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How Gender Commuting Patterns have Evolved Over Time: A Case for Sweden

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Abstract

Study of commuting helps policy makers in shaping transport development policies, analyse economic performance of large local labour markets and regional growth. One of the main arguments is that on average women commute shorter distances than men. This paper examines whether these differences have converged or diverged over time in Sweden, since the Swedish policies promote regional growth and gender equality. Convergence indicates increased travel time by women. Negative binomial model is used for the years 2000, 2007 and 2014. The results show no convergence between male and female commuting flow over time and females are more sensitive to the travel time than males and thus tend to commute shorter distances than men. Thus, despite of great emphasis on gender equality in Sweden, the gender differences in commuting pattern still occur but these differences are not very large. Furthermore, higher education effect is positive and significant for both genders but this ratio is higher for females.

Keywords: Commuting, Gender, Male Commuting, Female Commuting, spatial structure, Convergence, Negative Binomial Model, Sweden

1 Introduction

Today we live in a global world where due to improved infrastructure and fast modes of transport have made it less stressful and easier for individuals to travel long distances in a less time. Commuting has been increasing in western societies to a large extent as it is an essential part of life of many workers (Hofmeister & Schneider, 2010). It is considered as an alternative to the migration when individuals try to manage work and family related responsibilities within their time-space constraint (Lück & Ruppenthal, 2010). From a regional perspective, spatially extended labor market and increased commuting distance are considered important determinants of growth. These determinants can increase accessibility to jobs on a wider geographical area, increase incomes, increase competition between regions, and provide easy access to large work force for firms (Sola & Vilhelmson, 2012). To attain these opportunities, individuals do not have to leave their family neighborhood and ties (Sandow, 2011). In case of increased daily commuting distances, individuals prefer to commute on weekly basis, but this is not as common as daily commuting (Swedish Government Official Report, 2005). In Sweden approximately one percent of the workforce commutes to work on weekly basis, while 32 percent on daily basis (Statistics Sweden, 2011).

In order to define a commuter, this paper uses the official definition used in Sweden, as someone who crosses an administrative border to get to work (Nivalainen, 2010; Statistics Sweden, 2010). Thus, commuting in this paper is an act of travelling from home municipality to another municipality for work on a daily basis. Swedish regional development policy considers commuting as a source of creating large local labour markets and stimulating regional growth, but there still remains a main argument of large differences in gender commuting pattern. A large number of studies indicates that on average women commute shorter distances than men (Olsson, 2002; MacDonald, 1999). Studies of regional growth indicate that men benefit more in terms of income level which results in men commuting longer distances than women (Amcoff, 2009). Moreover, other factors to which these differences are attributed include household roles including dual

role of women, occupation, location choice and spatial distribution of jobs (Sandow & Westin, 2010; Crane, 2007; MacDonald, 1999; Hanson & Hanson, 1980).

The Research report on Women's Transport Issue (2006) showed that the developed nations have witnessed a convergence in men's and women's commuting behavior because of changes in household roles, increased participation of women in paid labor force and increased income. These changes have made women's commuting pattern more similar to men's in many ways. Several international studies observed changes in the commuting time between male and female which indicates decreased in commuting differences between genders (Crane 2007; Vandersmissen et al. 2003; Gossen & Purvis, 2005; Theriault et al. 2006). The term convergence is related to the increase in commuting time of women, while the term divergence is related to the increased commuting time for men (Sola & Vilhelmson, 2012).

The purpose of current paper is to investigate whether the differences between male and female commuting patterns have converged or diverged over time, since one of the main objectives of Swedish policies is to promote regional growth and gender equality. This convergence and divergence is measured by the travel time between municipalities. The motivation behind choosing this topic is the ongoing debate between governments whether investing in a high speed rail infrastructure in the Jonkoping County is economically and socially justified. Several studies showed that female commuting patterns are becoming less sensitive to the travel time but no research has examined this question across the whole Sweden over an extended period of time. Thus, the current paper based its analysis for the periods 2000, 2007 and 2014.

Thus, the study of commuting is of great importance for policy makers in different ways, as it helps in understanding how to make commuting easier for individuals and how it affects regional development. In addition to positive effects, it also highlights the consequences of increased commuting in terms of environment, social aspects and health issues (Fults, 2010). Substantial research on gender commuting pattern also helps us to understand how commuters manage their social life, highlights positive and negative effects of commuting and existing inequality issues in commuting patterns (Sandow, 2011).

1.1 Commuting Pattern in Sweden

In Sweden commuting pattern is continuously increasing over time. Since 1990 commuting between municipalities has doubled. The graphical analysis in Figure 1 shows that the percentage of employed male and female commuting during 2000 to 2014 has increased from 30 to 35 percent for males and 25 to 31 percent for females. The percentage increase in men commuting behavior from 2000 to 2007 has been approximately 6.2 percent for men and 10.7 percent for women and from 2007 to 2014 this increase is about 9.3 percent and 12.8 percent. Thus the overall increase in male and female commuting pattern from 2000 to 2014 is about 16.1 percent and 24.9 percent.

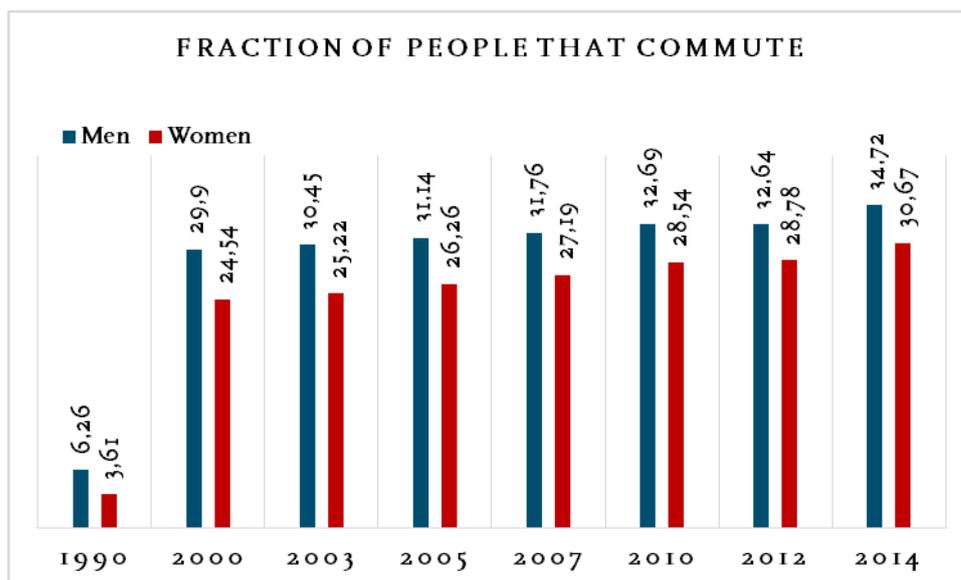


Figure 1 Fraction of Employed Male and Female that Commute

Moreover, the graphical analysis indicates that men commute more than women but these differences are not very large. Statistics indicate that the employment rate of women in Sweden is becoming nearly same to men which is approximately 76.5 percent for male and 73.1 percent for female in 2014 whereas it was 73.65 for male and 70.5 percent for female in 2004 (LFS, 2014). The growth and acceptance of female has ranked Sweden at

the fourth position in the world with regard to gender equality (World Economic Forum, 2014, Statistic Sweden, 2014). Increased gender equality has the impact of decreasing the commuting differences between men and women due to increased women participation in the labor force (Fransson & Vilhelmsson 2011; Hjorthol 2008).

