JÖNKÖPING INTERNATIONAL
BUSINESS SCHOOL
JÖNKÖPING UNIVERSITY

Local Economic Development

An Accessibility Analysis

Master's thesis in Economics

Authors: Carl Strömberg

Tutors: Börje Johansson

Peter Warda

Jönköping December 2014

Master's thesis in Economics

Title:	Local Economic Development – An Accessibility Analysis
Author:	Carl Strömberg
Tutors:	Börje Johansson
	Peter Warda
Date:	2014-12-08

Subject terms: Accessibility, local economic development, night time wage, day time wage, jobs, Jacobs hypothesis, New Economic Geography, panel data, OLS, SUR.

Abstract

This paper examines the impact of job accessibility on wages and productivity using Swedish municipality level data on night and daytime wages. The empirical analysis is based on annual data for 290 Swedish municipalities over the period 2005-2011. The strength of this paper lies in its empirical method. By using both Ordinary Least Squares (OLS) and Seemingly Unrelated Regressions (SUR) in a panel data setting, I find that empirical analysis have to take into account the joint determination of day and night time wages. The core of this paper builds on the theories of New Economic Geography and the Jacobs hypothesis. Accordingly, firms that cluster in space are assumed to benefit from urbanization externalities, allowing them access to a large variety of differentiated input service suppliers. Thus, the results of this paper are consistent with the Jacobs hypothesis.

Table of Contents

Figures

Tables

Appendix

1 Introduction

In 2006 around 1.33 million commuters, which represent around 31 percent of the Swedish labor force, crossed Swedish municipality borders on a daily basis in order to earn their paycheck. In 2011, these numbers had increased to 1.5 million people, which then represented 37 percent (Torége, Sandgren, Olander and Thulin, 2008). Hence, more than one third of the Swedish labor force resides for some reason, or other, in a municipality different from their location of employment.

The Swedish Association of Local Authorities and Regions (SALAR) and Arena for Growth distinguish four categories of commuters; i) commuting residents, ii) former unemployed commuters, iii) career commuters, iv) and commuters that are new to the labor force. By making this categorization, the underlying incentives for commuting become evident and emphasize the importance of access to key societal functions such as employment, services or recreational activities (Torége, et al., 2008). Therefore, the accessibility of a location provides residents with increased potential of qualified employment as well as potentials for consumption diversity.

Firms on the other hand tend to locate where there is great market potential. Market potential for firms relate to the availability of diversified labor as an input to production. The market potential is also related to the availability of local demand for diversified products. Hence, i) suppliers' access to customers ii) and firms access to input suppliers are crucial factors affecting the market potential and the attractiveness of the local economy. Fujita, Krugman and Venables (1999) show that the combination of transport costs and scale economies creates demand linkages across space which may contribute to agglomeration. As a result, firms are drawn to the cities by a set of diversified service input suppliers and the potential of serving a large local market from a concentrated number of production facilities at relatively low transport costs.

The purpose of this paper is to study to what extent access to jobs can explain the variation in municipality wages and productivity. I refer to night time wages as *Wages* and day time wages as *Productivity.* The analysis adopts labor market accessibility as municipal access to jobs both within and outside the municipality. Through the empirical analysis of this paper I aim to demonstrate that the labor market accessibility of individual municipalities plays a crucial role in the economic development of municipalities. The accessibility of a municipality is assumed to change in response to changes in infrastructure investments that change time distances between municipalities. To evaluate the growth potential of a municipality, the market access to characteristics that are important to residents and firms are of particular interest. Therefore, the adopted accessibility analysis allows for the determination of interaction patterns between municipalities subject to characteristics that are spatially far away or within close proximity (Karlsson and Gråsjö, 2013).

This paper distinguishes itself from other papers within the field by adopting both a panel data Ordinary Least Squares (OLS) and a seemingly unrelated regression (SUR) analysis framework. The analysis takes into account local, intra-regional and extra-regional access to jobs. Moreover, I deconstruct Gross Regional Product (GRP) into residential and productive wages in order to separate residential location choices from location choices made by firms. The strength of using a panel data framework lies within the ability to survey data over time and to take account of any structural changes that may occur. Additionally, SUR estimations allow

the empirical analysis to take any joint determination in to account using a system of equations. In contrast, most previous studies use a cross-sectional analysis that only uses one, or a few, points in time. Hence, this paper contributes to the study of these cross-sectional effects over time.

The modeling of space is crucial for the evaluation of the local growth potential. The theories of New Economic Geography (NEG) models space as a heterogeneous surface in which the uneven distribution of economic activities are easily discernible. Development of a municipality will, as a result, arise selectively in the areas where a concentration of production uses the available positive externalities in order to improve both its static and dynamic efficiency (Capello, 2011). A spatially well integrated area helps the accumulation of knowledge in the local markets and could also potentially accelerate the process of innovation. Thus, space may help in the operation of mechanisms of the markets in the sense that production may become less costly and more efficient. Ultimately, it may result in increased local development (Capello, 2011).

The importance of access to the local economic development has received increased attention as a result of discussions of co-financing of transport infrastructure by both the public and private sectors in Sweden as well as, in Europe (Billinger, Jäderholm, and Andersson, 2011; Europeiska Kommissionen, 2011). Generally, growth is referred to as enhanced productivity of a municipality, region or a country. For the purpose of this paper, local economic growth is referred to as an increase in wages of a municipality. The empirical analysis uses municipality level data on night and day time per capita wages, employment, higher education and natural amenities. The data source is the *Statistics Sweden* and the set covers all 290 Swedish municipalities in a balanced panel over seven years from 2005 to 2011.

The subsequent section of this paper proceeds to discuss the previous studies within the field of market access. Section 2 develops a theoretical framework on local economic development mainly based on theories of NEG and agglomeration economies. In Section 3 the measure of household and firm accessibility is presented. Section 4 presents the data set as well as empirical variables, models and methodology. The fifth section presents the empirical results of this paper. Hence, Section 5 provides descriptive statistics, correlation analysis as well as the results of the empirical models. Section 6 expands the empirical analysis to test the robustness of the presented models and Section 7 concludes the paper as well as provides an insight into future research in the field.

1.1 Previous Studies

Fujita et al. (1999) show that as the labor market accessibility of a municipality increases, local growth may be stimulated through a process of additionally attracted firms and households to the municipality. Increased presence of both firms and households in turn further enhances the potentials of fully exploiting economies of scale, both internal and external.

Minerva and Ottaviano (2009) examine what it is that constitutes a high accessibility and concludes that increased geographical mobility of goods and factors is achieved through efficient infrastructure. Similarly, Aschauer (2000) find that a vital driver for aggregate total factor productivity is the stock of public infrastructure. In a similar line of thought, Devarajan, Swaroop and Zhou (1996) as well as Esfahani and Ramirez (2002) both find inefficiency of infrastructure provision to be, at times, hampering the impact on long-run growth. Sugolev,

Dodonov and von Hirschhausen (2003) find that an efficient supply of the right sort of infrastructure in an appropriate place is more important than the actual amount of infrastructure expenditures.

The solutions to Krugman's (1991) model on increasing returns and geography are well known, certain parameter values will cause manufacturing to concentrate spatially (Helpman, 1998; Fujita et al., 1999). Hence, there is a desire among firms to be located in a municipality with high employment in order to serve large local consumer markets without the duplication of fixed costs. Large markets on the other hand tend to develop into local economies where the costs of production are higher as a result of, on average, higher wages (Krugman, 1991).

Johansson and Karlsson (2001) find that a large internal market potential of a municipality provides the municipality with an absolute advantage over others in finding diversified specialization. Furthermore, they find that the competitive advantage of a local economy is further increased if the municipality has a large internal as well as external market potential. Hence, the region is potentially a great host to a wide series of sectors, many of which will export their products to external markets and regions.

Combes, Mayer, and Thisse (2008) argue that the market size is positively related to the profitability of established firms in the market. This lies within the notion that locations with a high access to several markets offer a greater profit potential. Hence, firms locating in smaller municipalities will be assumed to realize lower profits than what corresponding firms in larger municipalities do.

Breinlich (2006) withholds the same reasoning, as well as Head and Mayer (2006), with their confirmation of the importance of proximity to large markets. Their results show that the proximity to large markets plays a key role in shaping a core-periphery structure of the per capita income within the European Union (EU). However, Breinlich (2006) finds that as the distance to the a market increases, periphery wages are negatively affected as a result of lower accumulation of physical and human capital rather than a result of the presence of trade costs. Nevertheless, the general understanding is that the market access of a municipality will have a positive impact on the wages as noted by De Bruyne (2003), Mion (2004), and Brakman, Garretsen (2004).

One strand of literature of particular interest for the purpose of this paper examines whether municipalities with market access to large markets for their goods experience higher incomes (Hanson, 1996, 1997; Redding and Venables, 2004). Among recent studies confirming the relationship between market access and wages, Fallah, Partridge and Olfert (2011) find that strong market accessibility also has an effect on the inequalities between labors of different skills. Markets with a strong accessibility are, in generally, markets with a high concentration of skilled labor. Thus, an increased demand for skilled labor will result in a relatively higher wage for skilled labor than that of the unskilled labor. They conclude that a heterogeneous labor market along with strong market accessibility may further widen wage inequalities.

In order to transport goods and factors of production as well as allowing residents to commute within and out of the municipality, high accessibility is a necessary condition. This may be achieved through a well-established network of transportation infrastructure. Additionally, for the infrastructure to be viable, a sufficient amount of population density is needed in order for a municipality to create attraction proportional to the infrastructure in place. Hence, the com-

bination of population density and infrastructure will determine its accessibility and thus represents the core of local economic development. Altering the balance of these factors may lead to congestion and tensions. The absolute right composition of density and infrastructure may, consequently, lead to improved accessibility with an increasing amount of unexploited economic opportunities (Karlsson and Pettersson, 2005).

The study by Minerva et al. (2009) examines the relationship between agglomeration, economic growth and infrastructure. They find that an improvement of the core municipalities' infrastructure further increases economic growth. However, unless there is existing or increased innovation in the peripheral municipalities, improved peripheral infrastructure may lead to hampered economic growth. As a result, there is a trade-off between local economic growth and equality since increasingly improved inter-regional infrastructure may foster further agglomeration in the core regions. Infrastructure improvements increase the accessibility of a region and in turn improve the individual municipality's market potential (Keeble, Owens and Thompson, 1982; Keeble, Offord and Walker, 1988) for better or worse.

2 Theoretical Framework and Motivation

In this section I present a theoretical framework for the understanding of local growth and development in space. Beyond the national level of economic development, it is important to understand that the local economies are very different in relation to the national economy. Whereas the nation has proper borders causing cross-border disruptions in trade, migration and commuting, the local economies potentially provide for a higher degree of openness and the potential for labor and firms to be inter-regionally mobile. Consequently, underlying market conditions such as monopolistic competition, transport costs and increasing returns may lead economic activities to concentrate in space.

This section introduces prominent theories in the field such as the theories of NEG and Agglomeration Economies to provide a working knowledge on what the conditions causing agglomeration may be. The ending subsection of Section 2 presents four empirically testable hypotheses.

2.1 New Economic Geography

The treatment of space has led to a definition of development which is endogenous of origin and therefore space may be considered to hold socio-economic and cultural systems whose components in the end determine the success of the local economy. New Economic Geography provides a platform of elements which allows for the theorization of how and why centripetal forces are able to attract economic activities into a specific location and then to persist there. The determination of spatial concentration and dispersion of economic activities in NEG theories are based on space as a spatial plane in which any occurring economic activities exhibits an apparent geographical divergence. Hence, the theories predict that some locations, for one reason or another, are more or less attractive as a location for firms and individual households (Capello, 2011).

