Doctoral Thesis

Transport Accessibility, Wholesale Trade and Spatial Development

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Acknowledgement

“Remember that you are an economist, not a geographer.” These are the words of my main advisor, Johan Klaessson, reminding me again to not stray too far outside of the realm of economics, but to focus my attention on this dissertation. It’s not an exaggeration to say that this dissertation would not have come into existence if it was not for Johan. Johan is an exceptional person and an exceptional economist. No words can do justice in explaining the support I’ve got from Johan throughout the last five years of my life. I am very privileged to have been able to work with and learn from him.

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Today, with the help of all people mentioned here and many more not mentioned, I have finally managed to finish a dissertation in economics. As I am about to embark into the real world not confined to the economics department, I graciously reply to Johan Klaesson’s comment to not stray outside of the realm of economics with a quote by Friedrich A Hayek: "But nobody can be a great economist who is only an economist - and I am even tempted to add that the economist who is only an economist is likely to become a nuisance if not a positive danger."

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Abstract

This thesis comprises four independent papers, which all explore some aspect of the relationship between accessibility and spatial development. The central question I pose is how improved accessibility to transportation services, human capital, jobs, or the market contributes to the spatial variation in economic development. Empirical data and estimations are utilized in all chapters.

The first paper (co-authored with Johan Klaesson) explores how a regional accessibility model can be used to analyze the growth of knowledge-intensive industries on a detailed geographical scale compared to a broader definition.

In the second paper (co-authored with Maria Börjesson and Christer Anderstig), a refined accessibility measure is used to estimate the magnitude of the causal effect of transport system investments on the unemployment rate, and whether the effect differs for people with different levels of education.

The third paper addresses the role that access to transportation services plays for wholesale start-ups, particularly in regions lacking in local demand.

The analysis in paper number four covers the same time period as the advancement of the Internet, which greatly reduced transaction costs. The paper examines the importance of access to human capital for the spatial reorganization and growth of wholesale industries during this time period.
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Introduction and summary of the thesis

1. Introduction

“One of the great mistakes is to judge policies and programs by their intentions rather than their results.”

-Milton Friedman (1975)

In this dissertation, I examine the importance of transport accessibility and human capital for regional development in terms of firms and employment. The principal question that I ask in the thesis is how improved access (to transportation services, human capital, jobs, and the market) contributes to the spatial variation in economic development, with special attention paid to the development of the wholesale sector. The thesis comprises four independent papers in which I utilize empirical data and estimations to establish relationships between economic variables. Central to all chapters are different quantifiable measures of the transportation system in the form of accessibility measures.

The second chapter explores how a regional accessibility model can be used to analyze the growth of knowledge-intensive firms on a detailed geographical scale compared to a lower resolution. In the third chapter, a refined accessibility measure is used to analyze the effect of the transport system on unemployment rates. The fourth chapter explores the role that access to transportation services plays for wholesale start-ups, particularly in regions lacking in local demand. The fifth chapter examines the importance of access to human capital for the spatial reorganization and growth of wholesale industries.

The contributions of this dissertation reside within the field of spatial economics and more generally in the economics field. Economics is the study of human choices in the presence of scarce resources. In spatial economics, location plays an active role in determining the most optimal choices. More precisely, the location relative to other locations plays a role and is explicitly taken into account in spatial economics. For example, an economic policy implemented in a location such as the establishment of a new railway station, a new university or a tax reduction could have different effects on the choices of agents depending on their locations.
Spatial econometrics is the toolbox used to model the extent to which agents are affected by variables in other locations, which is usually done by accounting for the distance between the locations, or points of interest, in one way or another. A reduction in transportation costs between locations or a change in the distribution of variables in locations alters these locations’ access to each other without affecting physical proximity. How do people and firms respond to such changes, and what is the implication for aggregate economic growth? Specific cases of these questions are answered in this dissertation by applying theoretically derived and motivated accessibility measures to investigate the impact of such accessibility on different elements of the economy.

In theory, accessibility to markets, services and infrastructure is a major determinant of economic status and welfare (Yoshida and Diechmann, 2009). The binscatter\(^1\) in Figure 1 shows a clear negative relationship between GDP per capita and travel time to the closest town in global admin 1 units, i.e., the relationship between economic welfare and access to markets is clearly positive.

On the surface, it seems obvious that improved accessibility to markets would be beneficial for economic growth. In particular, better infrastructure leads to reduced transport costs or to an expanded market with a wider range of choice and more competition (Berg et al., 2017; Vickerman et al., 1999). Firms in a region with improved access to input materials and markets will be more competitive and productive than firms in regions with lower accessibility. The emphasis on access to relevant markets here is key; a bridge to nowhere does not help anybody. Better accessibility facilitates knowledge transfers and the spread of information (Andersson et al., 2016). Transport investments influence growth through various channels, including firms’ decisions to trade and their location choices, income and employment generation, and structural transformation (for a review of empirical papers exploring these channels with a particular focus on developing countries, see Berg et al. (2017)).

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\(^1\) The binscatter plot groups admin 1 units by their x-values into 100 equal-sized bins. The mean x- and y-values within each bin are plotted. A quadratic fitted line is added.
However, despite decades of research, the exact role that transport accessibility plays in the process of regional development, and even the direction of causality, are issues still open to debate, and conflicting results continue to be reported in empirical research findings (Deng, 2013; Straub, 2011). In a review of the literature, Deng (2013) concludes that the reasons for the controversial results can be attributed to different contexts, different phenomena being measured, and different ways of measuring a similar phenomenon. Even in cases where the direction of causality is established, the magnitude of the relationship in different sectors is not. Many of the empirical models in the literature are plagued by methodological and statistical problems such as endogeneity. The seemingly clear relationship in Figure 1 becomes much more ambiguous once one applies appropriate controls and other techniques to establish identification of causal effects.

Improved accessibility affects economic sectors (Holl, 2004; Chandra and Thompson, 2000) and agents (for example, low educated versus highly educated workers, see Matas, 2010) differently. The effects further differ across the geography (Venables, 1996; Puga, 1999; Vickerman, 1991a). The latter phenomenon applies to regions of differing economic activity or the urban core versus peripheral regions. For example, a road improvement connecting a
peripheral region with a central marketplace improves accessibility to the center, but it also opens up for competition from the center for firms in the peripheral region, previously protected by remoteness (Vickerman et al., 1999; Vickerman, 1991b). Syversen (2004) investigates the effect of spatial substitutability in the product market and models how relatively inefficient producers among more densely clustered firms find it hard to operate profitably since it is easier for consumers to switch between suppliers. In this scenario, improved access could have a positive effect on economic growth in the center but a negative effect in the peripheral region.

