Commuter Mobility: An Indicator of Municipality Attraction

An Analysis Based on Swedish Register Data

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Abstract

In the present paper, we study the behavior of commuters in the Mälar region that surrounds Stockholm, the capital of Sweden. The purpose is to get better insight into what factors that may be related to municipalities' different levels of attraction. We study individual commuter behavior by means of Swedish register data on place of residence and place of work place for all residents in the region. Our baseline year is 2005 and we study the extent to which commuters change their behavior during a one-year follow up. Longitudinal micro-data on place of work and residence, and commuters' various individual socio-demographic characteristics are linked to data on a range of municipality characteristics. Our data are complemented with standardized data on travel distances and travel times.

We analyze the propensity of commuters to end commuting – by means of change of residence to the municipality where their workplace is located or by changing the workplace to the municipality where they live – by means of multinomial logistic regression. Migration rates and change of workplace rates are shown to decrease with the number of years being a commuter. The relative risks of domestic migration are strongly related to socio-demographic variables, whereas the relative risks of change of workplace mainly vary with individuals' economic variables such as earned income and commuting distance.

The relative risks of migration and change of workplace also vary with the characteristics of the municipalities involved. We demonstrate that the attraction of a municipality in terms of residence increases with the general accessibility to workplaces in the municipality and decreases with its level of housing prices. An increased supply of new dwellings in a municipality has a greater impact on the capacity to increase its population than has an increased supply of workplaces.

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Introduction

Background to the study

In Sweden, as in many other parts of Europe, the concept of region and regional development has been given much attention, so also in the *Mälar* Region that surrounds Sweden's capital, Stockholm. This regions comprises the counties of Stockholm, Uppsala, Sörmland, Örebro and Västmanland. The Mälar region contains several labor market regions consisting of many municipalities. E.g., the Stockholm labor market region consists of more than 25 municipalities, which are close to Stockholm. Investments in infrastructure are being made in this region and discussions are going on concerning different settlement structures (the Regional development plan for the Stockholm region, RUFS2010).

To have some idea about the feasibility of different settlement structures, regional data have to be analyzed. One set of data, which is essential for settlement studies, is data on commuting, migration and changes of workplaces. All municipalities want to increase their population. But is it for a municipality better to build infrastructure for workplaces or for dwellings? Or invest in the transport network?

One indicator of relevance for this can be derived through the study of the behavior of commuters: to what extent do they stop commuting by migrating to the municipality where their workplace is located or by changing workplace to the municipality they live in?

Research question

Commuting patterns are produced and maintained by the relationship between individuals' residence and workplace. On a yearly basis, these patterns are repetitive and quite stable. On a daily or weekly basis, however, commuting is dynamic in space. On a yearly basis, changes in commuter status can occur either by a change of residence or by migration – this is a dynamic and non-repetitive process.

In this study we analyze the factors that are related to commuters' mobility, as to their changes of residence and changes of workplace. More specifically, we study the propensity to "stop commuting" by taking the time being a commuter into consideration. Various demographic and socio-economic individual-level factors influence the propensities to migrate and change workplace. By standardizing for these individual factors we can study the impact of different characteristics of municipalities on commuter mobility. We aim at detecting which municipalities that are attractive for in-migration and which are attractive for changing the workplace to?

The paper is organized the following way. First we provide a literature review, this is rather short because there seems to be relatively few studies on commuter´s behavior as to migration and changes of workplace. More has been written about commuters in general and their living arrangements. After the literature review the data are presented and the multivariate analyses on how different individual variables affect the propensities to migrate and change workplace, respectively, are presented. Last, by standardizing for these individual factors, the role of different aggregate municipality variables in commuter mobility decisions is studied.

Literature

In a paper on migration between regions in Sweden by Anderstig, Jönsson and Schéele (1989), it was found that commuters had higher migration rates than non-commuters. This hints at the possibility that commuting often is something that precedes and triggers migration. Gordon (1988) and Gordon and Vickerman (1982) described this in a model where locational adjustments of either residence or workplace are seen as a search process. They argue that "the search process is conceived of as a sequential process in which opportunities have to be evaluated seriatim rather than being available for storage and simultaneous comparison". Vickerman (1984) formulated a disaggregated choice model of commuter mobility:

"There is, in effect, a triple level decision to be made. Decision makers have to recognize the need for some adjustment to their workplace-residence positions, i.e., they have to decide whether to enter into a search process for improvement. Secondly they have to identify what, if anything, should be changed which requires the perception of available opportunities. Finally they have to establish a decision rule for the precise change to be made. Most behavioral models to date have either concentrated on the final decision in one market alone, i.e. considered the probability of accepting a given opportunity, or used the convenient assumption of simultaneity in choices, and hence avoided the difficulties posed by the first and second levels of decision. However, it is useful to start from the position of observed changes and work backwards to illustrate the importance of these higher levels of decision. It is suggested that there are five possible types of change which we can observe. First, there is the case of workplace change only, where the residence is taken as fixed and job and commuting characteristics dominate. Secondly there is the case of residence change for housing or environmental reasons with the workplace here assumed fixed and commuting characteristics again important. Thirdly we have the cases of speculative moves of residence (and possibly workplace) where the other location is regarded as fixed in the short term but an attempt is being made to widen the area of search in the hope of making a later beneficial change. Fourthly the same sequential changes could be induced rather than anticipated, this would imply a rather different set of characteristics entering the decision function. The final case is that of the pure simultaneous decision where new residence and workplace are selected jointly. The third and fourth options above can involve either the movement of residence and then workplace or vice versa."

By using data from Greater London, Vickerman shows that there is very little evidence of simultaneous changes of workplace and residence. The yearly frequency of changing workplace is double that of changing residence, and a change of both a tenth of that of changing residence. But the order of events was somewhat uncertain with their data, as they only covered two years of observation. Vickerman concluded that it is practically impossible to formulate a disaggregated model that describes this decision process. Still, single decisions can be modeled with other decisions being given.

In later research, van Ommeren et al. (1999) developed a search model that assumes simultaneous search. In economic theoretical terms it states that:

"behavior on the labor and residence markets are related, as every job or residential move might imply a change in the commuting costs. Furthermore, it is assumed that jobs can be characterized by the wage rate and residences by "place utility". Whether an individual accepts a residence or job offer does not only depend on the direct gain in wage or place utility, but also on the residence and job moving costs. […Thus,] the workers search continuously for better jobs and dwellings, maximizing the discounted future flow of wages, place utilities, minus commuting costs, taking into account the costs of changing jobs and residences. Job and residential moving behavior and commuting behavior are due to a combination of chance – the arrival of an

offer – and a decision-making process – the decision to search with a certain intensity and to accept or reject an offer."

Their search model is estimated by duration models on the duration to stay at a residence and to stay at a given job, respectively. They argue that "job and residential mobility are *not* related*, conditional on commuting costs*." They estimated their duration models and found that both job and residential mobility increase with commuting distance. The correlation between job and residential mobility is not statistically significant at given commuting costs.

Van Ommeren et al. (1999) suggested that job moves may trigger residential moves. This discussion was based on the assumption

"that the probability of receiving a job offer is much smaller than the probability of receiving a residence offer. It can be seen then that it is rational for the individual first to move a job and then to move residence. This occurs because after a job move that increases commuting costs, the probability that the commuting costs can be reduced by moving residence is high. However, given a residential move that increases commuting costs, the probability of reducing the commuting costs by moving a job is small within a reasonable period."

However this assumption can be questioned in e.g. a housing market with scarcity.

Zax and Kain (1991) studied the effects of commuting distance on the propensities to migrate and change workplace. They found that in a metropolitan area in the US with conventional wage and housing price gradients there is a tendency that migration tends to lengthen commuting distances and change of workplace tends to shorten such distances. However, in an area with strong racial segregation these patterns become distorted.

Many studies have been made on migration from cities to more sparsely populated areas and how such migration affects commuting patterns (see, e.g., Champion at al., 2008). One of the conclusions is that further research relies on the availability of longitudinal data. Various social consequences of long distance commuting have been studied by, e.g., Sandow (2011).

In the Swedish Long-Term Survey 2008 (ref) a special appendix thoroughly describes available theories and facts on migration and commuting in Sweden. It is emphasized that very little has been done on the relationship between migration and commuting, but that access to Swedish register data of high quality provides the opportunity to develop research in this area.