In order to observe how space creates a divergence that result in some municipalities having a higher attraction value for firms and households than others, I resort to monopolistic competition, increasing returns, transaction costs and the occurrence of external economies that shape and alter the location behavior of firms and industries. The foundations of NEG lie within the framework of the Dixit-Stiglitz-Krugman (DSK) model with monopolistic competition and increasing returns to scale. This implies that each firm is producing a differentiated variety in order to relax the impact of competition and to have the benefit of realizing scale economies to reduce the costs of production as production increases. To investigate this properly, some attention must be given to works by Chamberlin (1933), Spence (1976), and Lancaster (1979) and as mentioned Dixit and Stiglitz (1977), namely, monopolistic competition.

Under monopolistic competition, horizontally differentiated products govern the markets. Hence, each consumer will buy only a small amount of each variety of the goods of the individual firm. Each firm, therefore, faces an individual downward sloping demand schedule that allow them to enjoy some market power in its pricing process. However, the market power is governed by the extent to which there are other firms in the same market and thus the monopolistic power over price is limited (Dixit et al., 1977).

By introducing scale economies the competition effect under monopolistic competition is further enhanced as large firms and industries to a greater extent are able to increase production while at the same time minimizing the average costs per unit (Krugman, 1991). This allows for the building of larger plants with which a higher efficiency in production may be pursued. Hence, scale economies imply that it is not possible to produce everything everywhere as larger firms can produce the same products more efficiently.

Within geography and transportation, the costs of transport are essential in firms and industries' choice of location. Generally, costs of transport are regarded as iceberg type transport costs (Samuelson, 1952) where a fraction of the shipped units' value is lost in freight. As a result, firms are faced with the choice of either concentrating their production in one location and serve other municipalities through exports, or to set up an additional plant in a different location. The latter is of course only viable if the benefit exceeds the expected fixed costs. Hence, in the absence of transport costs one single firm would be able to supply the entire market from a single location. The interaction between monopolistic competition, transport costs and increasing returns hence implies that under small to moderate transport costs there would be incentives for economic activities to concentrate in space.

The aforementioned concentration of economic activities is however further enhanced by the *home market effect* (Krugman, 1980). Generally, under the home market effect the larger municipality is assumed to attract a more than proportional share of the firms to the sector that is characterized by increasing returns to scale. As a result, the relatively smaller municipality will export capital to the larger municipality. Naturally, in terms of market size the larger municipality will attract more firms. Hence, there is interplay between market-access and market-crowding effects where the intensity of the agglomeration will get stronger as transport costs fall and the size of the already large market increases further. On the other hand, the market-crowding effects are dependent on the distribution of firms and these effects will increase as costs of trade increases (Dixit et al., 1977).

Individual firms' equilibrium prices will be independent of the distribution of firms across space. However, a change in the distribution of these firms will have an effect on the composite price index of the region. If the distribution changes toward favoring the larger municipality, a downward effect on the price index of the large municipality will occur, and in turn increase the local demand. Such a distribution will be the result of a change in the trade costs faced by individual firms. Thus, firms will experience a decreased demand for their differentiated products as the market become more fragmented as a result of more readily available varieties. As firms face a lower demand for their products, their profits will be reduced. This is referred to as the crowding-effect. Reduced potentials for profits hence impede attraction of the larger municipality that in turn will reduce the agglomeration forces (Krugman, 1991).

In short, the intensity of the home market effect may be claimed to vary with the level of trade costs. As the integration between municipalities increase, the geographical advantage of smaller municipalities' decrease with increased ability of larger municipalities to export to the smaller municipality. Consequently, the opportunities of scale economies are exploited. Thus, as one of the most important implications of the home market effect, deeper economic integration will lead to growing municipal disparities at the expense of smaller municipalities. However, this is for the benefit of all consumers.

Further, in a multi-regional setting of the home market effect it is stressed that accessibility of markets varies across municipalities and therefore the trade costs between the municipalities will be different. Hence, the relative position of a municipality within a network of municipalities will have a distinct importance for their success. Accordingly, an improvement in the relative accessibility of a municipality will in turn improve the municipality's attractiveness. Thus, physical geography affects the level of economic development on a local level as a barely accessible municipality will exhibit a certain advantage which may attract more investment capital than if the access was higher. A municipality with a low level of access will have a competitive advantage as a result of its inaccessibility as this reduces the competition from other firms. Because of geographical inaccessibility, local economies may experience a natural protection of its markets as well as its infant industries. This means that the municipality remains protected from foreign competition and that improved access may not always be a desirable feature (Krugman, 1991; Combes et al., 2008).

As explained by the home market effect, the larger municipalities will experience a self-reinforcing positive cumulative circle where the employment and services provided may cause an increase in intra-regional attraction which in turn may cause further in-migration of both firms and households. Thus, the theory of cumulative causation emphasizes the importance of the market place and why some places attract capital, skills and expertise. The accumulation of factors leads to a competitive advantage over other locations. Thus, disadvantaged locations are unable to develop the internal capacity needed to compete and later to prosper (Myrdal, 1957). Hence, we are able to discern a *core-periphery* structure in which the characteristics of the location depicts firms' and household's choice of location.

From a local economic growth perspective, the role of transport costs are negligible since the level of transport costs, to a great extent, determines whether economic activity is dispersing or concentrating. However, transport costs, solely, are unable to determine the success of large local economies. Principally, the home market effect is able to explain why large municipalities perform well in terms of local economic growth. However, knowledge of agglomeration economies is also vital in understanding the more than proportional attraction of relatively larger municipalities.

2.2 Agglomeration Economies

The literature refers to agglomeration economies as the ability of increasing returns to cause average costs to decline as production is expanded. In order to properly find the source of average cost falls, Scitovsky (1954) distinguished between external and internal economies of scale. Internal economies deal with the ability of the individual firm to decrease average cost as production increases. External economies on the other hand refer to the reduction of the average cost of production as a result of industry-wide output expansion. These external economies have two strands; the localization externalities and the urbanization externalities to which Glaeser, Kallal, Scheinkman and Shleifer (1992) came to establish the distinction between these two as a distinction between Marshall-Arrow-Romer (MAR) externalities and Jacobs externalities. The two specifications of externalities are concerned with the spillover of knowledge between firms. Whereas MAR externalities are assumed to be referred to as knowledge spillovers between firms of the same industry, Jacobs externalities are assumed not to be industry-specific but rather taking place among firms of different industries (Jacobs, 1969). As such, the work by Jacobs assumes that the city growth is achieved through a greater

diversity of consumer goods and producer inputs, also known as the Jacobs Hypothesis (Jacobs, 1984).

Marshall (1920) argues that the concentration of firms in one particular location exploits the ability for firms to take advantage of a pool of workers with skills specific to a particular industry. In addition, a localized industry or a cluster of firms may support production of specialized inputs that in nature are non-tradable as well as provide information spillovers that in the long-run may provide firms with an improved production function. The theories by Marshall originates from external economies as a source of spatial competitiveness in which firms that locate in close proximity benefit from increased efficiency of production and decreased production costs as production increases. Hence, the proximity enforces the realization of increasing returns and self-reinforcing mechanisms of local economic development.

Empirical results and literature is however inconclusive as to whether the Jacobian strand of diversification or Marshallian specialization externalities fosters local innovativeness. The empirical results of several studies, in fact, support both strands of externalities (see, e.g. Paci and Usai, 1999; Shefer and Frenkel, 1998).

Quigley (1998) supports the Jacobs Hypothesis by arguing that a high access to a rich variety of differentiated inputs is vital in order to increase the productivity of firms as well as the growth of a local economy. The lower the differentiation among inputs, the lower is the resultant impact of variety on the level of output. Hence, a greater differentiation of inputs in turn implies a higher impact on the production output and an increase in variety of producer inputs may yield external scale economies. This may occur even though only normal profits are earned by firms. The logic in this lies in the notion that larger cities hold a greater amount of labor. Thus, a larger labor force determines the number of differentiated producer inputs available which implies that a larger city can hold a greater variety of producer inputs. Generally, Quigley (1998) concludes that with heterogeneity in the producer market, the productivity of a municipality will increase.

Venables (1996) builds further on input factors as the main centripetal force for economic clustering. Venables notes that the cost and demand linkages between firms under increasing returns and imperfect competition gives firms an incentive to cluster in order to fully exploit the potentials of economies of scale. This reasoning is built on the fact that producers of intermediate goods will decide to locate in close proximity to firms demanding their intermediates. Hence, firms as consumers of intermediate goods will locate where the share of suppliers of intermediates is relatively high. Similarly, Koo (2005) found that when vital factors of production are no longer easily exchanged from a distance, firms will locate in closer proximity to each other. Hence, as the distance between firms' increases, the ease with which firms interact will diminish and as a result, vital factors of production will tend to spill over locally.

Combes et al., (2008) estimate that for US manufacturing, intermediate goods as a share out of total production is around 59 percent. Hence, the need for firms to locate in close proximity to the final demand for goods is relatively less important than their need to locate where the availability of intermediate goods is high.

2.3 Human Capital and Migration

The theory of endogenous growth proposes that economic growth is the result of endogenous factors rather than being determined exogenously. Endogenous factors of growth are referred to as investments in research and development; innovation and education are thus vital contributors to economic growth (Romer, 1990). In order to model increases in factor productivity that has its origins in endogenous factors, this requires the removal of the assumptions of constant returns and perfect competition and instead assume increasing returns and imperfect competition (Capello, 2007). The endogenous growth model incorporates a *learning-by-doing* factor which assumes that as individuals produce goods they also think of ways of improving the production process. Hence, knowledge accumulation leads to improvements in productivity that occurs without deliberate innovations in the production process (Romer, 2012). On this note however, it is necessary to understand that major innovations are more often than not the work of extremely talented individuals and thus economic and social incentives and activities stimulating the work of talented individuals may be a key aspect of the accumulation of knowledge (Baumol, 1990; Murphy, Sheifer and Vishny, 1991).

Therefore, endogenous economic development in space is driven by the entrepreneurial abilities, local labor and capital available as well as crucial decision making capacities that ultimately allow the local economic and social actors to be part of, and guide the local development process (Capello, 2007).

Hence, human capital is a crucial factor in determining economic growth. Growing municipalities would experience migration inflows that would add to the local aggregation of human capital and thereby increase the stock of human capital in the municipality. For contracting municipalities, the opposite holds true (Faggian and McCann, 2009). If the willingness to migrate with respect to human capital is very low, so is the flows of human capital and therefore the local growth will almost exclusively be dominated by internally generated human capital. Thus, more heterogeneous migration flows may contribute to a redistribution effect between municipalities in terms of their stock of human capital.

Previous studies find migration to be dependent on the level of embodied human capital in each individual. Hence, as the human capital embodied in individuals increases, so does the willingness to migrate (Bartel, 1979; Faggian and McCann, 2006). The willingness of individuals with a high embodied human capital to migrate introduces complications in the analysis of the human capital to local development relationship. Faggian et al. (2009) argue that this is the result of the nature of human capital as it, although produced in a region, may easily leak to other regions. Hence, potential multiplier effects generated from human capital tend not to spill over where the human capital is generated (Faggian et al., 2009).

Sjaastad (1962) notes, in *human capital migration theory,* that just as any other investment, migration is associated with both costs and returns. Hence, the decision to migrate is held in relation to its potential returns in the new location and the costs of remaining in the current location. Only when the migration investment generates a positive net present value will an individual decide to migrate.

With respect to migration, Crozet (2004) tests whether a high presence of production affect the locational decision made by workers. The results show that so-called forward linkages in fact matter but that low mobility of labor may reduce the agglomerating pattern. Further,

Pons, Paluzie, Silvestre and Tirado (2007) support the results reached by Crozet (2004), noting that the forward linkages are important in attracting further migration flows.

Among later contributions to the field, significant support is found for an increased push for the process of accumulative causation, as introduced by Myrdal (1957), through the adoption of new technologies and skills but also the importance of entrepreneurship, learning, education, increased institutional capacities and migration of households and firms (Karlsson, Johansson and Stough, 2001).

