 2003, Freel et al., 2012, Han et al., 2009, Chakravarthy and Xiang, 2013). Earlier literature (Lee and Brown, 2017) has found that both actual and the non-articulated demand for external finance differ between peripheries and urban centres, both types of demand being less in peripheries.7

2.6. Hypotheses

In sum, we hypothesize that

A. Even within peripheries concentration of capital and resulting distances between investor and investee leads to relatively higher financial constraints outside urban areas


C. Demand for external finance is lower for firms in peripheries of the periphery

7 This problem relates to the fact that some firms are never started because of financial constraints and are consequently not surveyed (Davidsson, 2006, Audretsch et al., 2012).
3. The data and case region

The data are based on surveys of private firms with at least five employees in North Jutland, Denmark. This survey is an ad hoc addition to a quarterly regional business cycle indicator measurement. The respondents were asked about their views of the past and future development of a number of variables including production, employment, profits and orders. A set of additional questions on innovation and access to financial capital was posed each year. In turbulent periods of time as in financial crisis especially issues of access to finance are affected, which means that responses from a single year may not be representative for the general situation regarding access to finance. We reduce this possible effect by using data from surveys in several years. In order to maximize the number of observations and to eliminate possible effects from variations over time we cluster the responses from four consecutive years, 2010-13 and obtain a total of 833 responses, which enable an industry and geographical breakdown of the results. Data collection methodology and questions were constant overall years the survey spans. Firms were phoned to ask for participation in the survey, and then emailed a questionnaire. Questions directly addressed the issues in this paper. Firms were asked on access to financial capital but focused on access to capital for investment projects, not any capital. The core question we use for the dependent variable was: ‘Did your firm during the past year experience problems in obtaining external finance for development activities?’ Yes/No/Did not apply/DKNA. A number of additional questions on firms’ innovation activities and financing needs were posed as well.

Response rates are incomparable to other surveys that rely on random sampling. In our case response rates may be interpreted and measured during the process of phoning firms to ask for participation, or they could be interpreted as the share of respondents who accepted to participate in the survey, but nevertheless did not fill in the on-line questionnaire. The firms included in the gross sample represent approximately 30% of the employment in the region. Data are weighted to make the results representative for the population of the firms in the region.

Our case region is located in the north of Denmark and has traditionally been characterised as a peripheral area within Denmark. Its unemployment rate has historically been approximately 1.7 percentage points above the national average (although this gap has in recent years been reduced). Aalborg (the capital city of the region) has historically been dominated by traditional labour-intensive manufacturing industries, and other parts of the region have been dominated by the primary sector, especially agriculture and fishing, and, in more recent decades, tourism. During the 1990s, the region experienced a process of structural change towards other industries as some parts of the region became specialised in machinery and equipment as well as electronics. However, the region can still be characterised as relatively peripheral in Denmark based on statistics on factors such as unemployment, income per capita, specialisation patterns, and GDP growth. Moreover, the share of people with the highest level of education is 1.5 times lower in North Jutland than in the whole of Denmark. Similarly, the R&D level in the region weighted with North Jutland’s share of Danish firms is for North Jutland approximately 2/3 of Denmark’s level, the lowest level among regions in Denmark. The same shares apply to the number of patents per 1000 inhabitants. The peripheral character of the region also has an ‘official’ label, as for many years, the region has been designated an EU Objective 2 area, one of the few areas (and by far the largest) in Denmark to have this status. North Jutland is also peripheral in spatial terms as it is in the opposite part of the country than the capital, Copenhagen. Train travel times are around 4.5 hours to Copenhagen from the main city, Aalborg.

Aalborg is the metropolitan centre of the region. By January 2017, the city had 139,000 inhabitants. If the areas surrounding Aalborg is included it constitute a third of the regional population, and many (a similar share) of the firms in the region are located there. In addition, spurred by the university, the city hosts a number of high-tech industries, especially in ICT. A few other towns in the region may qualify as urban or semi-urban areas, although they are smaller than Aalborg. The cities of Frederikshavn, Hjørring and Hobro may thus be classified.

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8 As our primary interest is not on the level of financially constrained firms per se but rather the relative proportions (periphery – center) the effects from financial crisis is reduced as it affects firms in both sub-samples. Only to the (probably limited) extent that the crisis has different effects on urban and rural areas the analyses need to account for the effect of the crisis.

9 Data were collected in January the following year, hence data for 2013 was collected in January 2014.
as urban areas, although they only have 23,500, 25,700 and 12,000 inhabitants, respectively. In many contexts such cities would be classified as villages. In this small region (in a small country with only one large city, Copenhagen), these cities are relatively large and contain several well-known and relatively large firms.