Data

Individual-level data

Our study is based on analyses of Swedish population register data of high quality. All individuals with legal residence in Sweden are registered with the location of their residence specified at a detailed geographical level. Data on work places of working individuals are also available with similar degree of geographical precision. The data are derived from population registers and administrative registers[1]. In our case, data on employment and residence are provided for all individuals with the geographical accuracy of that of a SAMS area (Small Area Market Statistics): The SAMS areas are

[1] Registers with employment data (RAMS) are maintained by Statistics Sweden with the purpose to produce statistics on employment, commuters, employees and industrial structures.

generally small and Sweden has about 10,000 such areas in total. This level of geographical precision is used as the basis for our data on travel distances of commuters in the Mälar region. Our definition of being a commuter, however, is based on municipality borders: An individual is defined as being a commuter if his or her place of residence is located in one municipality but the workplace is located in another municipality. The municipality level is used as this is perceived by commuters and residents as being the most critical geographical demarcation and as actions taken by municipalities in terms of planning - of dwellings and workplaces - are of primary interest for our study. We base our study on all individuals who were registered with legal residence in one of the municipalities of the Mälar region on Dec 31, 2005 and were gainfully employed with a given workplace location also in Märlardalen in November the same year. According to the RAMS register of Statistics Sweden, a person is gainfully employed if he or she worked at least one hour per week during November. Those with varying workplaces are excluded from our analyses. With these definitions, there were 1,225,697 employed residents within the Mälar Region at the end of 2005.

Population and other administrative registers provide information on demographic and socioeconomic characteristics of the all individuals in the Mälar region. We use these register data to define our dependent and independent individual-level covariates.

Our outcome variables relate to changes in commuter status from 2005 to 2006. The definition of being a commuter is that of having residence in one municipality and the workplace in another. With our definitions and data, there were 502,546 municipality commuters within the Mälar Region in 2005. We study the propensities of these commuters to stop being a commuter during a one-year follow up by either a (i) change of residence, (ii) change of work place location, or (iii) change of both workplace and residence during 2006.

We use the following individual-level variables as determinants of the termination of commuter status:

- Age
- Gender
- Family position
- Education
- Income

Age is classified by the following categories of working ages: 16-19, 20-24, 25-29, 30-34, 35-39, 40-64 and 65-74.

Family position is defined from variables on civil status and presence of children in the household as defined by Statistics Sweden and grouped into four classes:

1. Married with or without children or cohabiting with children, labeled *Married/Cohab*
2. Non married and not cohabiting with children but being a parent, labeled *Single with children*
3. Non married and no children, labeled *Single no children*
4. Person living in same household as his or her parents, labeled *In parental home*

Educational attainment is grouped into the following categories: Primary and lower secondary; Upper secondary; Post-secondary; and Post graduate levels.

Income cover earned income from wages as reported to the tax authorities. We have classified the earnings in 2005 into income quintiles, that is, into five classes of earnings that are common for women and men.

The variables described above are all for the year 2005 and are used in order to describe changes in commuter status during 2006.

A further variable depicts the duration of being a commuter. This variable is constructed by back-tracking each individuals data on commuter status during the ten years before the baseline year 2005 to detect the start of the current commuter status.

Data on commuting distances

For all SAMS areas in the Mälar Region, we have access to data on distances between the SAMS-areas (about 2600 in this region) as to distance and travel time by car, and travel time by public transport for the year 2005. (This is the main reason that we have chosen 2005 as the baseline calendar year for our study.) These data are provided to us by The Office of Regional Planning and Urban Transportation at Stockholm County. These travel distances are very important as the lake Mälaren is in the middle of the region acts as a border and makes the use of any Euclidian distances inappropriate. In our study, we use the travel distance by car as a measure of commuters travel distances.

Municipality data

Municipality categories

The municipalities can be classified into different categories according to their type of settlements, as defined by the Swedish Association of Local Authorities and Regions. These categories cover different dimensions of the size of the municipality, its density, general commuting patterns and, to some extent, its type of industry. The categories are as follows:

Metropolitan cities: Stockholm
Metropolitan suburbs: suburbs to Stockholm
Large cities: Södertälje, Uppsala, Nyköping, Eskilstuna, Örebro and Västerås
Suburbs to these large cities
Commuter municipalities that are no suburbs
Tourism municipalities: Norrtälje and Östhammar
Goods-producing municipalities
Other municipalities in a densely populated region

About a third of the population of Mälardalen live in suburbs to Stockholm. About 30% is found in Stockholm itself, and the other “large cities” cover about 20% of the population. The other five categories of municipalities have much lower fractions of inhabitants. The classification for Sweden also involves two additional categories, rural municipalities and municipalities in a low population density region, but there are no such municipalities in the Mälar region. See Appendix 1 for a full list of these categories and the municipalities that belong to our study.

Accessibility and housing prices

One important characteristic of a municipality is the accessibility for its inhabitants to workplaces in the municipality and the region that surrounds it. The accessibility measure that we use describes how many workplaces that an individual who lives in a given area can reach within reasonable time and cost limits. Our measure is defined in the following way. The travel cost between a given SAMS area and any other area in the region is measured in terms of a generalized cost, which amounts to a weighted sum over transport modes that cover both monetary costs and travel time costs. For a given area of residence all reachable workplaces are summarized by means of a weighted indicator of accessibility as computed by an exponential function with a negative parameter.

The accessibility in area i is thus defined by

$$Acc(i) = \Sigma(j)\ WP(j)*\exp\ [-\beta GC(ij)]$$

where GC is the generalized cost for trips between SAMS areas i and j, β is a constant estimated in the transport model, and WP denotes the number of workplaces in area j. The accessibility value for a given municipality is calculated as a weighted average of the accessibilities for all the SAMS areas in the municipality[2]. The accessibility is measured in thousands of workplaces and its value for each municipality in the Mälar region is given in Appendix 2.

Higher accessibility for a municipality is in general also related to higher taxation values on housing and real estate in the area. This could have a negative effect on the municipality's attraction and we apply this factor as a covariate in our model on commuter mobility. The mean taxation value of single-dwelling houses in each municipality is taken as our variable. Statistics on taxation values in 2005 (ref) is used and presented in Appendix 2.

Supply of dwellings and workplaces

Investments in new dwellings and new work places are two indicators of a municipality's development and expansion. We apply two variables on these dimensions to study how these factors may relate to commuters mobility. Data on the supply of new dwellings are derived from statistics on completed dwelling units during the five-year period 2002-2006 (ref). The average of these annual statistics is chosen to represent the supply of new dwellings in our study year. An average is chosen as single year statistics are heavily affected by random fluctuation. For further detail, see Appendix 2.

There are no exact statistics available on the number of new physical workplaces by municipality. Instead we use statistics on the annual changes in employment in each municipality as an indicator for the supply of new workplaces. An average for the years 2005 and 2006 is used.

Tax rate

Tax rates also differ by municipality and taxes are paid in the municipality of residence. The tax rates in 2005 are used as an additional variable to explain changes in commuter status. The background data for all our municipality variables are provided in Appendix 2.

[2] Data on accessibility are supplied by Christer Anderstig at WSP. These type of data are used in transport and land use models.

Summary statistics: Commuters and non-commuters in the Mälar region

Commuters versus non-commuters

In 2005 in the Mälar region, there were 1,225,697 employees for whom both the residence and the workplace were localized to specific SAMS areas of the region. Of those, 41 percent were commuters with the residence in one municipality and the workplace in another. Women are commuting to a slightly less extent than men. Among employed men the share was 44 percent and among employed women it was 38 percent. Table 1 provides statistics on the distribution of commuters and non-commuters on the individual-level variables specified above. The distributions are provided as well for women and men, separately. The statistics reveal that:

- The age structure is very similar for commuters and non-commuters, both for women and men.
- The most frequent family position is that of being married (with or without children) or cohabiting and having at least one child in the household. Men are more often single than women, but there is very little difference between commuters and non-commuters. Male commuters are more frequently married/cohabitating and less often single with no children than non-commuting men.
- Commuters have in general higher educational attainment than non-commuters. The most common educational level for female commuters is a post-secondary education.
- Commuters are less often found in the lowest earnings quintiles and more often in the highest quintiles. Male commuters have the highest earnings profile of all groups.
- The distribution of travel to work distances shows that the distance between residence and workplace is less than 10 kilometers for more than half of all employees. For non-commuters a great majority, 87 percent of men and 86 percent of women, has such a short travel distance. Even for those defined as commuters, 12 percent of men and 16 percent of women have a distance between residence and workplace that is less than 10 kilometers.
  Further calculations reveal that the mean distance between home and workplace is five kilometers for non-commuters and 30 kilometers for commuters. Furthermore, but not shown in Table 1 and not used as covariates in our analyses, the mean *travel time* by car from home to workplace is 12 minutes for non-commuters and 36 minutes for commuters. The mean travel time with public transport is 21 minutes for non-commuters and 59 minutes for commuters. The travel time with public transport includes access time, waiting time and time in vehicle.
- Finally, the duration of commuting in years is calculated for all commuters. The frequency of commuters decreases with increasing commuting duration, but as much as 30 percent have still been commuting for more than 10 years.