Evidently, the relationship between accessibility and economic growth is not as straightforward as it seems on the surface. Investing in improved access is expensive, and it is important for governments to know the expected outcome of such investments. Typically, agencies produce a standard Cost-Benefit Analysis (CBA) to assess the viability of transport projects. These include the direct time and cost savings from transport improvements and the indirect impact of these cost and time savings in the form of lower assembly costs in production and gains from logistical reorganization as well as associated external costs (Lakshmanan, 2010). However, the CBA approach does not consider network effects of transport improvements on other sectors using transportation in the broader economy (Lakshmanan, 2010). The wider economic benefits of transport system investments, such as reduced unemployment, are the particular focus of chapter 3, but the theme of the role of transportation and transaction costs for spatial economic development is present throughout the dissertation.

Chapter 2 explores the relationship between market access and innovative businesses and to what extent this relationship is dependent on the size of the spatial unit of analysis. In chapter 3, we estimate the magnitude of the causal effect of transport system investments on the unemployment rate and how it differs in small and large labor markets as well as for people with different levels of education. I further explore the role that the transport system plays in wholesale firm formation in central versus peripheral regions in chapter 4. Finally, I explain the driving forces behind the restructuring of the wholesale sector during the advancement of the Internet, which greatly reduced transaction costs, in chapter 5.

The focus on the wholesale sector in the last two chapters is rather unique in economic research and is in itself a contribution to the literature. The novel data and methodological explorations applied in the empirics of the remaining chapters, explained in more detail in section 4 of this introduction, also contribute to the field of spatial economics with new findings and analytical techniques. The results presented in this dissertation are useful mainly for regional policy makers considering investments in the transport system or human capital and for researchers in related fields.
2. Measuring accessibility

Hansen (1959) defines accessibility as the ‘potential of opportunities for interaction’ (p. 73). It is a measure of the ability to reach goods, services, activities or destinations (Reggiani, 1998). Accessibility has, similarly, been related to the concepts of nearness, proximity, ease of spatial interaction, or potential of contacts with activities or supplies in the regional science literature (Weibull, 1980 p. 54).

The concept of accessibility has its roots in spatial interaction theory (Batten and Boyce, 1986) and gravity models (Stewart, 1948; Zipf, 1949), where potential accessibility is the construct of the two opposing forces of mass and distance. Interaction increases with mass and decreases with distance. The gravity model of spatial interaction is analogous with the physical law of gravitation formulated by Isaac Newton in 1687: the force between two objects is proportional to the product of the two masses and inversely proportional to the square of the distance between them. In mathematical terms, this relationship can be described as:

\[ F = g \frac{m_1 m_2}{r^2} \]

where \( F \) is the force of gravity between the masses \( m_1 \) and \( m_2 \), \( r \) is the distance between them, and \( g \) is the constant of gravity. While there are many different versions of accessibility measures applied in the literature (reviews can be found in Martellato et al. (1998, pp. 163-70), Wegener et al. (2002) and Klaesson et al. (2015)), the operationalization of all of them is analogous to the formulation for the physical law of gravity stated above. For example, one of the most widely adapted measures is that for potential of opportunities, given by the following formula (Reggiani, 1998):

\[ A_i = \sum_j W_j f(c_{ij}) \]

where \( A_i \) is the accessibility of location \( i \) to opportunities \( W \) in location \( j \). Population or GDP often serves as a proxy for the variable measuring opportunities (or activities), \( W \), but it can be any “size” measure relevant to the study at hand. The distance-decay function \( f(c_{ij}) \) reflects the effort, time, distance or costs, \( c \), required to obtain the opportunities or activities in location \( j \) for an agent located in \( i \) (Wegener et al., 2002). The function is decreasing with distance, which represents the empirical fact that the interaction between two locations decreases as the distance between them increases.

\[ \text{This formulation of is almost identical to Harris’ (1954) measure of market potential.} \]
2.1. **Discounting distance**

The ‘cost of distance’ between two locations can be broadly defined and measured in two ways: (i) by the Euclidean distance; or (ii) by network impedance. The first way of measuring costs does not take the transport system into account at all, whereas the second definition is a measure of the travel distance, time or cost along the minimum path over the transport network(s), and therefore, it is determined by the quality and quantity of the transport system.

The functional form of an accessibility measure determines how the effect of distance on spatial interaction should be modeled in empirical work. A few popular examples of ways to discount distance are by (i) a reciprocal function: \( c_{ij}^{-k} \) (Stewart, 1948; Zipf, 1949; Carothers, 1956; Hansen, 1959); (ii) a negative exponential function: \( e^{-\lambda c_{ij}} \) (Wilson, 1967); (iii) the Gaussian curve: \( e^{hc_{ij}^{-k}} \) (Ingram, 1971) and (iv) a step, or rectangular, function (Ingram, 1971), where \( c_{ij} \) is the distance between \( i \) and \( j \) and \( \lambda, k \) and \( h \) are constants. These functional forms are depicted in Figure 2.

![Four distance-decay functions](image)

*Figure 2. Four distance-decay functions.*

*Source: Adapted from Klaesson et al. (2015), p. 422*

The simplest way of discounting distance is by the step function, which is applied in the measure of ‘access to human capital’ in chapter 5 in this dissertation. In practice, the step function implies that agents within a certain distance of an opportunity have access and everyone else does not. The reciprocal function, which is popular within the trade cost literature (see, for example, Donaldson and Hornbeck (2016)), has the disadvantage, among others, that \( c_{ij} \) needs to be non-zero (causing problems in the measurement of accessibility to opportunities in the origin location). The exponential distance decay function is used in all empirical
applications in this dissertation. By regressing population density on different functional forms of accessibility to jobs, Song (1996) found that the exponential distance decay function performed best with the highest explanatory power. The negative exponential function also has a well-founded theoretical underpinning\(^3\).

In addition to deciding the appropriate functional form of the accessibility measure, the value of the constant term (or the distance-discounting factor) must also be determined. This is the lambda, \( \lambda \), parameter in the negative exponential function. Theory offers some advice here, but in many cases, the empirical setting should be used to determine the appropriate value of lambda. The articles in this dissertation have both relied on previous research and own estimations in determining the distance decay constant values used in the accessibility measures.