There are arguments for and against why we should find differences in financial gaps among centre and periphery within this region. Most previous studies of this issue examine the US and UK contexts, with a few additional studies based in Germany, but all of these countries are relatively large and have large distances between centres and peripheries. One may question whether there is (in a relatively small country such as Denmark) an uneven distribution of financial capital between metropoles and other regions (in Denmark), as found in the literature for other countries (e.g., Mason and Harrison, 2002 and other work, as explained above). Additionally, Denmark is characterised both by its small size and by the relatively equal economic status and development among regions. Nevertheless, some regions may be characterised as peripheral in relative terms, even if these regions may be viewed as wealthy in comparison with the majority of other European regions. Moreover, as different types of infrastructure are also well developed in the Danish peripheral regions, it may be expected that financial capital is also readily available. Consistent with the studies from other countries that were reviewed above, venture capital in Denmark tends to be regionally concentrated. Venture capital investments are clearly concentrated in metropolitan areas although to a lesser extent than the management of funds. The majority of the venture funds are located in greater Copenhagen, as more than 90% of the capital under management is located in this area (The Growth Fund, 2011). Venture capital investments in regions outside of Copenhagen, such as North Jutland, are considerably below the Danish average. Approximately two-thirds of all investments were made in the Copenhagen region in the 2003–2009 period, although this region accounts for a much lower share of the total number of firms (approximately 40% of all Danish limited firms) or economic activity (38%).

The North Jutland region is particularly well suited for the current analysis because of its relative peripheral status in Denmark and because it is characterised by a relatively even structure of cities compared with other regions in Denmark. In a report on structural features of the region, The North Jutland Region (2004, p.92) compared the city structure in three Danish regions and found that the Århus and Funen regions are much more dominated by one large city and a number of small cities, whereas the North Jutland region has several cities of an intermediate size. According to earlier studies, this structure is better suited for the test of potential intra-regional differences (Fritsch and Schilder, 2011).

4. Empirical analyses

The empirical analysis aims at determining if there is an intra-regional financial centre-periphery or not, and if the geographical aggregation impact the results. We split the sample of firms in different geographical areas (as explained below) and estimate a model that takes into account multivariate and interaction effects and control for possible effects from differences in firm characteristics such as size, age, sector composition etc. The way the sample is sub-divided is decisive for the analysis and the argument. Therefore, in robustness checks, different geographical aggregations are tried out. We take possible differences among urban and peripheral areas in financial constraints as an indicator of a need to differentiate our perception of financial constraints geographically, even within sub-regions.

4.1. Geographical scale

In the proceeding analysis, the test of the overall hypothesis regarding the relevant geographical scale of financial constraints is based on two geographical aggregations stemming from three geographical areas. The first area is Aalborg as the urban centre. The second area is the three above-mentioned areas that are smaller but perhaps still urban. The third area contains the residual peripheral areas within North Jutland. Our sample is split in 31% of firms in the Aalborg city, 17% in the semi-sized towns, 52% in the remainder of the region. We do not know a priori the appropriate size level for designating cities as ‘urban’. By including both the extreme case in which Aalborg is the only urban centre in the region and the intermediary level, in which 4 towns (Aalborg + the three smaller cities) comprise the urban area (totalling 48% of the sample) and classify the remainder as peripheral, we may be able to more precisely determine which is the financial centre: should the
only (financially) interesting town in a peripheral area be considered the regional centre, or do firms that are localised in other medium-sized cities attract the attention of financiers? In principle, we do not know either if the three geographical levels employed here are appropriate aggregations. On the other hand, they encompass any town in the region that could possibly be argued to have a size that justifies a categorisation as ‘urban’. The rest of the cities are substantially smaller and/or less industrialised.

4.2. Variables.

We use questions on whether firms experience financial constraints (dichotomy) as dependent variable. The answers to these questions are self-reported and subjective; however, there is no reason to believe that a potential bias from this should be either particularly severe or systematically distributed in the geographical areas we compare. Moreover, as noted by Carriera and Silva (2010), ‘financial constraints are an abstraction, so researchers use proxies and indexes that allow them to identify and measure the degree of constraints’ (p. 745). As this quote illustrates, a precise measure of financial constraints is subject to discussion and remains an unresolved issue in the literature. As the purpose of the current analysis is to identify whether there is a dual level of financial constraints, it is of less concern whether the measure of the constraint is ideal; a potentially imprecise measure is presumably equally imprecise in every geographical tier that we analyse.