Naturally, commuters differ from non-commuters as to their travel distances (Table 1) and type of municipality of residence (Table 2). Among the socio-economic variables the largest differences were found for income and educational level : commuters have higher earnings and educational attainment than non-commuters. Further, we found that men differ from women in that they more often are commuters the first place and that they more often than women have relative large commuting distances.

Table 1 Distribution of commuters and non-commuters, males and females, on socio-demographic variables. Mälardalen 2005.

	Non-commuters males	*Non-commuters females*	*Male commuters*	*Female commuters*	*All*
Age					
16-19	2%	2%	1%	2%	2%
20-24	7%	6%	6%	6%	6%
25-29	10%	9%	9%	10%	10%
30-34	13%	12%	14%	14%	13%
35-39	13%	12%	15%	14%	13%
40-44	13%	13%	14%	13%	13%
45-49	11%	12%	12%	11%	11%
50-54	11%	11%	10%	10%	11%
55-59	11%	12%	10%	11%	11%
60-64	8%	9%	7%	7%	8%
65-74	2%	1%	2%	1%	2%
Family position					
Married/cohab	51%	53%	56%	55%	54%
Single with children	2%	9%	2%	8%	5%
Single no children	40%	34%	35%	32%	36%
In parental home	7%	4%	6%	5%	5%
Educational level					
Primary and lower secondary	16%	11%	13%	9%	12%
Upper secondary	48%	46%	46%	43%	46%
Post-secondary	34%	42%	38%	46%	40%
Post graduate	2%	1%	2%	1%	2%
Missing	1%	0%	1%	0%	1%
Income quintiles					
1st quintile	22%	25%	11%	19%	20%
2nd quintile	15%	28%	13%	23%	20%
3rd quintile	19%	22%	17%	21%	20%
4th quintile	21%	16%	24%	21%	20%
5th quintile	22%	9%	36%	16%	20%
Commuting distance by car					
<10km	85%	84%	12%	16%	56%
10-20km	9%	9%	29%	32%	18%
20-30 km	3%	3%	23%	23%	11%
30-40 km	1%	1%	13%	11%	6%
40-50 km	0%	0%	7%	6%	3%
50-60 km	0%	0%	4%	3%	1%
60-70 km	0%	0%	3%	2%	1%
70-80 km	0%	0%	3%	2%	1%
80-90 km	0%	0%	1%	1%	0%
>90 km	0%	0%	5%	3%	2%
Missing	2%	2%	0%	0%	1%
Number of years commuting					
1			16%	19%	
2			11%	12%	
3			8%	9%	
4			7%	8%	
5			6%	7%	
6			6%	6%	
7			5%	5%	
8			5%	4%	
9			4%	3%	
10			3%	3%	
11+			29%	25%	
Number of persons	**346 270**	**376 881**	**272 853**	**229 693**	**1 225 697**

Source: Swedish register data, authors' own calculations

Table 2 provides the distribution of employed residents by their municipality types of residence and workplace, respectively. In this region the most common municipality of residence is a suburb to

Stockholm (34%), followed by the city of Stockholm itself (28% of the working population) and the other large cities of the region (21%). Two thirds of the non-commuters live in Stockholm or the other large cities of the region, whereas for commuters the same fraction is found in suburban municipalities (or municipalities defined as commuter municipalities). In the region as much as 39 percent of the workplaces are located in the city of Stockholm. There is thus a shift in the distribution of workplaces towards the center of the region and a similar shift of dwellings towards suburban municipalities. Evidently, this pattern is particularly striking in the distribution of workplaces and dwellings by type of municipality among the commuters. Among non-commuters the distribution of municipality types of workplace and residence is of course the same.

Table 2 Distribution of commuters and non-commuters, males and females, by municipality type. Mälardalen of Sweden, 2005.

	Non-commuters males	*Non-commuters females*	*Male commuters*	*Female commuters*	*All*
Residence, type of municipality					
1 Stockholm city	37%	36%	16%	17%	28%
2 Suburbs to Stockholm	16%	18%	58%	61%	34%
3 Large cities	30%	30%	11%	8%	21%
4 Suburbs to large cities	1%	2%	3%	3%	2%
5 Commuter municipalities	5%	4%	5%	5%	5%
6 Tourism municipalities	3%	3%	2%	2%	2%
7 Goods-producing municipalities	5%	4%	3%	2%	4%
9 Municipalities in a densely-populated region	4%	4%	3%	2%	3%
Workplace, type of municipality					
1 Stockholm city	37%	36%	42%	43%	39%
2 Suburbs to Stockholm	16%	18%	37%	39%	26%
3 Large cities	30%	30%	11%	10%	22%
4 Suburbs to large cities	1%	2%	1%	1%	1%
5 Commuter municipalities	5%	4%	5%	4%	4%
6 Tourism municipalities	3%	3%	1%	0%	2%
7 Goods-producing municipalities	5%	4%	2%	2%	3%
9 Municipalities in a densely-populated region	4%	4%	1%	1%	3%
Number of persons	**346 270**	**376 881**	**272 853**	**229 693**	**1 225 697**

Source: Swedish register data, authors' own calculations

Mobility

In Table 3, we provide summary statistics on changes of residence and/or workplace for employed people in the Mälar region during the calendar year we study, 2006. Changes of workplace or residence refer to changes that involve a change in location across a municipality border. The statistics show that commuters are much more prone than non-commuters to either migrate or change their workplace. This indicates that commuting is not always the most desired status but may rather be seen as part of a search process for better work and living conditions. To change both municipality of residence and workplace in a calendar year was made by one percent of commuters and non-commuters alike. These results conform well with a previous study on commuter mobility in Greater London which showed the same relation between mobility by different mobility actions for commuters and non-commuters (Vickerman, 1984).

Table 3 Mobility for commuters and non-commuters, Mälardalen of Sweden, 2006

	Non-commuters	Commuters
No change	93%	81%
Change of residence	2%	5%
Change of workplace	4%	13%
Changing both	1%	1%

Source: Swedish register data, authors' own calculations

Table 4 provides further statistics on our outcome variable of interest. It shows how the mobility of commuters and non-commuters differs by age group. The same relative age pattern in mobility by migration and/or change of work place is found for commuters and non-commuters. Migration rates peak at age groups 20-24 and 25-29. Changes of workplace are most frequent at the youngest ages and continuously decrease with age. For each age group the mobility rates are higher for commuters than for non-commuters. However, for mobility that involves both a migration and change of work place the frequencies for commuters and non-commuters are almost the same.

Table 4 Mobility rates for commuters and non-commuters, Mälardalen of Sweden, 2006, by age group

	Non-commuters			Commuters		
	Migration	Change workplace	Both	Migration	Change workplace	Both
16-19	0.03	0.09	0.01	0.07	0.23	0.01
20-24	0.05	0.08	0.02	0.12	0.21	0.02
25-29	0.04	0.06	0.02	0.11	0.18	0.02
30-34	0.04	0.05	0.01	0.07	0.15	0.01
35-39	0.02	0.04	0.01	0.04	0.14	0.00
40-44	0.01	0.04	0.01	0.03	0.13	0.00
45-49	0.01	0.03	0.00	0.03	0.12	0.00
50-54	0.01	0.03	0.00	0.03	0.11	0.00
55-59	0.01	0.02	0.00	0.02	0.08	0.00
60-64	0.01	0.02	0.00	0.02	0.08	0.00
65-74	0.01	0.02	0.00	0.01	0.10	0.00

Source: Swedish register data, authors' own calculations

Table 5 presents frequencies of ending commuting by the duration of commuting spells, in calendar years. The frequencies of each of the three types of commuter mobility we study all decline with increasing length of commuter duration. Evidently, with increasing duration the pool of commuters become a more selected group of people who have adapted themselves to their status as commuters.