The expected results are the distance friction for women would be higher than men, indicating that women are more sensitive to increased travel time, and this sensitivity is expected to be decreasing over time. The outline of the following sections is as follows; section two presents the theories and literature review while section three highlights hypothesis used in this paper. Methodology and data are presented in section four and finally the section five evaluates the empirical findings and concludes the results.

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2 Theories and Literature Review

This chapter provides some basic information on the available empirical literature on commuting and how time, distance, education and location choice describes commuting.

2.1 Commuting

Commuting is an important part of total urban traffic as it provides a framework for transport planning. Commuting pattern differs with the differences in geographical context and access to employment opportunities. People who live in sparsely populated area are more likely to commute shorter distances than those living in high populated areas (Sandow, 2008; Nivalainen, 2010). In case of Sweden daily commuting is high around metropolitan areas due to a large variety and specialized job opportunities (Swedish Institute for Transport and Communications Analysis, 2007). Increased long distance commuting indicates that for individual's proximity is no more important while making certain destination choices for commuting (Naess, 2006). So the regions having more incentives and wide range of alternatives can be seen as a main source of increased commuting.

Commuting plays a vital role in improving the economic performance of local labour markets by improving the job matching process and formation of more competitive and geographically expanded labour markets which in turn can provide more job opportunities than smaller regions (Government Bill, 2001/02:4). Access to fast and frequent transport system is one of the main determinants of increased long distance commuting with a relatively constant travel time (Government Bill, 2005/06:160; Van Ommeren & Rietveld, 2005; Ham et. al., 2001; Sandow and Westin, 2010) and thus individuals have a wide range of opportunities in accessing jobs. *“Labor market accessibility can stimulate regional growth in a process where jobs and households are attracted to the region. Such growth implies that firms can better exploit internal and external scale economies” (Johansson and Kleasson, 2007; p: 73).*

2.2 Commuting and the Monocentric Model

Commuting cost is a substantial part of monocentric models where all jobs are concentrated in a single place. The main assumption of monocentric models is that the employment location is exogenous. Von Thunen (1826) analyzed how farmers locate themselves and showed a trade-off between land rents and transport costs and how individuals minimize their transport costs by trying to locate near to the city as possible. According to the model, objective of each farmer is to minimize transport costs but for that they will pay high rents equal to the incomes earned. This will have the effect of increasing the land rents close to the main city. Alonso (1964) used the same concept by considering commuting as a main tool and replacing farmers by commuters and the market place by central business district (CBD). He analyzed commuters preferred to live near CBD and maximize utility by staying close to the economic activity center due to transport costs. Thus forcing a bid- rent approach where individuals living near to the centre pay more. Similar to Von Thunen approach the rents are higher near cities and lower as the distance increase.

Hamilton (1982) laid criticism on the predictability of monocentric models by using decentralized employment¹. Monocentric model predicts that individual maximizes his utility by location and decreased commuting distance. But his findings showed different results. He argued that the individual maximizes his utility by trading off between price of houses and decentralized jobs. When individuals make the decision of where to live in such conditions they maximize their utility by paying high rent to live close to job areas by decreasing commuting cost.

2.3 Gender Differences in Commuting

Since 1970s large social structure changes, increased women participation in the labour market and increased female commuting motivated researchers to study the differences

¹ Decentralized employment means jobs are far away from the central business district (CBD) and assuming all jobs and houses are equally desirable

in the commuting pattern of men and women. Studies from United States and Europe showed that the differences in gender commuting behaviour are similar to Sweden (Hanson & Johnston, 1985; Hjorthol, 2000). Women on average face greater time-space constraint than men and they commute shorter distances than men (Blumen and Kellerman; 1990; Hanson & Johnston, 1985; Sandow & Westin, 2010; Sandow, 2008; Hjorthol 2000, 2008). The factors that are responsible for these differences includes lower incomes, mode of transport (Hanson & Johnston, 1985), occupation status, location choice (Blumen, 1994; Blumen & Kellerman; 1990; Cresswell & Uteng, 2008), socio-economic factors (Johnston-Anumonwo, 1992; White, 1986), geographical structure and infrastructure availability (Sandow, 2008; Sandow & Westin, 2010). These factors are seen as hurdles for women access to the labor market. For example, women use public transport more as compared to men, women work more in female dominated sectors as the jobs in these sectors are distributed evenly in a region and wages in these sectors are constant while male dominated sectors are clustered in a specific area and can increase their wages by commuting long distances. Also, proximity to home area is important for women as it allows them to continue their dual role of mother and wage earner easily. Females in two-worker household commute less than single-worker household. Females play a dual role as a wage earner and perform large share household activities than men do which reduces the willingness to commute longer distances. The literature showed commonly marital status, presence and age of children are used to measure the household responsibilities. White (1986) found that the presence of young children increased women's commuting time while (Hjorthol, 2000) found that women manage their commuting time and working hours according to the household responsibilities which make them work closer to home than their spouse.

2.3.1 Convergence in Male and Female Commuting Pattern

Crane (2007) used American housing survey to measure convergence in the commuting pattern of male and female for the United States from 1985 to 2005. The analysis showed that women's commuting distances have been converging and they commute longer distances with cars. Same phenomenon has been observed in case of San Francisco and Quebec, when controlled for type of households, presence of children and number of cars in the household (Gossen & Purvis, 2005; Theriault et al., 2006).

In case of Sweden (Fluts, 2010) studied commuting patterns by comparing two large surveys in Stockholm region for the period 1986-87 and 2004. The changes in the commuting pattern of gender and different household groups were examined by controlling of the car ownership, location of residence and employment status. Results showed that women have been commuting longer distances and their commuting pattern is becoming similar to men's. Frändberg and Vilhelmson (2011) used Swedish national travel surveys for the period 1978 to 2006. They observed convergence in the distance travelled by male and female and mentioned that in recent decades daily commuting and spatial dispersion have increased in Sweden over time. They analyzed how these variations have been growing over time and noticed that on average commuting distances to work have increased by 54.6 percent and cars are used as a mean of commuting to work. Since 1978 to 2006, young women by 11 percent and middle aged women by 21 percent have increased their daily mobility while men have somewhat reduced to 6 and 16 percent. Sola and Vilhelmson (2012) investigated changes in the gender commuting time and distances in Sweden. They used Swedish National Survey for the regions Malmö and Göteborg for the periods 1994 to 1995 and 2005 to 2006. The results showed convergence in case of Malmö and divergence in the Göteborg region which showed that gender related changes largely depend on region-specific factors.

2.4 Travel Time and Commuting Behaviour

Time constraint plays an important role in making decisions for long distance commuting. From a time-geographic perspective it is essential to know how individuals manage their daily life to commute longer distances (Lindqvist Scholten & Sandra, 2010). Distance, time and speed in commuting are described as barometer of gender equality (Hjorthol R., 2008). Increase in travel time decreases the willingness of individuals to commute longer distances. The Higher the time sensitivity the lower the commuting flow and this sensitivity differs among male and female (Johansson et al., 2002). Studies showed that the overall commuting pattern decreases when travel time exceeds 45 minutes and in the

sparsely populated areas car is the main mode of commuting. (Sandow, 2008; Sandow & Westin, 2010).

Travel times are measured as the travel time by car, as they have large share of all trips. Figure 2 illustrates how time sensitivity differs at different travel times and how willingness to commute decreases with increased travel time. Willingness to commute is plotted by first calculating the attractiveness factor 'b_{ks}'. The attractiveness measure which showed that the commuters flow depends on the size of the destination municipality.

$$b_{ks} = m_{ks}/A_s$$

Where, 'A_s' denote the number of jobs in municipalities, m_{ks} denote the flow of commuters from municipality 'k' to 's'. After calculating the attractiveness measure of destination municipality it is plotted with the corresponding time distance. The S-shaped curve in the beginning is flat due to short time distances, followed by a rapid fall when time increases more than 20 minutes and then becomes flat again after the time increases more than 45 minutes approximately.