Furthermore, previous research (Johansson, et al., 2003) on commuting patterns in Sweden has identified that almost all commuting flows are local (74% within the same municipality), approximately 18% are regional (within the same labor market region), and only 5% are extra-regional (rest of the country). The implication of this is that for any change in time, distances will have a nonlinear response across the geography. For this reason, Johansson et al. (2003) propose using a different lambda when modeling local, regional, or extra-regional accessibility to jobs; a methodology that is applied in chapter 2.

### 2.2. Accessibility and the transport system

The extent to which the quality and quantity of the transport system is reflected in the \( c_{ij} \) term of the accessibility measure varies considerably in empirical research. At a minimum, the quantity of the transport system can be incorporated by defining \( c_{ij} \) as the travel distance (in kilometers or meters) along the road network between nodes. Slightly more advanced measures include the quality of the transport system by defining \( c_{ij} \) as travel time (in hours or minutes) along the road network between nodes, calculated by including maximum allowed speed or reasonable speed given road condition per link. However, more sophisticated measures, such as the one applied in chapter 3 of this dissertation, reflect the actual monetary and time costs (generalized costs) of travelling by including traffic conditions, different modes of travel, waiting times and user’s preferences.

Both the transport infrastructure and the geographical distribution of population make up the accessibility index (Yoshida and Dieckmann, 2009), implying that the index can increase through a transport improvement or through a change in the geographical distribution of the population. If the objective of a given research project is to analyze the effect of transport improvements on spatial development, it is imperative to isolate these two factors. One can, for example, analyze the change in accessibility caused by changes in the transport system over time by holding population constant (see chapter 3 and Berg et al. (2016) for applications).

\(^3\) For example, from random utility theory (Klaesson et al., 2015)
3. Wholesale trade and transaction costs

"Nobody likes a middleman, but most of us are middlemen."

Krakovsky (2015, p. 1)

What matters for firms making an exchange is not only transportation costs but also transaction costs. A more efficient transportation system can bring places closer together through decreased transportation costs, but it does little to reduce other types of transaction costs. Wholesale firms deal with both transportation costs and transaction costs while facilitating the exchange of goods and services. The wholesale sector, which is the focus of two chapters of this dissertation, in itself is therefore an interesting case to study while investigating the role of transportation and transaction costs for spatial development. Recent decades have seen huge changes (mostly reductions) in transportation costs, transaction costs, and communication costs. What have the implications been on the wholesale sector?

In the mid-1990s, Bill Gates predicted that the Internet would become “the universal middleman” and that “often the only humans involved in a transaction would be the actual buyer and seller” due to decreased transaction costs brought about by the Internet (Gates, 1995, p. 182). Bill Gates’ prediction has proved to be wrong. In 1993, intermediaries accounted for approximately 25% of GDP in the US (Spulber, 1996), and in 2009, they accounted for approximately 34% of GDP in the US (Spulber, 2011). Wholesale trade in particular accounted for 6% in both years. In Sweden, wholesale trade turnover has grown by 50% between 2000 and 2013 (Statistics Sweden). Krakovsky (2015) argues the reason we have not seen a decline in middlemen in general and wholesalers in particular is trust. Middlemen have more interactions with buyers and sellers and are therefore able to establish trust with both sides.

These issues tie into the classic questions of knowledge use in economics. Hayek (1945, p. 521) famously speaks of “the knowledge of the particular circumstances of time and place”, referring to how all knowledge in society exists as dispersed bits of incomplete and frequently contradictory knowledge with

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4 Transportation costs can be a specific type of transaction costs, or they can be treated as separate costs. Transaction costs are the costs associated with the exchange of goods or services. They are broadly defined in Dahlman (1979) to encompass search and information costs (finding the right good for the lowest price), bargaining costs (the costs required to come to an agreement on the terms of the transaction, draw up contracts, etc.), policing and enforcement costs (making sure the other party sticks to the terms of the contract). The Business Dictionary defines transaction costs to cover: communication charges, legal fees, the informational cost of finding the price, quality, and durability, etc., and may also include transportation costs (http://www.businessdictionary.com/definition/transaction-cost.html).
individuals, and not with a single mind in its totality. The Internet has made great strides in collecting knowledge to one place. But this knowledge is not automatically obtained by all individuals, neither is it necessarily the type of specific knowledge that matters to buyers and sellers. The middleman has acquired unique knowledge, particular to time and place, through frequent interactions with seller and buyers and can therefore provide them with what they want.

Chapter 5 in this dissertation builds on these insights in providing an answer for the reason why wholesalers, or rather, certain types of wholesalers, have not been eliminated: human capital and knowledge (which could, of course, be related to trust). The wholesale sector in Sweden has grown in locations with better access to an educated population, and the types of wholesale firms that have survived and multiplied have an increased share of university-educated employees. I speculate that wholesalers that have taken advantage of new complex technological solutions in pace with the advancement of the Internet and communication technologies and have innovated in their service provision have thus been successful in providing value for their customers and hence in establishing efficient networks necessary to stay in business. For example, as a way to counteract the threat to wholesalers of manufacturers selling directly online to their customers, wholesalers have started to offer online purchasing options to all of their major customer groups in order to improve the distribution service provided (Rosenbloom, 2007).

The middleman, or wholesale firm, is often neglected in regional economic research. The location decision of retail firms and manufacturing firms have received in-depth scrutiny by scholars, whereas the connecting agent between these firms - the wholesale firm - has not. A search on Google Scholar generates 15,500 hits for “retail location”, 8,730 hits for “manufacturing location”, but only 146 hits for “wholesale location”. The wholesale sector has remained almost invisible in economics research, despite an annual turnover of approximately 1.2 billion SEK in recent years in Sweden, which is more than twice as much as the retail sector turnover according to Statistics Sweden.

The lack of research on the wholesale sector is probably mostly because they are, in a sense, invisible to the end customer. We know where we buy our products (retailers) and who produced them (manufacturers), but we do not care much about who else was involved in getting the good from the manufacturer into our hands. For the same reason, people underestimate the economic size of the transport sector. In addition, according to Krakovsky (2015), there is a negative sentiment toward middlemen since many people tend to view them as parasites that do not produce anything on their own but live off of the efforts of others. What we do not realize is that anybody who is connecting other people in a

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5 Hayek (1945) proclaims that the economic problem of society of how to allocate scarce resources would be easy if all knowledge was given to a single mind. But since knowledge is not given to anyone in its totality, the economic problem is best left to market mechanisms, such as pricing, where each individual’s choice decides market outcomes.

6 The Google Scholar search was done on July 22, 2017.
network is a middleman, which most of us do at some point or another. Clearly, middlemen provide value; otherwise they would not stay in business.