Table 5 Rates of ending commuting, male and female commuters in Mälardalen of Sweden, 2006, by type of mobility and duration of commuting spells in years

Commuting time	Migration		Change of workplace		Both	
Years	Males	Females	Males	Females	Males	Females
1	0.042	0.040	0.135	0.153	0.012	0.014
2	0.032	0.034	0.103	0.109	0.011	0.013
3	0.028	0.029	0.082	0.086	0.009	0.010
4	0.022	0.022	0.073	0.069	0.008	0.008
5	0.018	0.020	0.060	0.059	0.006	0.006
6	0.017	0.016	0.055	0.054	0.004	0.005
7	0.017	0.015	0.050	0.052	0.004	0.005
8	0.013	0.013	0.045	0.044	0.004	0.004
9	0.012	0.011	0.041	0.041	0.003	0.003
10	0.012	0.011	0.041	0.038	0.003	0.003

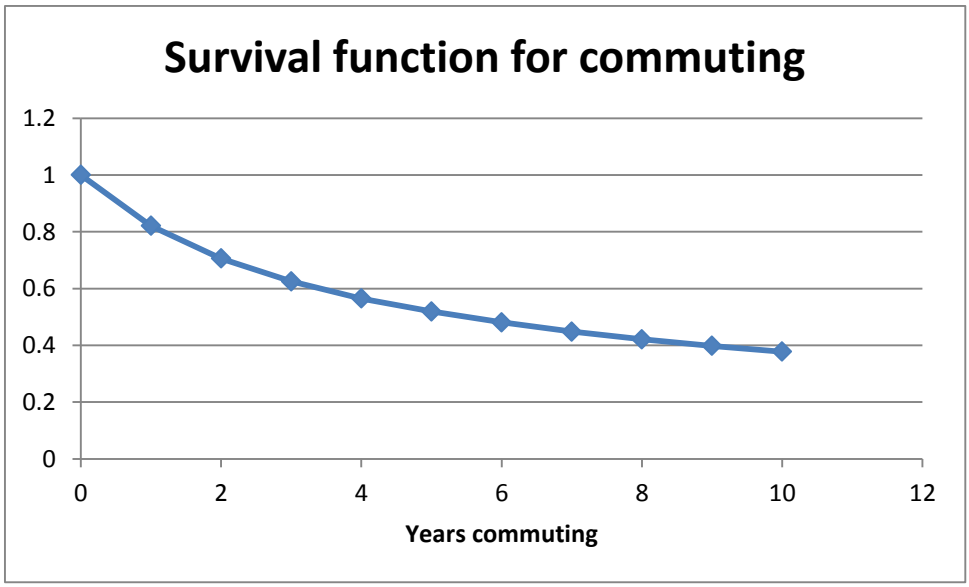
Source: Swedish register data, authors' own calculations

Commuter mobility

Survival function of commuter status

In our study, we will perform multivariate analyses of the factors that relate to each of the three types of ending commuting: migration, change of work place, or experiencing both events in the same year. As an introduction to our multivariate models we first present a univariate survivor function of the status of being a commuter, by duration of commuting time in calendar years. This function is calculated from the rates of ending commuting during 2006, regardless of the mode of ending commuting. It is estimated from life table data based on occurrence/exposure rates observed during 2006 where occurrences amounts to the numbers of ending commuter status during 2006 and the exposures measure the number of commuters at the beginning of the year, by duration of commuting. As all data refer to 2006, the survival function depicts the "survival" of a synthetic cohort of new commuters. The function demonstrates again that the intensity of ending commuting is highest at the shortest durations of being a commuter. After five years, around half of the commuters have stopped commuting. Still, almost 40 percent of new commuters in a calendar year are still commuters with the same municipality of residence and work place constellation after 10 years of commuting duration.

Figure 1 Survival function of being a commuter, Mälardalen of Sweden, synthetic cohort during 2006



Source: Swedish register data, authors' own calculations

Multivariate analysis with individual variables as covariates

In our multivariate analyses we study the propensity of ending being a commuter during 2006 by means of a multinomial logistic regression model. The model covers the following three competing events to become a non-commuter:

1. migration to the municipality where the workplace is located
2. change of workplace to the municipality of residence
3. both migrate and change workplace to any other municipality and become a non-commuter.

We provide separate models for women and men. Table 6 provides the estimated odds ratios for each of the individual-level covariates that we have applied to our commuter data.

Table 6 Propensity for male and female commuters to migrate, change workplace or do both in order to become a non-commuter. Odds ratios for covariates and baseline frequencies for duration of commuting, Mälardalen of Sweden, 2006.

Relative risks for different sets of covariates		Migrate		Change workplace		Both	
		Male	Female	Male	Female	Male	Female
Age	16-19	0.48 ***	1.20	1.04	1.12	0.77	2.28 ***
	20-24	1.33 ***	2.08 ***	1.05	1.03	1.79 ***	2.99 ***
	25-29	1.72 ***	2.07 ***	1.05	1.00	1.79***	2.40 ***
	30-34	1.28 ***	1.48 ***	1.04	0.96	1.71 ***	1.51 ***
	35-39	1	1	1	1	1	1
	40-64	0.78 ***	0.86 **	0.93 **	0.92 **	0.55 ***	0.58 ***
	65-74	0.34 ***	0.19 ***	0.88	0.78 **	0.26 ***	0.14 **
Family position	Married/cohab w child	1	1	1	1	1	1
	Single w child	1.44 **	1.75 ***	1.15 *	1.24 ***	1.20	1.75 ***
	Single no child	2.53 ***	2.49 ***	1.02	1.12 ***	1.68 ***	2.16 ***
	Child	3.54 ***	4.00 ***	0.83 ***	0.92	1.39 **	1.75 ***
Wage	Wage q1	1	1	1	1	1	1
	Wage q2	1.04	1.17 ***	0.81 ***	0.81 ***	0.87	0.85 *
	Wage q3	0.94	1.01	0.66 ***	0.68 ***	0.61 ***	0.69 ***
	Wage q4	0.91 *	1.02	0.57 ***	0.65 ***	0.51 ***	0.67 ***
	Wage q5	0.86 **	1.09	0.49 ***	0.69 ***	0.41 ***	0.42 ***
Education	primary and lower secondary	0.91 *	0.90	0.96	1.01	0.86	0.89
	upper secondary	1	1	1	1	1	1
	post-secondary	1.18 ***	1.04	1.03	1.08 ***	1.51 ***	1.54 ***
	post graduate	0.96	0.72	1.04	0.81 *	1.57 *	2.05**
Commuting distance	<10km	1.14 **	1.08	1.15 ***	1.14 ***	0.77 **	0.87
	10-20km	1	1	1	1	1	1
	20-30 km	1.04	1.09 *	1.05	0.98	0.89	1.07
	30-50 km	0.89 **	0.97	1.15 ***	1.23 ***	1.10	1.33 ***
	50-90 km	1.02	1.25 ***	1.54 ***	1.69 ***	1.53 ***	1.46 ***
	>90 km	1.12	1.61 ***	2.06 ***	2.32 ***	1.78***	2.85 ***
Baseline frequencies							
Duration being commuter	1 year	0.0200	0.0143	0.1575	0.1617	0.0075	0.0045
	2 years	0.0157	0.0125	0.1230	0.1143	0.0084	0.0044
	3 years	0.0145	0.0113	0.1091	0.0955	0.0073	0.0042
	4 years	0.0125	0.0101	0.1001	0.0772	0.0070	0.0041
	5 years	0.0102	0.0094	0.0827	0.0670	0.0063	0.0035
	6 years	0.0104	0.0081	0.0782	0.0611	0.0043	0.0031
	7 years	0.0108	0.0077	0.0707	0.0605	0.0043	0.0031
	8 years	0.0086	0.0071	0.0636	0.0516	0.0051	0.0033
	9 years	0.0081	0.0068	0.0583	0.0504	0.0046	0.0028
	10 years	0.0092	0.0066	0.0579	0.0465	0.0047	0.0025
Number of observations		270300	228466				
Loglikelihood		-90805	-82414				

Note: significance levels indicated at * 5%, **1%, or ***0.1%

Source: Swedish register data, authors' own calculations

Ending commuting by means of migration

Migration intensities are highest for women and men in their 20s, the intensities peak somewhat later for men than for women. At higher ages these intensities decline monotonically with age. As to family position the most common commuter is married (with or without children) or cohabiting and having children. Compared to commuters in other family positions these persons are less likely to migrate. Commuters who still live in their parental home have the highest odds to become a non-commuter by moving to the municipality where his or her workplace is situated. Singles with no children also have high odds for migration, which are higher than for single parents with a child or more in the household. Family position is the covariate which has the strongest impact on a commuter's migration rates.