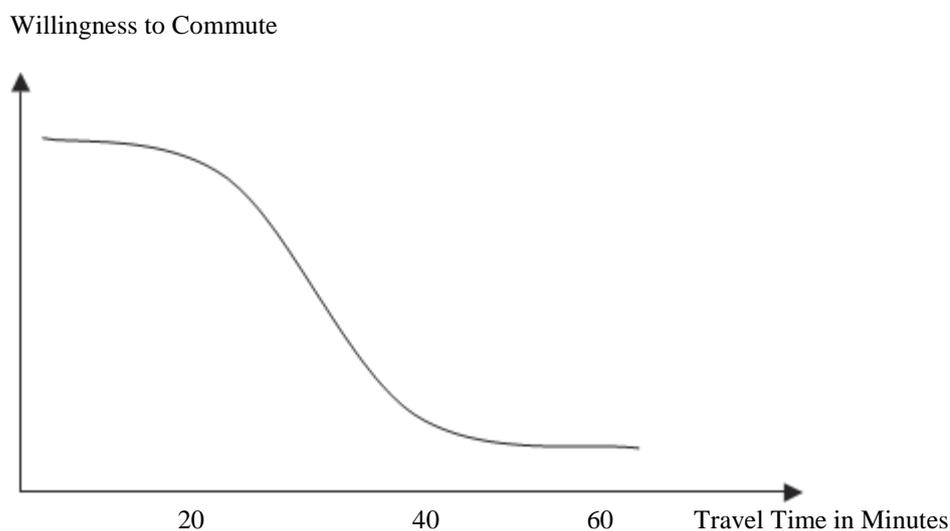


Figure 2 Relation between Travel Time and Willingness to Commute; Source: (Johansson et al., 2002)

After 45 minutes of travel time the willingness to commute is very low. Despite of improved infrastructure the maximum limit is around 60 minutes after that workers starts thinking of other possibilities like migration or weekly commuting (Olsson, 2002). This upper and lower limit makes worker to decide whether to commute or migrate.

2.5 Effect of Higher Education on Commuting Behaviour

It is a well-established fact that the education level of the commuters affects their commuting behaviour. Studies showed that the highly educated are more willing to commute longer distances than lower educated (Olsson, 2002). Economists consider education as an important determinant of human capital. Smith (1776) and other classical economists are of the view that the skills and abilities of an educated individual can be utilized in a different way to stimulate growth. In 1963 Schultz in his study described that the labor force with primary education can be used in basic production of goods and services while labor with secondary education would be able to use technology and the higher education attainment would make them capable of inventing technology. Harsman and Quigley (1993) argued that the individuals with higher education can select working hours more freely as compared to those with low level of education (Eliasson et al., 2003; Trendle & Siu, 2005) and there exists a difference in the commuting pattern of individuals with different levels of education. The higher the education level, lower is the effect of commuting time. Highly educated individuals are more likely to commute longer distances due to increased job matching possibilities, opportunities available on large geographical area and high wage levels (Sandow, 2011; White, 1986; Hanson & Hanson, 1980; Olsson, 2002). Thus commuting cost can be compensated by the higher wages. Thus, human capital can be seen as the foundation of growth for individuals with high level of skills and knowledge. Therefore, the impact of differences in education level is considered important in analyzing commuting pattern.

2.6 Agglomeration and Growth

Economies of scale, higher job matching efficiency and spillover effects are considered main determinant of agglomeration (Glaeser, 1994). Economic activities usually agglomerate in certain cities because different regions and cities specialize in different activities. Setting up new firms in these regions, increases more job opportunities for workers and make them commute in search of better job opportunities, higher wages, as they can find a range of firms which demand those skills and services. This in turn attracts more firms to these regions, as they expect to find a variety of workers with specific skills they require, while workers search jobs in places where they can find a range of firms which demand those skills and services (Marshall, 1890). Cities with large range of public services give incentives to people to move towards them and thus become ideal place for individuals to interact and exchange ideas and knowledge with others (Fisher, 1982). Henderson (1974) also described size of city can determine the commuting cost and housing rents. Large cities indicate that the cost of commuting and housing prices will be higher. Cities with different sizes can fulfill the demand of different industries, as they specialize in the production of goods and services where they can have higher economies of scale which in turn boosts the demand of specialized labor supply with specific skills in these cities.

Thus the purpose of this chapter was to describe different relevant theories and literature which will help in making the conclusions of the empirical results. They provide information on how an individual make decisions regarding commuting with respect to different circumstances, how they react to the time distance friction when making decisions to move towards their destination location. Thus, the increased accessibility to geographically spread large area have made male and female less constrained to the proximity.

Table 1 Literature Review of Few Studies in Sweden

Author	Purpose	Study Area/ Time Period	Statistical Method/ Variables	Conclusion
Sola & Vilhelmson (2012)	Changes in gender based commuting gaps	Malmö & Göteborg 1994–1995, 2005–2006	Swedish National travel survey. Variables: Distance, time use, speed, and car use	<u>During 1994–1995:</u> Both regions showed similar gender gaps. <u>During 2005–2006:</u> Malmö showed convergence depended on women increased their daily travel time by 18 per cent. While Göteborg showed divergence which was due to men increased their travel time by 15 per cent.
Fluts 2010	Changes and influences of travel time in different groups	Stockholm. 1986-87 and 2004	Large-scale travel surveys. Groups: Gender, age and household composition Control variables: external factors, such as automobile ownership, residence location and employment status	Overall the results showed increase in travel distance but women increased distance more than men. Women’s travel pattern has become more or less similar to men
Frändberg & Vilhelmson, 2011	Changes in daily and long-distance mobility of various groups	Sweden 1978–2006	Swedish national travel surveys. daily and long-distance mobility, travel abroad	Women’s increased their daily and abroad travels more than men’s. It is mainly due to change in transportation mean. (25-34 and 45-44) aged women increased daily travel distance by 11 & 21 percent while men decreased by 6 & 16 percent. While 55-64 aged men and women increased theirs by 29.3 and 24.1.
Hjorthol (2000)	How married couples use time and deal spatial choices of work location and transport.	Oslo-region (capital of Norway) 1990-91	Employed married women with spouse, 18 years and older	Women work closer to their homes than their spouse and have fewer options on the geographical labour market. In case of married men neither children nor occupation status affect their work location choice.

Continued....

Continued....