Table 1 provides an overview of variables used in the analysis. The dependent variable is a dichotomic variable based on the respondents’ statement on whether the firm has in the latest year experienced financial constraints on their development activities. Firms were also asked about how dependent their development activities were on external finance. In our analyses we use this variable for filtering out firms who do not feel constrained, however, we perform analyses on the full sample as well.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent</td>
<td>Geographical areas</td>
</tr>
<tr>
<td>Size of firm ‘firm size’</td>
<td>Log of number of empl. in full time equivalents</td>
</tr>
<tr>
<td>Innovation intensity ‘e_inno’</td>
<td>No of innovations per employee</td>
</tr>
<tr>
<td>Age of firm ‘firm_age’</td>
<td>Log of years since establishment</td>
</tr>
<tr>
<td>Short term economic performance ‘r_result_n’</td>
<td>Experienced improved/unchanged/worsened development in economic results in the quarter prior to the survey</td>
</tr>
<tr>
<td>Short term economic prospects ‘r_result_p’</td>
<td>Foresee improved/unchanged/worsened development in economic results in the next quarter following the survey</td>
</tr>
<tr>
<td>Industry ‘firm indu_1,2’</td>
<td>NACE2 sectors</td>
</tr>
<tr>
<td>Organisational form</td>
<td>Subsidiary etc</td>
</tr>
<tr>
<td>Incremental innovation ‘innoinc_in’</td>
<td>Has incremental product, service-, process innovation within the past year</td>
</tr>
<tr>
<td>Radical Innovation ‘innorad_in’</td>
<td>Has radical product, service-, process innovation within the past year</td>
</tr>
<tr>
<td>Dependent</td>
<td>Constrained access to capital</td>
</tr>
<tr>
<td>Filter</td>
<td>Need for finance</td>
</tr>
</tbody>
</table>

4.3 Empirical approach

The literature has discussed potential endogeneity problems in analyses of financial constraints (Mina et al., 2013, Lee and Drever, 2014, Lee and Brown, 2017, Zhao and Jones-Evans, 2017), that is, firms who do not demand external financial capital will not feel constraints on their financing and should therefore be accounted for in the empirical analyses. One could assume that potential endogeneity problems are similar across sub-
regions but in recent literature (Lee and Brown, 2017) we do have indications of different patterns in the demand for finance among firms in the peripheral and urban regions, and therefore choose both to do a two-stage estimation to account for potential differences in demand for finance, and to use a filtering variable for the same purpose.

The model contains a geographical aggregation of Aalborg in addition to the three above-mentioned smaller urban areas as the urban centre and the residual as the periphery. Another geographical aggregation singles out the town of Aalborg as the urban centre and considers the remainder to be the peripheral area. Thus, because we do not know a priori the appropriate ‘urban level’, we include both the extreme case, in which Aalborg is the only urban centre in the region, and the intermediary level, which we include in another model. As mentioned, we try out different variations of geographical aggregation, one set of models based on a ‘city-oriented’ aggregation using post codes to identify the narrowly defined cities. Another takes a broader aggregation using sub-regions by aggregating municipalities. In doing so we both add to our knowledge on whether there are within-region financial constraints, and to our knowledge on the possible impact of the geographical aggregation.

4.3 Correlations and frequencies

Table 2 and 3 shows correlations between our main variables. The survey includes a selection question regarding whether firms express demand for finance and we proposed that this may work as a selection devise for disregarding firms who were not in demand for finance. In the second correlation table this selection is applied, reducing the focused sample to 399 firms.

<table>
<thead>
<tr>
<th>Table 2: Correlation Coefficients (full sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>constraints</td>
</tr>
<tr>
<td>constraints</td>
</tr>
<tr>
<td>need_finance</td>
</tr>
<tr>
<td>firm_size_ln</td>
</tr>
<tr>
<td>firm_age_ln</td>
</tr>
<tr>
<td>r_result_p</td>
</tr>
<tr>
<td>r_result_n</td>
</tr>
<tr>
<td>e_inno</td>
</tr>
<tr>
<td>innoic_n</td>
</tr>
<tr>
<td>innorad_ln</td>
</tr>
<tr>
<td>region1</td>
</tr>
<tr>
<td>region2</td>
</tr>
<tr>
<td>region3</td>
</tr>
<tr>
<td>region12</td>
</tr>
<tr>
<td>region23</td>
</tr>
</tbody>
</table>

Lower-triangular cells report Pearson’s correlation coefficients, upper-triangular cells are Spearman’s rank correlation
*** p<0.01, ** p<0.05, * p<0.1

We note from table 2 and 3 that correlation coefficients are all below the 0.5 threshold indicating no multicollinearity issues. In table 2 firm characteristics like size and age and economic results correlate with constraints. The table also provides the first indications of regional differences in financial constraints: the Aalborg city
region is significantly and negatively correlated with constraints, whereas the peripheral parts of the region is positively and significantly correlated. The results regarding the need for finance variable are also interesting. Age does not seem to matter for demand, but unsurprisingly economic results do. Correlations with regions are highly significant indicating demand variations among regions. In the reduced sample (table 3) firm size is still correlated with constraints. Although the expected signs are at the regional correlations with constraints the statistical significance is no longer there.