The income level, here defined as quintiles of the commuters, is quite stable as to relative risk of migration. Income does not seem to have any influence on moving residence, neither for men nor for women. For men, the educational level post-secondary has higher relative risk than the other levels. The low value of post graduates is not significant due to very few observations. For women the educational level is irrelevant.

For commuting distance the relative migration risk is almost constant for men. For women the longest distances have higher risks. But in general commuting distance does not influence the propensity to migrate.

Gender differences are only found for the age structure of relative risks, with higher risks for younger ages for women and that women migrate for longer commuting distances with a higher relative risk.

Migration relative risks are mostly dependent on demographic variables.

Change of workplace

In opposite to migration the relative risk of changing work-place does not vary much with age. To some extent, this could be an effect of the fact that the baseline variable duration of commuting is correlated with age. The relative risks for the covariate family position do not vary much for neither men nor women. But single with children has a bit higher relative risk than others.

The relative risk to change work-place varies much with wage for both men and women. The highest quintile has for men almost half the risk as the lowest quintile.

The relative risks for different educational levels do not vary significantly.

Another interesting result is that unlike migration the relative risk of changing work-place increases continuously with commuting distance. For long commuting distances it seems as changing work-place is made instead of migrating to become a non-commuter.

Changing work-place is thus mostly dependent on economic variables and there are no gender differences.

Change of both workplace and residence

The age structure of relative risks shows much more variation than for migration. Younger ages have higher relative risks to change both residence and workplace and much more pronounced for women than men.

Married and cohabiting with children have the lowest relative risk, and single with no child the highest, for women higher than for men. The wage covariate resembles changing workplace for both men and women. Educational level has a very clear pattern of higher risks with higher educational level.

For commuting distance it is also a sharp pattern that longer commuting distances lead to changes of municipality for both work-place and residence, especially for the longest distance for women.

Conclusion

When taking account of all covariates the baseline frequencies do only vary much by commuting time for the event change of workplace. The frequency is 15 percent after one year and 5 percent after 10 years. The baseline frequencies for migration and both moves vary very little by duration time of being a commuter. To find a new municipality to both live and work in is not influenced by the time being a commuter. Any inconveniences being a commuter do not seem to affect the decision to move. This implies that the covariates, which to a great extent are socio-economic take care of the migration frequencies.

To conclude, socio-demographic variables have effects -in the sense that the relative risks are different – on migration, and economic variables like income and commuting distance and duration being a commuter have effect on change of workplace. This means that moving residence to stop commuting is a family based decision irrespective of economic variables – income and cost of commuting (commuting distance) - and of time being a commuter.

All variables except the time being a commuter have an effect on the event both migrate and change workplace. But the overall frequency for that event is very low.

The analysis shows that there are some differences between male and female commuters ending commuting, but the types of gradient are similar. Therefore in the following analyses gender is handled as a covariate in the models.

Municipality attraction

This leads to the question originally set, if a municipality primarily is attractive as residence or workplace. By standardizing for all individual covariates we study how different covariates describing the municipalities influence the propensities to stop commuting.

Four models with alternative set-ups of variables describing the municipalities are studied: 1) municipality types of residence and workplace , 2) tax rates in the municipalities, 3) supply of new dwellings respectively ”new” workplaces, and 4) accessibility and taxation values. For comparison a Model 0 is set up with only individual covariates, as above but with gender as a covariate. The four different setups of municipality variables are so dependent that taking more than one variable into a model makes it difficult to interpret the coefficients.

Model 1. Municipality types

The municipality types of residence and workplace municipality respective are used as categorical variables in the multinomial logistic regression model. The municipality types describe the size and the density of the municipality and the commuting situation – in-or out-commuting - and to some extent the type of industry. The type of each municipality is described in Appendix 1.

Model 2. Tax rates

The municipality tax rate is really something a municipality can decide upon. It is the greatest part of the local tax rate. In the Mälar region the year 2005 it varies between 29.85 and 33.05 percent. The difference between the actual tax rate and the smallest is taken as a continuous variable, excess tax rate. Data in Appendix 2.

Model 3. Supply of new residences and workplaces

The original question is if it is investments in new dwellings or workplaces that matters most. To the original multinomial logistic regression model with all its individual variables the number of new dwellings and workplaces are added. New dwellings in the municipality where the workplace is situated are of interest to see if that will increase the propensity to migrate to it. And new workplaces in the municipality of residence are of interest to see if that increases the propensity to change the workplace. For dwellings, statistics on new built dwelling is used. For workplaces, the change in employment is used. Data in Appendix2.

Model 4. Accessibilities and taxation values

For investment in transportation systems it is argued that good accessibility to workplaces is positive for population to increase. It is also known that good accessibility increases taxation values. But increasing taxation values could have a non-positive effect on population. The accessibilities and the taxation values for houses in the residence respectively workplace municipality are included as continuous variable in the model. Data in Appendix 2. The accessibility is measured in thousands of workplaces and the taxation values in 1000 SEK.

The results from the analyses are presented with one table for each event –migration, change of workplace and both.

Table 7 Propensity for commuters to migrate to become non-commuter, relative risks for different covariates, and baseline frequencies for duration of commuting, 2006, the Mälar Region

		Model 0	Model 1	Model 2	Model 3	Model 4
Gender	Male	1	1	1	1	1
	Female	1.05 *	1.04	1.04	1.03	1.06 *
Age	16-19	0.80 **	0.79 **	0.81 *	0.83 *	0.80 **
	20-24	1.63 ***	1.65 ***	1.64 ***	1.65 ***	1.64 ***
	25-29	1.86 ***	1.87 ***	1.88 ***	1.87 ***	1.88 ***
	30-34	1.35 ***	1.36 ***	1.37 ***	1.37 ***	1.37 ***
	35-39	1	1	1	1	1
	40-64	0.81 ***	0.82 ***	0.82 ***	0.83 ***	0.81 ***
	65-74	0.28 ***	0.28 ***	0.29 ***	0.28 ***	0.28 ***
Family position	Married/cohab w child	1	1	1	1	1
	Single w child	1.65 ***	1.70 ***	1.64 ***	1.67 ***	1.66 ***
	Single no child	2.55 ***	2.76 ***	2.63 ***	2.72 ***	2.69 ***
	Child	3.73 ***	3.77 ***	3.70 ***	3.62 ***	3.75 ***
Wage	Wage q1	1	1	1	1	1
	Wage q2	1.10 ***	1.11 **	1.10 **	1.11 ***	1.10 **
	Wage q3	0.96	0.98	0.97	0.99	0.97
	Wage q4	0.96	0.96	0.96	0.96	0.97
	Wage q5	0.96	0.93	0.95	0.91	0.96
Education	primary and lower secondary	0.90 **	0.92 *	0.89 **	0.90 **	0.90 **
	upper secondary	1	1	1	1	1
	post-secondary	1.11 ***	1.14 ***	1.14 ***	1.14 ***	1.13***
	post graduate	0.86	0.90	0.89	0.91	0.91
Commuting distance	<10km	1.11 ***	1.16 ***	1.13 ***	1.14 ***	1.36 ***
	10-20km	1	1	1	1	1
	20-30 km	1.06 *	0.98	1.01	1.03	0.96
	30-50 km	0.93 *	0.77 ***	0.89 ***	0.98	0.84 ***
	50-90 km	1.11 **	0.81 ***	1.08	1.13 **	0.96
	>90 km	1.31 ***	0.93	1.28 ***	1.30 ***	1.08
Municipality type, workplace	Stockholm city		1			
	Suburbs to Stockholm		0.32 ***			
	Large cities		1.00			
	Suburbs to large cities		0.59***			
	Commuter municipalities		0.45***			
	Tourism municipalities		1.18			
	Goods-producing municipalities		0.63 ***			
	Municipalities in a densely-populated region		0.66 ***			
Municipality type, residence	Stockholm city		0.90 *			
	Suburbs to Stockholm		1			
	Large cities		1.16 **			
	Suburbs to large cities		1.32 ***			
	Commuter municipalities		1.26 ***			
	Tourism municipalities		1.33 ***			
	Goods-producing municipalities		1.41 ***			
	Municipalities in a densely-populated region		1.17 *			
Excess tax rate	Residence municipality			1.002 ***		
	Workplace municipality			0.998 ***		
New dwellings and workplaces	New dwelling in the workplace municipality				1.0276 ***	
in 100:s	New workplace in the residence municipality				0.9977 ***	
Accessibility and taxation	Taxation value residence municipality					1.00004
in 1000:s	Accessibility residence municipality					0.9989 ***
	Taxation value workplace municipality					0.9988 ***
	Accessibility workplace municipality					1.0043 ***
Loglikelihood		-173441	-169395	-170227	-168277	-168870
Number of obs		498766	498766	492303	492303	492303
Baseline frequency	1 year commuting	0.017	0.024	0.015	0.012	0.041
	2 years	0.014	0.020	0.013	0.010	0.034
	3 years	0.013	0.018	0.011	0.009	0.031
	4 years	0.011	0.016	0.010	0.008	0.027
	5 years	0.010	0.014	0.009	0.007	0.024
	6 years	0.009	0.013	0.008	0.006	0.022
	7 years	0.009	0.013	0.008	0.006	0.022
	8 years	0.008	0.011	0.007	0.005	0.018
	9 years	0.007	0.010	0.006	0.005	0.018
	10 years	0.008	0.011	0.007	0.005	0.019