Hayek’s insights regarding “knowledge of time and place” directly relate to one of the key mechanisms through which middlemen provide value: knowledge of consumer’s differing preferences and market information. One interesting example that illustrates how middlemen tie into these concepts is the real story of how Kyle MacDonald traded his way from one red paperclip to a house in a series of fourteen online trades over the course of a year, without making any improvements to the products he traded. How could this be possible? All participants in the trades performed the exchanges willingly and therefore presumably felt that they were better off after the transactions. The middleman, Kyle, performed extensive market research and was able to offer them exchanges that would leave both parties better off due to their differing preferences. Rather than taking advantage and profiting off of the efforts of others, Kyle provided value through acquiring relevant knowledge and market information leading him to be able to offer people something they wanted. In addition, the advancement of the Internet and communication technologies made the extensive market research and exchanges performed by Kyle possible, it did not eliminate the need for his efforts.

Krakovsky (2015) gives another example of the Internet enabling wholesalers rather than eliminating them in EBay. Thousands of people use EBay to make their living by buying specialty products and reselling them on the site – these people are wholesalers and retailers of other people’s goods. The example of EBay illustrates how, while some middlemen have been more or less eliminated with the Internet, new ones have gained market shares.

3.1. Why do wholesale firms exist?

We can speculate on how changing transport costs and communication costs affect the wholesale sector and the reasons wholesale firms have not been eliminated from the economy, but why do they, or any firm, exist in the first place? As it turns out, the answer is transaction costs, according to Coase (1937). He asserts that the reason why firms exist is to reduce transaction costs that emerge during production and exchange. Coase argues that when transaction costs within the firm are less than the cost of using the price mechanism in a market arrangement, then the existence of the firm is feasible. Williamson (1981) builds upon Coase’s insights and describes transaction cost analysis as one of the most important factors in determining whether vertical integration or the use of intermediaries is more profitable. The key in terms of transaction cost analysis is “asset specificity” which describes the specialized knowledge held by the intermediary distributing the product and the type of services provided by the intermediary (Glasmeier, 1990).

7 http://oneredpaperclip.blogspot.com/
Introduction and summary of the thesis

To illustrate how Coase and Williamson’s insights apply to the existence of wholesale firms, consider the average total cost (ATC) curves example displayed in Figure 3 given by Rosenbloom (2007). The hypothetical manufacturer enjoys economies of scale in production and produces Q1 units of good x at the lowest point on the ATC curve at a cost of C1 per unit. The same economies of scale may not be attainable in terms of the distribution services given the number of units produced. To provide adequate distribution service the manufacturer would need a large order processing facility, to maintain large inventory in a number of separate warehouse locations near customers, and to provide for transportation, sales contact, market analysis, trade promotion, advice and technical support, etc.

To reach the lowest point on the ATC curve for distribution services, the manufacturer would have to increase production to a point beyond Q1, but this is not optimal in terms of production costs. In the diagram for distribution services, the average cost, C2, of distributing Q1 units is much higher than average cost, C1, of producing Q1 units. Consequently, it would be cheaper for the manufacturer to have a wholesaler, which can reach economies of scale in distribution by distributing a higher volume of goods from many manufacturers, handle its distribution services.
Figure 3. Average cost curves for the production and distribution of a product.
Source: Adapted from Rosenbloom (2007).

The optimal distribution strategy for firms can be altered depending on how new the product is. As the market expands geographically and competitors arise for a product, distribution through an intermediary becomes more beneficial (Vance, 1970). Additionally, the channel strategy depends on the type of product, whether it is mass-produced or a specialized product (Crespedes, 1988). This implies that the need for wholesalers and the spatial distribution of wholesalers will depend
on the type of product they are dealing with and where in the life cycle the product is.

As the theory outlined above showed, wholesalers exist because they can effectively and efficiently perform distribution (transaction) services needed by producers or customers at a superior level and at lower cost than other channel members such as the producers or customers themselves or third-party logistics firms (Rosenbloom, 2007). The need for wholesalers, or middlemen, was recognized already by Butler in 1917 (p.14):

“The middleman is the outstanding figure in modern marketing not because he has consciously set out to make a place for himself, nor because consumers have blindly permitted him to come between them and the manufacturers of the things they buy. It is because he has been forced into existence, on the one hand by the necessities of specialized and large scale industry, on the other hand by the necessities of consumers equally specialized in their activities and constantly demanding more and more in the way of services which the distant manufacturer must usually rely upon the middleman to give.”

The reasons why wholesale firms exist are also the reasons they contribute to the economy and spatial development. Viewed from the perspective of economic development, Tollens and Argenti (2000) outline several channels through which wholesale firms contribute to efficiency in the economy:

- They promote stability of supply through the existence of centralized locations that are known and easily accessible. With a wholesaler, both producers and retailers only have to deal with one agent rather than several different actors. This facilitates the flow of information through the entire channel and reduces uncertainty concerning supplies and completion of sales transactions.

- Wholesalers improve market information through the centralization of transactions. It is cheaper for one large wholesale firm to collect, process and disseminate accurate market information than it would be for individual smaller retailers and manufacturers. This improves the quality of investment decisions and thereby promotes efficient resource allocation in the economy. Without wholesale markets, multiple equilibrium prices might occur due to limited information, a scenario that is common in less-developed countries, but when transactions are centralized to a single location, the period of transactions is reduced, and when wholesale and retail activities are separated, there is a clearer interplay of supply and demand. In turn, there is greater transparency in the market, and one equilibrium price is more easily reached. Wholesalers further facilitate transactions in the market chain and reduce marketing costs through economies of scale by lowering per unit transaction costs.
Additionally, as I argue in chapter 4, wholesalers spread information on products and markets through face-to-face interaction with customers and sellers over much larger distances than other firms could do on their own. In this way, wholesalers can facilitate the spread of knowledge to remote locations.

- Wholesalers enable *specialization and innovation* by separating wholesale and retail functions, which leads to lower distribution costs for all firms. Wholesalers increase productivity in the economy since they increase the size of the market as they perform the task of transactions in the distribution channel and make it easier for other firms to specialize on their core business. Since they often provide goods to many suppliers and customers, they can benefit from economies of scale that lower costs and increase productivity. Since wholesalers focus intensely on marketing channels, distribution systems and supply chains, they are more likely to find new and innovative ways to perform distribution services (Rosenbloom, 2007).

- *Competition is enhanced* due to improved transparency and price information by the existence of wholesale markets in the economy.

