Bank branches and Entrepreneurship

A spatial analysis of new firm formation in Swedish regions and industries in a changing financial landscape

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Abstract

The purpose of this thesis is to analyse how bank branch closure has affected the formation of new firms and to explore the varying local relationships between the accessibility of bank branches and new firm formation in 290 Swedish municipalities. In the first paper, the effect of bank branch closure is examined through spatial econometric analysis, in particular, the fixed effects and the random effects spatial panel models. The findings of the first paper show that an increase in the weighted distance to the nearest bank branches due to bank branch closure negatively affects new firm formation, based on the random effects spatial panel model. The analysis also shows that spatial effects should be included in the analysis due to spill-over effects from neighbouring municipalities. In the second paper, the varying relationships between new firm formation and its determinants in 290 Swedish municipalities are examined through Geographically weighted regression (GWR). Mostly positive relationships with new firm formation are shown for firm density, human capital level, industry diversification level and percentage of immigrants living in the area. In contrast, mostly negative relationships are shown for weighted mean distance to the nearest bank branches, establishment size, unemployment rate, industry specialization. Spatially constrained multivariate clustering is also applied to group municipalities with similar conditions. Patterns in the industry composition and the location attributes are analysed for each cluster.

Keywords: New firm formation, entrepreneurship, financing, bank branches, proximity, spatial analysis, GWR, Sweden
Sammanfattning

Syftet med denna avhandling är att analysera hur nedläggningen av bankkontor påverkar frekvensen av nystartade företag och undersöker sambandet mellan nystartsfrekvens och avståndet till närmaste bankkontor i Sveriges 290 kommuner.


Nyckelord: Nystartsfrekvens, entreprenörskap, finansiering, bankkontor, närhet, rumslig analys, GWR, Sverige
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# Table of Contents

*List of Figures* .......................................................................................................................... ix
*List of Tables* ............................................................................................................................. x
*List of Papers* ............................................................................................................................ xi
*Acronyms* .................................................................................................................................... xii

**Chapter 1: Introduction** ............................................................................................................ 1
  1.1 Purpose of the study and research questions .......................................................................... 4
  1.2 Thesis organization ............................................................................................................... 5
  1.3 Declaration of contributions ................................................................................................. 5

**Chapter 2: Literature review** .................................................................................................... 6
  2.1 Entrepreneurial finance for new ventures ............................................................................. 6
    2.1.1 Liabilities of newness and smallness .............................................................................. 6
  2.2 Demand for capital .............................................................................................................. 8
    2.2.1 Trade-off theory ........................................................................................................... 8
    2.2.2 Pecking order theory ................................................................................................. 9
    2.2.3 Signalling theory ....................................................................................................... 10
    2.2.4 Financial lifecycle approach ..................................................................................... 10
  2.3 Supply of capital .................................................................................................................. 13
    2.3.1 Bank finance to entrepreneurs ................................................................................... 13
    2.3.2 Regional gap in the supply of capital ........................................................................ 16
  2.4 Summary of literature review ............................................................................................... 18

**Chapter 3: Methodology** .......................................................................................................... 19
  3.1 Data collection ..................................................................................................................... 19
  3.2 Research methodology ........................................................................................................ 20
    3.2.1 Cross-sectional models ............................................................................................. 21
    3.2.2 Time series models ................................................................................................. 21
    3.2.3 Panel data models ................................................................................................... 22
  3.3 Reflections on methodological choice .................................................................................. 23
  3.4 Afterthought – the incorporation of spatial effects into the models ..................................... 23
    3.4.1 Spatial regression models ......................................................................................... 24
    3.4.2 Geographically weighted regression ......................................................................... 25
    3.4.3 Limitations of the chosen methods .......................................................................... 26
    3.4.4 Frequency of the methods used in related literature ............................................... 27

**Chapter 4: Results** ................................................................................................................... 29
  4.1 Summary and contributions of paper I ................................................................................ 29
  4.2 Summary and contributions of paper II ............................................................................... 31

**Chapter 5: Conclusions and future research** ............................................................................ 34
  5.1 Conclusions .......................................................................................................................... 34
5.2 Limitations .................................................................................................................. 36
5.3 Theoretical implications .............................................................................................. 37
5.4 Practical implications for policymakers and entrepreneurs ........................................... 38

Chapter 6: References ....................................................................................................... 39
List of Figures

Figure 1: Number of commercial bank branches per 10,000 adults from 2004 to 2017. Data from International Monetary Fund: Financial access survey, by World Bank (2019). ...............1

Figure 2. Source of finance in different stages of venture development. Adapted from *The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle*, by Berger and Udell (1998). .................................................. 11

Figure 3: Types of financing applied by companies. Adapted from Financing in Swedish companies, by Swedish Agency for Economic and Regional growth (2017). .......................13

Figure 4. Thin and thick regional markets. Adapted from *Business angels, risk capital funds and policy portfolios*, by Swedish Agency for Economic and Regional growth (2013) ........17

Figure 5. Robust GWR estimates (Euclidean) and t-map for WeightedDist based on the Gaussian kernel weighting function (“Natural breaks” classification). ...........................33

Figure 6. Skater clustering based on the values of the 8 parameters. ..............................33
List of Tables

Table 1. Frequency counts of the methods used in the literature ........................................27
Table 2: Econometric results of the spatial panel models ..................................................30
Table 3: OLS and robust GWR regression results based on the Gaussian kernel function .....32
List of Papers


Acronyms

**Fintech** Financial technology

**VC** Venture capital

**SMEs** Small and medium-sized enterprises

**IPO** Initial public offering

**MVP** Minimal viable product

**OLS** Ordinary least squares

**GWR** Geographically weighted regression

**ARIMA** Autoregressive integrated moving average

**FEM** Fixed effects model

**REM** Random effects model

**SAR** Spatial autoregressive model

**SEM** Spatial error model

**SDM** Spatial Durbin model

**ESDA** Exploratory spatial data analysis

**AIC** Akaike information criterion
Chapter 1: Introduction

The evolution of the banking industry has led to a decline in the number of bank branches across developed countries in both Europe and the United States, as shown in figure 1. The driving forces behind the evolution of the banking industry are related to technological advancements and regulatory and organizational changes (Papi, Sarno, & Zazzaro, 2015). The global financial crisis from 2007-2010 has also quickened the pace of these changes and hence caused a paradigm shift in the banking industry (CGFS, 2018). However, the rapid closure of bank branches is a concern because bank finance is considered to be one of the most important sources of external finance for entrepreneurs (Vanacker & Manigart, 2010).

Figure 1: Number of commercial bank branches per 10,000 adults from 2004 to 2017. Data from International Monetary Fund: Financial access survey, by World Bank (2019).

Technological advancements in the area of financial technology (Fintech) have changed how banks and their customers communicate and therefore changed the relationship between the banks and their customers (Darolles, 2016). For example, the increasing use of credit scoring models by banks affects the role of proximity in banking relationships and lending decisions. Since credit scoring models primarily focus on hard information about the borrower, there is still an information gap about the borrower that can only be known and acquired by loan officers through face-to-face interactions (Degryse & Ongena, 2004). According to a special report in
The Economist, new technology has paved the way for the emergence of digital-only “neobanks” and for the rise of internet banking (The Economist, 2019). In a way, these technological innovations have increased the competition in banking and reduced the competitive advantages of a traditional bank branch (Bokhari, 2014).

In addition to technological changes, regulatory and organizational changes have also brought on structural changes to the banking industry. In response to the financial crisis, an international regulatory framework – Basel III has been set in place to strengthen the regulation, supervision and risk management of banks (BCBS, 2009). However, it has been debated whether the stricter regulations, such as the increase in capital requirements have had resulted in a credit crunch for the economy instead (Angelini et al., 2015; Budnik et al., 2019; Noss & Toffano, 2016). Furthermore, mergers and acquisitions and bank branch closures, have resulted in the concentration of banks in financial centres, high-tech regions and metropolitan areas, making bank branches less accessible to people living in the countryside (British Business Bank, 2014). As such, regulatory and organizational changes affect the accessibility of banking services, especially in the countryside.

Despite the technological, regulatory and organizational changes that have swept across the banking industry, banks continue to be the largest group of companies in the financial sector, with the most amount of assets and liabilities in Sweden (Swedish Bankers’ Association, 2019). Banks in Sweden continue to play a major role in the financing of small and new companies as observed from a survey conducted by the Swedish Agency for Economic and Regional Growth (Tillväxtverket, 2017). The importance of banks in the financing of new and small companies can be considered from both the perspectives of both the entrepreneur and the banks.

From the entrepreneurs’ perspective, a bank loan is often regarded as low-cost financing, which does not risk any ownership loss of the company, unlike external equity (Myers & Majluf, 1984). From the perspective of the banks, the risk of lending to small companies is controlled by the fact that the bank can use the personal assets of the entrepreneur as a form of collateral, in the event of bankruptcy of the company (Cassar, 2004). The provision of loans to new and small companies is an investment and a source of income for the banks (Werner, 2014). Hence, banks would try to foster a long-term relationship with their borrower firms, which will pay off for them in the long run if the borrower firm manages to develop into a successful venture.
Therefore, important sources of finance include external finance from the banks and the entrepreneur’s assets.