Note: significance levels indicated at * 5%, **1%, or ***0.1%

Source: Swedish register data, authors' own calculations

Migration

At first it is found that the relative risks for the individual variables have the same gradients for all models. There is one exception and that is commuting distance, when introducing municipality type or accessibility, the longest commuting distance – more than 90 kilometers – is not significantly different from the other distances. Greater job accessibilities outreach the distance.

When looking at the variable "municipality type of work place" in Model 1 the migration risks are highest for Stockholm city and the Large cities and the Tourism municipalities. This means that municipalities in these types have a higher relative risk to have people migrating to them if already the work-place is situated there. Suburbs to Stockholm have the lowest relative risk, that is having a work-place in this type of municipality does not attract people to move there.

When looking at the municipality of residence Stockholm city has the lowest relative risk of migration, thereafter the Suburbs of Stockholm. Municipalities of other types have higher risks, especially Goods-producing municipalities. This means that those who live in Stockholm and its suburbs to a less degree migrate than those in other municipalities. Given a residence in Stockholm you are less hearted to leave it, which could be caused by a tight housing market.

Therefore it seems to be a tendency for commuters – taking other factors in account –to favor Stockholm or Large cities when becoming a non-commuter.

Model 2 shows that higher excess tax rate in the municipality of residence increases the risk of migration and a higher excess tax rate in the municipality of workplace decreases the risk of migration. The directions are as expected. Although the relative risks are very low they are significantly different from 1.

Model 3 shows that new dwellings in the workplace municipality increase the propensity to migrate to it and new workplaces in the residence municipality decrease the propensity to migrate from the residential municipality. The directions are as expected.

Model 4 shows that taxation values on houses in the residence municipality increase the propensity to migrate from the municipality, but not significantly. But the higher the accessibility the lower the propensity to migrate from the municipality. And when looking at the conditions in the workplace municipality higher taxation values there decreases the propensity to migrate to it and higher accessibility increases the propensity. This is in accordance with findings on the macro level.

Table 8 Propensity for commuters to change workplace to become non-commuter, relative risks for different covariates, and baseline frequencies for duration of commuting,2006, the Mälar Region

		Model 0	Model 1	Model 2	Model 3	Model 4
Gender	Male	1	1	1	1	1
	Female	1.01	1.03 *	1.02	1.02	1.02
Age	16-19	1.10 *	1.11 *	1.11 *	1.13 *	1.11 *
	20-24	1.05	1.04	1.05	1.05	1.05
	25-29	1.03	1.00	1.02	1.01	1.01
	30-34	1.00	0.98	0.99	0.98	0.99
	35-39	1	1	1	1	1
	40-64	0.93 ***	0.90 ***	0.92***	0.92 ***	0.92 ***
	65-74	0.86 **	0.87 **	0.84 **	0.86 **	0.87 *
Family position	Married/cohab w child	1	1	1	1	1
	Single w child	1.21 ***	1.17 ***	1.19 ***	1.16 ***	1.16 ***
	Single no child	1.08 ***	0.96 **	1.02	0.96 **	0.99
	Child	0.87 ***	0.88 ***	0.87 ***	0.86 ***	0.88 ***
Wage	Wage q1	1	1	1	1	1
	Wage q2	0.81 ***	0.81 ***	0.81***	0.81 ***	0.81 ***
	Wage q3	0.68 ***	0.67 ***	0.67 ***	0.67 ***	0.68 ***
	Wage q4	0.61 ***	0.60 ***	0.61 ***	0.61 ***	0.62 ***
	Wage q5	0.57 ***	0.57 ***	0.57 ***	0.57 ***	0.60 ***
Education	primary and lower secondary	0.98	0.98	1.00	0.97	0.97
	upper secondary	1	1	1	1	1
	post-secondary	1.05 ***	0.98	1.00	0.99	1.03 *
	post graduate	0.95	0.82 ***	0.88 *	0.82 ***	0.88 *
Commuting distance	<10km	1.14 ***	0.95 *	1.03	0.96	1.05 *
	10-20km	1	1	1	1	1
	20-30 km	1.02	1.05 **	1.10 ***	1.09 ***	1.04 *
	30-50 km	1.19 ***	1.12 ***	1.31 ***	1.32 ***	1.28 ***
	50-90 km	1.61 ***	1.36 ***	1.80 ***	1.88 ***	1.85 ***
	>90 km	2.17 ***	1.64 ***	2.30 ***	2.48 ***	2.46 ***
Municipality type, workplace	Stockholm city		1			
	Suburbs to Stockholm		1.03			
	Large cities		1.01			
	Suburbs to large cities		1.01			
	Commuter municipalities		0.94 **			
	Tourism municipalities		1.32 ***			
	Goods-producing municipalities		0.89 *			
	Municipalities in a densely-populated region		1.24 ***			
Municipality type, residence	Stockholm city		2.70 ***			
	Suburbs to Stockholm		1			
	Large cities		2.21 ***			
	Suburbs to large cities		0.92			
	Commuter municipalities		1.28 ***			
	Tourism municipalities		1.49 ***			
	Goods-producing municipalities		1.56 ***			
	Municipalities in a densely-populated region		1.52 ***			
Excess tax rate	Residence municipality			0.997 ***		
	Workplace municipality			1.001 ***		
New dwellings and workplaces	New dwelling in the workplace municipality				0.9950 ***	
in 100:s	New workplace in the residence municipality				1.0041 ***	
Accessibility and taxation	Taxation value residence municipality					0.9996 ***
in 1000:s	Accessibility residence municipality					1.0031 ***
	Taxation value workplace municipality					1.0001 ***
	Accessibility workplace municipality					0.9988 ***
Loglikelihood		-173441	-169395	-170227	-168277	-168870
Number of obs		498766	498766	492303	492303	492303
Baseline frequency	1 year commuting	0.156	0.116	0.207	0.132	0.169
	2 years	0.115	0.089	0.155	0.099	0.126
	3 years	0.099	0.076	0.133	0.085	0.108
	4 years	0.085	0.066	0.114	0.074	0.093
	5 years	0.072	0.056	0.097	0.063	0.079
	6 years	0.067	0.054	0.092	0.060	0.075
	7 years	0.063	0.053	0.088	0.058	0.072
	8 years	0.056	0.047	0.077	0.052	0.064
	9 years	0.053	0.044	0.072	0.048	0.060
	10 years	0.050	0.043	0.069	0.047	0.058

Note: significance at * 5%, **1%, or ***0.1% levels. Source: Swedish register data

Change of work-place

The individual variables have the ”same” values for all models. When looking at the municipality type of the work-place, that is the work-place to leave, there are not any differences except for Tourism municipalities and for Municipalities in densely populated regions with higher relative risks. The Tourism municipalities thus have higher risks both of changing workplace for those commuting to the municipality and risks that commuters migrate to the municipality to become a non-commuter. This implies that the employment seems to be very unstable.