Table 3: Correlation Coefficient (reduced sample)

<table>
<thead>
<tr>
<th></th>
<th>constraints</th>
<th>firm_size ln</th>
<th>firm_age ln</th>
<th>r_result p</th>
<th>r_result n</th>
<th>e_inno</th>
<th>innoinc_ln</th>
<th>innorad_ln</th>
<th>region1</th>
<th>region2</th>
<th>region3</th>
<th>region12</th>
<th>region23</th>
</tr>
</thead>
<tbody>
<tr>
<td>constraints</td>
<td>-0.185***</td>
<td>-0.117**</td>
<td>-0.026</td>
<td>0.063</td>
<td>0.095*</td>
<td>-0.056</td>
<td>0.047</td>
<td>-0.074</td>
<td>-0.003</td>
<td>0.067</td>
<td>0.067</td>
<td>0.074</td>
<td></td>
</tr>
<tr>
<td>firm_size ln</td>
<td>-0.207***</td>
<td>0.271***</td>
<td>0.051</td>
<td>-0.062</td>
<td>0.181***</td>
<td>0.166**</td>
<td>-0.059</td>
<td>-0.070</td>
<td>-0.078</td>
<td>0.121**</td>
<td>-0.121**</td>
<td>0.070</td>
<td></td>
</tr>
<tr>
<td>firm_age ln</td>
<td>-0.094*</td>
<td>0.260***</td>
<td>0.090*</td>
<td>0.047</td>
<td>0.039</td>
<td>0.064*</td>
<td>0.026</td>
<td>-0.042</td>
<td>0.112**</td>
<td>-0.048</td>
<td>0.048</td>
<td>0.042</td>
<td></td>
</tr>
<tr>
<td>r_result p</td>
<td>-0.026</td>
<td>0.032</td>
<td>0.087*</td>
<td>-0.097**</td>
<td>-0.049</td>
<td>0.027</td>
<td>-0.047</td>
<td>-0.039</td>
<td>0.071</td>
<td>-0.071</td>
<td>0.047</td>
<td></td>
<td></td>
</tr>
<tr>
<td>r_result n</td>
<td>0.063</td>
<td>-0.031</td>
<td>0.052</td>
<td>0.339***</td>
<td>-0.076</td>
<td>-0.052</td>
<td>-0.022</td>
<td>-0.047</td>
<td>0.048</td>
<td>0.005</td>
<td>-0.005</td>
<td>0.047</td>
<td></td>
</tr>
<tr>
<td>e_inno</td>
<td>0.095*</td>
<td>0.187***</td>
<td>0.042</td>
<td>0.097*</td>
<td>-0.076</td>
<td>-0.082*</td>
<td>0.256***</td>
<td>0.067</td>
<td>-0.035</td>
<td>-0.033</td>
<td>0.033</td>
<td>-0.067</td>
<td></td>
</tr>
<tr>
<td>innoinc_ln</td>
<td>-0.062</td>
<td>0.214***</td>
<td>0.058</td>
<td>-0.048</td>
<td>-0.042</td>
<td>-0.058</td>
<td>0.020</td>
<td>0.195***</td>
<td>0.065</td>
<td>0.123**</td>
<td>-0.123*</td>
<td>0.195***</td>
<td></td>
</tr>
<tr>
<td>innorad_ln</td>
<td>0.062</td>
<td>0.053</td>
<td>0.009</td>
<td>0.028</td>
<td>-0.036</td>
<td>0.177**</td>
<td>0.330***</td>
<td>0.112**</td>
<td>0.107**</td>
<td>-0.180*</td>
<td>0.180**</td>
<td>-0.112*</td>
<td></td>
</tr>
<tr>
<td>region1</td>
<td>-0.074</td>
<td>-0.058</td>
<td>-0.055</td>
<td>-0.047</td>
<td>-0.047</td>
<td>0.067</td>
<td>-0.100**</td>
<td>0.068</td>
<td>-0.267**</td>
<td>0.681**</td>
<td>0.681**</td>
<td>1.000***</td>
<td></td>
</tr>
<tr>
<td>region2</td>
<td>-0.003</td>
<td>-0.084*</td>
<td>0.120**</td>
<td>-0.039</td>
<td>0.048</td>
<td>-0.035</td>
<td>0.009</td>
<td>0.061</td>
<td>0.627***</td>
<td>0.523***</td>
<td>0.267***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>region3</td>
<td>0.067</td>
<td>0.115**</td>
<td>-0.043</td>
<td>0.071</td>
<td>0.005</td>
<td>-0.033</td>
<td>0.082</td>
<td>-0.107**</td>
<td>0.681***</td>
<td>0.523**</td>
<td>1.000***</td>
<td>0.681**</td>
<td></td>
</tr>
<tr>
<td>region12</td>
<td>-0.067</td>
<td>-0.115**</td>
<td>0.043</td>
<td>-0.071</td>
<td>-0.005</td>
<td>0.033</td>
<td>-0.082</td>
<td>0.107**</td>
<td>0.681***</td>
<td>0.523**</td>
<td>1.000***</td>
<td>0.681**</td>
<td></td>
</tr>
<tr>
<td>region23</td>
<td>0.074</td>
<td>0.058</td>
<td>0.055</td>
<td>0.047</td>
<td>0.047</td>
<td>-0.067</td>
<td>0.100**</td>
<td>-0.068</td>
<td>1.000***</td>
<td>0.267**</td>
<td>0.681**</td>
<td>0.681**</td>
<td></td>
</tr>
</tbody>
</table>