However, it is noteworthy that the accessibility of bank branches is heterogeneous across regions, and the increasing closures of bank branches have worsened the accessibility to financial services in some regions (Backman, 2015; Nguyen, 2019; Sutaria & Hicks, 2004). Hence, the trend of the increasing disappearance of bank branches especially in vulnerable areas, such as the countryside, is a call for concern. To the best of my knowledge, few studies have investigated how the phenomenon of bank branch closure has had an impact on new firm formation (Backman, 2015; Brevoort & Wolken, 2008; Morrison & O’Brien, 2001).

In addition to the accessibility of financial services, there are also other factors that affect the formation of a new firm at the regional level. The factors can be characterized as demand- or supply-side factors. Demand-side factors explain the demand for entrepreneurs, while supply-side factors explain the supply of potential entrepreneurs. It is again noted that the conditions in each region are heterogeneous, which means that very different requirements must be met to form a company in each region (Breitenecker, Harms, Weyh, Maresch, & Kraus, 2017; Kibler, Kautonen, & Fink, 2014). Hence, it is interesting to determine how important each factor is for the formation of new firms in different parts of Sweden.

Based on the gaps identified in the existing literature, this thesis contributes to the study of the issues due to bank branch closure by assessing the effects of bank branch closure on new firm formation in 290 Swedish municipalities. This thesis also demonstrates the potential use of spatial analysis in the urban planning of the financial and non-financial infrastructure in each municipality. The use of spatial analysis on the regional level has also been recommended by many researchers because the results obtained from non-spatial methods and analysis at the national level can be misleading (Cumming, Deloof, Manigart, & Wright, 2019).
1.1 Purpose of the study and research questions

This thesis analyses the effects of bank branch closure on new firm formation and explores the varying importance of the regional determinants of new firm formation across space, which are the two main research topics in this thesis.

To summarize, the research questions (RQs) in this thesis are as follows:

**RQ1:** Analyse the effects of bank branch closures on new firm formation in Sweden.

**RQ2:** Explore the varying local relationships between new firm formation and accessibility of bank branches across 290 municipalities in Sweden.

The research project for this thesis is timely due to the trend of bank branch closure around the developed world. Hence, it is valuable to determine how the dismantling of the banking infrastructure has affected entrepreneurial lending and in turn affected new firm formation (Cole, Goldberg, & White, 2004; Morrison & O’Brien, 2001; Nguyen, 2019). For the first paper, the research objective is to analyse the effect of local bank branch closures on new firm formation in Swedish municipalities by using a panel database from 2000 to 2013.

After finishing the analysis for the first paper, a question that comes naturally afterwards is “Are the determinants for the formation of a new firm of equal importance in all the municipalities?” This is a question worth investigating since the characteristics of all the Swedish municipalities are different. Some municipalities have a higher spatial agglomeration of firms than others and own very distinct advantages; for example, there is access to a greater pool of venture capital and business angels in metropolitan municipalities (Mason & Harrison, 2002).

In addition to financial attributes, there are non-financial attributes to take into consideration in regard to the determinants of new firm formation. Non-financial attributes related to new firm formation are firm density, establishment size, human capital level, industrial structure, the proportion of immigrants and unemployment (Armington & Acs, 2002; Audretsch & Fritsch, 1994; Bishop, 2012; Davidsson, Lindmark, & Olofsson, 1994). Thus, the second research objective is to determine how important these financial and non-financial attributes are in the formation of new firms for each Swedish municipality. Moreover, the relationships between...
the characteristics of the municipality and the spatial agglomeration of certain types of industries are explored.

1.2 Thesis organization

This thesis consists of 6 chapters. Chapter 2 reviews previous studies on the demand and supply of capital for entrepreneurs, and identifies research gaps in the literature. In chapter 3, the discussion concerns the methodology used in papers I and II. The discussion focuses on the methodological choices for the research and the limitations of the selected designs. In chapter 4, the empirical findings from papers I and II are examined and the contributions of both papers are summarized. The results from the econometric models are provided, together with spatial map visualizations. Chapter 5 presents the theoretical and practical implications of the research and some concluding remarks regarding future research. Papers I and II are appended at the end of the thesis.

1.3 Declaration of contributions

Paper I – The Effect of Bank Branch Closure on New Firm Formation: The Swedish Case
Cynthia Ho conducted the analysis, built the models and wrote the paper. Björn Berggren provided supervision and feedback and edited the introduction and the literature review sections of the paper. Paper I was presented by Cynthia at the RENT XXXII conference in Toledo, Spain, from 14th to 16th November 2018. Paper I was submitted to the Annals of Regional Science journal for review on 13th March 2019.

Paper II – Accessibility of bank branches and new firm formation in Sweden
Cynthia Ho conducted the analysis, built the models and wrote the paper. Mats Wilhelmsson provided supervisions and feedback for the review of the paper. Paper II was presented by Cynthia at the 39th Babson College Entrepreneurship Research Conference (BCERC) in Boston from 5th to 8th June 2019. Paper II will soon be submitted to the Journal of Regional Science.
Chapter 2: Literature review

This chapter begins with an overview of entrepreneurial finance and provides a general review of the current state of entrepreneurial finance research. The review elaborates on theories that are commonly used to explain the demand and supply of capital for entrepreneurs. This section aims to uncover the research gaps and develop a theoretical framework to understand the importance of proximity to bank branches on new firm formation.

2.1 Entrepreneurial finance for new ventures

In the literature, most definitions of entrepreneurial finance combine the concept of entrepreneurship and corporate finance. Entrepreneurship essentially concerns the identification of an opportunity, which is then evaluated and commercialised into a business through the creation of a new venture (Shane & Venkataraman, 2000). Corporate finance addresses various sources of funding and the managerial use of tools and analysis to allocate financial resources to maximize the value of the shareholder (Damodaran, 2014).

By combining the concepts of entrepreneurship and corporate finance, entrepreneurial finance is defined in this thesis as the “acquisition and the use of capital for new and growing ventures” in which the value of the shareholder is maximized (see Landström, 2017). The decision involving the choice of capital depends on the characteristics and particularities of the venture’s financing structure, depending on the stage of venture development (Mitter & Kraus, 2011).

2.1.1 Liabilities of newness and smallness

During the early stages of venture development, new and small companies have difficulties in obtaining external resources, such as financing, for their businesses. The frameworks of the ‘liability of newness’ (Stinchcombe, 1965) and the ‘liability of smallness’ (Aldrich & Auster, 1986) have been used by scholars to explain why new and small companies experience problems with the acquisition of resources compared to larger and more established companies. Some new and small companies require much more capital than others. Some have an easier time obtaining the capital that they need, partly due to the subjective nature of the credit risk assessment. The credit risk assessment is not standard across all external capital providers and is subjected to the social judgement of the investors (Bitktine, 2011). Thus, entrepreneurial finance is heterogeneous for different types of companies in terms of the size of capital and the ease of obtaining the capital.
In many studies, the barriers to obtaining finance from external capital providers have been attributed to two main reasons – information asymmetry and lack of legitimacy (Choi & Shepherd, 2005; Fisher, Kotha, & Lahiri, 2016; Tornikoski & Newbert, 2007; Zimmerman & Zeitz, 2002). New companies often lack financial history, collateral and legitimacy (Venkataraman, Van De Ven, Buckeye, & Hudson, 1990). Their only way to make up for the lack of legitimacy is the entrepreneurs’ persuasive power in presenting the business idea’s viability, together with their only human resource – the team. Due to their lack of legitimacy, new companies are often characterized by a high risk of failure by external capital providers compared to older and more established companies (Stinchcombe, 1965).

A study conducted by the Swedish Agency of Growth Policy Analysis tracks the development of a population of Swedish start-up firms established in 1997 over the span of 14 years (Swedish Agency for Growth Policy Analysis, 2016). The high risk of failure of new companies is supported by the findings of the study in that approximately 75% of the studied firms failed by the 5th year mark and only 8% of the firms survived over the period of 14 years (Swedish Agency for Growth Policy Analysis, 2016). Thus, these findings corroborate the notion of a high risk of failure for new companies in the Swedish context.

In addition to the challenge of convincing capital providers, entrepreneurs often have to run their companies with limited knowledge of organizational management and limited experience in managing resources, which leads to internal inefficiency. Given the scarcity of the critical resources needed for a new firm to operate, managerial expertise is crucial to create the most value out of the resources and capabilities available to the firm and to respond quickly to a market opportunity (Sirmon, Hitt, & Ireland, 2007; Teece, Pisano, & Shuen, 1997). Hence, the barriers that a new company faces are both external and internal.

New companies often start small unless they started as a spin-off or franchise by large companies or they have received significant backing from other financiers, such as Venture Capital (VC) (Aldrich & Auster, 1986). The smallness of the venture means that these companies are not as attractive as large companies in recruiting talented and qualified labour (Cardon, 2003; Mayson & Barrett, 2006). Other disadvantages of being a small company include having to give up part of the ownership to secure funding as well as incurring high-interest expenditures from loans (Cassar, 2004). Overall, the frameworks of the liability of smallness and the liability of newness help to explain why new and small companies face
disadvantages in obtaining capital and hence have a higher rate of failure in the industry due to both human and financial constraints.