When looking at the municipality type of residence, that is in which municipality the new work-place is found, Stockholm city has the highest risk, followed by the Large cities. Lowest risks are found for Suburbs.

An increase in excess tax rate in the municipality of residence decreases the propensity to change workplace to the residence municipality, whereas an increase in the workplace municipality increases the propensity.

New dwellings in the workplace municipality decrease the propensity to change workplace. It can be interpreted such that the commuter can later become non-commuter by migration to the workplace municipality. New workplaces in the residence municipality increase the propensity to change workplace, to become a non-commuter in the municipality of residence.

The propensity to change workplace decreases with job accessibility in the workplace municipality and taxation values in the residence municipality, and increases with the job accessibility in the residence municipality and the taxation value in the workplace municipality. This is the opposite situation as for migration. For a commuter considering stopping commuting the two municipalities are competitors.

Table 9 Propensity for commuters to change both residence and workplace to become non-commuter, relative risks for different covariates, and baseline frequencies for duration of commuting, 2006, the Mälar Region

		Model 0	Model 1	Model 2	Model 3	Model 4
Gender	Male	1	1	1	1	1
	Female	1.03	1.04	1.04	1.04	1.03
Age	16-19	1.48 **	1.44 *	1.55 **	1.50 **	1.54 **
	20-24	2.35 ***	2.31 ***	2.38 ***	2.35 ***	2.38 ***
	25-29	2.08 ***	2.08 ***	2.09 ***	2.09 ***	2.09 ***
	30-34	1.61 ***	1.62 ***	1.63 ***	1.64 ***	1.64 ***
	35-39	1	1	1	1	1
	40-64	0.56 ***	0.56 ***	0.56 ***	0.55 ***	0.56 ***
	65-74	0.22 ***	0.22 ***	0.23 ***	0.23 ***	0.22 ***
Family position	Married/cohab w child	1	1	1	1	1
	Single w child	1.49 ***	1.49 ***	1.50 ***	1.51 ***	1.51 ***
	Single no child	1.94 ***	1.96 ***	1.94 ***	1.99 ***	1.92 ***
	Child	1.54 ***	1.57 ***	1.52 ***	1.55 ***	1.52 ***
Wage	Wage q1	1	1	1	1	1
	Wage q2	0.87 **	0.86 **	0.87 **	0.86 **	0.87 **
	Wage q3	0.66 ***	0.66 ***	0.66 ***	0.66 ***	0.66 ***
	Wage q4	0.59 ***	0.60 ***	0.60 ***	0.61 ***	0.60 ***
	Wage q5	0.46 ***	0.48 ***	0.48 ***	0.49 ***	0.47 ***
Education	primary and lower secondary	0.88	0.88	0.87	0.89	0.89
	upper secondary	1	1	1	1	1
	post-secondary	1.53 ***	1.56 ***	1.54 ***	1.57 ***	1.50 ***
	post graduate	1.77 ***	1.85 ***	1.77 ***	1.86 ***	1.72 ***
Commuting distance	<10km	0.82 **	0.87 *	0.89	0.89	0.80 **
	10-20km	1	1	1	1	1
	20-30 km	0.98	0.97	0.96	0.96	1.03
	30-50 km	1.21 ***	1.19 **	1.13 *	1.09	1.21 **
	50-90 km	1.52 ***	1.61 ***	1.46 ***	1.41 ***	1.55 ***
	>90 km	2.24 ***	2.45 ***	2.14 ***	2.04 ***	2.30 ***
Municipality type, workplace	Stockholm city		1			
	Suburbs to Stockholm		1.74 ***			
	Large cities		1.29 ***			
	Suburbs to large cities		1.93 ***			
	Commuter municipalities		1.62 ***			
	Tourism municipalities		1.33			
	Goods-producing municipalities		1.38 *			
	Municipalities in a densely-populated region		1.60 **			
Municipality type, residence	Stockholm city		0.61 ***			
	Suburbs to Stockholm		1			
	Large cities		0.90			
	Suburbs to large cities		0.73 **			
	Commuter municipalities		0.86			
	Tourism municipalities		0.55 ***			
	Goods-producing municipalities		0.77 *			
	Municipalities in a densely-populated region		1.12			
Excess tax rate	Residence municipality			1.000		
	Workplace municipality			1.001 ***		
New dwellings and workplaces	New dwelling in the workplace municipality				0.98125 ***	
in 100:s	New workplace in the residence municipality				0.99815 ***	
Accessibility and taxation	Taxation value residence municipality					1.0002 ***
in 1000:s	Accessibility residence municipality					0.9994 **
	Taxation value workplace municipality					1.0002 ***
	Accessibility workplace municipality					0.9985 ***
Loglikelihood		-173441	-169395	-170227	-168277	-168870
Number of obs		498766	498766	492303	492303	492303
Baseline frequency	1 year commuting	0.006	0.004	0.005	0.007	0.005
	2 years	0.006	0.005	0.005	0.008	0.005
	3 years	0.005	0.004	0.004	0.007	0.004
	4 years	0.005	0.004	0.004	0.007	0.004
	5 years	0.004	0.003	0.004	0.006	0.004
	6 years	0.003	0.003	0.003	0.004	0.003
	7 years	0.003	0.003	0.003	0.005	0.003
	8 years	0.004	0.003	0.003	0.005	0.003
	9 years	0.003	0.003	0.003	0.004	0.003
	10 years	0.003	0.002	0.003	0.004	0.003

Note: significance at * 5%, **1%, or ***0.1% levels. Source: Swedish register data

Change of both residence and workplace

Compared to Stockholm city all municipalities have higher risks that their commuters will leave, both if commuters were residents or if they had work-place in the municipality.

To both migrate and change workplace increases with taxation values in both municipalities and decreases with job accessibility in both municipalities.

Comparison of models

The model with the maximum likelihood value is model 3 with supply of new dwellings and workplaces. (The number of observations is less in models 2-4 compared to model 1 as there are some new municipalities with no values.) This is interesting since this could give a hint of the answer to the research question – if a municipality should invest in dwellings or workplaces.

In Table 10 an illustration is made of consequences for the relative risks for a supply of 100 dwellings and workplaces respectively.

Table 10 Factorial change in the relative risks for 100 new dwellings respectively workplaces.

	Propensity to		
	Migrate	Change workplace	Both
Workplaces in the residence municipality	**0.998**	**1.004**	**0.998**
Dwellings in the workplace municipality	**1.028**	**0.995**	**0.981**

Source: Swedish register data, authors' own calculations

For 100 new workplaces in the residence municipality, the relative risk of migration decreases with a factor 0.998 and it increases the relative risk to change workplace with a factor 1.004. 100 new dwellings in the workplace municipality increases the relative risk to migrate to it by a factor 1.028 and decreases the relative risk to change workplace with a factor 0.995. Both dwellings and workplaces decrease the propensity to both migrate and change workplace. Looking at the size of the factors it is found that dwellings have the largest effect to increase the population in the municipality. This is for a region with a by comparison very large dominating workplace municipality, the metropolitan city of Stockholm.

Conclusions

Commuters are more mobile than non-commuters not only on a daily basis but also concerning migration and/or change of workplace. Changing workplace is the most frequent action or event to stop commuting. That event is very dependent on and decreasing with the time being a commuter. Migration is also decreasing with the time being commuter while both migration and change of workplace is almost independent on time being commuter when other variables are taken into account.

For migration the relative risks for different variables vary much for the demographic variables age and family status. At younger ages and with less family ties the relative risk of migration is higher as could be expected, more pronounced for women than for men. For the economic variables income and commuting distance there are no significant differences on the relative risk of migration.