- Wholesalers *improve quality* of products since it becomes easier to compare and introduce standardizations when all products are collected into a single location.

One might caution here, that improved efficiency and productivity are not necessarily the same as economic development. Improved productivity can lead to increased unemployment if demand remains constant. However, increased productivity should entail higher incomes and hence an increase in the demand for goods and services. Thus, any initial net job loss due to the creation of wholesale markets and increased productivity should be offset by increased demand, leading to economic growth and job creation in the long run (Tollens and Argenti, 2000).

To sum up, this section has illustrated how middlemen contribute to the economy by increasing a product’s accessibility – both in the form of geographic accessibility and in the form of better information. Wholesalers create and facilitate an infrastructure of information. Given the benefits wholesalers provide to the regional economies they operate in, understanding the driving forces behind the spatial and dynamic patterns of the sector is valuable. Development plans for cities and regions should be concerned with the location of wholesale markets and how the availability of adequate infrastructure affect wholesalers’ location choices. These topics are dealt with in more detail in chapter 4 and 5.

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8 Mike Munger uses this formulation when describing the services of middlemen in the EconTalk podcast “Munger on middlemen” from October 27, 2008.
4. Empirical issues

This section summarizes some of the main data and statistical issues that are likely to arise in empirical research on transport accessibility and regional economic growth as well as in spatial economic research more generally. The introduction of this chapter already flagged the persisting controversy of the exact role that transport accessibility plays in the process of regional development and that much of the conflicting results are caused by different methodological approaches (Deng, 2013). As an example, a review by the What Works Centre for Local Economic Growth (2015) of 2300 policy evaluations and evidence reviews found that while road projects can positively have an impact on local employment, the effects are not always positive and a majority of evaluations show no (or mixed) effects on employment. In addition, only 29 of all studies met the Centre’s minimum standards of robustness of research methods⁹.

Clearly, researchers in transport economics face complex methodological and statistical issues, of which many are recurrent throughout the spatial economics field more broadly. I discuss the main methodological issues below and give examples from the remaining chapters of how to deal with these issues.

4.1. Endogeneity and causality

Endogeneity is the all-of-the-above encompassing term for a statistical problem that can arise due to a variety of sources. Technically, endogeneity is present in a regression model when there is correlation between one of the explanatory variables, X, and the error term. This implies that there is ‘something’ (not necessarily a variable) unaccounted for in the model that is related to both X and the dependent variable, Y.

One of the causes of this could be an omitted variable, i.e., one or more important variables have been left out of the model. The solution to this problem is quite obvious: include the omitted variable (if possible). If the omitted variable is not available, an alternative solution is to estimate panel data models with individual fixed effects. This technique measures the same subjects at different points in time, implying that the subjects are used as their own controls. The major issue with this solution, which is particularly problematic in spatial econometric research, is that if the explanatory variables do not vary over time, their effects cannot be estimated - we cannot estimate the effect of a change over time in a variable if there is no change. And if the explanatory variables have little variation over time but vary more across individuals, the fixed effects estimates will be imprecise with large standard errors. In a sense, much of the explanatory power of the relatively time-invariant explanatory variables will be soaked up by the

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⁹ The minimum standard is 3 on a five-point scale ranging from 1, for evaluations based on simple cross sectional correlations, to 5 for randomized control trials.
fixed effects (Buddelmeyer et al., 2008). This implies that the explanatory variables could become statistically insignificant even when they are economically significant. Many spatial features have no or little variation over time (think of the presence of a railway station in a municipality or the travel time to a university for example), but most of the variation occurs on the cross-section, across the geography. This is one of the reasons why I do not implement the individual fixed effect modelling technique in this dissertation.

The other two main sources of endogeneity are even more difficult to address: reverse causality (or simultaneity) between X and Y and selection bias. These problems are related to the process that brings about the level of X and to what extent that process is related to Y. For example, does improved accessibility through transport investments lead to increased productivity, or could the direction of causality run the other way as well? Were the locations for transportation investments randomly selected, or did the investments occur due to anticipated growth (or conversely, to help lagging regions along)?

The project selection issue is closely related to the problem of spatial sorting: the non-random sorting of individuals into locations based on their attributes, often the very spatial attributes the researcher is trying to evaluate. For example, more entrepreneurial agents, and more entrepreneurial agents of higher quality, may disproportionally self-select to more favorable dense environments with better infrastructure. This implies that a model yielding a positive and significant coefficient of a variable explaining the impact of better infrastructure on entrepreneurial activity does not necessarily mean that the improved infrastructure causes individuals to become more entrepreneurial.

Again, the cause of the bias in all these examples is related to the process that brings about the value of X and whether this process is related to Y. The preferable way of addressing these sources of endogeneity is already at the stage of research design if possible, where the goal is to make sure that X is generated by a random process exogenous to Y. Randomized control trials (RTCs), where agents are randomly allocated into control and treatment groups, have been celebrated in economic research as the gold standard of robust research designs (Duflo, 2004; Sherman, et al., 1998). However, conducting perfectly designed RTCs are rarely, if ever, applicable in practice and many attempts still suffer from sources of endogeneity problems (such as agents in the control group receiving some relatable treatment) (Deaton, 2010). This leaves us with alternative ways of establishing identification such as quasi-randomization (through, for example, instrumental variable techniques or treatment discontinuity) and difference-in-difference or panel fixed effects methods.

The third chapter in this dissertation, in particular, addresses endogeneity issues (between transport investments and labor market outcomes) in the form of reverse causality and selection bias. In this paper, we establish identification by using a first difference approach in estimating a relationship between changes (1985–97) in labor market accessibility caused by transport investments (X) and changes in the unemployment rate (1993–2002) (Y). The time lag between X and Y reduces both the risk of reverse causality and selection bias, but we also argue
that accessibility changes due to changes in the transport system are exogenous because transport investments are quasi-randomly selected in Sweden and exogenous from changes in labor market conditions (labor market polices, regional aid, macroeconomic changes and external shocks) according to previous research and statements by Sweden's transport agency (Nilsson, 1991; Eliasson et al., 2014).

In estimating the relationship between entrepreneurial activity (Y) and better transport services (X) in chapter 4, the main methodological problem is spatial sorting. The potential problem of more entrepreneurial people sorting themselves into areas with better infrastructure is addressed by controlling for the movement of people as well as completely excluding people that have moved into the municipality within the last 20 years. In chapter 5, endogeneity can occur in the form of confounding of third factors influencing both wholesale growth (Y) and growth of human capital (X) and in the form of reverse causality between these two variables. This is addressed by the use of instrumental variables and controls.