2.2 Demand for capital
Not all companies choose to be financed through debt; there are many other sources that an entrepreneur can obtain finance to support the operation of the company. This subsection reviews several theories that explain the capital structure of a company and the reasons behind the choice of capital from the perspective of an entrepreneur. The theories to be covered in this section are the trade-off, pecking order, signalling, and financial lifecycle theories (Berger & Udell, 1998; Kraus & Litzenberger, 1973; Myers & Majluf, 1984; Ross, 1977).

2.2.1 Trade-off theory
Trade-off theory assumes that there is an optimal capital structure of how much money a company should borrow by weighing the tax advantages of borrowing money and the disadvantages of a potential increase in agency costs and bankruptcy risks (Kraus & Litzenberger, 1973). In high-tax countries, such as the United States, the marginal benefits of borrowing become larger due to the deductibility of interest from income tax (Graham, 2000). The deductibility of interest from tax hence incentivises the use of corporate debt. However, as the level of debt increases, the cost of borrowing also increases due to increased monitoring costs and a higher interest rate compensates for the greater risk of bankruptcy (Cassar, 2004).

There are several empirical studies in the financing of new and small firms that have applied the trade-off theory. In one study, it is shown that ventures boasting high investment opportunities or lacking the required cashflow are more likely to employ debt as a financial instrument due to the lower opportunity cost of borrowing money (López-Gracia & Sogorb-Mira, 2008). Other studies with empirical results related to trade-off theory have shown that there are several characteristics that are favourable to a company applying for a loan (Cassar, 2004; Masiak, Block, Moritz, Lang, & Kraemer-Eis, 2019; Michaelas, Chittenden, & Poutziouris, 1999). For example, the borrower company’s ownership of tangible assets suggests that banks are able to rely on the fixed tangible assets to minimize agency costs as part of the contract in their financing of the company (Cassar, 2004).
2.2.2 Pecking order theory

The pecking order theory when applied to young and small ventures states that the preferences for funding in a firm are in the following order: first, through the entrepreneur’s internal capital, followed by debt, and equity financing as a last resort (Myers & Majluf, 1984). Myers and Majluf (1984) argued that the cost of financing is positively associated with the level of asymmetric information. Information on the company’s performance, prospect, risks and future outlooks is not common knowledge, and opportunistically biased information may be presented to capital providers by the present owner, which results in adverse selection problems (Vanhaverbeke, Duysters, & Noorderhaven, 2002). Hence, capital providers can demand higher premiums to compensate for the information asymmetry, which creates a preference for internal funds (Fazzari & Variato, 1994).

Only when the internal funds are not enough to finance the operations of the company do entrepreneurs often have to turn to external finance, such as external equity or debt. One disadvantage of choosing external equity as external finance is the dilution of the ownership of the entrepreneur (Myers & Majluf, 1984). The use of external equity as an option for financing is especially unfavourable to the entrepreneur if the business becomes very profitable in the future. If debts have been chosen instead, entrepreneurs will not risk the loss of control and will only need to pay back the loan interest (Du & Dai, 2005). Thus, entrepreneurs may be reluctant to accept external equity due to control aversion and only choose external equity as a last resort. In other words, entrepreneurs tend to prefer debts over external equity if they search for external capital.

Empirical tests of the pecking order theory in entrepreneurial ventures are limited and have shown mixed results. The studies that have tested for pecking order theory differ with regard to the national context, the sample of firms in terms of size and industry and the methodology used (Chen, 2004; Frank & Goyal, 2003; Serrasqueiro, Armada, & Nunes, 2011; Sogorb-Mira, 2005). There are a few studies that have confirmed the pecking order theory (Mac an Bhaird & Lucey, 2011; Masiak et al., 2019; Sogorb-Mira, 2005; Zeidan, Galil, & Shapir, 2018). Other studies have argued that the pecking order theory was first developed for large corporations and is thus not applicable to entrepreneurial ventures, leading to several modified versions of pecking order theory for small firms, such as the ‘bridged’ pecking order theory (Frank & Goyal, 2003; Howorth, 2001; Paul, Whittam, & Wyper, 2007).
2.2.3 Signalling theory

Signalling theory explains how entrepreneurs try to reduce uncertainty and information asymmetries by communicating with different capital providers (Connelly, Certo, Ireland, & Reutzel, 2011). Signalling theory has been used in the literature to explain how entrepreneurs signal legitimacy to external capital providers when they try to sell their business idea to investors at an initial public offering (IPO) or pitch their business to ventures capitalists and business angels to raise funds (Davila, Foster, & Gupta, 2003; Prasad, Bruton, & Vozikis, 2000).

In the context of bank lending, the lending technology that is highly linked to the signalling theory is relationship lending. In relationship lending, positive signals from the entrepreneur and soft information gained through contact over time can help to compensate for a firm’s lack of track record (Berger & Udell, 2002). Examples of such positive signals could be ownership of intellectual property, provision of collateral, and media coverage that emphasizes the competence of the entrepreneurs (Carter, 2006; Markman, Balkin, & Schjoedt, 2001).

A qualitative study performed by Silver (2001) shows that in both metropolitan and non-metropolitan districts in Sweden, the loan officers emphasized the importance of visiting the firm and the effects of the visit on credit-risk assessment. The main objective of the visit for the bank branch loan officers is to gather a general impression of how the firm functions in the normal day-to-day operation and “on the spot” personality assessment of the entrepreneur and his or her employees during the tour. Hence, the outcome of the credit risk assessment relies largely on the signals of the entrepreneur to the loan officer about the current and future state of the company during the visit as well as on the intuitive judgement of the loan officer (Hensman & Sadler-Smith, 2011; Lipshitz & Shulimovitz, 2007).

2.2.4 Financial lifecycle approach

The financial life cycle approach assumes that the availability of financial sources varies in different phases of firm development. Information asymmetry between the firm and the capital providers decreases as the firm ages (Berger & Udell, 1998). As this thesis focuses on the creation of new firms, the typical sources of finance advanced by entrepreneurs at different stages of venture development are examined using the lifecycle approach.

Berger and Udell (1998) developed a financial lifecycle model that presents firms based on size, age and information availability continuum. As the firm survives and grows, the reduction in
the information asymmetry between the firm and the capital providers opens doors to a wider range of financing opportunities for the firm. Hence, the conceptualization of the lifecycle model is based on information opacity and follows the hierarchy of preferences for funding as postulated in the pecking order theory. Empirical evidence for the financial lifecycle model has been shown in few studies but it is noteworthy that the financial lifecycle model does not provide a “one size fit all” approach for small and medium-sized enterprises (SMEs) financing (Fluck, Holtz-Eakin, & Rosen, 1998; Gregory, Rutherford, Oswald, & Gardiner, 2005; Mac an Bhaird & Lucey, 2011).

Figure 2 summarizes the financial sources in different stages of venture development, as adopted from Berger and Udell (1998).

![Figure 2. Source of finance in different stages of venture development. Adapted from The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle, by Berger and Udell (1998).](image)

In the seed stage, the entrepreneur has already found a promising business opportunity and is moving on to developing the idea. In the process of developing the idea, much research and development are involved in creating the ‘minimal viable product’ (MVP) (Vogel, 2017). At
the seed stage, the entrepreneur tends to be quite constrained by the availability of finance since external capital providers need more proof of the viability and feasibility of the business idea (Carpenter & Petersen, 2002; Harrison, Mason, & Girling, 2004). Therefore, they must rely on internal capital which is pooled from their personal savings, loans from family and friends, bootstrapping and government grants (Harrison et al., 2004). Personal savings are the primary source of internal capital. The reliance on external capital will result in the dilution of ownership of the business, which the entrepreneur will try to avoid (Myers & Majluf, 1984). Moreover, the valuation of the venture is fraught with uncertainty, and hence, the venture is given low valuation in the early stages due to lack of access to a verifiable track record, further discouraging entrepreneurs from seeking external equity (Sanders & Boivie, 2004; Stuart, Hoang, & Hybels, 1999).

As the venture becomes more established at the start-up stage, the entrepreneur starts thinking about the commercialisation of the product and the targeting of potential customers. The resource demand will be higher at the start-up stage since more equipment and manpower will be needed due to the iterative nature of product development in refining the product for the customers (Picken, 2017). At this point, trade credits and support from customers and suppliers can contribute significantly to the venture (Carb-Valverde, Rodriguez-Fernández, & Udell, 2009).

As the venture gains more traction in the initial growth stage, the venture needs more funds to expand the production by employing more staff and investing in more plant and equipment. If the venture earns enough profits to sustain the increased growth, the venture can capitalise on growth opportunities by reinvesting the profits generated to invest in labour and equipment (Abraham, Harris, & Auerbach, 2018). Otherwise, entrepreneurs can turn to external capital providers, since at this stage, they gain a higher ability to provide collateral and possess more proof to show that they have a track record as the firm ages (Ezeoha & Botha, 2012). The information asymmetry due to uncertainty and risk also decreases at this point.