For change of workplace it is the opposite, no influence on the relative risk for the age and family variables, but much lower relative risks with higher incomes and higher relative risks for longer commuting distances. There are no differences between men and women.

To both migrate and change workplace is not very frequent, but the relative risks vary for all variables and in this case also by education, with a higher relative risk for higher educational level. Women have much higher relative risks for younger ages and long commuting distance than men.

How the commuter is acting is in this study taken as an indication on the attractiveness of the municipalities. The ultimate goal is to increase the residential population, that is to have as little out-migration as possible of the residential population in this case commuters living in the municipality, and as much in-migration as possible of the working population, that is commuters changing workplace to be a non-commuter.

From the analysis shown above we can draw the conclusion that an employee who is a commuter has

- a higher risk to migrate to the municipality where the workplace is situated if the workplace municipality is Stockholm or a Large city or a Tourism municipality
- a higher risk to change workplace to the municipality of residence if the residence municipality is Stockholm or a Large city.

Therefore it seems to be a tendency for commuters – taking other factors into account –to favor Stockholm or Large cities when becoming a non-commuter.

Furthermore it is found that accessibility to workplaces has a positive impact on population growth, either to decreasing out-migration from the residential municipality or increasing in-migration to the work-place municipality. But higher accessibility will also create higher taxation values on houses, and that has a decreasing effect on residential population.

A supply of dwellings has a better effect than supply of workplaces. Higher tax rates have a negative effect on population growth when taking care of all individual effects of commuting.

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Appendix 1 Municipality categories

1 Metropolitans

Municipalities with more than 200 000 inhabitants.

In the Mälar Region: Stockholm

2 Metropolitan suburbs

Municipalities where more than 50 percent of the employed population commute to a workplace in another municipality. The most common workplace is a metropolitan.

In the Mälar Region:

- Upplands Väsby
- Vallentuna
- Österåker
- Värmdö
- Järfälla
- Ekerö
- Huddinge
- Botkyrka
- Salem
- Haninge
- Tyresö
- Upplands-Bro
- Täby
- Danderyd
- Sollentuna
- Nacka
- Sundbyberg
- Solna
- Lidingö
- Vaxholm
- Nynäshamn
- Håbo

3 Large cities

Municipalities with 50 000 – 200 000 inhabitants and with at least 70 percent living in urban areas.

Municipalities in the Mälar Region:

- Södertälje
- Uppsala
- Nyköping

- Eskilstuna
- Örebro
- Västerås

4 Suburbs to Large cities

Municipalities where more than 50 percent of the employed population commute to a workplace in another municipality. The most common municipality workplace should be one of the Greater cities.

Municipalities in the Mälar Region:

- Nykvarn
- Älvkarleby
- Knivsta
- Gnesta
- Trosa
- Lekeberg
- Kumla

5 Commuter municipalities

Municipalities where more than 40 percent of the employed population commute to another municipality.

Municipalities in the Mälar Region:

- Sigtuna
- Heby
- Vingåker
- Strängnäs
- Hallsberg
- Degerfors
- Nora
- Skinnskatteberg
- Surahammar
- Kungsör
- Hallstahammar
- Norberg

6 Tourism municipalities

Municipalities where the number of guest-nights at hotels, hostages and camping exceeds 21 per inhabitant or where the number of cottages exceeds 0,20 per inhabitant.

Municipalities in the Mälar Region:

- Norrtälje
- Östhammar

7 Goods-producing municipalities

Municipalities where more than 34 percent of the employed population aged 16-64 are employed in industry of mining, energy and environment and construction.

Municipalities in the Mälar Region:

- Tierp
- Oxelösund
- Laxå
- Ljusnarsberg
- Askersund
- Karlskoga
- Lindesberg
- Fagersta
- Köping
- Arboga

8 Rural municipalities

Municipality with less than 70 percent of its population in urban areas and less than eight inhabitants per square kilometer.

No municipalities in the Mälar Region

9 Municipalities in a densely-populated region

Municipality with more than 300 000 persons within a radius of 112.5 kilometers.

Municipalities in the Mälar Region

- Enköping
- Flen
- Katrineholm
- Hällefors
- Sala

10 Municipalities in a low population dense region

Municipality with less than 300 000 persons within a radius of 112.5 kilometers.

No municipalities in the Mälar Region.

Appendix 2 Municipality variables

Municipality	Average of weighted accessibility, number of workplaces 2003	Average taxation value for houses 2005, 1000 SEK	Average change of employment 2005-2006	Total supply of dwellings, average 2002-2006	Local tax rate 2005 , percent
Upplands Väsby	153 006	1305	-449	142	31.85
Vallentuna	123 299	1317	369	200	31.45
Österåker	131 499	1297	276	263.4	32.15
Värmdö	104 680	1557	721	198.8	32.73
Järfälla	198 039	1456	621	199.4	31.4
Ekerö	105 718	1508	-245	134	31.5
Huddinge	237 441	1450	988	244	32.5
Botkyrka	183 135	1118	1941	252.6	32.4
Salem	141 880	1142	119	72.8	32.4
Haninge	174 720	1218	155	218	32.35
Tyresö	198 725	1525	304	156	31.9
Upplands-Bro	122 441	1179	290	101	31.85
Nykvarn	113 870	1072	40	57.6	32.22
Täby	179 845	1962	-71	153.8	30.55
Danderyd	223 321	3307	163	76	30.7
Sollentuna	215 109	1905	320	180	30.95
Stockholm	385 047	1842	21021	2639	30.35
Södertälje	113 870	1073	1514	240.6	32.4
Nacka	210 448	2169	2224	467.6	30.93
Sundbyberg	351 983	2299	1749	50.2	31.55
Solna	355 934	2645	1952	597.6	29.85
Lidingö	227 260	2904	596	133.6	31.64
Vaxholm	128 046	2121	-101	63	32.15
Norrtälje	78 196	798	334	127.2	32.39
Sigtuna	128 142	1410	-412	145.8	32.6
Nynäshamn	43 574	974	-354	88.2	32.1
Håbo	50 677	1057	128	101.8	32.2
Älvkarleby	8 190	403	-54	10.2	33.05
Knivsta	75 324	1081	261	84	31.87
Heby	11 832	364	211	9.6	32.27
Tierp	21 150	402	-145	7.6	31.45
Uppsala	75 324	1195	3550	899.8	31.9
Enköping	31 684	767	-167	121.2	31.35
Östhammar	16 374	531	204	19.2	32.55

Municipality	Average of weighted accessibility, number of workplaces 2003	Average taxation value for houses 2005, 1000 SEK	Average change of employment 2005-2006	Total supply of dwellings, average 2002-2006	Local tax rate 2005 , percent
Vingåker	5 899	412	85	1.4	31.5
Gnesta	25 017	713	107	44.4	31.8
Nyköping	12 579	686	633	119.2	31
Oxelösund	10 639	643	126	7.4	31
Flen	8 775	491	-48	10.4	31.1
Katrineholm	11 102	590	132	13	31.25
Eskilstuna	22 168	691	1794	163.2	31.7
Strängnäs	33 042	863	-641	111.8	30.5
Trosa	25 971	943	125	59.6	31.4
Lekeberg	12 488	399	27	7	31.9
Laxå	6 569	327	-176	0	32.75
Hallsberg	16 095	391	-205	3.4	32.1
Degerfors	7 019	303	-140	1	32.55
Hällefors	2 013	228	-66	1.6	32.6
Ljusnarsberg	2 715	196	-71	1.8	32.1
Örebro	37 665	796	2387	350.2	31.9
Kumla	22 001	546	77	42	31.1
Askersund	7 895	367	43	6.8	32.4
Karlskoga	11 153	441	317	27.4	32.1
Nora	9 346	424	60	4.8	32.6
Lindesberg	11 871	340	120	2.4	32.35
Skinnskatteberg	2 368	279	-169	1.4	32.17
Surahammar	12 469	419	-18	8.2	32.47
Kungsör	10 956	459	249	2	32.19
Hallstahammar	18 803	537	55	25.8	31.97
Norberg	3 326	321	18	0.2	32.82
Västerås	36 639	896	986	514.2	30.77
Sala	10 522	468	234	12.6	32.47
Fagersta	6 773	336	61	1.6	32.57
Köping	15 475	525	74	13.4	32.32
Arboga	9 590	541	-58	4.6	32.02