2.4 Amenities

The importance of natural amenities has for a long time, been examined both in terms of its economic value for local development as well as its role in improving the quality of life for people living in the municipality. Thus, during the course of history, the importance of natural amenities as a driver for economic growth has varied. The early stages of economic development were dependent on the natural amenities in order to run extractive industries such as farming, forestry, mining and fishing which at that time created a large amount and relatively high-paying job opportunities (Kwang-Koo, Marcouiller and Deller, 2005). Since the 1960s however, the resource extractive industries have lost much of their price competitiveness in the world commodity markets (Freudenburg, 1992).

Local development has since the 60s been forced to reexamine the use and managing of natural resources. Consequently, the focus has broadened to encompass non-extractive environmentally sensitive land use and practices (Power, 1996; Marcouiller and Deller, 1996; Hays, 1998). Natural amenities have also turned into somewhat of a quality-of-life factor, which is believed to play a critical role in human migration patterns as well as in firm location decisions (Graves, 1979, 1980, 1983; Gottlieb, 1994; Dissart and Deller, 2000). However, Roback, (1982; 1988) found that the natural amenities might lower wages as well as increase house rents.

In a broader context, these studies have been fairly simple in terms of the amenities considered and typically lacked a focus on specific natural amenities that can be affected or influenced by the local economic public policies (Kwang-Koo et al., 2005). Recent studies have however, devoted a greater emphasis on the effects of natural amenities on human migration and economic conditions. Accordingly, Rudzitis and Johansen (1991) provided evidence for wilderness and large open spaces as a key factor in understanding why people would decide to live in or move to remote rural municipalities. A study by Deller, Tsung-Hsiu, Marcouiller, and English, (2001) finds evidence for amenities as an influence to growth in population, employment and per capita income.

The positive relation identified by many previous studies is, however, not sufficient in providing the whole picture since some studies do not support the notion that natural amenities have strong effects on neither economic growth nor development. Among these are Keith and Fawson (1995) who could not find any contribution of wilderness on local economic activity but also Duffy-Deno (1997) who proved unable to find satisfactory empirical evidence of state parks on population and employment growth. On a general note however, McGranahan (1999) and English, Marcouiller and Cordell (2000) conclude that natural amenity-based economic development is an important determinant in population, employment and income growth. On this note, a meta-study by Waltert and Schläpfer (2010) find amenities to have a

significant and positive effect similar to that of low tax burdens. Their study find support for the notion that amenities enters into each individual's utility function and that the existence of amenities therefore shape individuals' location decisions. Hence, amenities are found to be a substantial determinant of migration flows.

2.5 Motivation

The aim of this subsection is to extract conclusions from the theoretical framework and previous studies in order to state four empirically testable hypotheses. In the NEG literature, the interaction between transport costs and increasing returns creates centrifugal and centripetal forces that may serve as an explanation for the existence of agglomeration economies. Whereas the transport costs represent the centripetal forces that bring firms and households closer together in order to realize increasing returns to scale, the centrifugal forces relates to purely immobile factors such as natural resources and the cost of land.

Jacobs (1984) sets out to provide a framework for explaining the existence of agglomeration with the use of specialization externalities. Along these lines, Jacobs (1984) states that, as the local market increases there is improved potential for firms to benefit from an increased supply of diversified inputs, which in turn may lead to enhanced local productivity.

Krugman (1991) concludes that firms are attracted to locate in locations where the existing level of jobs is high as this allows firms to serve a potentially large market without incurring increased fixed costs. Hence, firms with high access to jobs typically also have a high degree of access to household customers and suppliers of producer services. Consequently, households with a high access to jobs also tend to have a high access to the supply of household services. The dynamics of supply of jobs can simultaneously bring cumulative processes of growth or decline in municipalities over time. Thus, in order to test this theoretical reasoning I state the following two hypotheses:

H1: According to the Jacobs hypothesis, *Productivity* is expected to increase with market access.
H2: *Wage* is expected to increase with market access.

The accumulation of knowledge is, according to Romer (1990), a source of productivity improvements that arise exogenously to deliberate innovations in the production process. Hence, by improving the social and economic environment the accumulating process of knowledge may be enhanced which further stimulates the work of talented individuals. As such, major innovations are often the result of extremely talented individuals' work (Baumol, 1990 and Murphy, et al., 1991).

The level of local labor and capital available along with existing entrepreneurial abilities are, therefore, expected to drive the endogenous economic development in space (Capello, 2007). This allows me to state the third hypothesis on the relationship between local economic development and education.

H3: *Wage* and *Productivity* is expected to increase as education is augmented.

In the literature on natural amenities, natural amenities are regarded as a quality-of-life factor that influence human migration patterns as well as the locational decisions of firms (Graves,

1979, 1980, 1983; Gottlieb, 1994; Dissart et al., 2000). Similarly, Rudzitis et al. (1991) provided compelling evidence for wilderness and large open spaces as an influencing factor in human migration patterns and a reason for why people enjoy living in or moving to the very remotest rural counties. On this note, natural amenities may be an influencing factor in individuals' location decisions (Waltert and Schläpfer, 2010) as a well source of growth in population, employment and per capita income (Deller et al., 2001). Hence, the relationship between local economic development and natural amenities serves as the fourth and last hypothesis:

H4: Local *Wage* and *Productivity* is expected to increase with amenity access.

3 Household and Firm Accessibility

The previous section provided a theoretical framework along with four testable hypotheses. This section builds upon acquired knowledge to develop two model-like scenarios where the supply of jobs potentially alters the economic activities in space.

3.1 Household Accessibility

This section starts from the basic assumption that households find high attraction values in municipalities where job opportunities are frequent. Increased access to jobs is assumed to increase an individual's probability to get a job that matches her qualifications. Hence, job accessibility may be considered to reflect welfare opportunities. Increased welfare of a household is not only assumed to affect the ability to get a qualified job but also the possibilities to consume its additional welfare as a customer to firms both internal and external to the municipality.

Johansson, Klaesson and Olsson (2002) relate the opportunities of interaction to preferences which have been specified in the theory of random choice. Assuming that the choice of residential location and commuting is made by households in order to ease the problem of spatial matching, associated with the local labor market, random choice theory can be applied to relate the opportunities of interaction to household preferences.

In an infrastructure network of commuting links, each representative individual is assumed to face a number of choices, *s*. The indirect utility derived from commuting from municipality *k* to municipality *l* may thus be specified as, U_{kl}. Total indirect utility will therefore be specified as a function of the cost of commuting between two arbitrary municipalities, the time distance between these municipalities, some attributes of municipality *l* and random influences on the utility which is derived from unobserved factors such that:

$$U_{kl} = a_l + b(w_l - w_k) - \gamma c_{kl} - \mu t_{kl} + \varepsilon_{kl} \quad (1)$$

where, c_{kl} is the cost of commuting between municipality *k* and *l* and t_{kl} is the time distance for a commute between *k* and *l*. ε_{kl} represents the random influence on the utility which comes from unobserved factors and a_l refers to attributes in municipality *l*.

Letting $V_{kl} = U_{kl} - \varepsilon_{kl}$, the possibility of choosing commuting link (*k*, *l*) is derived:

$$P_{kl} = exp\{V_{kl}\} / \sum_s \{V_{ks}\} \quad (2)$$

The probability of choosing a specific link follows a Poisson distribution. Introducing two additional assumptions, $c_{kl} = \mu_c t_{kl}$ and $(w_l - w_k) = 0$, the cost of commuting is regarded as the time spent commuting from municipality *k* to *l* and that the wages in all municipalities are equal. We are now able to specify a measure of access:

$$T_k^A = \sum_s exp\{-\lambda t_{ks}\} A_s \quad (3)$$

where $A_s$is our access measure and λ is the time sensitivity parameter that decays as the distance in time travelled increases. Consequently, with this specification in hand we are now

able to specify other access parameters by substituting A_s for measures such as the supply of available housing, consumption diversity, natural amenities, natural resources, supply of household services and the supply of knowledge intensive business services in municipality *s* (Johansson, et al., 2002). The construction of the measure allow for the measurement of the ease with which potential opportunities can be reached and how this alters the interaction in space Weibull (1980).

Johansson et al., (2002) find that the employment opportunities of an individual residing in a municipality consists of jobs in the home municipality, jobs in municipalities in close proximity to the home municipality, but also of jobs located in other municipalities as seen in (4) below. Thus, commuting exhibits apparent distance decay in the willingness to commute as the time distance increases. Critically, there are three thresholds:

i) $t \leq 15$ mins, $Local_{it}$ = Intra-municipal access to jobs
ii) $15 < t \leq 60$ mins, $Intra_{it}$ = Intra-regional access to jobs (4)
iii) t > 60 mins, $Extra_{it}$ = Extra-regional access to jobs

3.2 Firm Accessibility

Suppliers of both intermediate and final goods and services make their location decisions based on the size of the demand potential, but also on the size and diversity of service input suppliers. Hence, the firms' opportunities to find a diversified enough composition of local inputs are crucially dependent on the supply of input alternatives. The Jacobs hypothesis states accordingly that an increase in output diversity in agglomeration economies is an analogous result of a larger and denser market which causes a disproportionate increase of jobs in knowledge-intensive producer services (Jacobs, 1984).

Venables (1996) notes that producers of intermediate goods have a high propensity to locate in close proximity to firms in demand for their intermediate supplies. Thus, this leads to a cumulative causation where firms as intermediate goods consumers locate where the share of input suppliers is relatively high. Similarly, vital factors of production do not only shape the activities of firms but also their location in space. As outputs of production are no longer easily exchanged from a distance, firms tend to locate in close proximity to other firms (Koo, 2005).

Accordingly, Klaesson and Johansson (2014) investigate how individual firms' opportunity to find a set of suitable inputs is dependent on the distance-discounted supply of input alternatives. Hence, the location of the individual firm has the potential to affect the productivity of the firm and therefore the input-supply potential of the location is of utmost importance. The access to a dense area is of key interest as it may determine the success and failure of firms. A high access of firms allows firms to reach out to a potentially diversified market for both final and intermediate goods. High access also means that they are easily able to access information as well as the local and international infrastructure networks.

An individual firm in an urban region has a local supply potential, S_r, an intra-regional supply potential, $S_{R(r)}$, as well as an extra-regional supply potential, $S_{E(r)}$ as specified below:

$$S_r = exp\{-\lambda t_{rr}\}\, V_r \tag{5}$$

$$S_{R(r)} = \sum_{s \in R(r)} exp\{-\lambda t_{rs}\} V_s \quad (6)$$

$$S_{E(r)} = \sum_{s \in \mathrm{E(r)}} exp\{-\lambda t_{rs}\} V_s \quad (7)$$

where, λ is the local and intra-regional time distance sensitivity parameter and V_s is the supply of business services in the urban area *s* (Klaesson and Johansson, 2014). The accessibility thresholds for firms are assumed analogous to the thresholds for household accessibility in Specification (4).

Following Klaesson and Johansson (2014) the location of knowledge-intensive business services (KIBS) is assumed to be given at each point in time. Hence, with the location given, each firm will operate to supply a variety of intermediary service inputs based on their accessibility of supply in Equation (5) - (7). Assuming that each firm produces an amount equal to q of variety *i*, the total amount of service varieties supplied in each location will equal $V_s \approx n_s q$.

Accordingly, Fujita and Thisse (2002) argue that the productivity of a sector in a location is positively affected by the level of input diversity. Hence, the greater the level of input diversity the higher the productivity and thus sectors will be attracted to locate in an area where the supply potential is high. As such, the supply potential provides the sector with an incentive to locate and expand in locations where the supply is relatively higher. When the sectors located in a municipality grow, this leads to the stimulation of further service-producing firms to locate in the very same urban area. However, this agglomeration force may potentially cause too high density which may have a detrimental impact in the accessibility advantage. Consequently, the growth in a certain area may come to halt.