At the maturity stage, the profits and cash flow have reached the required level for launch into the public equity market, where shares are made publicly available (Brau & Fawcett, 2006). If the venture is interested in new growth opportunities, such as the entry into the international market or the acquisition of other companies, entrepreneurs will seek additional financing, for example, from institutional venture capital and the public stock market (Lowry, 2003).
2.3 Supply of capital

This section will elaborate on bank financing to the entrepreneur because it is a major supply of capital to new and small companies. There are however many individual ventures that might face difficulties in raising capital from external capital providers due to the financial gap. The financial gap is a result of market failure, which means that there is an inefficient allocation of resources from capital providers for investment in profitable projects in different regions due to information asymmetry and agency costs (Stiglitz & Weiss, 1981). The regional capital gap is a type of finance gap, which is explored in the second part of this section.

2.3.1 Bank finance to entrepreneurs

The majority of companies currently rely on internal capital and external financing. Financing via loans and credits is the most common form of external financing, according to a survey conducted by the Swedish Agency for Economic and Regional Growth (Tillväxtverket, 2017). The four types of financing specified in the survey are loans and credits, external equity, family and friends, and public support.

![Figure 3: Types of financing applied by companies. Adapted from Financing in Swedish companies, by Swedish Agency for Economic and Regional growth (2017).](image-url)
Figure 3 shows that most SMEs applied for loans and credits, followed by borrowing money from family and friends. Figure 3 also shows that very few SMEs (less than 5%) managed to successfully obtain external equity from VC and business angels, which is in line with the findings from research on VC and business angels (Barry, 1994).

**Types of lending technology used by banks**

The availability of accurate information about the borrowers and their business is a key factor in bank managers’ decision concerning the granting of loans to entrepreneurs. However, in reality, the existence of asymmetric information between the borrowers and the lenders and within the banking organizations results in an inefficient allocation of credits in the market (Dell’Ariccia, 2001; Dell’Ariccia & Marquez, 2004; Marquez, 2002).

Loan services consist of both transaction-based and relationship-based elements as there is an exchange of both hard and soft information between the borrowers and the lenders (Norberg, 2016). The use of hard information is related to transaction-based lending and the use of soft information is related to relationship-based lending (Berger & Udell, 2006; Elyasiani & Goldberg, 2004; Fredriksson & Moro, 2014). Some banks use more transaction-based elements than relationship-based elements in their credit risk assessment of the borrowers while other banks use more local information in their decision-making process.

Transaction-based lending is a lending technology that depends on quantitative information, such as financial reports, balance sheets and repayment records (Berger & Udell, 2006). Quantitative information can be collected easily from companies and one can communicate the figures or numbers from the financial report effectively to another person without introducing his own bias. The quantity and quality of the quantitative information made available to banks are affected by the sophistication of the credit scoring technology they use and by the regulatory environment of the banking industry (Papi et al., 2015).

For example, banks can request a credit report from public and private credit bureaus to check on a potential borrower. The credit report usually contains information on tax declarations and the history of loans, repayments and debts. The report can be used to weigh the risk of lending money to a potential borrower. The main advantages of using credit scoring include a reduction in the information search costs, faster processing time of loan approval and improved objectivity in the decision-making process (Mester, 1997). The increasing use of credit scoring
techniques can lead to an increase in the small credits granted to SMEs through economies of scale, as credit scoring helps reduce information asymmetry, especially in low-income areas (Berger & Frame, 2007; Frame, Padhi, & Woosley, 2001).

Relationship-based lending is another type of lending technology, but it is based on qualitative information. In an opaque market, relationship-based lending relies heavily on the relationship between the borrower and the bank (Berger & Udell, 2006). Qualitative information includes subjective knowledge accumulated over time through multiple face-to-face meetings with the same borrower (Boot, 2000). The qualitative information gathered from multiple interactions with the same borrower allows the loan officer to have a better understanding of the borrower’s personality, the quality of his firm’s management and his relationship with customers (Uchida, Udell, & Yamori, 2012). However, the impression gathered also depends on the intuitive judgement of the loan officer, which can only be verified if the loan applicant has contacts in the banks who know him or her (Hensman & Sadler-Smith, 2011; Lipshitz & Shulimovitz, 2007).

Moreover, the nature of this kind of soft information is very local, which means that the geographical distribution network and the positioning of each bank branch are important factors for relationship-based lending to work well (Agarwal & Hauswald, 2010; Papi et al., 2015). Closer proximity between the lenders and potential borrowers would reduce search cost because a long-distance affects the quality of soft information acquisition and transmission (Brevoort & Wolken, 2008). A downside of relationship lending is the problem of adverse selection (Myers & Majluf, 1984). Entrepreneurs do not always fully disclose all information to the loan officer as they tend to show more positive information about their firm, or the loan officer might not fully understand the technicality of their product or market (Stiglitz & Weiss, 1981).

The extent of the usage of transaction-based lending and relationship-based lending largely depends on the characteristics of the banks, such as the size of the bank, the hierarchy level and how geographically dispersed the bank branch is in the local region (Berger, Miller, Petersen, Rajan, & Stein, 2005; Cole et al., 2004; Scott, 2004). Various characteristics of the bank influence how the bank acquires, obtains and interprets information about the loan applicant. For example, large, hierarchical and geographically dispersed banks are able to take advantage of their large proprietary information database due to the extensive network of their bank branches. However, the database might not contain information on informationally opaque
borrowers. Soft information is difficult to codify and it suffers from loss of information through transmission across several layers of the bank hierarchy, making relationship-based lending an unsuitable instrument (Becker & Murphy, 1992; Bolton & Dewatripont, 1994; Geanakoplos & Milgrom, 1991). Small local banks are better equipped to collect and assess qualitative information though regular face-to-face meetings at the local level with potential borrowers who live in the vicinity due to their simpler organizational structure (Stein, 2002).

2.3.2 Regional gap in the supply of capital
There exists geographical disparity in access to finance. There are many financial possibilities in the larger cities and metropolitan areas compared to the limited selection of financial possibilities in the peripheral areas as both informal and formal venture capital markets are mainly concentrated in the metropolitan areas (Avdeitchikova, 2009; Mason & Harrison, 2002). Especially in some peripheral areas where there is a high proportion of businesses in sectors such as tourism and hospitality, access to finance from banks is even more crucial since they are cash-dependent and have limited access to other forms of external capital (Torluccio, 2012).

The regional capital gap can be explained by two dimensions: the number of investment-ready ventures with growth potential and the number of supporting actors, such as banks, venture capitals and business angels (Nightingale, Mason, Cowling, Gordon, & Dannreuther, 2009). There are four different kinds of markets: ‘market with a supply shortage’, ‘thick market’, ‘thin market’ and ‘market with a demand shortage’, according to the variation in the two dimensions, as shown in figure 4.

As venture capital firms and business angels are mainly concentrated in metropolitan regions, the bank becomes the sole capital provider in some peripheral regions (Alessandrini & Zazzaro, 1998). As the number of bank branches decreases in the peripheral areas, there will be more peripheral areas with cash-dependent industries trapped in a market with a lack of supply. The lack of supply of bank branches in the region means that more entrepreneurs will find more difficulties in trying to apply for finance from the banks. In the long run, this phenomenon could result in the dwindling formation of new firms in peripheral regions, which then leads to the downscale from a market with ‘lack of supply’ (quadrant 1) to a ‘thin market’ (quadrant 3) in figure 4. A ‘thin market’ arises when the high-potential firms and investors are both in small number, and high transaction and search costs are incurred to obtain a suitable match between the two parties (Nightingale et al., 2009).
In addition to the limited supply of financial institutions in peripheral areas, there exists an unequal distribution of wealth across the country and large variation in housing prices. The lower housing prices in the peripheral areas can be disadvantageous for entrepreneurs who want to apply for a bank loan for their business. Housing can be used as collateral and collateral is important for banks in reducing their risk of lending money to a small company with no track records (Cassar, 2004). Several studies have also shown that the formation of new firms and the creation of jobs are higher in regions with higher housing prices (Adelino, Schoar, & Severino, 2015; Berggren, Fili, & Wilhelmsson, 2017; Schmalz, Sraer, & Thesmar, 2017).

![Figure 4. Thin and thick regional markets. Adapted from Business angels, risk capital funds and policy portfolios, by Swedish Agency for Economic and Regional growth (2013).](image-url)
2.4 Summary of literature review

Bank finance is an important source of external finance in several stages of venture development, as presented by various finance theories, as bank financing prevents the dilution of ownership control for entrepreneurs and allows the deduction of interest payment from income taxes (Graham, 2000; Myers & Majluf, 1984). In several stages in the lifecycle of venture development, bank finance is also a valuable source of finance for new ventures, especially in the start-up and initial growth stage (Berger & Udell, 1998).

However, the increasing trend of bank branch closures affects the supply of capital to entrepreneurs to varying extents in different regions. As such, the dismantling of the bank branch network and infrastructure can widen the regional capital gaps as entrepreneurs in the countryside face an even larger constraint in the access to capital for their companies. Furthermore, as the positioning of bank branches becomes more dispersed, the quality and quantity of soft information transmission about potential firms in the region decrease, leading to an increase in the search cost and transport cost for both the banks and the borrower firms (Brevoort & Wolken, 2008).