Lower-triangular cells report Pearson’s correlation coefficients; upper-triangular cells are Spearman’s rank correlation

**p<0.01, *p<0.05, *p<0.1

In table 4 we list results from comparing constraints and demand in different regional aggregations. In the top part of the table we compare Aalborg and the rest of the region, and in the lower part of the table Aalborg is merged with the semi-sized towns. Both demand and constraints are shown for the full and reduced sample. T-tests indicate that there is a difference in demand between periphery and urban areas the demand being less in peripheries. Constraints also display a difference, however, in the reduced sample the statistical significance disappears. This is partly caused by the fact that the number of observations is less than half of the full sample, but it also indicates differences between firms in these two types of regions.

Table 4: frequency analysis

<table>
<thead>
<tr>
<th></th>
<th>Rest of NJ</th>
<th>Aalborg</th>
<th>Difference</th>
<th>(p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm in need for external finance</td>
<td>0.51</td>
<td>0.40</td>
<td>0.11</td>
<td>0.00</td>
</tr>
<tr>
<td>Firms experienced finance constraints (no selection)</td>
<td>0.20</td>
<td>0.13</td>
<td>0.08</td>
<td>0.01</td>
</tr>
<tr>
<td>Firms experienced finance constraints (selection)</td>
<td>0.39</td>
<td>0.31</td>
<td>0.08</td>
<td>0.14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Rest of NJ</th>
<th>Aalborg + semi</th>
<th>Difference</th>
<th>(p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm in need for external finance</td>
<td>0.53</td>
<td>0.43</td>
<td>0.10</td>
<td>0.00</td>
</tr>
<tr>
<td>Firms experienced finance constraints (no selection)</td>
<td>0.20</td>
<td>0.13</td>
<td>0.08</td>
<td>0.01</td>
</tr>
<tr>
<td>Firms experienced finance constraints (selection)</td>
<td>0.40</td>
<td>0.33</td>
<td>0.07</td>
<td>0.18</td>
</tr>
</tbody>
</table>
4.4. Regression results

Finally, Table 5 and 6 provides the results of the estimations of a random effect logit model. Again, we estimate both the full sample models and the reduced model.

