Demography in LINE
- Migration Patterns

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Abstract:
In order to be able to analyse the incentives for rural municipalities to support an offensive politics on nature preservation, a demographic model with the focus on migration, is built up. By including this model into LINE, a regional macro economic model, it is possible to carry out model calculations to judge upon the effects on disposable income, employment, production etc. The focus is upon people's incentives to move to municipalities with a "green profile", and the effects of this.

1. Introduction

To estimate the rural municipalities' economic incentives to support an offensive politics on nature preservation, the consequences of such initiatives for disposable income, employment, production etc. will be analysed. A "green profile" can influence the migration pattern and attract new citizens to a municipality. By building up a demographic model including migrations and including it into the macroeconomic model LINE, built up at municipality level, those consequences can be analysed.

The focus in this paper is on the construction of the demographic model with special attention to the migration model. The inclusion of the model in LINE is only shortly described, but will be further described elsewhere, as will the policy experiments carried out.

In Denmark, several analyses of migration patterns exist, focussing on different themes, and using different theories and econometric methods. An example is Hummelgaard et al. (1995), focussing on ethnic minorities. Another example is Graversen et al. (1997) looking at rural districts. Here, a detailed description of migration to and from rural municipalities is given. For example, the migration pattern of young people in the process of education is studied. In Kristensen and Henry (1998) migration is analysed in connection with location of firms, with a special focus on the connection between centre municipalities and surrounding areas. Also, the importance of different characteristics of the municipalities is investigated. In Dilling-Hansen and Smith (1996) the regional mobility is looked upon. The importance of different labour-market characteristics, e.g. the number of vacant jobs and the share of long-term unemployed people in a region, is described. Also some spatial variables are used in the analysis, e.g. the distance between two regions.

Also some more traditional demographic studies, with less focus on economy and econometric analysis, exist. Examples are Illeris (1996) and Illeris (2000). In the former, the migration behaviour between the counties in Denmark, including the development since the 1950s, is described. Until the 1970s there was a net migration to Copenhagen, followed by a net migration from Copenhagen in the 1970s and 1980s. The pattern seems to be reversed in the 1990s, which is further analysed in the latter article.

As reflected by the above Danish analyses, there are different theoretical angles to understand migrations. Some different theories are described in Gelting (1992) and Isserman et al. (1986). According to the *neoclassical theory,* migrations occur due to differences in wages and differences in job opportunities. According to *human capital theory* migration is an investment in one's productivity similarly to education. Besides the increased productivity there are other advantages and disadvantages due to migration, for example moving costs, distance to friends and family etc. These changes can be included in the human capital theory as well. Migrations can also be explained by the so-called *search theory*. Here, individuals' choices of job are described when full information on jobs and wages does not exist, so that people have to search for the information. Individuals can move either to increase their job possibilities or after they have found and accepted a job. Finally, migrations have often been described using the so-called *gravity models.* They stem from physics and are thus not built upon economic theory. The main focuses in the gravity model are the importance of distance - and push and pull factors. Later on similar - and extended - models are, however, derived using economic stochastic utility theory, sometimes called discrete choice models. This includes, e.g. the logit model, further described below. In the model frame different explanations and theories for migration can be included, via the push and pull factors. These models are often denoted *spatial interaction models.*

Here, the goal is to construct a migration model to be included in a demographic model, which in the end can be included in the regional economic model LINE. Theory and method are chosen in order to fulfil this goal. In the demographic model equations for change of status, migrations, births, deaths etc. are set up for a single year. Using linear coefficients, the model can be used for analyses and extrapolations. To reflect migration behaviour, migration coefficients between the municipalities will be estimated, from different characteristics of the municipalities. Some might represent whether a municipality has nice recreational areas, e.g. forest, while others might represent other characteristics, e.g. housing costs. The importance of the recreational characteristics can give a hint on the consequences of offensive policy on nature preservation in a municipality.

It is important to notice that the objective is *not* to make a general econometric analysis, examining all different explanations for choice of migration destinations. The objective is, as described, to set up a migration model, and to include it into a demographic model to be integrated in LINE. By that, the econometric analysis is a tool to give proper estimates of migration behaviour, leaving room for, e.g. exclusion of improper variables.