Overall, the closure of bank branches could affect the demand and supply of capital to entrepreneurs to different extents in different regions and could therefore sabotage entrepreneurs’ chances of starting a new company. However, there has not been much research that provides empirical evidence to prove the impact of bank branch closure on new firm formation at the regional level (Backman, 2015; Brevoort & Wolken, 2008; Morrison & O’Brien, 2001). Hence, it would be interesting to narrow this research gap by analysing how the closure of bank branches has affected the rate of new firm formation in Sweden and how important the proximity to bank branches is for the formation of start-ups at the municipal level.
Chapter 3: Methodology

In this chapter, the data collection process is described. Furthermore, this chapter explains the different methods considered for the analysis and why the chosen methods are appropriate for the research.

3.1 Data collection

When the database was first accessed, it was in the form of shapefiles that had not been merged. Essentially, the database consists of data related to employment by industry, income, population age demographics, number of establishments, total revenue by these establishments and the locations of all the bank branches and other financial intermediaries. However, the dataset was incomplete, and hence, several meetings were organized to discuss how the data would be used in the research and determine the additional data required for the analysis.

In the literature review process, more research relating to spatial analysis and location theory was gathered. Location theory addresses questions on the types of economic activities in a particular location and the reasons why they are located there (Hong, Hong, & Kwak, 2009). Location theory assumes that agents generally act in their self-interest. In the context of firms, location theory assumes that the firm chooses locations that maximize its profits. Therefore, based on location theory, the questions that surfaced are “Why do entrepreneurs prefer to set up their companies in a particular location?” and “What kind of impact does the closure of bank branches have on entrepreneurship?”.

As the first law of geography states “everything is related to everything else, but near things are more related than distant things”; thus, proximity to bank branches can be an important factor for an entrepreneur when deciding where to set up his company because proximity is directly related to accessibility (Tobler, 1970). Discussions were held to acquire additional data and the consensus was that information regarding the proximity of the bank branches would be valuable for the research. Network analysis was applied using the National Road Database of Sweden to calculate the driving distance from each household area to the nearest bank branch office. The algorithm calculates the actual distance in metres using each road segment and identifies the shortest road route from each household area to the bank branch office. A unique and comprehensive dataset was obtained, which includes information on the accessibility of bank branches in different areas in Sweden on the micro level.
Eventually, a harmonised dataset was obtained for 2000, 2007 and 2013 after all the different datasets were merged. Since 2007 and 2013 were not involved in a recession, there was no need to include recession effects in the analyses. Using a year that is involved in a recession entails bias issues because a recession has a dampening effect on new firm formation due to lower overall consumer confidence in the market.

Additional data were collected through other channels. From the Swedish Agency for Growth Policy Analysis, information on the new firm formation in each municipality was downloaded for 2007 and 2013 because the data on new firm formation were not available for 2000. Data related to education and unemployment data were downloaded from the websites of Statistics Sweden and the Swedish Public Employment Service, respectively.

### 3.2 Research methodology

The main objective of the first paper is to analyse the effect of bank branch closure on new firm formation. As data on new firm formation are not available at a spatial resolution finer than the municipal level, all the data were aggregated and merged into a single database for ease of analysis at a municipal level. Distances to the two nearest bank branches were weighted by the labour population living in the included area and then averaged to obtain a single measure of proximity to bank branches for each municipality. For the second paper, the same database was used to analyse the importance of several determinants of new firm formation for each municipality. In these two papers, the analyses were conducted with the consolidated database using different software and programming languages – Python, R, Geoda, QGIS and MATLAB.

To determine suitable methods for the analysis, research on the different types of methods was carried out to compare the limitations and strengths of each method. Cross-sectional models, time series models and panel data models are common methods used in the current literature, and these methods are explained further in this section (Andrews, 2005; Gardiner, Luo, & Roman, 2009; Hillmer & Tiao, 1982).

A further consideration is the inclusion of spatial aspects in the modelling such as spatial regression models and geographically weighted regression (GWR), as explained in section 3.4. (Anselin, 1988; Cliff & Ord, 1970; Fotheringham, Charlton, & Brunsdon, 1998).
3.2.1 Cross-sectional models

The cross-sectional model is a type of regression model that measures the relationship between the dependent and independent variables at a specific point in time. An example of a cross-sectional model is the linear regression model, which is represented by a function of independent variables and an error term. By estimating the coefficients of the independent variables, it is easy to interpret which independent variable affects the dependent variable more relative to the other independent variables (Schneider, Hommel, & Blettner, 2010).

The cross-sectional model has been used extensively in many studies. For example, a cross-sectional approach is adopted in a study to measure the relationship between new firm formation rate and the characteristics of the local bank sector in Sweden in 2010 (Backman, 2015). However, a caveat of a cross-sectional study is that it only addresses a single point in time, which means that it does not include temporal effects (Kesmodel, 2018). The inclusion of the temporal dimension allows causality to be examined.

Another shortcoming of the cross-sectional model is that it tends to over-generalize the results, especially if a single general model is used to explain the relationship for the entire country (Levin, 2006). For example, rural areas and urban areas have different conditions for entrepreneurs to set up their business. Urban areas have an advantage in regard to setting up a business since the accessibility to different types of resources is much higher than that in rural areas. Hence, it would be naïve to set up a single general model for both urban and rural areas. In addition to the lack of inclusion of temporal effects and the over-generalization issue, the cross-sectional model may fail to address endogenous variables and the linear regression model assumes the error term to be normally distributed, which might not always be the case (Bascle, 2008).

3.2.2 Time series models

The time series model describes the pattern of the data over time. There are two main applications of a time series model: to improve the accuracy of forecasts and to explore and understand the dynamic relationship between variables of interest (Tiao & Box, 1981). One common “time domain” model is the autoregressive integrated moving average (ARIMA) model, which relates the present values of a series to past values and past prediction errors (Box, Hilimer, & Tiao, 1978). As this model considers seasonal trends and outliers, it is a good model for forecasting future values.
As it is not our objective to measure the time-stationarity of new firm formation or predict new firm formation, the time series method is not suitable. It is difficult to observe a general trend in the new firm formation rate since the conditions in all the Swedish municipalities are different. It is hard to build a “one size fit all” time series model for all the municipalities in Sweden since there are many other unobserved factors that could lead to the change in new firm formation rate. In other words, new firm formation is dynamic. For example, there is better access to other forms of external finance, such as business angels and venture capitalists in the metropolitan regions and lower rent in office spaces in the rural parts of Sweden, which are not captured in the time series model (Torluccio, 2012). Hence, the time series model is not suitable for the research, but it could be considered in future research aiming to find out whether the past new firm formation rate can predict the future new firm formation rate (Fotopoulos, 2013).

### 3.2.3 Panel data models

Panel data models are known for their advantages over cross-sectional models because longitudinal data are used and causality can be analysed on a deeper level (Halaby, 2004). Two common types of panel data models are the fixed effects model (FEM) and the random effects model (REM). The main advantage of the FEM and REM is that they can control for all omitted time-invariant variables that affect the dependent variable. The REM assumes that there is no correlation between the omitted time-invariant variables and time-varying covariates, while the FEM allows these variables to correlate freely (Mundlak, 1978). A Hausman (1978) test allows researchers to determine whether the REM or FEM is appropriate for analysis.

There are two prerequisites for the FEM and REM. The first requirement is to have time series data as an input to the model. If the cross-sectional unit of observation is the municipality, the unit of observation for the complete time series data is municipality/period, in which the period could be weeks, years or any other unit of time. The second requirement is that there be variation over time within each cross-sectional unit. Thus, if the unit of observation is the municipality/year for the regression, then the new firm formation rate must vary over time within some or all of the cities (Dranove, 2012).

In the FEM and REM, the key source of omitted variable bias is eliminated, namely, unobservable between-municipality differences (Dranove, 2012). However, one limitation is that the unobservable variables in the model are assumed to be time invariant (Gardiner et al., 2009). If the unobservable variables increase or decrease over time within the group in a way
that is correlated with the independent variables included in the regression, the problem of omitted variable bias still exists.

3.3 Reflections on methodological choice

After an overview of the potential methods considered initially, the panel data model was considered to have an advantage over the other two models, the cross-sectional model and time series model.

Panel data models are preferred to the cross-sectional models because they help to reduce the problem of omitted variable bias (Gardiner et al., 2009). For example, if the entrepreneurial environment differs across municipalities but does not vary over time within each municipality, the FEM and REM can pick up this between-municipality difference. By controlling for all time-invariant differences in observable and unobservable variables, the FEM and REM greatly reduce the threat of omitted variable bias even if they cannot ensure its elimination (Chi, 2005). Moreover, the cross-sectional model does not include temporal effects, i.e., examine changes in new firm formation over time due to bank branch closure. Hence, a panel data model would be more suitable for the research in this thesis.

In addition, panel data models are preferable to the time series model because panel data models allow us to measure the effects of local bank branch closure on new firm formation over time. Time series analysis is not able to help us attribute the change in new firm formation to bank branch closures since the reasons for the change are not directly observable from the time series model.

3.4 Afterthought – the incorporation of spatial effects into the models

After conducting an initial analysis using panel data models, the results obtained from the FEM indicate that the model is not suitable because it has a negative R-square. In the research process, spatial analysis was identified, and the importance of including spatial autocorrelation in the model was recognized in case spatial dependency exists in the data.