Figure 1 describes so-called self-reinforcing dynamics that, through increased labor market accessibility, may lead to increased productivity. This productivity increase is the result of two mechanisms which assumes that i) as a municipality grows larger, the opportunities of realizing economies of scale increases ii) and that this growing density increases the labor market participation. Hence, this leads to a cumulative process where household's access to jobs is expected to attract an increasing number of migrating households that consequently increase the labor market participation. It is also expected that a high access to labor supply for firms attracts additional firms and stimulates expansion (Johansson and Klaesson (2007).

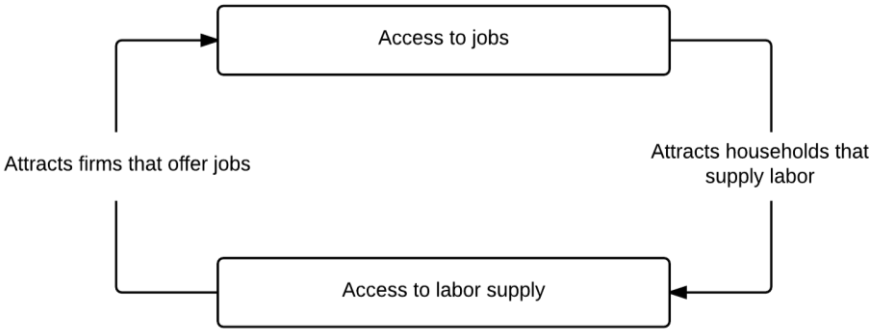

Figure 1 – Cumulative Causation of Jobs and Labor Supply
Source: Johansson and Klaesson (2007)

4 Data, Empirical Models and Methodology

This section is devoted to the data set used for the empirical analysis of this paper. In the subsequent sections, I present the data sources and empirical models along with the calculation and interpretation of the explanatory variables. The variables used to construct the empirical models are based on the four hypotheses presented in Section 2.4. I also provide a motivation for the empirical methodology adopted in this paper as well as discuss common characteristics that may affect the results of the empirical analysis.

4.1 Data

The empirical part of this paper uses secondary data collection from two major sources in order to create a suitable data set. The first is *Statistics Sweden*, which provided municipal-specific data on wages, employment, GRP, education and natural amenities for this empirical analysis. Data has been collected over a 7 year period, 2005 to 2011, for all 290 Swedish municipalities. In total the available data gives a theoretical observation count of 2030 for panel data analysis.

In order to construct the accessibility measures outlined in Section 3, a second source has been used. Courtesy goes to Johansson, et al. (2002) who studied *how time distances within and between municipalities determine the spatial extent of local and regional labor markets* (Johansson et al., 2002). In order for the measures to fit this study, data from Statistics Sweden on employment, amenities, and wages have been used in order to construct distance weighted access measures for the relevant years. Table 1 gives a short description of the variables used in the empirical analysis.

Table 1 – List of Variables

Dependent Variables	
$Wage_{it}$	Residential, per capita nighttime wages.
$Productivity_{it}$	Productive, per capita daytime wages.
Independent Variables	
$AccLocal_{it}$	Local access to jobs.
$AccIntra_{it}$	Intra-regional access to jobs.
$AccExtra_{it}$	Extra-regional access to jobs.
$Local\text{-}A_{it}$	Local access to natural amenities.
Intra-A	Intra-regional access to amenities.
$Education_{it}$	Higher education, 2≤ years, as share of population.

Note: All variables are in their natural logarithm form except $Education_{it}$.

4.2 Empirical Models

For the purpose of this paper, I use two distinguished measures of local wages in place conventionally used GRP. This distinction is made as GRP is not exclusively local and does not distinguish between labor as residents of the municipality and labor as in-commuters to the municipality. The considered measures are i) *Wage* as proxied by per capita night time wage sum and the ii) *Productivity* as proxied by per capita day time wage sum.

Using the night time wage as a measure of *Wage* gives an indication of municipalities welfare and consumption abilities. It is calculated as the share of nighttime wage on the nighttime population. Hence, it gives an indication of per capita incomes of the residing population of the municipality. It is merely the place of residence which is of interest and therefore work-place location has been given no concern. Additionally, *Wage* gives an indication of the municipalities' purchasing power and is used in its natural logarithm form.

$$Wage_{it} = \beta_0 + \beta_1 lnAccLocal_{it} + \beta_2 lnAccIntra_{it} + \beta_3 lnAccExtra_{it} + \beta_5 Educaction_{it} + \beta_6 Local - A_{it} + \varepsilon_i \quad (8)$$

where *i* represents each individual municipality and *t* represents the time period studied.

The use of the daytime wage serves as a measure of local productivity and is generated from the jobs in the municipality. It is calculated as the wage sum per employee in the subject municipality. Thus, the per capita daytime wage is of interest as it gives an indication of how the productivity and employment levels in the local economy are developing. It is also to gives an indication of the consumption abilities of the knowledge intensive labor force that commute to the region in order to earn their pay check. A positive change in the productivity measure may, however, indicate a loss in the number of jobs during a period and therefore positive changes have to be treated with caution. I use *Productivity* in its logarithm form.

$$Productivity_{it} = \beta_0 + \beta_1 lnAccLocal_{it} - \beta_2 lnAccIntra_{it} + \beta_3 lnAccExtra_{it} + \beta_5 Education_{it} + \beta_6 Intra - A_{it} + \varepsilon_i \quad (9)$$

i represents, the cross-sectional observations and *t* represents the time period.

4.3 Explanatory Variables

Local, Intra- and Extra-regional Accessibility

In order to use the accessibility measure, as outlined in Section 3, employment statistics from Statistics Sweden has been employed. The statistics on employment covers the full working population from the age of 16 for each municipality in Sweden.

The accessibility measure is used in its natural logarithm form which makes elasticity interpretations of the dependent variables rather straight forward. The elasticity of *Wage* with respect to any of the accessibility variables is β_1, β_2 *or* β_3. Hence, a 1 percent increase in job accessibility can be interpreted as a β_1, β_2 *or* β_3 percent increase in *Wage*. The interpretation of *Productivity* is analogous to the interpretation of *Wage* (Gujarati and Porter, 2009).

Education

Both empirical models of this paper use education as an explanatory variable in order to control for the municipally embodied human capital. It is calculated as the number of people with a higher education which is two years or longer. By setting the limit at two years and longer allows for the inclusion specialized programs of tertiary education (such as *KY*[1] programs) which arguably is an important part of individuals' economic development.

[1] *KY* – Referred to as advanced vocational training (free translation of Kvalificerad Yrkessutbildning).

I calculate the education variable by calculating the ratio between educated individuals in each municipality and the total municipality population, such that:

$$Education_{it} = \frac{Educated\ individuals\ in\ each\ municipality}{Municipality\ Population} \quad (10)$$

The measure of education is used in its linear form because to the complexity of interpreting ratios. Thus, the elasticity interpretation of the variable is different from the interpretation of access to jobs. It is convenient to talk about the impact of a unit increase in the education ratio on the level of *Wage* in such a way that if *Education* increases by one unit, then *Wage* is expected to, on average, increase by β_6x100 percent (Gujarati and Porter, 2009). The interpretation of *Productivity* is carried out in the same fashion. Hence, β_6x100 percent is referred to as a semi-elasticity as it represents an approximate per-period change in the dependent variable. Alternatively, the elasticity may be discussed at the mean of *Education*, i.e. $\beta_6\overline{Education}$.

Amenities

In order to evaluate the impact of amenities on the level of local *Wage* and *Productivity* the accessibility measure outlined in Section 3 is applied. Natural amenities are measured as the access to the total amount of natural parks, reserves and conservation areas in and from each municipality. *Local-A* and *Intra-A* are used in their natural logarithm form and the elasticity interpretation of the variable is analogous to the access to jobs measure presented earlier.

4.4 Emprical Method

In order to pursue the purpose of this study, I focus on transport infrastructure in place rather than infrastructure expenditures or information technologies such as the internet. Alternatives to transport infrastructure will be disregarded for the sake of parsimony. With that said, this paper does not regard other infrastructure options as inferior to transport infrastructure but rather makes this distinction as individual municipalities have a greater influence over transport infrastructure and habitation and thus the physical access of the municipality.

Hence, access may arise through a selection of ways and is subject to the needs of its end user. For this study, transport infrastructure is central as it affects the time distance between places and thereby the accessibility. Location and settlement structures play a vital role in minimizing the number of movements needed to reach various destinations.

For the empirical analysis of this paper, a panel data analysis using Ordinary Least Squares (OLS) is adopted. The advantage of using panel data lies in the fact that this method allows for the maximization of observations for the econometric analysis. By using panel data, cross sectional units are surveyed over time, providing the data set with both time and space dimensions. It also reduces the potential of collinerarity among regressors and provides increased degrees of freedom (Gujarati and Porter, 2009).

Macroeconomic data is by nature mostly non-stationary and has the characteristics of a random walk. Estimating such regressions may result in spurious results (Kennedy, 2003). If the data, however, is characterized by a large number of cross sectional observations (*N*) over a short time period (*T)*, Baltagi, (2008) suggests the adoption of a *fixed effects* approach in order to avoid non-stationarity to affect the significance of the coefficients. Additionally, fixed ef-

fects estimation is advantageous as the explanatory variables cannot be assumed to be independently distributed within a geographical area (Greene, 2012). Greene (2012) also notes that in panel data sets, the correlation across included observations within each specified municipality group is expected to have a greater influence on the estimated covariance matrix of the least square estimator than any present heteroskedasticity. Nonetheless, by including the *fixed* common effect across groups in panel data models does not remove the presence of heteroskedasticity but rather centers the conditional mean in a proper way. This allows the empirical analysis over a period to take into account individual-specific effects and still be time-invariant (Greene, 2012).

The panel data approach allows for the estimation of an empirical model which tells how much of the variance of the dependent variable can be explained by the specified independent variables. Significance of an independent variable implies that the effect of the relationship between independent variable and the dependent variable is significantly different from zero. Hence, we reject the null hypothesis (Gujarati and Porter, 2009).

Previous studies by Anselin (2003), and Andersson and Gråsjö (2009) point to the fact that including spatially discounted variables such as access variables in empirical models reveals a spatial dependence through the parameter estimate. Anselin (2003) and Andersson and Gråsjö (2009) also find access variables to be significantly different from zero and that when these variables prove statistically significant, the issue of spatial autocorrelation is significantly reduced. By this token we may interpret the access variables as having a spatial dependence.

The proxies *Wage* and *Productivity* are, as mentioned in Section 4.2, constructed by the use of data on day- and night time wages and population in a municipality. Existing firms in a municipality are, most likely, employing both local residents as well as extra-locally based labor which implies that the wages that are paid to the local labor force and in-commuters are determined with respect to the efforts and skills of the local and extra-local labor. Hence, the residuals from the estimation of the wages are assumed to be highly correlated (Zellner, 1962) and should as such be regarded as being determined jointly as they originate from existing firms in the municipality.

By implementing seemingly unrelated regressions (SUR), I construct a system of equations that include this inter-relationship among the dependent variables. Thus, I allow for the joint determination of day and night time wages. Equation by equation estimation under joint determination will lead to consistent yet less efficient results than if the equations were estimated in a SUR setting. SUR estimation is in itself a Generalized Least Squares (GLS) estimation which, with equations with identical explanatory variables, is identical to estimation of OLS (Zellner, 1962). However, the greater the correlation between the estimated residuals the higher is the efficiency gain from GLS-like SUR estimation. The results of the residual correlation analysis of the two equations, *Wage* and *Productivity*, are shown in Table 2.

The results (0.6718) indicate that the estimated residuals are highly correlated (67 pecent) at a 1 percent significance level. The results of the SUR regression supports the assumption that the wages are determined jointly which in turn supports the use of the SUR approach.

Table 2 – Correlation Matrix of Residuals

	Wage	*Productivity*
Wage	1.0000	
Productivity	0.6718	1.0000

Note: Wage and Productivity are in log form.