Author	Purpose	Study Area/ Time Period	Statistical Method/ Variables	Conclusion
Sandow & Westin (2010a)	Investigate economic outcome of long distance commuters including both partners and their characteristics	Sweden 1995-2005	Multiple linear regression models; Multinomial logistic regression model. Variables: Long-distance commuters living with a partner in 2000 One-way travel distance (30 km or more). Individual characteristics: Gender, Children in household, Age, Education level, Income, employment sector, residential region, previous experience of mobility, partner	Positive correlation between higher income and long distance commuting. Long distance commuting is a long term plan rather than a short term solution for households. Male Commuters benefit more from long distance commuting.
Sandow (2008)	Analyse what factors influence individual's willingness to commute longer distances	Umeå, Örnsköldsvik and Lycksele (Northern Sweden) (1991, 1996, 2001, 2003)	Binary logistic regression models; GIS to estimate employment opportunities and residential density Variables: All gainfully employed persons Socio-economic & Demographic factors: age, education, income level, employment sector, family status, presence of children, gender Geographical characteristics: employment opportunities and residential density	Significant effect of socioeconomic and demographic factors on willingness to commute. Women commute shorter distance than men. Individuals prefer to commute close to residence and car is used for about 70 percent to commute
Frändberg & Vilhelmson, 2011	Changes in daily and long-distance mobility of various groups	Sweden 1978–2006	Swedish national travel surveys. daily and long-distance mobility, travel abroad	Women's increased their daily and abroad travels more than men's. It is mainly due to change in transportation mean. (25-34 and 45-44) aged women increased daily travel distance by 11 & 21 percent while men decreased by 6 & 16 percent. While 55-64 aged men and women increased theirs by 29.3 and 24.1.
Sandow & Westin (2010b)	Analyze individual's willingness to commute in terms of travel time	Umeå, Örnsköldsvik and Lycksele 2004	Survey, Descriptive statistics. Variable: Gainfully employed persons	Geographical structure, available infrastructure, and socio-economic factors (such as education, employment, and family situation) limit women's

and modal
choice

access to the local labor
market more than that of
men.
The willingness to
commute decreases as
commuting time exceeds
45 minutes. Car is the
main mode of transport in
sparsely populated areas.

3 Hypothesis

This paper intends to investigate the effect of travel time on men and women commuting pattern. It is done by analyzing the level of convergence or divergence in the time distance friction parameter of male and female which will indicate that how much the difference between male and female commuting pattern have converged or diverged over time in Sweden. Let $\lambda_{F2000}, \lambda_{F2007}, \lambda_{F2014}$ denote the time sensitivity or distance friction measure for female and $\lambda_{M2000}, \lambda_{M2007}, \lambda_{M2014}$ for male for the years 2000, 2007 and 2014. High time sensitivity specifies that additional time will reduce the commuting flow. According to above, the hypothesis can be established as

H₁: $\lambda_{F2000} > \lambda_{M2000}, \lambda_{F2007} > \lambda_{M2007}, \lambda_{F2014} > \lambda_{M2014}$. This indicates that the time sensitivity (distance friction) is hypothesized to be higher for female than male.

H₂: Differences between male and female λ 's is expected to decrease over time. In other words, λ 's is converging.

The above hypothesis can be interpreted as females are assumed to have a higher commitment to perform family related activities, and this makes female time budgets stricter and binding for them. Hence, female commuters should be expected to have higher time sensitivity than male commuters. On the other hand, due to increased gender equality and increased women participation rate in Sweden, the commuting differences between male and female are expected to decrease over time. In addition to time distance, the literature indicates that there are other elements that might affect the commuting decision of male and female. This paper has taken in to account the attractiveness measure for the destination municipality in terms of number of job opportunities (day population), employment level in the manufacturing and public sector, housing prices in the destination municipalities, as the location choice measure can affect the commuting decision. This leads different hypothesis as;

H₃: Female commuting is positively related to the jobs in public sector in the destination municipality

H₄: Male commuting is positively related to the jobs in the manufacturing sector in the destination municipality

H₅: Individuals with Higher education commute more. This implies for both male and female

It is assumed that the manufacturing sector considered as male dominating sector and public sector as the female dominating sector. Thus hypothesis H₁ and H₂ are of main interest in the present study. The next section presents the models which are used to test these hypotheses. The required results are presented in section (5.2).

Table 2 Testable Hypothesis

H1	$\lambda_{F2000} > \lambda_{M2000}, \lambda_{F2007} > \lambda_{M2007}, \lambda_{F2014} > \lambda_{M2014}$. Time sensitivity (distance friction) is higher for female than male
H2	Differences between male and female λ 's are expected to decrease over time. In other words, λ 's is converging
H3	Female commuting is positively related to the jobs in public sector in the destination municipality
H4	Male commuting is positively related to the jobs in manufacturing sector in the destination municipality
H5	Individuals with Higher education commute more

4 Data and Methodology

The research methodology is a logical sequence that connects the empirical data to the studies initial research question and ultimately to its conclusions. This study focuses on testing the convergence in the commuting pattern of males and females in Sweden over time. Convergence in the commuting pattern of male and female is examined by the time travelled in minutes from origin municipality to the destination. Time distance is measured as the travel time by car. The paper uses secondary data set from Statistic of Sweden for the years 2000, 2007 and 2014. The gravity model is used for this purpose. The following sections will describe the gravity model that is used in studying the commuting pattern of male and female.

4.1 The Gravity Model

Since 1940's gravity model has been used to model the spatial interaction behavior of people which illustrates analogy with Newton's Law of Gravitation. In social sciences the gravity concept follows the theoretical work of (Carey, 1858) indicated that the number of people travel is positively related to the pull² factors and inversely related to the distance. Carey explained this concept theoretically while this relation was formalized by (Young, 1924).

$$M = kF/D^2$$

Here 'M' indicates movement of population, 'F' is the attractiveness measure of another community, 'D' is the distance between two communities and 'k' is a constant. Next section presents the specification of the gravity model with respect to commuting that is used for analysis in this research work.

² Mean attractiveness or mass word used in theories

4.2 Commuting and the Gravity Model

This section describes the model used for analysis of this research work. Haynes and Fotheringham (1984) assumed that gravity model is composed of two main components i.e. size and distance. Size indicates that the destinations with larger population tend to attract more than smaller population, whereas, the distance indicates that more the individual is far from the activity, lesser is the interaction between them. According to the theory, commuting from municipality i to j , (C_{ij}), increases with the size of the origin municipality, (O_i), the size of destination municipality, (D_j), and decreases with the increased travel time between municipalities. The basic model is specified as;

$$C_{ij} = \alpha O_i^{\beta_1} D_j^{\beta_2} e^{-\lambda t_{ij} + \varepsilon_{ij}} \quad (1)$$

C_{ij} , is the flow of commuters from municipality 'i' to another municipality 'j', O_i , is the number of workers who live in municipality i , D_j , is the number of people who work in municipality j , and t_{ij} , is the commuting time travelled between two municipalities and ε_{ij} is a normally distributed random error term that has a zero mean and a constant variance. Commuting from i to j will decrease if the municipality j has excess labor supply in the proximity of municipality j . However, the commuting from municipality i to j will also decrease with the number of increased alternative job opportunities in the proximity of municipality 'i' (Olsson, 2002).

4.2.1 Model Specification for Male Commuting

To analyze the commuting pattern for male over time, the functional form with respect to linear transformation is specified as;

$$\ln m C_{ij}^t = \alpha + \beta_1 \ln O_i + \beta_2 \ln D_j - \lambda t_{ij} + \varepsilon_{ij} \quad (2)$$

where;

- ✓ $mC_{ij,t}$, is the flow of male commuters from municipality ‘i’ to another municipality ‘j’
- ✓ t represents the year used in the analysis 2000, 2007 and 2014.
- ✓ β_1, β_2 and λ are the statistical parameters
- ✓ ‘ λ ’ is the distance decay parameter or sensitivity parameter and is of great interest in this paper.