Two general types of models that incorporate spatial autocorrelation are spatial regression models and GWR models, as elaborated in this section. By testing spatial autocorrelation in the data, Moran’s I test indicates that spatial autocorrelation exists, and this implies that
municipalities with similar new firm formation per capita are more likely to be spatially clustered than they would be in conditions of randomness (Moran, 1950). Thus, spatial autocorrelation must be included in the model.

Ultimately, the fixed effects and the random effects spatial panel models are adopted in the first paper, and the GWR model is adopted in the second paper to analyse the importance of the various determinants of new firm formation across the entire study area. These spatial methods are further explained in the following subsections which follow.

### 3.4.1 Spatial regression models

Spatial regression models are useful when spatial autocorrelation exists in the data (Cliff & Ord, 1970). Spatial autocorrelation can be tested using Moran’s I test (Moran, 1950). There are three different types of spatial models: spatial lag, spatial error and spatial Durbin models.

The spatial lag or spatial autoregressive (SAR) model can be expressed in matrix form as

\[ y_{it} = \delta Wy_{it} + X_{it}\beta + \mu_{i} + u_{it}, \]

where \( \delta \) is the spatial autoregressive coefficient.

The spatial error model (SEM) can be expressed as

\[ y_{it} = X_{it}\beta + \mu_{i} + u_{it}, \]  \hspace{1cm} (2)

\[ u_{it} = \rho Mu_{it} + \varepsilon_{it}, \]  \hspace{1cm} (3)

where \( u \) is the spatially autocorrelated error term and \( \rho \) denotes the spatial autocorrelation coefficient on the error term.

The spatial Durbin model (SDM) can be specified as

\[ y_{it} = \delta Wy_{it} + X_{it}\beta + \gamma WX_{it} + \mu_{i} + u_{it}, \]  \hspace{1cm} (4)

where \( \delta \) is the spatial autoregressive coefficient and the parameter \( \gamma \) indicates a spatial autocorrelation coefficient on the observed exogenous variables \( X \). The SDM can be used to determine whether the model can be simplified to a spatial lag or spatial error model because the dependence on the disturbances and the dependent variables is nested in the model (Mur & Angulo, 2005).
In the context of this thesis, in equations 1 to 4, $i$ and $t$ refer to the spatial unit of the municipality and the year, respectively, $y$ is the matrix representing the new firm formation per capita in each municipality, $X$ is the matrix representing all the observed exogenous variables, $W$ and $M$ are the spatial weight matrices that define the dependence across the spatial units, $\mu$ is the matrix of individual fixed effects, $\beta$ is the matrix that represents all the regression parameters, $u$ is the matrix of the disturbance terms, and $\varepsilon$ is the matrix of innovation error terms. $Wy$ and $Mu$ are defined as the spatial lag and the spatial error lag, respectively. The spatial lag and error lag express the impact of the observed and the unobserved effects of the new firm formation per capita of municipality $i$ on the new firm formation per capita of neighbouring municipalities, respectively.

3.4.2 Geographically weighted regression

The GWR model is an extension of the classical linear regression model, with the addition of spatial dependence of the regional data and considering the spatial variation between the dependent and independent variables (Brunsdon, Fotheringham, & Charlton, 1996; Fotheringham et al., 1998). As the model is estimated at a local level, the coefficients of the variables vary across the entire study area.

The GWR model is represented by

$$ y_i = \beta_0(u_i, v_i) + \sum_{k=1}^{p} \beta_k(u_i, v_i)x_{ik} + \varepsilon_i , \quad (5) $$

where $\beta_0(u_i, v_i)$ are the intercepts that vary in each municipality $i$ ($i = 1, \ldots, n$) and $\beta_k(u_i, v_i)$ is the coefficient of the independent variable $x_{ik}$ ($k = 1, \ldots, p$) for each municipality $i$. The municipalities in this analysis are represented by the coordinates $(u_i, v_i)$ of their centroids (Breitenecker et al., 2017). Spatial weights are included in the estimation procedure. The results from all the individual local models can then be mapped for visualization and interpretation. A weighting matrix is needed in the GWR model to calculate the importance of individual observations among locations. The weighting matrix assumes that areas that are closer to municipality $i$ have more influence on municipality $i$ than areas that are farther away (Chasco, García, & Vicéns, 2007). Therefore, more weight is given to observations near municipality $i$, and less weight is given to municipalities that are farther away. Two weighing matrices used in this thesis are Gaussian and bi-square kernel functions, both of which are spatial kernel functions (Brunsdon, Fotheringham, & Charlton, 1998).
Spatial kernel functions can be either fixed or adaptive. In a fixed spatial kernel function, an optimal single spatial bandwidth is used uniformly across the study area. However, the downside of this approach is that in sparse areas, the local regressions are only based on a few observations. The inconsistency in the number of observations included in each local regression due to the area density leads to large variance between the results in sparse areas and dense areas (Páez, Uchida, & Miyamoto, 2002). Hence, the degree of non-stationarity might be exaggerated in sparse areas and underestimated in dense areas.

A more flexible approach is to incorporate a spatially adaptive weighting function into the GWR model. In an adaptive spatial kernel function, the bandwidths differ based on the density of the area. The bandwidths are relatively larger in areas where the observations are sparsely distributed and smaller in areas where the observations are densely distributed. The bandwidth is calculated such that a certain proportion of observations that are nearest to municipality \( i \) will be included in the local regression for each municipality. This optimal proportion can be computed by cross-validation which outputs the number of nearest neighbours beyond which zero weights are imposed (Cleveland, 1979).

The adaptive Gaussian and bi-square weighting functions are defined formally as:

Gaussian: \[ w_{ij} = \exp \left(-\frac{1}{2}\left(\frac{d_{ij}}{h_i^2}\right)^2\right), \]  

Bi-square: \[ w_{ij} = \begin{cases} 
\left[1 - \left(\frac{d_{ij}}{h_i}\right)^2\right]^2, & \text{if } d_{ij} < h_i, \\
0, & \text{otherwise}
\end{cases} \]  

where \( w_{ij} \) represents the weight assigned to the data for municipality \( j \) when considering the calibration of the model in municipality \( i \), and \( h_i \) represents the different bandwidths that consider the same proportion of municipalities to be included in the estimation of the regression model for each municipality.

3.4.3 Limitations of the chosen methods

However, even the spatial methods chosen are not without their limitations. Although the fixed effects spatial panel model and random effects spatial panel model greatly reduce the threat of omitted variable bias, there still exist other problems, such as confounding variables that influence both the dependent and independent variables, causing a spurious association (VanderWeele & Shpitser, 2013). Moreover, complete data only exists for 2007 and 2013. Although this is not a limitation of the fixed effects spatial panel model and random effects
spatial panel model, it would have been more desirable to obtain data for a longer period to increase the reliability and accuracy of the results.

Concerning the limitations of the GWR model, the GWR model is a cross-sectional analysis and hence the results might not be as robust as the results obtained from panel data models. From the methodological side, the issues of multicollinearity may arise in the GWR model due to the common data used in local estimation procedures (Wheeler & Tiefelsdorf, 2005). Furthermore, the choice of bandwidth and spatial kernel functions can lead to different results. Finally, the GWR is considered to be a tool mainly for exploratory spatial data analysis (ESDA) rather than for making inferences (Gollini, Lu, Charlton, Brunsdon, & Harris, 2015; Páez, Farber, & Wheeler, 2011).

### 3.4.4 Frequency of the methods used in related literature

The frequency of use of the methods used in the literature related to the determinants of new firm formation is considered, similar to the approach in a study conducted by Breitenecker (Breitenecker et al., 2017). A SCOPUS query on articles published up to the end of 2017 was conducted by selecting articles that contained the keywords new firm formation, new venture formation and firm birth in their titles or abstracts. Only empirical analyses that have variables measured at the regional level were included in the frequency measurement of the methods used in the literature related to the regional determinants of new firm formation.

**Table 1. Frequency counts of the methods used in the literature**

<table>
<thead>
<tr>
<th>Method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poisson model</td>
<td>2</td>
</tr>
<tr>
<td>Logistic regression model</td>
<td>3</td>
</tr>
<tr>
<td>Probit model</td>
<td>3</td>
</tr>
<tr>
<td>Spatial lag model</td>
<td>3</td>
</tr>
<tr>
<td>Fixed effects model</td>
<td>6</td>
</tr>
<tr>
<td>Geographically weighted regression model</td>
<td>6</td>
</tr>
<tr>
<td>Cross-sectional model</td>
<td>17</td>
</tr>
</tbody>
</table>

Not surprisingly, the results shown in table 1 indicate that the cross-sectional model is still the most commonly used method in the literature, based on a sample of 40 different published
articles. Only 9 out of these 40 studies have considered the inclusion of spatial effects in the analysis, using, for example, spatial regression methods or the GWR model in their analyses. An important takeaway message from this investigation is that it is important to use models that consider spatial heterogeneity when analysing at a regional level if spatial dependency exists in the regional data.