By applying a bootstrap to the results of the SUR regression, I use the sample data to obtain asymptotically appropriate standard errors for the empirically estimated parameters. The asymptotically appropriate standard errors give a description of the sampling properties of the estimators as well as reducing the potential bias in the estimators (Greene, 2012). The results are shown in Table 6 under *SUR-Boot.*

5 Empirical Results and Analysis

This section is devoted to the presentation of the results of this paper. First, subsection presents the descriptive statistics. Means, medians, standard deviations, and minimum- and maximum values are reported. Secondly, a correlation analysis is carried out in order to highlight the correlations between the dependent and the independent variables. In subsection three, the results from the empirical analysis are presented and analyzed.

5.1 Descriptive Statistics

The descriptive statistics of the data set for this paper are presented in Table 3. Thus, this section provides an overview of the minimum- and maximum values, mean and median values as well as the standard deviations. The data set appears to be well behaved as all standard deviations are rather small and there is a very small discrepancy between the mean and median values. The reported standard deviations are within a third of its mean value and hence there is no reason to believe that the data set may exhibit any skewness problems. Thus, the data set is believed to be homoskedastic.

Table 3 – Descriptive Statistics

Variable	Obs.	Mean	Median	Std. Dev.	Min	Max
Wage	2030	-1.380	-1.390	0.131	-1.710	-0.600
Productivity	2030	-1.430	-1.430	0.123	-1.770	-0.890
GRP	2030	-1.382	-1.430	0.344	-2.410	0.170
AccLocal	2030	9.546	9.370	0.957	7.390	13.510
AccIntra	2030	9.471	10.300	3.437	0	13.630
AccExtra	2030	8.994	9.220	1.185	0.030	10.920
Local-A	2030	2.004	2.135	0.931	-0.220	4.540
Intra-A	2030	2.203	2.470	1.121	-0.760	4.330
Education	2030	0.170	0.150	0.059	0.090	0.470

Note: Variables in log form: Wage, Productivity, GRP, Local, Intra, Extra, Local-A and Intra-A.

The number of observations available for this study may be regarded as satisfactory in order to carry out regression analysis. Due to availability and restrictions in data the analysis for this paper is carried out for seven years between 2005 and 2011, which are the latest available years for which a suitable data set could be constructed.

5.2 Correlation Analysis

This section is devoted to a correlation analysis of the dependent and independent variables used for the regression analysis of this paper. Table A1, in the Appendix, includes an alternative measure of market size access of each municipality in Sweden. However, for the regression analysis of this paper, the market size access has been excluded for the benefit of labor access as the variables are highly correlated (0.973, 0.997, and 0.996). Thus, their explanatory power is arguably the same.

Table 4 presents a summary of the correlations between the selected variables. As for the measure of local growth, *Wage*, *Productivity* and *GRP*, the correlation analysis shows that the *Productivity* and *Wage* measures have a high correlation (0.714) at a 1 percent significance level which may indicate that the two measures, to a great extent, measure the same thing. The *Productivity* measure also has a high correlation with the *GRP* measure (0.645) at a 1 percent significance level. However, *Wage* is found to have a low correlation with *GRP* (0.243), indicating that the two measures are able to measure different aspects of local economic development. Hence, the three measures provide a quite solid fundamental to the evaluation of local economic development.

The measure of local growth is presented as the variables *AccLocal*, *AccIntra* and *AccExtra* and measures the local, intra-regional and extra-regional access to employment from municipality *i*, respectively. *Wage* is found to be correlated with local access to employment, *AccLocal*, at a 1 percent significance level and indicating that *AccLocal* is positively correlated to *Wages.* Similarly, *AccIntra* is found to be significantly positively correlated with *Wage* (0.396 at 1 percent significance level). However, for the correlation between *AccExtra* and *Wage* the null hypothesis of zero correlation is not rejected.

Productivity is correlated with *AccLocal* (0.538), *AccIntra* (0.192), and *AccExtra* (0.13) at a 1 percent significance level, although the relationships are not very strong they indicate positive correlation. Whereas *AccLocal* (0.422) displays a positive correlation with *GRP*, *AccIntra* (-0.120) is found to be negatively correlated with *GRP*, both at a 1 percent significance level. Finally, *AccExtra*-regional access (-0.022) displays a negative insignificant correlation with *GRP* as the null hypothesis of zero correlation cannot be not rejected.

Table 4 – Correlation Analysis

	Wage	*Productivity*	*GRP*	*AccLocal*	*AccIntra*	*AccExtra*	*Local-A*	*Intra-A*	*Education*
Wage	1.000								
Productivity	0.714	1.000							
GRP	0.244	0.645	1.000						
AccLocal	0.460	0.538	0.422	1.000					
AccIntra	0.396	0.192	-0.121	0.312	1.000				
AccExtra	0.007	0.128	-0.022	0.063	0.284	1.000			
Local-A	-0.138	-0.042	0.150	0.209	-0.342	-0.113	1.000		
Intra-A	0.435	0.270	-0.080	0.343	0.838	0.256	-0.300	1.000	
Education	0.728	0.480	0.252	0.687	0.388	-0.158	-0.008	0.430	1.000

Note: All variables are log transformed except Education.

Table 5 provides a matrix of the correlations between *Local*, *Intra*-regional, and *Extra*-regional access to jobs and market (*MA*), indicating that *MA* may be used as an alternative measure to *Local*, *Intra* and *Extra* due to the very high correlation between the two measures.

Table 5 – Correlation Analysis Access Measures

	Local MA	*Intra MA*	*Extra MA*
AccLocal	0.973	0.244	0.041
AccIntra	0.319	0.997	0.262
AccExtra	0.066	0.275	0.996

Note: All variables are in log form.

5.3 Empirical Results

The empirical analysis begins with the examination of hypothesis *H1* and *H2*. *H1* states that *Productivity* is expected increase with market access. The second hypothesis, *H2*, is that *Wage* is expected to increase with market access. These hypotheses are assessed by estimating the equations for *Wages* and *Productivity* are using the OLS procedure. Both regressions obtain high R^2-values indicating that the fit of the regressions are very high for both *Wage* (0.789) and *Productivity* (0.775). This implies that the specified models are able to explain just short of 80 percent of the variation in *Wage* and *Productivity*.

Under panel data OLS estimation of Equations (8) and (9), the results obtained for *AccIntra* and *AccExtra* provide support for hypothesis *H1* and *H2*. The results are significant at all conventional significance levels indicating that, all else equal, an increase in the intra- and extra-regional job access improves both *Wage* and *Productivity* in the individual municipality. Similarly, statistical significance is found for *AccLocal*, however indicating a negative relationship to both *Wage* and *Productivity*.

H3 stated that *Wage* and *Productivity* is expected to increase as *Education* is augmented. The estimates for *Education* show a positive relationship between the municipality-embodied human capital and the level of *Wage* and *Productivity* of the municipality. Education as a contributor to *Wage* and *Productivity* is statistically significant at a 1 percent significance level, thus the obtained estimates provide support for *H3*. It is expected that an increase in the share of educated people per municipality will, all else equal, positively contribute to an increase in the level of *Wage* and Productivity of the municipality.

The fourth and last hypothesis, *H4*, states that local *Wage* and *Productivity* is expected increase with amenity access. For the evaluation of amenity access I use two different measures, locally accessible amenities, *Local-A*, in Equation (8) and intra-regional amenities, *Intra-A*, in Equation (9). The two different measures are in their respective regressions found to be statistically significant at all conventional levels with an indicated positive relationship to its dependent variables giving an indication that local access to amenities, all else equal, improves upon local *Wage*. Similarly, the results indicate that for the *Productivity* of a municipality, the level of intra-regional accessible amenities is, all else equal, important.

Using a SUR framework to estimate a simultaneous equation system to account for jointly determined wages now show, on average, lower R^2 than under single equation OLS estimation. As seen in Table 2, the matrix of correlated residuals, the correlation coefficient for *Wage* and *Productivity* amounts to 0.67 (67 percent). The reported R^2's under the SUR approach have been altered to 0.56 for *Wage* and 0.34 for *Productivity* both models indicating a relatively over all good fit. However, the explanatory performance of *Wage* is slightly higher.

Table 6 – Regression Outputs for Main Regression Models. Dependent Variables are Wage and Productivity. Estimated Using Fixed Effects and Seemingly Unrelated Regressions.

	FE		*SUR*		*SUR-Boot*[2]	
Variable	*Wage* *(Eq.8)*	*Productivity* *(Eq.9)*	*Wage* *(Eq.8)*	*Productivity* *(Eq.9)*	*Wage* *(Eq.8)*	*Productivity* *(Eq.9)*
C	-3.729*** (0.377)	-3.345*** (0.389)	-1.668*** (0.025)	-2.085*** (0.029)	-1.668*** (0.023)	-2.085*** (0.025)
AccLocal	-0.382*** (0.039)	-0.291*** (0.040)	-0.017*** (0.003)	0.044*** (0.003)	-0.017*** (0.004)	0.044*** (0.003)
AccIntra	0.217*** (0.045)	0.112** (0.047)	0.004*** (0.001)	-0.005*** (0.001)	0.004*** (0.001)	-0.005*** (0.001)
AccExtra	0.311*** (0.055)	0.269*** (0.060)	0.013*** (0.002)	0.018*** (0.002)	0.013*** (0.002)	0.018*** (0.002)
Education	5.956*** (0.114)	5.426*** (0.129)	1.775*** (0.050)	0.619*** (0.059)	1.776*** (0.096)	0.620*** (0.059)
Local-A	0.065*** (0.005)		0.000 (0.002)		0.001 (0.002)	
Intra-A		0.138*** (0.009)		0.009*** (0.003)		0.009*** (0.003)
R^2	0.7893	0.7752	0.5593	0.3437	0.5589	0.3436
Obs.	2030	2030	2030	2030	2030	2030

Note: Both dependent and independent variables are in log form except *Education (level).*
*** Denotes significance at a 1 % significance level. ** Denotes significance at a 5 % significance level.

Changing to a SUR framework[3], the results of *AccLocal* are consistent with the Jacobs hypothesis, *H1*. By changing the empirical method the sign of *AccLocal* changes from negative to positive and *AccIntra* from positive to negative, in Equation (9). The reported results are significant at a 1 percent significance level showing that as the local municipal access to jobs increases, this leads to, all else equal, a *Productivity* increase in the municipality. A large local supply of jobs implies that there is a vast supply of diversified firms producing both intermediaries and final goods, increasing the opportunities for the individual firm to benefit from a diversified set of input service suppliers. This, in turn, allows for the realization of economies of scale.

In addition to the notable changes in the estimated parameter signs, in Equation (9), for *AccLocal* and *AccIntra* under SUR, rather than the OLS, the estimate on the relationship between *AccLocal* and *Wage* in Equation (8) remain significant under simultaneous SUR estimation, at all conventional levels. Its negative relationship to the municipal level of wages indicates that an increase in local access to jobs, all else equal, decreases the level of municipal *Wage.* Thus, *AccLocal* is not consistent with *H2.*

[2] SUR-Boot refers to bootstrapped standard errors.
[3] The correlation results of the estimated residuals amounts to 0.67 (67 percent) which indicates that the estimated residuals are highly correlated at a 1 percent significance level. This result is presented in Table 2.

A negative local access to jobs may be explained by the local market as principally a workplace for in-commuting efforts. Hence, local *Wages* for residents are expected to decrease as the local market grows. This relationship further emphasizes the importance of out-commuting for residents in order to raise their paycheck. The results thus support the notion that intra-regionally accessible jobs improve local *Wage* levels. Hence, this allows for the interpretation that intra-regional commuting has a greater impact on *Wage* than the locally accessible job market. As a large share of the Swedish labor force is commuting to work every day the results on residential wages will naturally be showing, accordingly, that commuting from your residential location will, all else equal, improve your expected wage. The results of *AccIntra* and *AccExtra* are consistent with *H2*.