Commuting pattern depends on many parameters but size and time are the most important explanatory variables. The literature indicated that the commuting pattern is also influenced by the housing prices in the destination, jobs available in manufacturing and public sector, wages and higher education. Commuting pattern can also be explained by the distribution of jobs in different occupations, as men and women choose different occupations and people having higher education choose different occupations than the one with lower education level. The workers with higher education on average commute longer distances (White, 1986; Hwang & Fitzpatrick, 1992). The variables which are supposed to affect the male and female commuting patterns are included as a control variable in the model. After including control variables, the above equation is specified as;

$$\begin{aligned} \ln mC_{ij}^t = & \alpha + \beta_1 \ln O_i + \beta_2 \ln D_j - \lambda t_{ij} + \beta_3 \ln \text{HousePrice} \\ & + \beta_4 \text{Share_ManufactureSector} \\ & + \beta_5 \text{Share_HigherEducation} + \varepsilon_{ij} \end{aligned} \quad (2.1)$$

4.2.2 Model Specification for Female Commuting

To analyze the commuting pattern for female over time, the functional form with respect to linear transformation is specified as;

$$\ln wC_{ij}^t = \alpha + \beta_1 \ln O_i + \beta_2 \ln D_j - \lambda t_{ij} + \varepsilon_{ij} \quad (3)$$

where;

- ✓ wC_{ij}^t , is the flow of female commuters from municipality 'i' to another municipality 'j'

This equation will be used separately with respect to three years namely, 2000, 2007 and 2014. After including control variables is specified below

$$wC_{ij}^t = \alpha + \beta_1 \ln O_i + \beta_2 \ln D_j - \lambda t_{ij} + \beta_3 \ln HouseP + \beta_4 PublicSector + \beta_5 HigherEd + \varepsilon_{ij} \quad (3.1)$$

Here 't' indicates years. Female commute shorter distances as they prefer to work in female dominated occupations (Hanson & Johnston, 1985; Hanson & Pratt, 1995; Hjorthol, 2008). Due to this fact, the paper has controlled the effect of people working in the public sector on female commuting pattern. The Ordinary least square method will be used to estimate the above models.

4.3 Negative Binomial Regression Model

One of the main assumption of OLS regression is that the dependent variable is continuous, normally distributed and linearly related to the independent variables (McClendon, 1994). In case when the dependent variable is in the form of counts, linear regression models do not work equally well (Piza, 2012). Usually, when variables are transformed in their logarithm forms, their residuals follow a normal distribution. This is not the case for count variables whose transformation is not as easy and their errors usually follow a Poisson distribution. The starting point of count data is usually the Poisson model. However, since it does not measure heterogeneity and have the assumption that the mean and the variance of a variable are the same. Thus, the model which relaxes the assumption of the variance being equal to the mean and is usually superior to the Poisson estimator, is the negative binomial regression. This model deals with over dispersion by allowing the dependent variable have a specific distribution. It arises from a formulation of cross-section heterogeneity and is based on an underlying probability distribution function (Greene, 2008; Gujarati, 2009). The negative binomial

model is derived from a Poisson-gamma mixture distribution and is estimated by using the maximum likelihood and the marginal effects (Hilbe, 2011).

The dependent variables used in this paper did not showed a normal distribution but rather one skewed to the left even after transforming into logarithmic forms. This indicates that OLS is not appropriate for this data set. Secondly the descriptive statistics, presented in Table 5 , highlights that the dependent variables do not have a mean equal to the variance. Hence, the Poisson regression is inappropriate and thus this paper chooses negative binomial regression model for empirical analysis.

4.4 Description of Data and Variables

The purpose of this section is to describe the data and variables that are used in the model. Data has been collected for 289 municipalities instead of 290 municipalities from statistics of Sweden. In 2000, Knivsta was the part of Uppsala while since 2007 and 2014 it has been considered as a separate municipality. Therefore, Knivsta and Uppsala municipalities are merged in 2007 and 2014. Table 3 shows the definitions and units of measurements for variables used in this paper and Table 5 provides the descriptive statistics for these variables.

Table 5 in Appendix (1) describes the descriptive statistics for the dataset used for the empirical analysis. The unit of observation is municipalities which are considered 289 in Sweden. Three time periods are used and the numbers of observations are 250,563. This reduced number of observations show statistics for commuters only. On average number of male commuters is more than females which are 0.22 and 0.19 and averagely individuals working in origin municipality are more than destination municipality.

Table 6 in Appendix (1) contains outputs of Pearson correlation test which shows strength and direction of the association between two variables. The results show that the size of origin and higher education show high positive correlation. The coefficients of share of

people working in manufacturing and public sector are also highly correlated but this correlation is negative.

4.4.1 Commuting, Size of Origin, Destination and Travel Time

The variables male and female commuting flow, mC_{ij} , wC_{ij} , are the two dependent variables of the model. The commuting data is gathered for the men and women commuting from home municipality to the work. The size of origin and destination are considered as independent variables in the model. For each year the data contains the information for the number of workers who live in origin municipality (O_i) and the proxy used for it is the gainfully employed night-time workers³. The data also contains information on the number of people who work in destination municipality (D_j) and the proxy used to estimate this variable is the gainfully employed daytime workers⁴.

Travel time is an important independent variable in the model, as with the help the pattern of travel time between labor supply and job opportunities, one can describe the region or municipality. If the time sensitivity of one municipality is lower than the other municipality, it indicates that the first municipality has stronger labor market integration. Furthermore, the level of commuting is affected by the distance friction. Distance is supposed to have a negative sign and significant due to the fact the longer is the distance, the lower is the probability that an individual will commute.

4.4.2 Control Variables

According to literature the variables which are supposed to affect the commuting behavior of male and female over time are included in the model. These include share of people having higher education, share of people working in manufacturing sector, share of people working in public sector, housing prices.

³ The concept of nighttime population refers to the employed workers who live in a given municipality and are usually present during the evening and nighttime hours (SCB, 2015).

⁴ The concept of daytime population is used to indicate the number of workers who are present in the municipality during normal working hours (SCB, 2015).

Higher Education

This variable is formulated as the share of people having three or more years of university education. It is defined as

$$\begin{aligned} & \textit{ShareHigherE} && (4) \\ & = \frac{\textit{people with three years or more of university education}}{\textit{Total of all education levels}} \end{aligned}$$

Statistics indicate that in Sweden women are more highly educated as compared to men whereas the secondary education attainment of men and women has leveled over the last 10 years. Over the past ten years the percentage increases in female having higher education is about 91.27percent while percentage increases in male having higher education level is about 58.6percent. Overall in Sweden the percentage of women having higher education is higher than men (Statistics Sweden, 2015).

Occupation Sectors

In Sweden there exist a gender bias in the distribution of men and women in occupation sectors and choice of education. Labor market is segregated horizontally in terms of public and private sector work and vertically in terms of male and female employment positions within the workplace (Berger, 2013). The degree of occupational gender segregation in Sweden is higher than other European Union nations. The most common men dominated sectors are technology and manufacturing in which percentage of men and women during 2013 were about 69 and 31 percent (Statistics Sweden, 2014)

This paper has used manufacturing and public sector to see the effect of occupational gender bias on commuting pattern. It is supposed that the share of people working in the public sector in the destination municipality will affect the female commuting pattern while share of people working in manufacturing sector will affect the male commuting pattern. These two variables are defined as;

$$ShareManuf = \frac{People\ working\ Manuf\ sector}{Total\ of\ people\ working\ in\ all\ sectors} \quad (5)$$

where as;

$$SharePublic = \frac{People\ working\ in\ Public\ sector}{Total\ of\ people\ working\ in\ all\ sectors} \quad (6)$$

According to literature wage is also one of important variable that effects the level of commuting but it was highly correlated with main independent level, .i.e., the level of people employed in the destination municipality. Due to this problem the wage variable is dropped from the regression model as it is supposed to be containing much of the same information. Next section presents the empirical analysis of the described models.