A recently published article about the developments in forms of entrepreneurial finance has also noted that more fine-grained analysis is needed at the regional and sub-regional levels, as estimating funding and equity gaps at the national level can entail misleading results (Cumming et al., 2019). The misleading results from non-spatial methods can then result in opposing implications drawn for researchers and policymakers.
Chapter 4: Results

In this chapter, the objectives, methods and contributions of the two papers are summarized and presented. The summary of the papers provides the basis for the discussion of the theoretical and practical implications in chapter 5.

4.1 Summary and contributions of paper I

The Effect of Bank Branch Closure on New Firm Formation: The Swedish Case

Paper I explores the effects of bank branch closure on new firm formation over time. The main hypothesis of this paper is that an increase in the overall distance to the nearest bank branches due to bank branch closure results in lower new firm formation for the municipality over time. An increase in the distance to the bank branches affects the quality of soft information transmission about the borrower firm and can increase the monitoring cost for the bank managers. As such, potential borrowers situated far away from banks have a disadvantage in borrowing money from banks. The analyses were conducted using spatial panel data regression analysis, with data from 2007 and 2013.

The originality of the paper is that the use of the weighted mean distance to the nearest bank branches has not been previously used as a proxy representing the proximity to bank branches in the existing literature. The number of bank branches per capita is commonly used to represent the accessibility to bank branches in a municipality, but it is a misleading variable for areas with a relatively small population; hence, the weighted mean distance to the bank branches is used in place of the number of bank branches per capita to tackle this problem in the paper.

This study’s findings confirm that the weighted mean distance to banks is a significant and negative variable based on the random effects spatial error model. That is, an increase in the weighted mean distance to bank branches dampens the municipality’s new firm formation per capita. A farther distance to the nearest bank branches leads to greater information asymmetries and monitoring costs for the banks. As a consequence, firms located far away from the banks might have a harder time obtaining a loan from the banks. Other results from the spatial error model show that human capital and firm density to have positive significant effects on new firm formation per capita, while the establishment size has a negative significant effect. The results of the spatial panel models are summarized in table 2.
This study contributes to the existing literature by showing evidence on the detrimental impact of bank branch closure on new firm formation and hence supports policy interventions to reduce the closure of even more bank branches and identify areas that had higher new firm formation per capita before the bank branch closure. Although the study uses Swedish data, the results can also be applied to other countries where SMEs rely heavily on bank finance.

Table 2: Econometric results of the spatial panel models

<table>
<thead>
<tr>
<th>Dependent variable: New firm formation per capita (ln)</th>
<th>Fixed effects, spatial error model</th>
<th>Random effects, spatial error model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weighted mean distance to banks (ln)</td>
<td>-1.219 (1.449)</td>
<td>-0.159 (0.058) ***</td>
</tr>
<tr>
<td>Firm density (ln)</td>
<td>-0.190 (0.361)</td>
<td>0.255 (0.064) ***</td>
</tr>
<tr>
<td>Establishment size (ln)</td>
<td>-0.318 (0.360)</td>
<td>-0.135 (0.048) ***</td>
</tr>
<tr>
<td>Unemployment rate (ln)</td>
<td>0.136 (0.110)</td>
<td>-0.035 (0.027)</td>
</tr>
<tr>
<td>Human capital level (ln)</td>
<td>0.330 (0.283)</td>
<td>0.290 (0.046) ***</td>
</tr>
<tr>
<td>Specialization index(ln)</td>
<td>0.060 (0.077)</td>
<td>-0.010 (0.028)</td>
</tr>
<tr>
<td>THEIL index (ln)</td>
<td>0.214 (0.633)</td>
<td>0.156 (0.228)</td>
</tr>
<tr>
<td>Income growth (ln)</td>
<td>0.056 (0.142)</td>
<td>-0.046 (0.046)</td>
</tr>
<tr>
<td>Constant</td>
<td>-</td>
<td>-2.201 (0.627) ***</td>
</tr>
<tr>
<td>Spatial error</td>
<td>0.067 (0.197)</td>
<td>0.067 (0.197)</td>
</tr>
<tr>
<td>n (Number of municipalities)</td>
<td>290</td>
<td>290</td>
</tr>
<tr>
<td>Number of time periods</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.068</td>
<td>0.367</td>
</tr>
</tbody>
</table>

*, **, and *** shows significance levels at 10%, 5% and 1% respectively. Standard errors are in parentheses.
4.2 Summary and contributions of paper II


Accessibility of bank branches and new firm formation in Sweden

Paper II aims to explore the local relationships of new firm formation and its regional determinants across 290 municipalities in Sweden in 2013. It helps answer the question of why the formation of new firms exhibits spatial agglomeration, whereby more new firm formation occurs in some geographic areas than in others (Glaeser, 2010). The hypothesis is that some location attributes in a particular location offer favourable conditions for an entrepreneur to start a business (Backman & Karlsson, 2013; Lavesson, 2018). The location attributes analysed are both financial and non-financial. The analysis is conducted at a municipal level with empirical data from Argomento GIS & IT AB, Statistics Sweden and the Swedish Agency for Economic and Regional Growth.

The main methods used in this paper are GWR modelling and spatially constrained multivariate clustering. To understand the spatial agglomeration of new firm formation, eight possible location attributes are chosen: weighted mean distance to 2 nearest bank branches, firm density, establishment size, human capital level, unemployment rate, industry diversification index, industry specialization index and the percentage of immigrants living in the municipality. New firm formation per capita in the labour force is the dependent variable, which is calculated by averaging the number of new firms per 1000 people in the labour force in a three-year period. The independent variables are measured a year before the start of the data period, to mitigate endogeneity problems. The originality of this paper is the inclusion of a financial location attribute in the GWR model to measure the effects of proximity to bank branches on new firm formation on the regional level.

The study findings reveal that the determinants of new firm formation are non-stationary across space, based on the results of the GWR model. The results of the ordinary least squares (OLS) and the robust GWR regressions models based on a Gaussian kernel function are reported in table 3. As the robust Gaussian GWR model using a Euclidean distance metric shows scarce multicollinearity between the independent variables, it is superior to the robust Gaussian GWR model using a great circle distance metric. The results of the study also suggest that the proximity to bank branches can play an important role in the formation of new firms, especially in the southern part of Sweden but not in the northern part of Sweden, as shown in figure 5A.
By observing the change of signs between the minima and the maxima of local parameter estimates in table 3, sign changes are observed for all the variables except for human capital. The change of signs of the local parameter estimates across space shows that spatial heterogeneity should not be neglected, and the GWR model can help prevent over-generalization of the results due to counterbalancing effects (Breitenecker et al., 2017).

Regions with similar profiles are clustered contiguously using the skater algorithm to facilitate exploratory and post hoc analysis, as shown in figure 6 (Berggren & Silver, 2010; Breitenecker et al., 2017). This study contributes to the existing literature by showing that the effects of the determinants of new firm formation can vary across the whole country. Another contribution of this study is the possibility of tailor-fitting and testing the effectiveness of policies to help improve entrepreneurial conditions in different regions with the use of spatially constrained multivariate clustering.

Table 3: OLS and robust GWR regression results based on a Gaussian kernel weighting function

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>Gaussian (Great circle)</th>
<th>Gaussian (Euclidean)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Min</td>
<td>Median</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.578 ***</td>
<td>0.969</td>
<td>3.523</td>
</tr>
<tr>
<td>WeightedDist (ln)</td>
<td>-0.026</td>
<td>-0.113</td>
<td>-0.049</td>
</tr>
<tr>
<td>FirmDensity (ln)</td>
<td>0.065</td>
<td>-0.210</td>
<td>0.148</td>
</tr>
<tr>
<td>EstSize (ln)</td>
<td>-0.148 ***</td>
<td>-0.302</td>
<td>-0.161</td>
</tr>
<tr>
<td>HumanCap (ln)</td>
<td>0.300 ***</td>
<td>0.046</td>
<td>0.284</td>
</tr>
<tr>
<td>UnempRate (ln)</td>
<td>-0.215 ***</td>
<td>-0.309</td>
<td>-0.157</td>
</tr>
<tr>
<td>TheilIndex (ln)</td>
<td>0.807 **</td>
<td>-0.766</td>
<td>0.261</td>
</tr>
<tr>
<td>SpecIndex (ln)</td>
<td>-0.141</td>
<td>-0.999</td>
<td>-0.324</td>
</tr>
<tr>
<td>ImmigrantsShare (ln)</td>
<td>0.155 ***</td>
<td>-0.032</td>
<td>0.127</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>–</td>
<td>24 municipalities</td>
<td>26 municipalities</td>
</tr>
<tr>
<td>F-test</td>
<td>49.427***</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>F1-test</td>
<td>–</td>
<td>0.855**</td>
<td>0.844**</td>
</tr>
<tr>
<td>F2-test</td>
<td>–</td>
<td>1.462 ***</td>
<td>1.575***</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.573</td>
<td>0.482</td>
<td>0.706</td>
</tr>
</tbody>
</table>

*, **, and *** shows significance levels at 10%, 5% and 1% respectively.
Figure 5. Robust GWR estimates (Euclidean) and t-map for WeightedDist based on the Gaussian kernel weighting function (“Natural breaks” classification).