In chapter 2, endogeneity could exist between the variable measuring accessibility to economic activity (X) and growth of jobs in innovative sectors (Y). We use panel data for the estimations, but decided to apply random effects rather than fixed effects due to very little variation in the explanatory variables of interest (accessibility variables) over time. We argue that the main level of spatial aggregation (SAMS-level) is less prone to endogeneity problems since policy is not drafted at this level. However, endogeneity is still likely present due to spatial sorting to some extent in these estimations and we hesitate to interpret the relationships as causal in this case, but rather correlational.

4.2. Spatial interdependence

The very reason the field of spatial economics exists is also the source of its main statistical problems: spatial dependence and spatial heterogeneity (referred to together as ‘spatial effects’). These problems occur because “everything is related to everything else, but near things are more related than distant things” (Tobler, 1970, 234). If observations are related to each other based on their location and this is not accounted for in the model, it would violate the assumption of independence of observations in econometric modeling.

Spatial dependence exists when observations are related to each other due to their relative position in geographic space (Anselin, 2010), or as defined by Black (2012): “Spatial dependence exists when the structure of dependence between random variables is determined by the relative position of observations in the underlying space”. Spatial heterogeneity is a special case of the familiar problem of heterogeneity in standard econometrics. Spatial heterogeneity can be related to the spatial structure or the spatial data generation process. In other words, it has to do with the process that brings about the uneven distribution of a trait, event, or relationship across a region (Anselin, 2010). It can also be defined as structural instability or nonstationarity of economic relationships over space.
Spatial heterogeneity is often difficult to separate from spatial dependence in practice. Spatial dependence and heterogeneity can be controlled for or reduced by including spatially lagged variables for the dependent variable (spatial lag model), explanatory variables (spatial cross-regressive models) and error terms (spatial error models) as well as combinations of these (Anselin, 2010). Andersson and Gråsjö (2009) find that substantive spatial dependence among observations can be modeled directly in empirical spatial models by the implementation of accessibility variables (a type of spatially lagged variable), without having to resort to alternative models such as the spatial lag model. In a sense, spatial correlation can be thought of as a missing variable problem. Accessibility variables are implemented in the empirical models used for analysis in the remaining chapters of this dissertation, and hence, the problems of spatial effects are reduced in the estimations.

I estimated both a spatial lag model and a spatial error model for the purpose of establishing the relationship between human capital and wholesale sector growth in chapter 5. The small size of the grid data used in the analysis provides a natural case for spatial spillover effects in neighboring grid cells. However, a randomly generated grid (as opposed to administrative boundaries) reduces the likelihood of spatial correlations related to the data-generating process\(^\text{10}\). The results of the spatial lag model and the spatial error model were ultimately excluded from the final paper (but are available upon request) since their estimated coefficients were virtually identical to those obtained by the spatial cross-regressive models with the inclusion of an accessibility variable.

### 4.3. Data availability, GIS and unit of observation

Regardless of methodology, the quality of the results of any econometric model can at best only be as good as the quality of the underlying data. I have been fortunate enough to have access to unique, by international comparisons, micro-socioeconomic data. These data are register-based and cover the entire Swedish population over age 16 as well as all firms and establishments (Statistics Sweden - Microdata\(^\text{11}\)). The data inform on population characteristics (such as age, gender, education, employment status, marriage status, and immigration status) and establishment characteristics (such as number of employees and 5-digit industry code). Employers and employees are connected through identification numbers, and their characteristics can be tracked yearly starting in 1990 through 2013 (at the moment of writing). Establishments and individuals are pinpointed to 250x250 meters squares in built up areas and 1,000 x 1,000 meters squares in rural areas.

\(^{10}\) For example, municipality boundaries could contain a certain population- or firm density due to how the boundaries were originally drawn up or due regulations within the boundaries. In turn, this could lead to spatial correlations of variables. This will not be the case with randomly generated grid cells.

areas. Full population data of this sort eliminates many of the common statistical problems of sample data and the need for adjustments and testing, since the real relationship between variables can be observed directly. In addition, random assignment of observations to squares reduces endogeneity problems in general, since no social, political or economic activity can affect the delineation.

Geospatial technologies such as geographic information systems (GIS) have become increasingly advanced in the past decade. Great improvements have even occurred during the timespan of writing this dissertation. This has enabled me to connect the socioeconomic data with other data (such as features of the transport system and the natural environment) with great precision as well as enabled the creation of new spatial variables (such as geographically detailed accessibility variables). Geospatial techniques and software also open up the possibility to define the geographical unit of observation without having to adhere to pre-defined boundaries.

The modifiable areal unit problem (MAUP) is a source of statistical bias recognized in spatial analysis that can influence the results (Openshaw, 1983). It occurs since summary statistics of aggregated point-based measures depend on both the shape and scale of the aggregation unit. For example, a choropleth map of the increase of wholesale firms in municipalities will look different from a map of the increase of wholesale firms in grid cells with a 5 km cell length. In chapter 5, I show that while a significant and positive relationship between wholesale industry growth and population growth exists on the municipality level, no such relationship exists on the 5x5 km grid cell level. The illustration in Figure 4 shows how the shape of the boundaries can make a big difference on the outcome of the data.

Additionally, administrative borders tend to change over time, making it problematic to relate temporal data based on administrative borders between two time periods. GIS and the availability of point-based measures allow the researcher to escape many of these problems and test if the results are robust to different geographical scales of measurement. In Chapter 2, we compare two different geographical resolutions (SAMS13-level and municipality level) in order to see whether the relationship between market potential and the growth of innovative industries holds on different geographical scales. In chapter 5, I depart from the use of pre-defined borders completely and structure the data with the help of GIS on the spatial scale of 5x5 km grid cells. This allows for a more accurate identification of spatial attributes in, or close to, the observational unit, and it evades the introduction of potential bias in the structure of the data due to the definition of (administrative) boundaries.

12 At the time I started writing the dissertation, the most detailed level of the spatial unit available was the municipality unit. The more detailed geographical units have become available in more recent years.
13 Small Area for Market Statistics (about the size of neighborhoods).
Many statistical and data analysis problems are exacerbated with a greater level of aggregation. For example, transport accessibility measures usually focus on the connection between places, although the intra-accessibility (connections within the municipality for example) might be more important for many individuals. For example, travel time between one’s home and office might be much more important than the travel time to another city. If the most detailed spatial unit available is the municipality, there is no way to include transport accessibility explicitly within the own municipality into the model (instead, often other variables such as population density serve as a proxy for it, or it is completely ignored). The problem of the lack of measures accurately describing an area becomes greater the greater the spatial unit in question is.