Table 3 Definition And Unit of Measurement

Variables	Definition and Unit of Measurement
mC _{ij} & wC _{ij} (Male and Female Commuting)	Flow of commuters from the home municipality to the municipality they work in, i and j. mC _{ij} indicates male commuting from i to j & wC _{ij} refers to the women's commuting from i to j. These are dependent variables in the model.
Size of Origin(O _i)	It indicates the size of origin municipality (i). The proxy used for it is the number of employed night population in municipality I. In other words, the number of workers who live and work in that municipality.
Size Destination (D _j)	It indicates the size of destination municipality (j). The proxy used number of employed day time population in the municipality j.
Travel Time (t _{ij}) (Commuting Time)	Time travelled by car between municipality i and j
α, β ₁ , β ₂ and λ's	Parameters to be estimated.

Control Variables

Share_Higher Education	Share of people having 3yrs or more university education in the origin municipality
Share_Manufacture sector	Share of people working in the manufacturing sector in the destination municipality
Share_Public Sector	Share of people working in the public sector in the destination municipality,
HousePrice	Prices of dwellings in destination municipality

5 Results and Discussion

A negative binomial regression method is used for estimation. The empirical analysis separates male and female commuters and the estimations are done for the years 2000, 2007 and 2014, as mentioned in equation (2) and (3) respectively. The main hypothesis of the paper is to examine whether the time sensitivity (distance friction) is higher for females than male commuters and to examine whether the differences between male and female commuting pattern has converged or diverged over time. The estimated regression results have been presented in Table 4 .

From the findings, it can be noted that most of the variable coefficient have the signs that have been predicted by theoretical literature except for the manufacturing sector and housing prices. The findings indicate a negative relation between commuting time and commuters. In other words, the higher the commuting time between two municipalities, the lower the probability of individuals commuting to that municipality. The results reveals that the results are in line with the hypothesis H_1 , H_3 , H_5 but in case of H_2 , H_4 they are not.

The distance friction parameter for any particular year and gender is measured by the negative of the associated coefficient estimate for the commuting distance time. We can see then from Table 4 that $\lambda_{F2000} > \lambda_{M2000}$, $\lambda_{F2007} > \lambda_{M2007}$ and $\lambda_{F2014} > \lambda_{M2014}$ which are in line with the hypothesis H_1 . The distance frictions are higher for female than for males which indicate that females are sensitive to travel time more than males and thus tend to commute shorter distances than men, but these differences are not very large. By comparing distance friction for females over time, it shows that they have become less sensitive to the travel time in 2014 than 2000 but this change is very small. Similarly, in case of comparing male distance frictions over time, λ 's show that men have become even less sensitive to the travel time from 2000 to 2014 and has been constant for the last seven years. The results show no convergence between male and female commuting flow over time so the paper rejects hypothesis H_2 . The findings show converging pattern in 2000

but in 2007 and 2014 it shows a diverging pattern as male becoming less and less sensitive.

Table 4 Estimation Results Of Negative Binomial Method

Variables	Commuting2000		Commuting2007		Commuting2014	
	Male	Female	Male	Female	Male	Female
Origin Size	0.724*** (.023)	0.694*** (.022)	0.737*** (.020)	0.696*** (.021)	0.706*** (.019)	0.685*** (.020)
DestinationSize	1.067*** (.021)	1.031*** (.019)	0.966*** (.017)	0.993*** (.018)	0.944*** (.017)	0.968*** (.017)
Commuting Time	-0.0166*** (.00021)	-0.0169*** (.00021)	-0.0143*** (.00016)	-0.0161*** (.00018)	-0.0144*** (.00016)	-0.0165*** (.00018)
Share_HigherEd	3.570*** (.5003)	3.734*** (.469)	2.209*** (.379)	3.416*** (.386)	1.569*** (.327)	2.687*** (.333)
Share_Manufac	-2.176*** (.167)	-	-2.499*** (.160)	-	-2.123*** (.163)	-
Share_Public	-	0.863*** (.223)	-	0.831*** (.216)	-	0.137 (.212)
HouseP	-0.235*** (.045)	0.0288 (.039)	-0.268*** (.033)	-0.0253 (.030)	-0.231*** (.031)	-0.0632** (.029)
Constant	-14.40*** (.327)	-16.49*** (.294)	-13.20*** (.271)	-15.85*** (.258)	-13.01*** (.251)	-14.86*** (.240)
Observations	83,521	83,521	83,521	83,521	83,521	83,521
R square	0.2115	0.2286	0.2040	0.2284	0.2052	0.2328

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

The variable size of origin (O_i) has a positive relation with the male and female commuting outside the municipality which highlights the higher the number of workers living in one municipality, higher is the probability of number of workers moving outside that municipality. At the same the results show that this ratio is higher for male than female. In the same line the variable size of destination municipality (D_j) also have a positive relation with the male and female commuting outside the municipality refers to the fact that if there are more job opportunities in the destination municipality, it will attract more people to that municipality.

The findings indicate positive and significant relationship between share of people having higher education and commuting flow of male and female which shows that the higher is the level of education, the higher will be the commuting flow. The chances of people having a higher education will be commuting is higher for females than for males, all else equal. The analysis shows positive and significant relationship between people working in public sector and female commuting flow, but this relation is insignificant in 2014 which is about 86 % and 83% in 2000 and 2007. In case of manufacturing sector and housing prices the results indicate a negative but significant relation with male commuting flows. While in case of female commuting flow and housing price it shows insignificant and positive for 2000 while negative for 2007 and negative and significant for 2014 and therefore results assert that residential mobility does not explain the commuting pattern for both male and female, which are similar to findings of Van Ommeren (2004).

6 Conclusion

Today, commuting to work has become a part of individual's daily life, as this provides access to a large labor market and potentials for personal growth. The studies showed that in Swedish labor market possibilities for men to benefit from long distance commuting are more than that of women. The purpose of the paper is to investigate whether the differences between male and female commuting pattern has converged or diverged over time in Sweden. Empirical results show convergence in 2000 but indicate divergence in 2007 and 2014 and the results as well have confirmed that females are more sensitive to the travel time as compared to males. Hence men are becoming even less sensitive and thus tend to commute more whereas the sensitivity level for female has been higher and remained almost same over time with a slight decrease in 2007 and minor increase in 2014. Thus, male still commute longer than female and this difference is not converging over time. However, the analysis shows that despite of great emphasis on gender equality, the gender differences in commuting pattern still occur. Regardless of the fact that more women are highly educated than men in Sweden, they still commute shorter distances than men which could be due to the fact that they work more in public sector, whereas, the jobs in public sectors are evenly distributed among municipalities and for that women don't have to travel longer distances. Secondly, it could be due to the household factors as mentioned in literature. The findings as well indicated that the number of workers who live in a municipality and the number of available jobs in a destination municipality both have positive effect on commuting. The higher the number of workers lives in one municipality, the higher are the chances of workers commuting from that municipality. Similarly, more competition in one municipality will increase outflow from that specific municipality. The parameters of size of origin and destination indicate how valuable it is to expand the number of jobs in the municipalities. The spatial structure of jobs plays an important role in explaining the commuting pattern. In case of relation between higher education and commuting, this ratio is higher for women than men. It might be due to the fact that men work more in manual jobs where they do not require higher education which is according to the findings of (Mattisson et al. 2014). The results confirmed positive and

significant relationship between public sector and female commuting flow. Thus, more jobs in the public sector will have the effect of increasing female commuting flow while manufacturing sector shows negative and significant effect on male commuting pattern. The overall analysis indicates that more improved infrastructure could play an important role in decreasing these gender differences to a large extent as this will help women to travel long distances in short time interval. Thus, commuting research helps to understand the differences in commuting patterns for male and female in Sweden. It will be interesting to repeat this study by focusing on the highly educated men and women both with and without children and the type of job they travel for. This group would be interesting to study because the highly educated commute more. It would help to understand what factors make women commute longer and type of jobs for which they usually commute to other municipalities.