Figure 6. Skater clustering based on the values of the 8 parameters.
Chapter 5: Conclusions and future research

5.1 Conclusions
In this thesis, the aim is to study the effects of bank branch closure on new firm formation and to analyse the importance of proximity to bank branches in relation to the acquisition of external finance from banks at the municipal level. This aim is achieved by using different spatial analysis techniques. The results are discussed in this section, referring to earlier research on the relationship between new firm formation and its determinants at the regional level.

In paper I, the results show that weighted mean distance to banks is a significant and negative variable based on the random effects spatial error model. These results are in line with the empirical results of Backman (2015), which show that the number of independent bank branches per capita positively affects new firm formation. The higher the number of independent banks per capita in the region is, the higher the probability that at least one bank will grant a financial request. In the same vein, the shorter the weighted average distance to banks is, the better the local knowledge the bank officers possess in a particular location, and the higher the probability that at least one bank will approve a loan to the borrower firm.

On a methodological note, spatial panel data modelling is used in paper I because spatial autocorrelation is identified in the data. To account for the presence of spatial dependence, both the fixed effects and the random effects spatial error models are used in paper I. In paper I, only the results of the random effects spatial error model are discussed, as it indicates better performance based on the higher adjusted R-square than that in the fixed effects spatial error model (for more details, see paper I). Other interesting variables that can be considered in the modelling are housing prices since a common form of collateral for the bank is the house of the borrower (Berggren et al., 2017).

Moreover, the only proxy in this research that represents the proximity to bank branches is the distance to the two nearest bank branches from every household area. Future research could also extend the analysis with the addition of more proxies such as functional (branch-to-headquarters) distance and interbank (borrower-to-rival banks) distance, with the use of network analysis. Network analysis helps in the study of relationships between several actors, and network analysis can be used in this case to measure the financial interconnectedness of the local credit markets (Otte & Rousseau, 2002). The notion of functional distance helps fill
the information gap about the hierarchical structure of a banking organization (Papi et al., 2015). Functional distance is measured by calculating the distance between the local bank branches and the bank headquarters. Although most of the loan decisions are taken at the local bank branch offices, some of the loan decisions have to be taken at its regional or central offices if the loan is large or if the company’s balance sheet is showing badly (Backman, 2015). However, decisions not taken at the local bank branch office might entail a loss of information, which can negatively affect the probability of the loan application, especially when the borrower firm is far from the bank headquarters.

The interbank distance measures the presence and proximity of competing banks and branches in a certain area. Higher competition influences the availability of credit in the local economy and hence, lending banks can price discriminate the borrowers based on the proximity between the competitor banks and the borrower (Boot & Thakor, 2000; Dell’Ariccia & Marquez, 2004; Hauswald & Marquez, 2006). Empirical evidence has shown that the interest rate charged to the borrower is lower, on average, if the competitors of the lending bank are far from the borrower (Agarwal & Hauswald, 2010; Bellucci, Borisov, & Zazzo, 2013; Degryse & Ongena, 2005). Moreover, competition between banks facilitates the switching of the lender because a borrower can change to another lender in the vicinity or initiate an additional banking relationship if the other lender offers better rates than the current lender (Farinha & Santos, 2002; Hauswald & Marquez, 2006).

In paper II, the location attributes are assessed at a municipality level by considering the spatial variation of the relationship between the new firm formation rate and the regional determinants of new firm formation, considering the effects of the spatial dependence of regional data. The results show that new firm formation and its regional determinants are non-stationary across space, which aligns with the case for Germany (Breitenecker et al., 2017). Mostly positive relationships with new firm formation are shown for human capital level, firm density, industry diversification level and percentage of immigrants living in the municipality. In contrast, mostly negative relationships are shown for the weighted mean distance to the nearest bank branches, establishment size, unemployment rate and industry specialization. Spatially constrained multivariate clustering is also applied with the means of the skater algorithm in paper II. Five clusters are then formed with distinctive characteristics in each cluster.
On a methodological note, geographically weighted regression modelling and spatially constrained multivariate clustering are used in paper II. Because the analysis is only conducted at the municipality level, more micro-level analysis can be performed, for example, examining intra-regional differences in access to finance (Christensen, 2017). As the research has shown that the degree of importance of the regional determinants is heterogeneous across municipalities, it would also be interesting to analyse the importance of the determinants of new firm formation across urban and peripheral regions within a municipality. Furthermore, other sources of external financing, such as VC, business angels and government support, can be examined.

5.2 Limitations

The main limitations pertaining to the research in this thesis are the data and methodological limitations. There could also be other potential confounding factors that were not included in the modelling due to the lack of data. For example, essential information, such as the size of the bank branches, could be key in the loan application process. Not every bank branch has the power to approve large loans without contacting the regional or central office for permission (Papi et al., 2015). Bank branches that are higher up in the hierarchy are susceptible to more severe information asymmetry because they can be in charge of approving a loan in another municipality, where there are only small bank branches (Backman, 2015). Two years of data are used for the spatial panel models in the first paper due to the lack of data for the other years. Including data from other years would increase the reliability of the results and improve the fit of the spatial models.

The other limitation is related to the methodology used. For spatial models, the choice of the spatial weight matrix can yield different results. Although a K-nearest neighbour weight matrix has been chosen in the first paper, the number of K-neighbours for the weight matrix must be decided through trial and error, based on measures of the best model fit, such as AIC statistics. For geographically weighted regression, different choices of the bandwidth and spatial kernel function can yield slightly different results (Breitenecker et al., 2017). Moreover, the GWR model does not allow spatial inferences but allows researchers to observe and explore relationships between the variables across space (Páez et al., 2011).
5.3 Theoretical implications

Bank finance is an important form of external finance for an entrepreneur because it does not risk the dilution of control for the owner (Du & Dai, 2005). With the increasing closure of bank branches, it is even more crucial to study whether the decrease in proximity to bank branches has an impact on new firm formation. The random effects spatial error model in the first paper has shown that an increase in the weighted mean distance to bank branches hurts new firm formation. One possible explanation is that the chances of securing a bank loan for business are partly limited by the number of nearby bank branches where one can apply for a loan (Backman, 2015). Another possible explanation is that the greater distance between the banks and potential borrower firms means increased monitoring costs and higher information asymmetries for the bank branch managers and higher search costs for both the banks and the borrower firms (Cassar, 2004). A longer distance is thus travelled by bank branch managers to keep updated on the financial status and well-being of the firm.

The results also show that higher firm density, higher human capital and smaller establishment size are linked to a higher new firm formation. High firm density stimulates knowledge spillover in the region, and small establishment size enables employees to learn more about the creation of new ventures and to gain personal contacts, which could be valuable for them if they were to set up their own company in the future (Fallah & Ibrahim, 2004; Kelly & Hageman, 1999). Higher human capital means that there is a higher chance of the labour population being educated about entrepreneurship and eventually setting up their own companies because of the right knowledge and skills possessed.

However, the degree of importance of the regional determinants for new firm formation varies from municipality to municipality, which means that the degree of importance is non-stationary across space. This means that each municipality has a unique set of conditions that are more or less favourable for the creation of new ventures and that may change over time. In addition, external events will continue to influence the dynamics of the entrepreneurial scene, for example, immigrant influx and financial crises which can affect the confidence in starting a new company (Levie, 2007; OECD, 2009).

Moreover, proximity to bank branches has been found to have a greater influence on new firm formation in the southern part of Sweden than in the northern part. One reason could be that all the facilities tend to be farther away in the countryside or remote areas, where the locals are
more used to travelling long distances to access most services (Pateman, 2011). Another reason could be the differences in the industry structures between the municipalities, as different types of industry have different capital requirements (MacKay & Phillips, 2005).

5.4 Practical implications for policymakers and entrepreneurs
Generally, the results show that bank branch closure affects new firm formation. Hence, this calls for the support of policy interventions to reduce the rapid closure of even more bank branches and identify affected areas that had high new firm formation before the bank branch closure in the local region.

By using spatial data analysis, areas with high potential for entrepreneurship can be identified, and these areas have a need for more bank financing. Hence, banks can be advised to target such areas in the positioning of their branches to augment the local financial infrastructure. A strong local financial infrastructure can help support budding entrepreneurs.

In addition to the need for a stronger financial infrastructure on the macro-level, assistance on the micro level can also be given to firm owners in developing better quality business proposals. One of the main reasons a loan application is rejected is incompleteness of the application (Lesonsky, 2018). As many as twenty to thirty hours are spent writing a loan application, and much information and work is needed to finish the paperwork, for example, the business plan, business and personal tax returns, business bank account statements, financial projections for the business, and the owner’s personal and business credit reports (Lesonsky, 2018). Hence, it would be helpful for an entrepreneur to know what to expect and what is needed when applying for a bank loan to secure a higher chance of obtaining a bank loan.

The use of GWR modelling and spatially constrained multivariate clustering, as shown in the second paper, allows the tailoring and evaluation of the success of interventions that aim to improve the entrepreneurial conditions in a region. A policy that works well for one municipality could also work well for another municipality with similar conditions. Although the analyses in this thesis are based on Swedish data, the results can be applied to developed countries around the world where SMEs are dependent on bank financing. Overall, a close collaboration among banks, municipality developers and policymakers is essential for a sustainable entrepreneurship ecosystem in the long run.
Chapter 6: References


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