In addition, certain relationships and processes cannot accurately be captured if the spatial aggregation is too coarse. Marshall (1890) already acknowledged this by emphasizing the importance of direct contact in order for knowledge transfers to occur. Even today, with the increase in information and communication technology as well as reductions in transport costs, scientists still recognize the importance of face-to-face contact in order to facilitate knowledge spillovers, since it eases the formation of relationships, networks and trust (Storper and Venables 2004). For example, Andersson et al. (2016) find a sharp attenuation of agglomeration effects, by exploring squares of 1 and 0.0625 km². This evidence further highlights the importance of the spatial unit of analysis. There are, of course, instances where a larger spatial aggregation can be more desirable.

Figure 4. An illustration of the modifiable areal unit problem.
Source: https://en.wikipedia.org/wiki/Modifiable_areal_unit_problem
Computational technologies have come a long way in recent years, but there are still obstacles related computer software and hardware, in particular as datasets become larger and more complex. At the time of writing chapter 2, we did not have the computational capability to calculate accessibility variables on the SAMS level for all SAMS areas in Sweden since this would have required a huge matrix of approximately 85 million (approximately 9,200*9,200) combinations of travel times. We opted for conducting the analysis for the 298 SAMS areas in Jönköping County instead. We then used interaction variables with Jönköping County and the relevant variable of interest in order to compare the results of the municipality level analysis (covering all of Sweden) and the SAMS level analysis (covering only Jönköping County).

Choosing the correct spatial disaggregation ultimately depends on both the research question at hand as well as the availability of data. The remaining chapters in this dissertation explore different spatial scales, which became a possibility with the availability of more detailed data and the implementation of GIS technology.

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14 Today, we have the ability to perform these calculations.
5. Contribution of each paper

In this section, a short summary of the next four chapters and their contribution to the existing literature is given.


In this paper, we investigate the role that the geographical resolution plays in empirical research relating regional innovativeness and accessibility to economic activity. Earlier empirical research establishing the relationship between agglomeration forces and regional growth typically includes a measure of accessibility, or market potential, as an explanatory factor. The geographical scale that conventional accessibility measures operate on is usually on the level of municipalities or coarser, even when theory suggests that a more disaggregated scale is desirable. The reason for this is usually due to data availability. In addition, researchers rarely perform robustness tests of their findings using different geographical resolutions. Using observational units that are too large risks hiding interesting relationships within the regional boundaries.

This paper utilizes an exploratory approach to investigate the relationship between the spatial distribution and growth of knowledge-intensive services (KIS) and accessibility to economic activity (market potential) with two different spatial scales as the unit of observation. The research sheds light on the importance of the spatial unit of analysis, and whether results are robust when the spatial unit changes. We use regional employment growth in KIS as a proxy for regional innovativeness. Since the main good or service traded by KIS firms is knowledge and since knowledge is partly geographically bounded, physical accessibility to both input and output is believed to be the main contributing factor to the success and regional growth of the KIS industry. We hypothesize that the spatial variation of the regional growth of KIS industries is more sensitive to proximity to markets than is the case for other industries. We further propose that while these patterns could be missed at the municipality level, they can be detected at a more detailed geographical scale.

We hypothesize that while the spatial relationship between the growth of KIS and market potential could be missed at the municipality level, it can be detected at a more detailed geographical scale.

Contribution and summary of main findings

We use panel data on all firms in Sweden between 2002 and 2010 and divide them into different groups of service and manufacturing industries. The goal is to explain what drives the growth of high-tech KIS (knowledge intensive services)
as a proxy for regional innovativeness in areas; and in particular, how important accessibility to economic activity is for its growth. Other industries were used as comparisons: general KIS, less KIS, high-tech manufacturing and low-tech manufacturing.

We performed the analysis on two different spatial units of analysis: municipalities (a conventional unit common in previous literature) and SAMS, Small Areas for Market Statistics (these are basically neighborhoods and are not conventionally used in previous research, mainly due to lack of data availability on this level). Four different variables measuring accessibility to economic activity were calculated on the SAMS level: accessibility within the own SAMS region, accessibility within the own municipality, but outside of the own SAMS region, accessibility within the own labor market region, but outside of the own municipality, and accessibility within the county, but outside of the own labor market region. Analogously, we also calculated three different variables measuring accessibility to economic activity on the municipality level: accessibility within the own municipality, accessibility within the own labor market region, but outside of the own municipality, and accessibility within the country, but outside of the own labor market region. Our results show the following:

- Accessibility to economic activity is particularly important for the growth of high-tech KIS industries.
- This pattern can be detected at a detailed geographical scale (SAMS level) and becomes stronger with an increasing time lag.
- The more knowledge-intensive and homogeneous the population is, the more appropriate it is to use a finer geographical scale.

We therefore conclude that the positive relationship between accessibility and regional innovativeness identified in previous research is robust on a smaller spatial scale. We also assert that it is particularly important to analyze the growth of the more advanced sectors of the economy on a spatially granular level.

5.2. Chapter 3: Labor Market Accessibility and Unemployment

In this chapter, we estimate the causal effect of changes in accessibility through transport system improvements on unemployment rates in Swedish municipalities. The study originates in the generally recognized proposition that the standard partial cost-benefit analysis (CBA) framework does not capture all benefits from infrastructure investments unless there is perfect competition in non-transport sectors (Venables, 2007; Graham & Van Dender, 2009; Lakshmanan, 2011).

We hypothesize that the unemployment is higher than NAIRU (Non-Accelerating Inflation Rate-of-Unemployment) because there is a spatial
mismatch between the locations of the supply and demand of labor. This mismatch arises because the geography is sticky: unemployed workers are too slow to move to areas with higher demand for labor to keep the labor market in equilibrium. For an unemployed worker with a given reservation wage, a reduction in the generalized commuting cost will extend the spatial radius of the job search area as well as reduce search costs, effectively increasing the chance of finding a job.

**Contribution and summary of main findings**

The accessibility measure, central to the analysis, is derived from the national transport model taking consumer behavior, all travel modes and different travel time components into account, implying a detailed measurement of accessibility changes and consistency with cost-benefit analyses (CBA). To isolate transport improvements, we divide the accessibility measure into three components: (i) baseline accessibility, (ii) accessibility change due to changes in the transport system (jobs are held constant) and (iii) accessibility change due to changes in the number of available jobs (transport system is held constant). While the latter may be affected by policy changes, external shocks or other macroeconomic factors, the second variable is not, because transport investments are exogenous in our research setting (Nilsson, 1991; Eliasson et al., 2014).