In addition to the change of sign for local job access under SUR estimation for *Productivity*, the *AccIntra* variable change as well. The SUR estimation hence produces major changes to the results of the estimation process. Going from an OLS estimation procedure to a simultaneous SUR estimation, the *AccIntra* changes sign from positive to negative in Equation (9). The result is significant at a 1 percent significance level and hence there is support for the idea of competition for labor between municipalities. An increase in the size of the intra-regional market for jobs, all else equal, decreases the local *Productivity*. The results show, compared to the OLS estimation, that the SUR estimation produces a more robust result for the intra-regional access to jobs as the significance changes from a 5 percent level to a 1 percent level.

Estimating Equation (8) in a simultaneous SUR setting further emphasizes the relationship between *AccIntra* and local *Wage* levels. As the intra-regional access to jobs increases, the local wage levels are expected to increase, all else equal. Hence, a larger and thus more diversified intra-regional labor market improves the potential of getting a qualified job which in turn helps improve the residential *Wage* levels in the municipality.

Education is for the purpose of this study included as a control variable for municipally embodied human capital. Its reported estimates are significant in relation to *Wage* but also for *Productivity*. Both regressions, under SUR, estimate a positive relationship with their dependent variables. These results are consistent with *H3*. Consequently, an increase in the municipally embodied human capital leads, all else equal, to an increase in both local *Wages* and *Productivity*. The magnitude of the estimates suggests that household wages would benefit more from an increase in human capital than the actual production of goods and services.

The fact that wages benefit more from an increase in education may be understood by the simple fact that higher education leads, on average, to higher wages no matter where you live or what you do. *Productivity* is in contrast to individual wages beneficiaries of a more diversified labor force. Hence, for the production of diversified varieties the full spectra of labor is needed. Whereas higher education is needed for the ingenuity and development, lower skills is put in the hands-on production of these ideas.

The reported result for the access to locally present amenities also changes as the estimation procedure changes. *Local-A* changes from highly significant under OLS to insignificant under SUR. Hence, it is possible to conclude that locally present amenities have no empirical support as a contributor to local *Wage* levels. Hence, the results of *Local-A* are not consistent with *H4*. However, the results of the SUR maintain the results that *Intra-A* have a significant impact on local *Productivity*.

As noted by the results in Table 6, simultaneous equation estimation using SUR specification improves the empirical results substantially. Under estimation of models with identical explanatory variables, SUR estimation is, as noted by Zellner (1962), identical to regular OLS

estimation. However, the results of the correlated residuals find a high correlation that with a SUR procedure gives significant efficiency gains. From reading Table 6, the efficiency gain from SUR estimations become rather evident. While the results of the OLS procedure produce negative slope coefficients for local access to jobs for both wages and productivity, the SUR estimation accounts for their joint determination. As a result, local access to jobs changes sign to positive with the indication that a larger local job market positively influences productivity. Thus, using a SUR procedure significantly improves small sample results when estimating individuals' *Wage* and *Productivity*.

Using a bootstrap procedure, I obtain the asymptotically appropriate standard errors for the estimated coefficients. Results are presented in Table 6 under *SUR-Boot* for both wages and productivity. The results of the bootstrap gives an indication that the previously obtained results are stable as the asymptotically obtained standard errors are more accurate. Estimated coefficients are kept constant while the potential bias in the estimators is reduced as shown by the slightly smaller standard errors.

5.4 Assessment of Empirical Results

The assessment of the empirical results starts with the first hypothesis that stated that productivity is expected to be positively associated with access to jobs. Results of the estimations show that local access to jobs support the first hypothesis. This result of local jobs access is in line with Krugman's (1991) model suggesting that certain parameters such as transport costs will cause economic activities to concentrate spatially. Hence, this supports the idea that it is desirable for firms to be located in a location with high employment to serve large local consumer markets without any drastic increases in fixed costs. Studies by Venables (1996) and Koo (2005) further support this notion.

Ultimately, the empirical results for the local market provide support for the Jacobs hypothesis. The Jacobs hypothesis relates to the urbanization externalities arising as economic activities concentrates in space. These externalities are assumed to take place among firms of different industries (Jacobs, 1969). Urbanization externalities are assumed to arise through a greater diversity of consumer goods and producer inputs (Jacobs, 1984). This hypothesis is further emphasized by Quigley (1998) who argues that the concentration of economic activities in space gives firms access to an increasing level of varieties of differentiated inputs. Quigley (1998) argues further that these differentiated inputs are vital in order to achieve firm productivity growth. This firm productivity is assumed to spill over locally, lead to further differentiation of inputs and varieties, and in turn yield external economies of scale.

Similarly, the results support the notion that a large internal market potential, of a municipality, gives an absolute advantage over others in exploiting diversified specialization, as studied by Johansson et al. (2001). Their results are further enhanced by the fact that the competitive advantage of a local economy is further enhanced with both a large internal and external market potential. As a result, the municipality may potentially serve as a host to a wide selection of sectors. The products of such municipalities will in turn be exported to external markets. This notion is shared by more recent studies such as Combes et al. (2008).

However, the results show intra-regional job access to be negatively associated with the productivity of the municipalities. Keeble et al. (1998) and Keeble et al. (1982) find that an improvement can change the accessibility of a municipality that in turn will improve its mar-

ket potential. In contrast, the results of this paper support the complete opposite as intra-regional job access turn out negative. Thus, an improvement of a municipality's intra-regional access is expected to decrease its productivity. This supports the idea of a competition effect between municipalities within close proximity compete for labor supply. Hence, a sizeable increase in jobs in one municipality will affect neighboring municipalities negatively. Additionally, this emphasize the importance of carefully balancing the composition of population density and infrastructure as it ultimately defines the accessibility of a location (Karlsson et al., 2005). In comparison to the effect of extra-regional access to jobs, intra-regional competition is expected to have less of an impact on the local economy. Hence, the extra-regional market access may more than compensate for the competition effect from neighbor municipalities.

To put the empirical results into perspective, it is possible to construct an example using three municipalities of different size. The municipalities of concern are Gothenburg, Borås and Mark where Gothenburg is the largest and Mark the smallest. From the perspective of Borås municipality, intra-regionally accessible Mark possibly exhibits a competition effect implying that as Mark grows, Borås will potentially decrease somewhat in size as some of the differentiated input services suppliers are attracted to locate in Mark instead. Borås is, on the other hand, potentially positively influenced by extra-regional access to a municipality such as Gothenburg. Thus, as Gothenburg grows there is an increased possibility that the qualified labor supply of Gothenburg spills over to Borås.

Additionally, physical geography may potentially serve as a protecting barrier for geographically inaccessible municipalities. An increase in their intra-regional access will, thus, increase the competition effect from other municipalities. Hence, improved transport infrastructure access is not always a desired development (Krugman, 1991; Combes et al., 2008). Considering the access to jobs from Kiruna, intra-regional access is almost non-existent. Hence, improving the accessibility from neighboring municipalities potentially has an adverse effect on these municipalities.

The second hypothesis of this paper states that wages are expected to increase with market access. Empirical results of this paper are significantly consistent with *H2* for intra- and extra-regional access to jobs using both an OLS and SUR framework. This gives an indication that there is robustness in the results. However, for local access to jobs, the results are found to have a negative relationship with the level of local wage. This runs along the lines of studies by Breinlich (2006), and Head et al. (2006) who argued that the proximity to large markets plays a key role in setting a core-periphery structure in per capita incomes in the EU economy. Breinlich (2006) also notes that as the distance to the large markets increases the peripheral local wages are affected negatively. Thus, the result of this paper suggest that for regions where intra- and extra-regional commuting is possible, a decrease in their transport infrastructure may potentially decrease the local wages substantially as the cost of commuting both in terms of time and money increases. A more cemented core-periphery structure, thus have a detrimental effect on peripheral local economic opportunities. The results are in line with studies by De Bruyne (2003), Mion (2004), and Brakman et al., (2004) suggesting that in general the intra-regional and extra-regional access to a larger market improves residential wages.

Empirical analysis of Equation (8) also provides support for the home market effect where smaller municipalities are expected to export to the larger municipalities (Krugman, 1980). Hence, as shown by the positive sign for intra-regional access when estimating Equation (8), smaller regions will on average, export their working population to larger and more attractive

municipalities. The larger municipalities are therefore expected to attract a relatively larger amount of both firms and labor that further emphasizes the support a core-periphery structure where the larger municipalities will move into a process of cumulative causation (Myrdal, 1957) where inflows of firms are by itself further increased. Additionally, the results indicates that for municipalities such as Mark, job access to Borås may potentially improve on labor market matching and local wages for residents in Mark as a result of a well functioning labor market. In contrast, though, the access to jobs through the extra-regional market may potentially generate further improvement on labor market matching and local wages. Thus, a municipality such as Mark may potentially benefit more from extra-regionally connections to Gothenburg than from its intra-regional proximity to Borås.

The third hypothesis examined in this paper states that wages and productivity is expected to increase as education is augmented in the individual municipality. This hypothesis is found to be strongly supported across the empirical results indicating that the higher the embodied human capital in the municipal population, the higher is the expected wage and productivity of the municipality. In line with the third hypothesis, the endogenous growth model assumes that the growth of an economy is the result of endogenous factors rather than having growth being determined exogenously. As such, research, education and innovation are considered vital contributors to economic growth. By using a *learning-by-doing* factor labor is assumed to think about ways of improving the production while producing. This is assumed to enhance the economic growth of an economy as knowledge accumulation is expected to cause improvements in productivity without deliberately improving the production process (Romer, 1990).

Previous studies within the field of knowledge find migration to be dependent on the level of individual-embodied human capital (Bartel, 1979; Faggian et al., 2006). The embodied human capital is, all else equal, expected to affect the willingness of individuals to migrate or commute. To this topic, Faggian et al. (2009) find that growing municipalities would experience migration inflows that add to the local aggregation of human capital. As a result the local stock of human capital would grow. For contracting municipalities, the opposite is expected. In municipalities where the willingness to migrate with respect to human capital is low so are the internal flows of human capital. Local growth will, in these cases, almost exclusively be dominated by internally generated human capital.

Accordingly, previous studies may provide an explanation to why the coefficient estimates for education come out differently for wages and productivity. The results of the estimation of Equation (8) suggest that the residents of the municipality would increase their wage level if they were to commute intra-regionally. For individuals to take this step, their embodied human capital level must be high. Thus, the relatively large education coefficient in Equation (8) suggests that if residents were to increase their embodied human capital their willingness to commute would increase and thus there are augmented potential for increased wages.

The contrary is observed for Equation (9) where the education coefficient is relatively small. This indicates that the embodied human capital in municipalities with high productivity is already high. Hence, an increase in the embodied human capital will, on average, not have the same impact on productivity. The education coefficient may also give an indication of the importance of education within the entire labor force. Thus, the results show that an increase in the share of education will not influence productivity more than a third of its impact on wages. Using Mark and Gothenburg as reference, Mark may to a greater extent benefit from an education increase, as its internal market is relatively smaller. Gothenburg, which already

holds a relatively large amount of production, is expected to have a high level of human capital and therefore an increase in education have a relatively smaller impact.

The fourth and last hypothesis states that wages and productivity are expected to increase with amenity access. The results show that local amenity access as an impact on wage is insignificant when controlling for jointly determined wages. In contrast, intra-regional access to amenities as a contributor to productivity is significant. Considering the high education coefficient in Equation (8) this suggests that these municipalities as a residential location were chosen based on other factors than its quality of life features (Graves, 1979, 1980, 1983; Gottlieb, 1994; Dissart et al., 2000). Less educated people are expected to be less prone to migrate (Bartel, 1979; Faggian et al., 2006) and hence their residential location is endogenously determined based on their educational level and perhaps place of upbringing. On the other hand, as highly educated individuals have a higher willingness to migrate (Bartel, 1979; Faggian et al., 2006) their residential location may potentially be based on its quality of life features to optimize the life in residential locations. Such features may be natural amenities but also the access to jobs. Thus, in municipalities where the productivity is high, the level of in-commuters will be high as shown by the intra-regional access to amenities as this reflects their willingness to commute and choice to locate according to quality of life features. Similarly, Deller et al. (2001) provide insights to natural amenities as a contributing source of population, employment and per capita wage growth.