A spatial interaction model, i.e. the logit model, will be used as a model frame for the estimations. It is described in further detail in section 2.3. The use of a spatial interaction model to handle migration in connection with population forecasts is recommended by

Kupiszewski and Rees (1999). Similar studies have been carried out several times. For example, in Anas (1982) it is demonstrated that discrete choice models are suitable for housing demand analyses. There, however, the focus is on the distance to workplace, implying that commuting data are used for the estimations. In other contributions, commuting and migration are analysed jointly using discrete choice models. An overview is given in Evers (1989). But discrete choice models are also used for migration analyses only. In Stambøl et al. (1998) a migration model in the regional economic model REGARD for Norway, using the logit approach, is described. Also, some policy analyses are carried out. In Fotheringham and O'Kelly (1989) spatial interaction models are used for analyses of migrations in the United Kingdom and The Netherlands. The logit model has also been used in connection to the importance of environmental conditions for migration, as in Amacher et al. (1998). Here migration in the Philippines is analysed, with the focus on migration to uplands with land that can be converted to agriculture. Even though the situation and the economy in the Philippines are quite different from Denmark, the method employed is quite similar, and inspiration to explanatory variables can be found.

The entire LINE model is described in section 2, as is the demographic model within the LINE model with special focus on the migration model. The data used for the analysis are described in section 3. This includes descriptive variables as well as different key numbers from the demographic model. The estimations carried out for the migration model are described in section 4, while section 5 concludes.

2. Description of the Model

2.1 LINE

LINE is a macro economic model for Denmark. In it, the economic activities in all Danish municipalities are described. It rests upon AKF's regional economic data bank (SAM-K). The model is described in further detail in Madsen et al. (1999). In the applied version of LINE income, production, consumption etc. are determined in a Keynesian demand circle. The model has previously been used for different analyses, for example on changed welfare politics (Dam et al., 1997), structures in the agricultural sector (Jensen, 1998) and increased public consumption in the western part of Denmark (Andersen, 2000).

All activities are assigned to a geographical locality - either place of work, place of residence or place of demand. Besides, all activities are characterised according to a type, for example sector, educational level or consumption component.

The demographic model to be included in LINE is developed on the basis of Madsen (1999). It should be considered an independent unit. The population in the beginning of the year is given exogenously. The different transformations are carried out and give rise to the population at the end of the year. The interaction with the remaining part of LINE is (at least) in two different places. First, when the migration patterns are to be described, different characteristics from LINE can be used. For example, the unemployment rate in the municipalities will possibly influence the migration pattern. Second, the population at the end of the year as determined in the demographic model, gives rise to labour force used further in LINE for determination of unemployment. That is, the demand for labour (employment) is given in LINE, while the supply of labour (labour force) is given in the demographic model. The number of unemployed is determined as the residual.

2.2 The Demographic Model in LINE

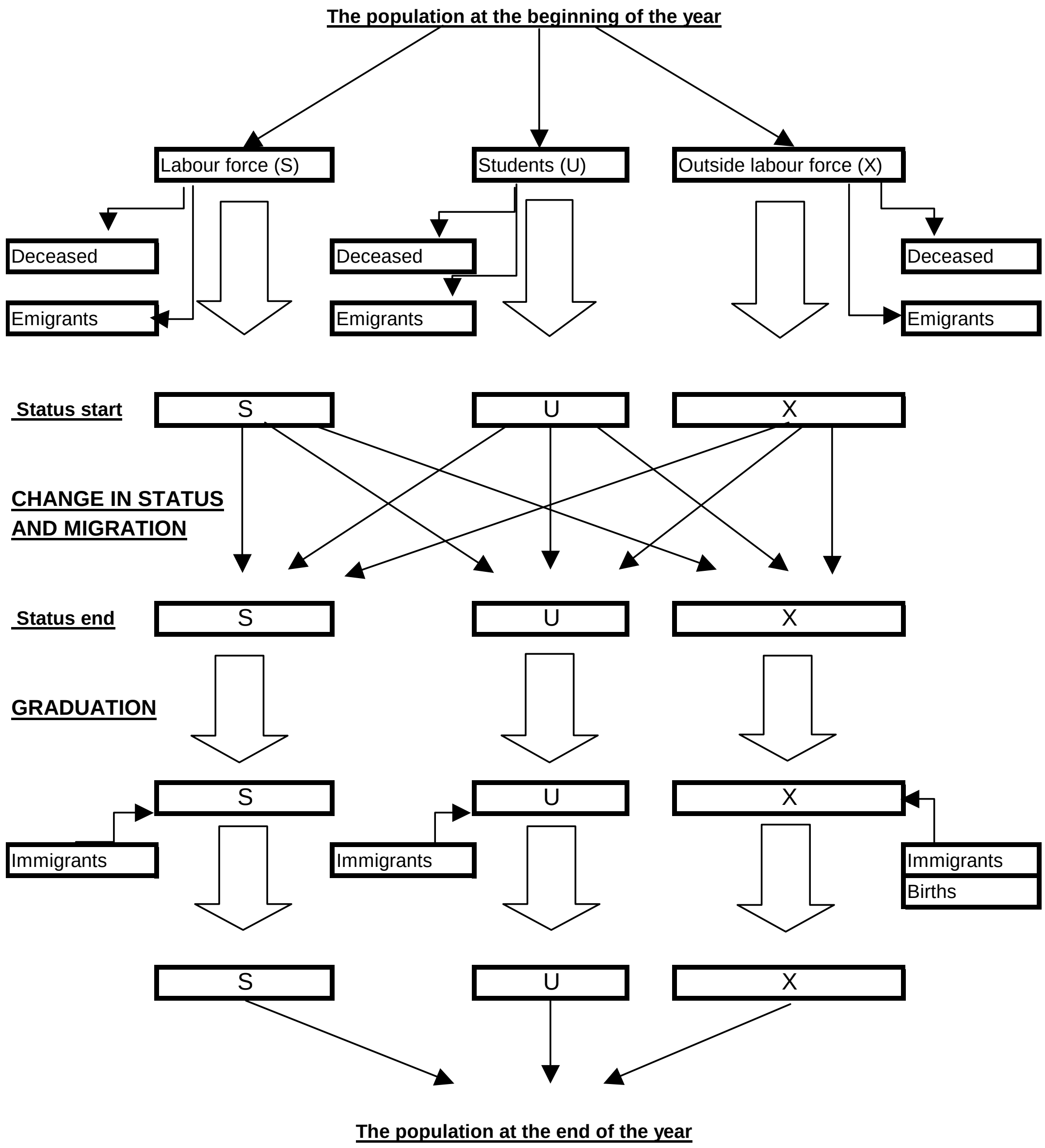
In order to be able to describe the population and its composition, and to analyse the connection between the population and the economy, a demographic model is built up and introduced into LINE. The fundamental structure of the demographic model is illustrated in figure 1. The description is valid for a single year. When more years are to be connected, some further equations are necessary, i.e. on the aging of the population.