The data is structured as a pseudo-panel where the entire population of Sweden is divided into segments according to their characteristics (such as age group, gender, education level, and residential municipality). Each segment is used as an observation in a fractional logit regression framework, weighted on the number of individuals per segment. The change in the employment rate between 1993 and 2002 of each segment is explained by the change in accessibility to jobs due to changes in the transport system between 1985 and 1997 and a set of control variables.

The main contribution of this paper is that we focus on changes in accessibility from transport improvements and use a highly sophisticated accessibility measure that is consistent with cost-benefit analyses (CBA). This implies higher policy relevance, and it reduces the main endogeneity problems of most previous studies. Our study covers all municipalities in Sweden, whereas previous studies have focused on metropolitan areas. The results indicate the following:

- Improvements in labor market accessibility due to changes in the transport system have a negative impact on unemployment, with an elasticity of approximately 0.01, in both small and large labor markets.
- The elasticity is higher for workers with low education.
In summary, we conclude that reduced travel costs reduce unemployment and that the magnitude of this effect decreases with educational attainment. These results are consistent with previous findings (see, for example, Matas, et al. (2010)).

### 5.3. Chapter 4: Transport Infrastructure and Wholesale Start-ups in Peripheral and Central Locations in Sweden

This chapter departs from the hypothesis that regions lacking in local demand can compete for start-ups in wholesale trade through promoting their transport infrastructure. A logistically convenient location and satisfactory provision of transportation services are often emphasized as key elements in marketing strategies by local governments attempting to attract businesses. However, as mentioned earlier in this introduction, theory predicts that increasing transport accessibility between a location with lower economic activity in the periphery and the urban center could have either of two contradicting outcomes: (i) Firms are attracted to the peripheral location because it now has better accessibility to the urban center. (ii) Firms are deterred from investing in the peripheral location because better accessibility implies that any firms there now face increased competition from the urban core.

In the paper, I argue that wholesale start-ups in particular will generally not locate in urban centers because of expensive start-up costs and high rents in the urban core, particularly for wholesale firms that require large facilities as they keep stocks. Instead, wholesalers will be attracted to the peripheral municipalities that offer the best transport services. Attracting wholesale businesses is important for the economic development of peripheral areas since wholesalers transfer information over large distances while trading their goods and hence contribute to the revitalization of peripheral regions. The wholesale sector is of particular interest in the transportation economics field since these firms are assumed to be heavily reliant on the local infrastructure as their main function is to connect suppliers and customers through established distribution links. This paper explores the role of local transport infrastructure in attracting new wholesale firms in central and peripheral locations.

**Contribution and summary of main findings**

In the paper, I compare all individuals over the age of 25 in Sweden who went from wage-employment in 2010 to starting a wholesale business in 2011 to all individuals who remained wage-employed, using a logit regression framework. Both individual characteristics and location characteristics are controlled for. The regression analysis distinguishes between peripheral municipalities and central municipalities. The central question investigated is whether peripheral municipalities with better transportation services are able to attract relatively more wholesale start-ups. To the best of the author’s knowledge, this question has
not been investigated before in previous research. The main findings show the following:

- Wholesale entrepreneurs prefer to stay outside of central and denser municipalities but prioritize locations with good connections to these places.
- The provision of transport infrastructure, in terms of proximity to highways, overall logistical convenience, and access to market demand, is particularly important for wholesale start-ups in peripheral locations.

The conclusion drawn from these findings is that the development and promotion of logistics and the transport infrastructure can be a viable regional development policy for smaller peripheral municipalities that results in encouraging investments in wholesale firms and hence knowledge transfer between distant locations.

5.4. Chapter 5: The Fate of the Middleman in the Information Age: The Role of Human Capital in the Growth of Wholesale Services in Sweden

This chapter explores the role that human capital has played in the spatial reorganization of wholesale industries on a granular spatial scale in Sweden between 1990 and 2010. In the early 1990s, Bill Gates (and many others) anticipated that the Internet would become the “universal middleman” and that “the only humans involved in a transaction will be the actual buyer and seller” (Krakovksy, 2015). It was anticipated that the wholesale sector would be eliminated with the advancement of the Internet and communication technologies (ICTs). After all, why should one pay for a middleman when the Internet makes it so easy to connect sellers and buyers directly?

It turns out, however, that the middleman was not eliminated with the advancement of ICTs but has remained relatively stable in numbers in Sweden, although a restructuring of the wholesale sector has occurred. Why did ‘the middleman’ not disappear with the advancement of the Internet, and what role did human capital play in the restructuring of the wholesale sector?

Contribution and summary of main findings

In the chapter, a 5-by-5 km grid is superimposed on Sweden, and all wholesale establishments in the grid cells in 1990 and 2010 in four different subsectors (wholesalers trading producer goods, food, household goods/clothing and high-tech ICT goods) are recorded. Separate ordinary least squares (OLS) regressions explain the growth rates of the four wholesale subindustries in each cell by human capital (the share of university educated) in the cell and surrounding cells.
(spatially lagged using the step function), market access and other relevant control variables.

I hypothesized that human capital is a main driver for the success of wholesale subindustries and that the wholesale firms that have located in proximity to a highly educated labor force are the ones that have survived and thrived in the Internet Age. An instrumental variable approach is used to address potential endogeneity. The findings indicate the following:

- Wholesalers trading producer goods have been the biggest losers and have disappeared between 1990 and 2010 in Sweden, whereas wholesalers trading high-tech ICT goods have almost doubled in numbers of firms and employees. The latter category has also substantially increased their share of employees with a university degree.
- Locations where human capital is high had significantly higher growth rates for all wholesale subindustries, except for the producer goods subindustry.

These results lead to the conclusion that access to human capital has been crucial for the success of wholesalers in Sweden in recent decades.
References


Collection of Articles

Paper 1
Market Potential and the Location of Knowledge Intensive Services: Comparing different Geographical Resolutions

_Johan Klaesson & Therese Norman-Monroe_

Paper 2
Labor Market Accessibility and Unemployment

_Therese Norman-Monroe, Maria Börjesson & Christer Anderstig_

Paper 3
Transport Infrastructure and Wholesale Start-ups in Peripheral and Central Locations in Sweden

_Therese Norman-Monroe_

Paper 4
The Fate of the Middleman in the Information Age: the Role of Human Capital in the Growth of Wholesale Services in Sweden

_Therese Norman-Monroe_