The use of different estimation procedures in the empirical part of this paper proves to be a fruitful exercise as the implications of the results under OLS are a bit confusing. Using the regular balanced panel data OLS approach there is no support for *H1* of this paper and thus the results are not consistent with the Jacobs hypothesis. Applying a SUR framework, I find *Wages* and *Productivity* to be jointly determined and it turns out that properly accounting for their joint determination changes the results favorably. The joint determination between wages and productivity explains the previous results obtained using the regular OLS. This result is important as single equation OLS cannot properly account for the joint determination of *Wages* and *Productivity*. Consequently, running econometric analysis on night and daytime wages requires a careful choice of methodology.

Table 7 provides a summary of the empirical results of this paper. The table presents the expected and observed relationships between the dependent and independent variables using fixed effects and SUR estimation.

Table 7 – Assessment of Empirical Results. Dependent Variables: Wage and Prod.

	Expected		FE		SUR	
Variable	*Wage*	*Prod*	*Wage*	*Prod*	*Wage*	*Prod*
AccLocal (H1)	+	+	–	–	–	+
AccIntra (H2)	+	+	+	+	+	–
Education (H3)	+	+	+	+	+	+
Local-A (H4)	+		+		+*	
Intra-A (H4)		+		+		+

*Note: * Denotes overall insignificance.*

6 Robustness Diagnostics

It is of interest to examine whether the obtained results are specific to the sample chosen and if they are robust to changes in specification of the model. Hence, as an additional exercise, the outlined hypotheses of this paper are further examined through alternations in the specification of the models. The obtained results are presented in Table 8.

The purpose of this section is to explore the explanatory power of accessibility on *Productivity* further. I specify three robustness models. The first model explores the extent to which access to market size impacts the *Productivity* in the local economy. It is put to test using both an OLS and SUR estimation procedure. The second and third models are specified using an altered measure of productivity. For this purpose I use per capita (GRP) for the individual municipality, denoted just *GRP*. GRP is the local equivalency to the Gross Domestic Product (GDP). GRP measures the value added from production by local production units and therefore incorporates the operating surplus generated in the region. Table 4 established market access as a complementary measure to access to jobs. Thus, *GRP* is run using both market size and job access. Equations (11) – (13) represent the considered models, respectively.

$$Productivity_{it} = \beta_0 + \beta_1 lnAcc1MA_{it} - \beta_2 lnAcc2MA_{it} + \beta_3 lnAcc3MA_{it} + \beta_5 Amen_{it} + \beta_6 Education_{it} + \varepsilon_i \quad (11)$$

$$GRP_{it} = \beta_0 + \beta_1 lnAccLocal_{it} - \beta_2 lnAccIntra_{it} + \beta_3 lnAccExtra_{it} + \beta_5 Amen_{it} + \beta_6 Education_{it} + \varepsilon_i \quad (12)$$

$$GRP_{it} = \beta_0 + \beta_1 lnAcc1MA_{it} - \beta_2 lnAcc2MA_{it} + \beta_3 lnAcc3MA_{it} + \beta_5 Amen_{it} + \beta_6 Education_{it} + \varepsilon_i \quad (13)$$

where, *Acc1MA*, *Acc2MA*, and *Acc3MA*, are respectively the local, intra-regional and extra-regional access to market size. Applying the outlined Empirical Method, in Section 5.3, the robustness diagnostics account for the issue of joint determination between *Wages* and *Productivity*. The results presented in Table 8 are based on Equations (8) and (9) just as in the previous section. In Table A1, I report the matrix of the correlation between the SUR residuals. The results show that the correlation between the residuals amounts to 0.669 and as such they may be considered to be highly correlated. Hence, I resort to SUR estimation. Using the altered model for *Productivity* using market size access as explanatory variables, SUR estimation improves some on the regular OLS. Under SUR estimation, *Local* in Equation 8 is found to be insignificant at all conventional levels, which indicate that it has no impact on *Wage* levels in the municipality. Other than that, market size access is able to prove prior results in this paper robust by providing compelling support for the hypotheses of this paper. Per capita day time wages, hence, serve as a perfectly well functioning proxy for GRP using both access to jobs and market size.

Altering the specified dependent variable for models using both access to jobs and market size the obtained results provide further robust results to the reasoning in Section 5.5. Thus, this section provides additional support for the hypotheses of this paper and further deepens the credibility of the results.

As an additional exercise, I obtain asymptotically normal standard errors using a bootstrapping technique for *Productivity.* The results do not change but the accuracy and stability is improved using this procedure. Table A2 in the Appendix show the obtained results.

Table 8 – Robustness Diagnostics

	OLS		SUR		OLS	
Variable	Wages (Eq. 4)	Productivity (Eq. 11)	Wages (Eq.4)	Productivity (Eq. 11)	GRP (Eq.12)	GRP (Eq.13)
C	-3.729***	-4.184***	-1.767***	-2.093***	-17.102***	-9.409***
	(0.377)	(0.126)	(0.024)	(0.021)	(0.864)	(0.084)
Acc1MA		0.031***		0.061***		0.950***
		(0.011)		(0.003)		(0.007)
Acc2MA		-0.015		-0.006***		-0.064***
		(0.015)		(0.001)		(0.010)
Acc3MA		0.203***		0.016***		0.092***
		(0.018)		(0.002)		(0.012)
Local	-0.382***		-0.002		0.873***	
	(0.039)		(0.003)		(0.090)	
Intra	0.217***		0.003***		-0.102***	
	(0.045)		(0.001)		(0.104)	
Extra	0.311***		0.011***		0.844***	
	(0.055)		(0.002)		(0.125)	
Local-A	0.065***		0.001			
	(0.005)		(0.002)			
Intra-A		0.130***		0.012***	0.084***	0.018***
		(0.009)		(0.003)	(0.021)	(0.006)
Education	5.956***	4.365***	1.613***	0.341***	3.425***	-0.539***
	(0.114)	(0.142)	(0.050)	(0.053)	(0.286)	(0.095)
Obs.	2030	2030	2030	2030	2030	2030
R^2	0.789	0.793	0.553	0.433	0.385	0.949

Note: All variables are in log form except Education.
*** Denotes significance at a 1 %, ** 5 %, and * 10 % significance level.

7 Conclusion

The purpose of this paper has been to examine the impact of job accessibility on wages and productivity using Swedish municipality level data on night and daytime wages. Market accessibility may, in many aspects, prove fruitful for firms in realizing economies of scale. For households and individuals the market accessibility may improve the potentials for getting a qualified job as well as increase the opportunities of consumption diversity. Wages and productivity are determined using night and daytime wages, allowing the empirical analysis to capture location choices of both firms and residents in a municipality. The data set used covers 290 Swedish municipalities over a period of seven years, 2005 – 2011.

The strength of this paper lies in the deconstruction of GRP into night and daytime wages allowing for a separation of household and firm location choices. By adopting balanced panel data and SUR analysis, I use local, intra- and extra-regional access to jobs to explain the variation in wages and productivity. The majority of previous studies adopt cross-sectional analysis at one, or a few, points in time. The strength of using a panel data framework lies within the ability to survey the data over time, taking into account structural changes that may occur. This provides a more nuanced picture. Additionally, SUR estimations allow the empirical analysis to take account of any joint determination in simultaneous equation systems.

The results of the SUR analysis demonstrate that the separation of wages is necessary in order to understand firm and residential location choices with respect to accessibility. Further, access based analysis with separated wages requires a framework which takes into account their joint determination in order to be fully credible.

The empirical results of this paper find that access to jobs is a significant factor shaping the level of local wages and productivity. On this note, this paper finds compelling support for the Jacobs hypothesis when surveying Swedish municipalities. A large local market where economic activities concentrate in space is expected to benefit from Jacobs type of urbanization externalities that allow for a greater diversity of consumer goods and producer inputs. Consequently, concentration in space is expected to give firms greater access to varieties of differentiated inputs to production that may turn into a process of cumulative causation attracting additional firms and differentiated inputs (Jacobs, 1984; Quigley, 1998).

Further, this paper find, along with previous studies, support for a core-periphery structure in the spatial distribution of wages (Breinlich, 2006; Head et al., 2006). In addition, local wages are expected to increase with intra- and extra-regional access to jobs. This notion relates to the home market effect where relatively small municipalities are expected to export their production to the relatively larger municipalities. This is expected to further deepen the concentrating processes due to cumulative causation as hypothesized by Myrdal (1957).

To further investigate this topic, future research should explore individual sector's responses to local, intra- and extra-regional access to jobs as different sectors experience differences in their labor requirements. Additionally, this study could be decomposed to study smaller local entities such as smaller cities or towns. The present study assumes that all jobs accessible to individual workers are jobs that are available regardless of prior qualifications. Thus, future research should incorporate this potential mismatch in their analysis.

.

List of References

Books, Journals and Reports

Andersson, M. & Gråsjö, U., 2009. Spatial Dependence and the Representation of Space in Empirical Models. *Annals of Regional Science,* 43:159-180.

Anselin, L., 2003. Spatial Externalities, Spatial Multipliers and Spatial Econometrics. *Internationall regional Science Review,* 26:153-166.

Aschauer, D. A., 2000. Do states optimize? Public capital and economic growth. *The Annals of Regional Science,* 34(3):343-363.

Baltagi, B., 2008. *Econometric Analysis of Panel Data.* 4th ed red. Great Britain: Wiley.

Bartel, A., 1979. What Role Does Job Mobility Pay?. *American Economic Review,* 69:775-86.

Baumol, W., 1990. Entrepreneurship: Productive, Unproductive and Destructive. *Journal of Political Economy*, 98(1):893-921.

Billinger, N. G., Jäderholm, B., & Andersson, H., 2011. Medfinansiering av transport-infrastruktur; Ett nytt system för den långsiktiga planeringen av transportinfra-struktur samt riktlinjer och processer för medfinansiering, *SOU 2011:49,* Stockholm.

Brakman, S., Garretsen, H., & Schramm, M., 2004. The Spatial Distribution of Wages and Employment: Estimating the Helpman-Hanson model for Germany. *Jour-nal of Regional Science,* 44:437-466.

Breinlich, H., 2006. The spatial income structure in the European Union – What role for economic geography? *Journal of Economic Geography*, 6:593-617.

Capello, R., 2007. *Regional Economics.* Cornwall, Great Britain: Routledge.

Capello, R., 2011. Location, Regional Growth and Local Development Theories. *Aestimum,* 58:1-25.

Chamberlin, E., 1933. *The Theory of Monopolistic Competition.* Harvard University Press.

Combes, P., Mayer, T., & Thisse, J., 2008. *Economic Geography*. Princeton University Press.

Crozet, M., 2004. Do migrants follow market potential? An estimation of a New Eco-nomic Geography Model. *Journal of Economic Geography,* 4:439-58.

De Bruyne, K., 2003. The Location of Economic Activity: Is a there spatial employment structure in Belgium? *Mimeo*, KU Leuven.

Deller, S. C., Tsung-Hsiu, S. T., Marcouiller, D. W. & English, D. B., 2001. The Role of Amenities and Quality of Life in Rural Economic Growth. *American Journal of Agricultural Economics ,* 83(2):352-265.

Devarajan, S., Swaroop, V. & Zhou, H., 1996. The Composition of Public Expenditure and Economic Growth. *Journal of Monetary Economics,* 37:313-44.

Dissart, J.-C. & Deller, S. C., 2000. Quality of Life in the Planning Literature. *Journal of Planning Literature,* 15(1):135-161.

Dixit, A., & Stiglitz, J., 1977. Monopolistic Competition and Optimum Product Diversity. *American Economic Review,* 67:297-308.

Duffy-Deno, K., 1997. Economic Effects of Endangered Species Preservation in the Nonmetropolitan West. *Growth and Change,* 28:263-288.