References

- Adam, S. (1776). *The Wealth of Nations*. New York: The Modern Library, 1937.
- Allan, P. (1977). The Choreography of Existence: Comments on Hägerstrand's Time-Geography and Its Usefulness. *Economic Geography*, 53(2), 207-221.
- Alonso, W. (1964). *Location and land Use: Toward a General Theory of Land Rent*. Cambridge: Harvard University Press.
- Amcoff, J. (2009). Rapid regional enlargement in Sweden: A phenomenon missing an explanation. *Geografiska Annaler: Series B, Human Geography*, 91(3), 257-287.
- Berger, R. (2013). *The current situation of gender equality in Sweden-Country Profile*. European Commission. Retrieved from http://ec.europa.eu/justice/gender-equality/files/epo_campaign/131006_country-profile_sweden.pdf
- Black, D., & Henderson, V. (1999). A Theory of Urban Growth. *Journal of Political Economy*, 107(2), 252-284.
- Blumen, O., & Kellerman, A. (1990). Gender Differences in Commuting Distance, Residence and Employment Location: Metropolitan Haifa 1972 AND 1983*. *The Professional Geographer*, 42(1), 54-71.
- Brakman, S., Grrtsen, H., & Marrewijk, C. v. (2001). An Introduction To Geographical Economics: Trade, Location And Growth. In *An Introduction To Geographical Economics* (pp. 24-30). Cambridge, United Kingdom: Cambridge University Press.
- Clark, A. W., Huang, Y., & Withers, S. (2003). Does Commuting Distance Matter? Commuting Tolerance And Residential Change. *Regional Science and Urban Economics*, 33(2), 199-221.
- Conference Proceedings 35. (2006). *Research on Women's Issues in Transportation*. Chicago, Illinois: Transportation Research Board.
- Coppin, L., Vandenbrande, T., & Van Der Hallen, P. (2006). *Mobility in Europe. Analysis of the 2005 Eurobarometer survey on Geographical and Labour Market Mobility*. European Foundation for the Improvement of Living and Working Conditions.
- Crane, R. (2007). Is there a Quiet Revolution in Women's Travel? Revisiting the Gender Gap in Commuting. *Journal of the American Planning Association*, Vol. 73, No. 3, 73(3), 298-316.
- Cresswell, T. (2012). *Geographic Thought: A Critical Introduction*. John Wiley & Sons.
- Cresswell, T., & Uteng, T. P. (2008). *Gendered Mobilities: Towards An Holistic Understanding*. *Gendered Mobilities*.
- Eliasson, K., Lindgren, U., & Westerlund, O. (2003). Geographical Labour Mobility: Migration or Commuting. *Regional Studies*, 37(8), 827-837.
- Evers, A., & Sieverding, M. (2013). Why do Highly Qualified Women (Still) Earn Less? Gender Differences in Long-Term Predictors of Career Success. *Research Article, Psychology of Women Quarterly*, 38(1), 93-106.
- Fischer, C. L. (1982). *To Dwell Among Friends: Personal Networks in Town and City*. Chicago: University of Chicago Press.
- Frändberg, L., & Vilhelmson, B. (2011). More or less Travel: Personal Mobility Trends in the Swedish Population Focusing Gender and Cohort. *Journal of Transport Geography*, 19(6), 1235-1244.
- Fults, K. (2010). A Time Perspective On Gendered Travel Differences In Sweden. *Licentiate thesis, School of Architecture and the Built Environment, Royal Institute of Technology, Stockholm*.
- Gil Sola, A. (2009). Vägen till jobbet: Om kvinnors och mäns arbetsresor i förändring [The way to work: On women's and men's changing work trips]. *Licentiate thesis, Department of Human and Economic Geography, University of Gothenburg, Gothenburg, Sweden, Choros 2009:2*.
- Glaeser, L. (1994). Cities, Information and Economic Growth. *A Journal of Policy Development and Research*, 1(1), 9-47.

- Government Bill. (2001/02:4). *A Policy for Growth and Vitality Throughout Sweden*. Ministry of Industry, Employment and Communications.
- Government Bill. (2005/06:160). *Modern Transports*. Ministry of Industry, Employment and Communications.
- Greene, W. H. (2008). *Econometric Analysis*. Granite Hill Publishers.
- Gujarati, D. N., & Porter, D. (2009). *Basic Econometrics (5 ed.)*: (Mc Graw-Hill International Edition ed.).
- Ham, v. M., Mulder, H. C., & Hooimeijer, P. (2001). Spatial Flexibility in Job Mobility: Macrolevel Opportunities and Microlevel Restrictions. *Environment and Planning*, 33, 921 - 940.
- Hamilton, B. W. (1982). Wasteful Commuting. *The Journal of Political Economy*, 90(5), 1035-1053.
- Hanson, S., & Hanson, P. (1980). Gender and Urban Activity Patterns in Uppsala, Sweden. *Geographical Review*, 70(3), 291-299.
- Hanson, S., & Johnston, I. (1985). Gender differences in work trip. *Urban Geography*, 6(3), 193-219.
- Harsman, B., & Quigley, J. M. (1993). Worker and Workplace Heterogeneity, Transport Access, and Residential Location. *Working Paper, Center for Real Estate and Urban Economics, University of California, Berkeley*, 95-233.
- Henderson, J. V. (1974). The Sizes and Types of Cities. *American Economic Review*, 64(4), 640-656.
- Hilbe, J. (2011). *Negative Binomial Regression*. Cambridge University Press.
- Hjorthol, R. (2008). Daily Mobility of Men and Women—A Barometer of Gender Equality. In P. T. Uteng, & T. Cresswell (Eds.), *Gendered Mobilities* (pp. 193-210). Ashgate Publishing Company.
- Hjorthol, R. J. (2000). Same City-Different Options: An analysis of the Work Trips of married Couples in the Metropolitan Area of Oslo. *Journal of Transport Geography*, 8(3), 213-220.
- Hofmeister, H., & Schneider, N. (2010). *Job Mobilities in Europe: Core Findings, Policy Implications and Future Outlook in Mobile Living across Europe, Volume II: Causes and Consequences of Job-Related Spatial Mobility in Cross-National Perspective*. N. Schneider & B. Collet (Hg.). Barbara Budrich Verlag.
- Hårsman, B., & Quigley, J. M. (1998). Education, Job Requirements, and Commuting: An Analysis of Network Flows. In M. J. Beckmann, B. Johansson, F. Snickars, & R. Thord, *Knowledge and Networks in a Dynamic Economy: Festschrift in Honor of Åke E. Andersson* (pp. 261-272).
- Hägerstrand, T. (1970). What About People In Regional Science? *Papers in Regional Science*, 24(1), 7-24.
- Johansson, B., & Klaesson, J. (2006). Infrastructure, Labour Market Accessibility and Economic Development. In C. Karlsson, W. P. Anderson, B. Johansson, & K. Kobayashi, *The Management and Measurement of Infrastructure: Performance, Efficiency and Innovation* (pp. 69-98). New Horizons in Regional Science.
- Johansson, B., Klaesson, J., & Olsson, M. (2002). Time Distances and Labour Market Integration. *Paper in Regional Science*, 81(3), 305-327.
- Johansson, B., Klaesson, J., & Olsson, M. (2003). Commuters Non-linear Response To Time Distances. *Journal of Geographical Systems*, 5(3), 315-329.
- Johnston-Anumonwo, I. (1992). The Influence of Household Type on Gender Differences in Work Trip Distance. *The Professional Geographer*, 44, 161-169.
- Kwan, M.-P. (2000). Gender Differences in Space-Time Constraints. *Area*, 32.2, 145-156.
- LFS. (2014). European Union Labour Force Survey Statistics. European Commission, Eurostat.
- Lindqvist Scholten, C., & Sandra, J. (2010). *long Distant Commuters and Employers Reflections on Extended Functional Regions*. Arbetsliv i omvandling nr.2, Linneuniversitetet, Institutionen för samhällsvetenskaper. In.
- Lucas, R. E. (1988). On the Mechanics of Economic Development. *Journal of Monetary Economics*, 3-42.
- Lück, D., & Ruppenthal, S. (2010). Insights into Mobile Living: Spread, Appearances and Characteristics. In N. Schneider, & B. Collet, *Mobile Living Across Europe II. Causes and Consequences of Job-Related Spatial Mobility in Cross-National Perspective*, Opladen: (pp. 37-68). Barbara Budrich Publishers, Opladen & Farmington Hills.
- MacDonald, H. (1999). Women's Employment And Commuting: Explaining The Links. *Journal of Planning Literature*, 13(3), 267-283.