For a single year, the model's starting point is the population at the beginning of the year. The population is divided into three groups, i.e. the labour force s, the students u and the persons outside the labour force x. The labour force encompasses employed and unemployed persons. A person can only be in one group at a time, and the student group dominates, meaning that a student who has a (part time) job is only placed in the group of students, u.

First, the deceased and the emigrants are subtracted from each group. Following that, changes in status are in focus. Some people in the labour force stay there, while others in the labour force people leave it, for example because they retire or begin an education. Similar changes occur for the two other groups. Therefore, in each group there will be an entrance from and an exit to the two other groups.

Figure 1: The demographic model in LINE

The demographic model



The next step in the model is migration within Denmark during the year. Migration is analysed for all nine different groups changing status as just defined. By that, the migration intensity and pattern are connected to the change in status. Migration is modelled in two steps. First, probabilities for whether people migrate or not, are determined. Second, probabilities for migration destination *given* migration are determined. Estimations are only carried out for the latter (the former coefficients are assumed to be constant).

If a person moves more than once during the year, it is not analysed in the model, since the model catches only the change from the first to the last place of residence in the year, and not all the migrations in between. Furthermore, since the geographical level of the demographic model is the municipality level, migration is defined as a move between two different municipalities, while moves within municipalities are ignored in the analysis. According to the numbers in Dilling-Hansen and Smith (1996) the local moves constitute a significant share of the total number of moves. From a labour market point of view, the moves within the municipalities are of smaller interest though, since they seldom are connected to a job move.

After the changes in status and the migration, graduation is determined. Graduation is when the highest level of education changes from the beginning to the end of the year.

Now, immigrants are added to each group while the new-borns only enter the group with persons outside the labour force, since a new-born child per definition belongs to this group (and not to the labour force or the group of students). Finally, at the end of the year the population is given as the sum of persons in each of the groups.

All the calculations are made for each municipality and for a number of age groups, male and female and a number education groups.

The number of immigrants and the live-born only count persons who live in Denmark at the end of the year. By that, persons who are born in or immigrate to Denmark during the year, but die or leave the country before the end of the year, do not count as born or immigrated persons in the model. Similarly, the deceased and emigrants only count the persons present in Denmark in the beginning of the year - and by that not new-borns or immigrants.

2.3 Migration Model

As described above, a migration model is included in the demographic model. The model reflects the migration pattern between the Danish municipalities for nine different groups, representing the changes in status. That is the shifts between the labour force, the student group and the group encompassing those outside the labour force (e.g. pensioners and children). These groups are further divided into a number of age groups, male and female and a number education groups.