Table 5. Financial constraints. Full sample

<table>
<thead>
<tr>
<th></th>
<th>(1) constraints</th>
<th>(2) constraints</th>
<th>(3) constraints</th>
<th>(4) constraints</th>
<th>(5) constraints</th>
<th>(6) constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>_lfirm_indu_1</td>
<td>-0.887</td>
<td>-0.628</td>
<td>-0.671</td>
<td>-0.671</td>
<td>-0.663</td>
<td>-0.628</td>
</tr>
<tr>
<td></td>
<td>(-0.987)</td>
<td>(-0.705)</td>
<td>(-0.752)</td>
<td>(-0.752)</td>
<td>(-0.738)</td>
<td>(-0.705)</td>
</tr>
<tr>
<td>_lfirm_indu_2</td>
<td>-1.466*</td>
<td>-1.179</td>
<td>-1.125</td>
<td>-1.125</td>
<td>-1.160</td>
<td>-1.179</td>
</tr>
<tr>
<td></td>
<td>(-1.762)</td>
<td>(-1.408)</td>
<td>(-1.344)</td>
<td>(-1.344)</td>
<td>(-1.376)</td>
<td>(-1.408)</td>
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<tr>
<td></td>
<td>(-3.187)</td>
<td>(-3.055)</td>
<td>(-3.055)</td>
<td>(-3.055)</td>
<td>(-3.102)</td>
<td>(-3.052)</td>
</tr>
<tr>
<td>firm_age_Ln</td>
<td>-1.066</td>
<td>-1.178</td>
<td>-0.969</td>
<td>-0.969</td>
<td>-0.841</td>
<td>-1.178</td>
</tr>
<tr>
<td></td>
<td>(-0.480)</td>
<td>(-0.530)</td>
<td>(-0.433)</td>
<td>(-0.433)</td>
<td>(-0.376)</td>
<td>(-0.530)</td>
</tr>
<tr>
<td>r_result_p</td>
<td>-0.351</td>
<td>-0.371</td>
<td>-0.392</td>
<td>-0.392</td>
<td>-0.401</td>
<td>-0.371</td>
</tr>
<tr>
<td></td>
<td>(-0.816)</td>
<td>(-0.860)</td>
<td>(-0.906)</td>
<td>(-0.906)</td>
<td>(-0.925)</td>
<td>(-0.860)</td>
</tr>
<tr>
<td>r_result_n</td>
<td>0.932**</td>
<td>0.918**</td>
<td>0.907**</td>
<td>0.907**</td>
<td>0.906**</td>
<td>0.918**</td>
</tr>
<tr>
<td></td>
<td>(2.053)</td>
<td>(2.019)</td>
<td>(1.995)</td>
<td>(1.995)</td>
<td>(1.988)</td>
<td>(2.019)</td>
</tr>
<tr>
<td>e_inno</td>
<td>1.331**</td>
<td>1.338**</td>
<td>1.312**</td>
<td>1.312**</td>
<td>1.298**</td>
<td>1.338**</td>
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<tr>
<td></td>
<td>(2.428)</td>
<td>(2.449)</td>
<td>(2.402)</td>
<td>(2.402)</td>
<td>(2.375)</td>
<td>(2.449)</td>
</tr>
<tr>
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<td>0.449</td>
<td>0.469</td>
<td>0.469</td>
<td>0.497</td>
<td>0.449</td>
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<tr>
<td></td>
<td>(0.329)</td>
<td>(0.263)</td>
<td>(0.274)</td>
<td>(0.274)</td>
<td>(0.289)</td>
<td>(0.263)</td>
</tr>
<tr>
<td>innorad_Ln</td>
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<td>1.371</td>
<td>1.547</td>
<td>1.547</td>
<td>1.615</td>
<td>1.371</td>
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<tr>
<td></td>
<td>(0.618)</td>
<td>(0.596)</td>
<td>(0.669)</td>
<td>(0.669)</td>
<td>(0.695)</td>
<td>(0.596)</td>
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<tr>
<td>_lfirm_regi_2</td>
<td>0.273</td>
<td>(2.430)</td>
<td>0.147</td>
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<td></td>
</tr>
<tr>
<td>_lfirm_regi_3</td>
<td>1.459**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>region1</td>
<td>-1.181*</td>
<td>-1.386**</td>
<td>-2.185</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.940)</td>
<td>(-2.185)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>region2</td>
<td>-0.863</td>
<td>0.523</td>
<td>0.639</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.184)</td>
<td>(0.639)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>region3</td>
<td>1.386**</td>
<td>(2.185)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>region12</td>
<td>-1.192**</td>
<td>(-2.194)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>region23</td>
<td>1.181*</td>
<td>(1.940)</td>
<td></td>
<td></td>
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<tr>
<td>_cons</td>
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<td>0.080</td>
<td>0.152</td>
<td>-1.234</td>
<td>0.117</td>
<td>-1.101</td>
</tr>
<tr>
<td></td>
<td>(-0.314)</td>
<td>(0.049)</td>
<td>(0.094)</td>
<td>(-0.732)</td>
<td>(0.072)</td>
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</tr>
<tr>
<td>/ lnsig2a</td>
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<td>2.608</td>
<td>2.598</td>
<td>2.598</td>
<td>2.619</td>
<td>2.608</td>
</tr>
<tr>
<td></td>
<td>(3.455)</td>
<td>(2.455)</td>
<td>(2.604)</td>
<td>(2.604)</td>
<td>(2.627)</td>
<td>(2.455)</td>
</tr>
<tr>
<td></td>
<td>(-1.897)</td>
<td>(-1.333)</td>
<td>(-1.421)</td>
<td>(-1.421)</td>
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<td>(-1.333)</td>
</tr>
<tr>
<td>_diparm1:rho</td>
<td>-2.1706</td>
<td>(-15.630)</td>
<td>(-16.483)</td>
<td>(-16.483)</td>
<td>(-16.847)</td>
<td>(-15.630)</td>
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<tr>
<td>N</td>
<td>834</td>
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Table 5 shows that firm size is still highly significant and in accordance with extant literature smaller firms are more constrained. Both economic results and innovation intensity are also significant. The same pattern applies regarding regional differences. Coefficient for Aalborg city (‘region1’) has negative sign, for periphery positive indicating a significant difference between regions in how financially constrained they are, in the periphery more firms are constrained. In this model we also try out a different geographical aggregation where the basic is municipalities rather than postcodes. This aggregation is expected to be less precise compared to the city-oriented aggregation based on postcodes. The regi_3 variable covers areas south of Aalborg, which can be characterized as peripheral in North Jutland. There is a positive and significant coefficient for this region, however, not for the area north of Aalborg.
Table 6 shows results for the reduced sample. Generally the significance and size of coefficients drop indicating that the heterogeneity in demand has a substantial impact on results, in line with findings in other literature (Lee and Brown, 2017). Our frequency analyses did, though, indicate that in our case demand in the periphery seem to be higher than in the urban centres, contrasting findings in Lee and Brown (2017). Overall results still hold. Firms in Aalborg city are less constrained, in periphery more constrained. In the semi-sized towns there is no significant coefficient. Firm size remains highly significant. Increased innovation intensity is, as in the full sample model, associated with more financial constraints. Incremental and radical innovation variables have the expected sign – radical innovation rendering more constraints – but none of these two variables are statistically significant.