- Madden, J. F., & White, M. J. (1980). Spatial Implications of Increases In the Female Labor Force: A Theoretical And Empirical Synthesis. *Land Economics*, 56(4), 432-446.
- Marshall, A. (1890). *Principles of Economics*. Macmillan, London: 8th edition published in 1920.
- Mattisson, K., Håkansson, C., & Jakobsson, K. (2014). Relationships Between Commuting and Social Capital Among Men and Women in Southern Sweden. *Environment and Behavior*, 734-753.
- McClendon, M. (1994). *Multiple Regression and Causal Analysis*. F.E. Peacock.
- Metz, D. (2008). The Myth of Travel Time Saving. *Transport Reviews*, 3, 321–336.
- Naess, P. (2006). Accessibility, Activity Participation And Location of Activities: Exploring the Links Between Residential Location And Travel Behaviour. *Urban Studies*, 43(3), 627-652.
- Nivalainen, S. (2010). Essays on family migration and geographical mobility in Finland. . *Dissertation, Pellervo Economic Research, Helsinki, Finland*.
- Olsson, M. (2002). Studies of Commuting and Labour Market Integration. *JIBS Dissertation Series, No. 016*, 60-138.
- Piza, E. L. (2012). Using Poisson and Negative Binomial Regression Models to Measure the Influence of Risk on Crime Incident Counts. *Rutgers Center on Public Security*.
- Plaut, P. O. (2006). The intra-household Choices Regarding Commuting and Housing. *Transportation Research Part A: Policy and Practice*, 40(7), 561–571.
- Sandow, E. (2008). Commuting Behaviour In Sparsely Populated Areas: Evidence From Northern Sweden. *Journal of Transport Geography*, 16(1), 14-27.
- Sandow, E. (2011, 2). On the road: Social aspects of commuting long distances to work. *Doctoral thesis*, 1-61. Umeå University.
- Sandow, E., & Westin, K. (2010a). The persevering commuter – Duration of Long-distance Commuting. *Transportation Research Part A: Policy and Practice*, 44(6), 433–445.
- Sandow, E., & Westin, K. (2010b). Preferences For Commuting In Sparsely Populated Areas: The Case of Sweden. *Journal of Transport and Land Use*, 2(3/4), 87-107.
- Schafer, A., & Victor, G. D. (2000). The Future Mobility of the World Population. *Transportation Research Part A: Policy and Practice*, 34(3), 171-205.
- Schultz, t. W. (1963). *The Economic Value of Education*. New York: Columbia University Press.
- Singell, L. D., & Lillydahl, J. H. (1986). An empirical analysis of the commute to work patterns of male and females in two-earner households. *Urban Studies*, 23(2), 119-129.
- Sohn, J. (2005). Are commuting patterns a good indicator of urban spatial structure? *Journal of Transport Geography*, 13, 306-317.
- Sola, A. G., & Vilhelmson, B. (2012). Convergence or divergence? Changing gender differences in commuting in two Swedish urban regions. *Cybergeo: European Journal of Geography*, 1-19.
- Statistics Sweden. (2005). *Geography In Statistics - Regional Divisions In Sweden. MIS*. Statistic Sweden.
- Statistics Sweden. (2010). Construction and use of labour market areas. In E. Sandow, *On the Road: Social Aspects of Commuting Long Distances to Work*. Statistics Sweden.
- Statistics Sweden. (2011). *Online statistical database: Labour market, Official Statistics of Sweden*. Statistics Sweden.
- Statistics Sweden. (2014). Women and Men in Sweden. *Thirty Years (1984-2014)*. SCB.
- Statistics Sweden. (2015). *Online Statistical Database: Education and Research, Official Statistics of Sweden*. Statistics Sweden.
- Swedish Government Official Report. (2005). *Dual residence for increased mobility. SOU 2005:28*, Stockholm, Sweden: Ministry of Finance.
- (n.d.). *Swedish Institute for Transport and Communications Analysis (2007): The national travel survey RES 2005/06. Swedish Institute for Transport and Communications Analysis (SIKA), No. 2007:19*.
- Theriault, M., Vandersmissen, M.-H., & Villeneuve, P. (2006). Work Trips: Are There Still Gender Differences? Case of Quebec Metropolitan Area, 1991 and 2001. *Transportation Research Board 85th Annual Meeting, 06-0201*.
- Trendle, B., & Siu, J. (2005). Commuting Patterns of Sunshine Coast Residents and the Impact of Education. *Working Paper No. 37. Labour Market Research Unit Department of Employment and Training, Queensland Government*.
- Weibull, J. W. (1980). On the Numerical Measurement of Accessibility. *Environment and Planning*, 12(1), 53-67.

White, M. J. (1986). Sex Differences in Urban Commuting Pattern. *American Economic Review*, 75(2), 368-372.
 World Economic Forum. (2014). The Global Gender Gap Report. Switzerland: World Economic Forum.

Appendix 1

Table 5 Descriptive Statistics

Variable	Mean	S.D.	Minimum	Maximum
Manufacturing	0.21	0.12	0.02	0.68
Public	0.38	0.07	0.15	0.65
Male Commuting	0.22	0.94	0.00	9.54
Female Commuting	0.19	0.84	0.00	9.62
Size of Origin	9.05	0.95	6.93	13.08
Size of Destination	8.90	1.02	6.63	13.38
House Price	6.86	0.70	5.42	9.14
Higher Education	0.12	0.06	0.04	0.43
Travel Time	296.44	208.52	0.69	999.58
No. of observations	250,563			

Table 6 Pearsson Correlatin Test

Variables	Manufacturing	Public Sector	Higher Education	HousePrice	Size Origin	Size Destination
Public	-0,661*					

Higher Education	-0,103*	0,052*				
HousePrice	-0,441*	0,102*	0,1422*			
Size origin	-0,007*	0,004*	0,612*	0,011*		
Size Destination	-0,229*	-0,024*	0,009*	0,484*	0,001*	
MaleCommuting	-0,086*	-0,018*	0,145*	0,186*	0,188*	0,257*
FemalCommutin	-0,087*	-0,014*	0,142*	0,179*	0,179*	0,245*

Note: if $0.1 < |r| < .3$ shows small correlation, $0.3 < |r| < .5$ means medium correlation and $|r| > .5$ shows high correlation