English, D. B., Marcouiller, D. W. & Cordell, K. H., 2000. Tourism Dependence in Rural America: Estimates and Effects. *Society and Natural Resources,* 13:185-202.

Esfahani, H. & Ramirez, M., 2002. Institutions, Infrastructure and Economic Growth. *Journal of Development Economics,* 70:443-77.

Europeiska kommissionen, 2011. Vitbok; Färdplan för ett gemensamt europeiskt transportområde; ett konkurrenskraftigt och resurseffektivt transportsystem, KOM(2011) 144 slutlig, Bryssel.

Faggian, A. & McCann, P., 2006. Human Capital Flows and Regional Knowldege assets: a simultaneuous equation approach. *Oxford Economic Papers,* 52:475-500.

Faggian, A. & McCann, P., 2009. Human Capital and Regional Development. i: R. Capello & P. Nijkamp, red. *Handbook of Regional Growth and Development Theories.* Cornwall, United Kingdom: Edward Elgar Publishing Limited, 133-151.

Fallah, B. N., Partridge, M. D., & Olfert, M. R., 2011. New Economic Geography and US Metropolitan Wage Inequality. *Journal of Economic Geography*, 11:865-895.

Freudenburg, W. R., 1992. Addictive Economies: Extractive Industries and Vulnerable Localities in a Changing World Economy. *Rural Sociology,* 57(3):305-332.

Fujita, M., Krugman, P., & Venables, A., 1999. *The Spatial Economy: Cities, Regions, and International Trade.* Cambridge, United States: MIT Press.

Fujita, M., & Thisse, J.-F., 2002. *Economies of Agglomeration – Cities, Industrial Location and Regional Growth*. Cambridge, United Kingdom: Cambridge University Press.

Glaeser, E. L., Kallal, H. D., Scheinkman J. A., & Shleifer A., 1992. Growth in Cities. *Journal of Political Economy,* 100(6):1126-1152.

Gottlieb, P. D., 1994. Amenities as an Economic Development Tool: Is There Enough Evidence?. *Economic Development Quarterly,* 8(3):270-285.

Graves, P. E., 1979. A Life-cycle Empirical Analysis of Migration and Climate, by Race. *Journal of Urban Economics,* 6:135-147.

Graves, P. E., 1980. Migration and Climate. *Journal of Regional Science,* 20:227-237.

Graves, P. E., 1983. Migration with a Composite Amenity: The Role of Rents. *Journal of Regional Science,* 23:541-546.

Greene, W. H., 2012. Econometric Analysis. 7th edition. United States: Pearson Education Limited.

Gujarati, D. N., & Porter, C. D., 2009. Basic Econometrics. 5th edition. Singapore: McGraw-Hill.

Hanson, G., 1996. Localization economies, vertical organization, and trade. *American Economic Review*, 86:1266–1278.

Hanson, G., 1997. Increasing returns, trade, and the regional structure of wages. *Economic Journal,* 107:113–133.

Hays, S. P., 1998. *Explorations in Environmental History: Essays.* Pittsburgh, PA: University of Pittsburgh Press.

Head, K., & Mayer, T., 2006. Regional Wage and Employment responses to Market Potential in the EU. *Regional Science and Urban Economics*, 36:573-94.

Helpman, E., 1998. The Size of Regions, in Pines, D., Sadka, E., & Zilcha, I., (eds.). *Topics in Public Economics*. Cambridge, U.K.: Cambridge University Press, 33–54.

Jacobs, J., 1969. *The economy of cities*. Random House, New York.

Jacobs, J., 1984. *Cities and the Wealth of Nations – Principles of Economic Life.* Penguin, Hammondsworth.

Johansson, B., & Karlsson, C., 2001. Geographic Transaction Costs and Specialization Opportunities of Small and Medium-Sized Regions: Scale Economies and Market Extension. In: Johansson, B., Karlsson, C., and Stough, R.R., 2001. *Theories of Endogenous Regional Growth: Lessons for Regional Policies.* Heidelberg: Springer-Verlag Berlin.

Johansson, B., Klaesson, J. & Olsson, M., 2002. Time Distances and Labor Market Integration. *Papers in Regional Science,* 81:305-327.

Johansson, B., & Klaesson, J., 2007. Infrastructure, Labour Market Accessibility and Economic Development. In: Karlsson, C., Anderson W. P., Johansson, B., & Kobayashi, K., (eds) The Management and Measurement of Infrastructure – Performance, Efficiency and Innovation. Edward Elgar Publishing Limited, Cheltenham. United Kingdom.

Karlsson, C. & Gråsjö, U., 2013. Accessibility: a useful analytical and empirical tool in spatial economics – experiences from Sweden. *CESIS: Electronic Working Paper Series* , 314.

Karlsson, C., Johansson, B., & Stough, R.R., 2001. Introduction: Endogenous Regional Growth and Policy. In: Johansson, B., Karlsson, C., Stough, R. R., (eds) Theo-

ries of Endogenous Regional Growth. Springer Heidelberg Berlin New York. 3-13.

Karlsson, C. & Pettersson, L., 2005. Regional Productivity and Accessibility to Knowledge and Dense Markets. *CESIS: Working Paper,* 32.

Keeble, D., Offord, J. & Walker, S., 1988. *Peripheral Regions in a Community of Twelve Member States,* Luxembourg: Office for Official Publications, European Commision.

Keeble, D., Owens, P. & Thompson, C., 1982. Regional Acessibility and Economic Potential in the European Community. *Regional Studies,* 16:419-432.

Keith, J. & Fawson, C., 1995. Economic Development in Rural Utah: Is Wilderness Recreation the Answer. *Annals of Regional Science,* 29(3):303-313.

Kennedy, P., 2003. *A Guide to Econometrics.* 5th ed red. UK: Blackwell Publishing.

Klaesson, J., & Johansson, B., 2014. Distance Decay for Supply and Demand Potentials. *CESIS Royal Institute of Technology and CEnSE Jönköping International Business School Working Paper,* Sweden.

Koo, J., 2005. Agglomeration and Spillovers in a simultanenous framework. *The Annals of Regional Science ,* 39:35-47.

Krugman, P., 1980. Scale Economies, product differentiation, and the pattern of trade. *The American Economic Review,* 70: 950-59.

Krugman, P., 1991. Increasing Returns and Economic Geography. *Journal of Political Economy,* 99:483-499.

Kwang-Koo, K., Marcouiller, D. W. & Deller, S. C., 2005. Natural Amenities and Rural Development: Understanding Spatial and Distributional Attributes. *Growth and Change,* 36(2):273-297.

Lancaster, K., 1979. *Variety, Equity and Efficiency*. Columbia University Press

Marcouiller, D. W. & Deller, S. C., 1996. Natural Resource Stocks and Regional Economic Change: Seeing the Forest and the Trees. *Journal of Regional Analysis & Policy,* 26(2):95-116.

Marshall, A., 1920. *Principles of Economics.* 8th ed red. London: MacMillan.

McGranahan, D., 1999. Natural Amenities Drives Rural Population Change. *Agricultural Economic Report Number ,* 781.

Minerva, A. G. & Ottaviano, G. I., 2009. Endogenous Grwoth Theories: agglomeration benefits and transportation cost. i: R. Capello & P. Nijkamp, red. *Handbook of Regional Growth and Development Theories.* Cornwall, Great Britain: Edward Elgar Publishing, Inc., 86-97.

Mion, G., 2004. Spatial Externalities and Empirical Analysis: the case of Italy. *Journal of Urban Economics,* 56:97-118.

Murphy, K. M., Shleifer, A. & Vishny, R. W., 1991. The Allocation of Talent: Implications for Growth. *Quarterly Journal of Economics* , 106:503-530.

Myrdal, G., 1957. *Economic Theory and Under-developed Regions.* London: Duckworth.

Paci, R. & Usai, S., 1999. Externalities, knowledge spillovers and the spatial distribution of innovation. *GeoJournal*, 49:381–390.

Pons, J., Paluzie, E., Silvestre, J., & Tirado, D., 2007. Testing the New Economic Geography: Migrations and Industrial Agglomeration in Spain. *Journal of Regional Science*, 47:289-313.

Power, T. M., 1996. *Lost Landscapes and Failed Economies.* Washington, DC: Island Press.

Quigley, J. M., 1998. Urban Diversity and Economic Growth. *Journal of Economic Perspectives,* 12(2):127–138.

Redding, S., & Venables, A., 2004. Economic Geography and International Inequality. *Journal of International Economics*, 62:53– 82.

Reinfeldt, F., & Olofsson, M., 2009. Mål för framtidens resor och transporter, *Proposition 2008/09:93,* Stockholm.

Roback, J., 1982. Wages, Rents, and the Quality of Life. *Journal of Political Economy,* 90(6)1257-1278.

Roback, J., 1988. Wages, Rents, and Amenities: Differences Among Workers and Regions. *Economic Inquiry,* 26(1): 23-41.

Romer, P., 1990. Capital, Labor and Productivity. *Brookings Papers: Microeconomics*. University of Chicago and Center for Advanced Study in the Behavioral Sciences.

Romer, P., 2012. *Advanced Macroeconomics.* 4th ed red. New York: McGraw-Hill.

Rudzitis, G. & Johansen, H. E., 1991. How Important is Wilderness? Results from a United States Survey. *Environmental Management,* 15(2):227-233.

Samuelson, P., 1952. Spatial Price Equilibrium and Linear Programming. *American Economic Review*, 42:283-303.

Scitovsky, T., 1954. Two Concepts of External Economies. *The Journal of Political Economy,* 62(2):143-51.

Shefer, D. & Frenkel, A., 1998. Local milieu and innovations: some empirical results. *Annals of Regional Science,* 32:185–200.

Sjaastad, L., 1962. The Costs and Returns of human migration. *Journal of Political Economy,* 70(5):80-93.

Spence, M., 1976. Product Selection, Fixed Costs and Monopolistic Competition. *Review of Economic Studies,* 43:217-235.

Sugolev, P., Dodonov, B. & von Hirschhausen, C., 2003. Infrastructure Policies and Economic Development in East European Transition Economies: first evidence. *DIW Berlin,* WP-PSM(02).

Torége, J., Sandgren, P., Olander, C. & Thulin, C., 2008. *Pendlare Utan gränser? En Studie om Pendling och Regionförstoring,* Stockholm: Swedish Association of Local Authorities and Regions; Arena for Growth.

Venables, A., 1996. Equilibrium Locations of Vertically Linked Industries. *International Economic Review,* 37: 341-59.

Waltert, F., & Schläpfer, F., 2010. Landscape amenities and local development: A review of migration, regional economic and hedonic pricing studies. *Ecological Economics,* 70(2):141-152.

Weibull, J. W., 1980. On the Numerical Measurement of Accessibility. *Environment and Planning,* 12:53-67.

Zellner, A., 1962. An Efficient Method of Estimating Seemingly Unrelated Regression Equations and Tests of Aggregation Bias. *Journal of the American Statistical Association* 57:348-368.

Database

Statistics Sweden, 2005 – 2011.
http://scb.se/sv_/Hitta-statistik/

Appendix

Table A 1 – Correlation Matrix of residuals

	Wages	Productivity
Wages	1.0000	
Productivity	0.6695	1.0000

Note: Income and productivity are in log form.

Table A 2 – Robust SUR-Boot Output

	SUR-Boot	
Variable	Wages	Productivity
C	-1.763*** (0.025)	-2.087*** (0.021)
LocalMA		0.062*** (0.003)
IntraMA		-0.009*** (0.001)
ExtraMA		0.015*** (0.002)
Local	-0.000 (0.004)	0.023*** (0.003)
Intra	-0.000 (0.001)	0.305*** (0.054)
Extra	0.010*** (0.002)	
Intra-A	0.014*** (0.003)	
Edu	1.554*** (0.105)	
Obs.	2030	2030
R^2	0.5546	0.4321

Note: All variables are in log form.
*** Denotes significance at a 1 %, ** 5 %, and * 10 % significance level.