Overall, the tests were aimed at revealing whether there is a difference in financial constraints between urban and peripheral areas and, if such differences exist, the geographical levels at which such differences are observed. The results reveal parameter estimations on our variables of primary interest in line with the proposed hypothesis. Specifically, the variable representing the urban area defined as Aalborg in addition to the semi-sized towns is significant negative and significant indicating that firms in the urban area is less constrained than in the periphery. However, the geographical aggregation where Aalborg is defined as the only urban area has stronger significance and larger coefficient.
5. Conclusions, Discussion, and policy implications

The literature has established that financial capital tends to be spatially concentrated around large metropolitan areas and in relatively prosperous regions of a country. Moreover, because of reduction in agency costs and informational asymmetries by investing in close proximity to investee firms, investments tend to be spatially restricted. Capital markets work differently in small, dense environments because information flows more easily and networks of firms and of financiers facilitate both mitigating information asymmetries and the insourcing of knowledge on capital market reactions (Sorenson, 2001). However, the literature has not yet precisely identified the relative scale of cities and regions, where these effects occur. Moreover, empirical studies are primarily confined to venture capital in the US and the UK. Studies that explicitly focus on the intra-regional financial constraints in peripheral areas and include both equity and debt financing are very sparse. This paper contributed to closing this gap in our knowledge. It hypothesised that in peripheral areas, there may be structures that are similar to those in urban centres that attract the bulk of financial capital and thus potentially deprive firms in the ‘periphery of the periphery’ of financing.

In the empirical analysis of this hypothesis, we found evidence that the perceptions of the extent of a possible financial constraint in the North Jutland region differed between firms that are located in urban centres and peripheral areas, especially if urban areas are considered to be the primary centre, Aalborg. This finding also holds when we controlled for differences in size or industry structure and economic performance. Thus, intra-regional financial constraints do appear to differ between these two geographical areas. Apparently, Aalborg is considered the primary growth pole as firms in the semi-sized towns also reported significantly higher financial constraints. It was clear in the results that some of the differences were driven by differences among regions in how much firms demand external finance. The size and level of significance of coefficients decreased when firms with less dependence upon external finance were considered.

One possible explanation relates to the finding by Wray (2012) that the geographies of relationships between firms and their financiers must inevitably be analysed in the local context. This finding raises questions concerning whether the perception of the difficulty related to an hour-long drive is independent of the local cultural context. Local differences in culture and perceptions regarding finance may exist within North Jutland. Another question is whether the web of business service intermediaries, specifically financing sources, is denser in cities and perhaps does not operate outside of the urban centre. This would reduce the likelihood of a deal flow of opportunities for investors in peripheral areas.10 A third contextual issue that may contribute to explaining why intra-regional differences persist even in an area covered by an hour-long drive is that the explanations related to personal trust and referrals in the deal flow and due diligence process are stronger than the reduction of the post-investment monitoring costs. These effects are likely to be embedded in regional contexts that are determined by relative, rather than absolute geographical scales. Even if providing assistance to firms increases their performance, such aid cannot compensate for the consequences of poor initial decisions. This is consistent with Bellucci et al., (2014) and Brancati (2015) who find that when financiers have well-established lending relationships with firms, they evaluate innovation positively, whereas the innovation variable has a negative impact on access to credit for firms that are more likely to suffer from information asymmetries. Proximity is, in turn, a facilitator of reducing asymmetric information, hence increasing access to financing. This

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10 Such reasoning has prompted the dominating, state-owned venture capital fund, The Danish Growth Fund, to establish two regional branch offices.
points to the need to take contextual factors into account and to evaluate these theories differently in different regional settings.

The findings in this paper demonstrate the impact of the geographical level and type of aggregation used in the analyses. This message may be simple but is important and should not be overlooked because the results have implications for the assessment of the need and rationale for policies. Usually averages are used in access to finance analyses and in the policy process, however, this study points to a potential second-order problem: the averages comparing the major metropolitan area in a country and peripheries may find disparities between their respective access to capital. However, if intra-regional differences exist, then the need for policy may be enhanced or should be re-oriented. The typical method of comparing means across regions may obfuscate the real problems, as firms within regions in peripheries may differ in terms of financial constraints depending on whether they are located in a central urban area or not, rather than if they are located in the peripheral region as such.

Policy makers have used a wide spectrum of instruments to alleviate financial constraints in less favoured regions. Both demand-side instruments and supply-side measures have been used, although the latter has clearly been the predominant approach (EC/JRC, 2016). In addition to increasing the supply of regional capital, it could be questioned if operating policy entities should necessarily be in close geographical proximity to the firms who are financially constrained. Arguments for why access to finance policy should have a regional orientation note that local operators are better equipped to respond to regional specificities, to use local knowledge and networks, and to coordinate with other regional support programmes (Heger et al., 2005, Sunley et al., 2005). There has been significant debate regarding the general rationale for governments to provide regional capital as a response to the challenge of stimulating innovation and growth in less favoured regions (Mason and Harrison, 1998, Mason 2007, Murray, 1998). Again, much of the discussion has focused on the supply of venture capital. One of the criticisms of the public regional venture capital model is that the size of funds are generally excessively small and thus limit the capacity to make follow-on investments (Murray, 1999). This criticism implies that fund managers must direct much of their attention to seeking further financing (Mason and Pierrakis, 2013). It is, however, noteworthy that discussions of rationales and instruments, rarely involve specifying the appropriate geographical level of intervention.

The results of this study also have research implications. First, it was pointed out above that financial capital, in particular equity, tends to be located primarily in urban areas. Contrary, according to earlier literature, debt is likely to be more evenly distributed and perhaps be even more frequently used in firms in the periphery because these firms would need to compensate for the lack of equity finance and because debt financing institutions, especially banks, are more geographically dispersed. In other words, equity capital-constrained firms may substitute equity with debt, which is more easily accessible. Thus, the capital structure of firms in peripheral areas may deviate from what would be prescribed by capital structure theory as originally formulated by Modigliani and Miller (1958). This theory assumed that firms have free, unrestricted, costless access to the full range of debt and equity sources. The later version of capital structure theory, the pecking order theory (Myers and Majluf, 1984), in which firms prefer first internal equity, then short-term debt, followed by long-term debt and finally new equity, appears to work if there is this substitution effect. However, the reason for this hierarchy is not only to maintain control, as postulated in the theory; rather, the pecking order would, in many cases, be induced by necessity and lack of alternatives. The traditional pecking order explanation of the financial structure in firms disregards the constraint imposed by geographical differences in access to capital of firms in peripheral areas; specifically they may be particularly constrained of certain (equity) types of financing. The potential effect is that firms substitute inaccessible forms of finance with what is available in the market. This point to a potentially interesting research agenda around

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11 Even if debt financing is readily available, conditions for access to capital may differ. The Bank of England (2002) reported a significant difference between margins on bank loans that are paid by SMEs in deprived areas compared with those in other areas. Geographical differentials in loan maxima in mortgage institutions are additional indicators of the effects of geography on financial conditions.

12 For example, data on loan guarantees show that North Jutland has a share of loan guarantees that is significantly above the share of firms in the population in Denmark (The Danish Growth Fund, 2011). 75% of loan guarantees are for firms that are located in the western part of Denmark, and North Jutland is the region with the relative and absolute largest number of guarantees despite representing only 11% of Denmark’s GDP. This is not a complete analysis of the geographical differences in the capital structure of firms, however, the results indicate that the hypothesised substitution effect, in which firms seek debt when access to equity is restricted, may be relevant.

13 Combined with the hypothesis that in a small, networked region like North Jutland capital market information flows
possible differences in capital structure of firms in peripheries and centre. Secondly, and more generally, our find-
ings suggest the substantial need for a research agenda on the extent of intra-regional disparities. Related, the
findings spurred interest in testing even more types of geographical aggregation such as including individual firm
level indices for location in dense business environments. Geography is akin to a Russian nested doll: peeling off
each layer reveals a new but similar set of features, structures and problems at a higher level. Similarly, the eco-
nomic problems related to differences between the centre and the peripheries are also likely to be present at levels
of aggregation that differ from those considered in the literature. The general policy implications are that the ap-
propriate regional level of policy should be considered carefully because of different efficiencies at different levels
and because the initial rationale for policy may depend on the level of aggregation.

A number of limitations apply to this study. Because we used a case from Denmark in this paper, one may question
the generalisability of the results. However, this case may actually be the most effective in illustrating the
importance of the findings because the analysis is applied in a country in which regional differences are believed
to be relatively small and in a region in which differences between the urban centre and the periphery are not
particularly substantial. Therefore, replicating this study in other geographical contexts with larger disparities is
likely to render even stronger results.

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smoothly this may explain why Lee and Brown (2017) find that innovative firms in peripheral are more likely to be dis-
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