As noted above, the logit model is used as the frame for the migration model. The logit model can be derived via stochastic utility functions. For a thorough derivation of the logit model, see for example Anas (1982) or Ben-Akiva and Lerman (1985). In the situation looked upon here, a utility function is assumed for the segment of individuals initially living in municipality *a*. The utility obtained by moving to municipality *b* is given by

$$U_a(b) = V_a(b) + \mu_{ab} \tag{1}$$

where $V_a(b)$ is the part of the utility function, which is deterministic with exogenous variables as arguments, while μ_{ab} is a stochastic part. By assuming that the stochastic parts are independent and identically distributed with the Weibull distribution, this model comes up:

$$p_a(\bar{b}) = \frac{\exp(V_a(\bar{b}))}{\sum_b \exp(V_a(b))} \tag{2}$$

where $p_a()$ is the probability of choosing to migrate to the specific municipality for an individual initially living in municipality *a*. The deterministic part of the utility model, $V_a(b)$, is assumed to be a linear function of several characteristics of the choice, for example distance and local tax level. Assuming that the parameters in the utility function are equal for all municipalities, the deterministic part of the utility function becomes:

$$V_a(b) = \sum_{i=1}^{I_1} \beta_i x_{iba} + \sum_{i=I_1+1}^{I} \beta_i x_{ib} \tag{3}$$

Here, the first I_1 variables depend on the municipality where the individual migrates *from* as well as the municipality the individual migrates *to*; an example is distances. The remaining variables depend only on the municipality migrated *to*, an example is the amount of forest.

No constant is included in the utility function, since terms that do not differ between the alternatives fall outside the probability (cf. Greene 1990). Constants varying with the alternatives can be included. If enough alternative specific constants are included, the model becomes doubly constrained in the sense that the estimated probabilities will equal the observed. An example using this approach is given in Berglund and Lundqvist (1998).

When deriving the logit model, it is, as mentioned above, assumed that the stochastic terms are independently and identically distributed with the Weibull distribution. A consequence of these assumptions is the *independence of irrelevant alternatives*, which states that the ratio of probabilities between two alternatives only depends on the characteristics of these two alternatives. This characteristic is critical for model use, and has led to several extensions of the logit model, in order to handle it. One example is the nested logit model. Another alternative is to use the probit model instead. For a discussion, see e.g. Ben-Akiva and Lerman (1985). Due to computational tractability the standard logit model is, however, used in this application, despite the complications.

As formulated above, individuals choose to migrate to a municipality. In reality, however, individuals choose to migrate to a dwelling in a municipality. When the municipalities differ in size, this is critical. The problem is taken into account by Rietveld and van Ommeren (1989). The model they derive corresponds to a situation where individuals first choose a municipality and then secondly a dwelling within this municipality. The resulting model is:

$$p_a(\bar{b}) = \frac{N_{\bar{b}} \exp(V_a(\bar{b}))}{\sum_b N_b \exp(V_a(b))} \qquad (4)$$

where N_b is the number of alternatives available in municipality b. The best measure would be the number of dwellings. As a close approximation, the total number of households in a municipality is used.

By using this model, it is secured that the probability of preferring a municipality increases if the number of dwellings is large, which is reasonable. It is easy to incorporate this extension, since the formulation alternatively can be stated as:

$$p_a(\bar{b}) = \frac{\exp(\ln(N_{\bar{b}}) + V_a(b))}{\sum_b \exp(\ln(N_b) + V_a(b))} \qquad (5)$$

The extended model can thereby be estimated simply by taking the logarithm of the number of alternatives (households), including it in the model and fixing the parameter to one.

3. Data

An important part of the model construction consists of data work, i.e. to obtain the appropriate data and to organise them correctly. Different data sources and some key numbers are presented in the following section.

In section 3.1 key numbers for the demographic model are presented in order to give an overall impression of the patterns. In section 3.2 the explanatory variables are presented and discussed.

3.1 Key Numbers

Different registers in Statistics Denmark are the main source for the demographic model, i.e. registers of for example education, population and the labour market. Initially, the demographic model is set up for one year only, i.e. 1996. One should take care when interpreting the different numbers and patterns. As pointed out by Rees et al. (1996) it is important to have both a long and a short term perspective in order to capture and understand all aspects of migration behaviour.

At the beginning of 1996, the total population was 5,250,629 persons. 550,266 of these were students, 2,492,777 were in the labour force while 2,207,586 were outside the labour force. In table 1, the developments of the three aggregate groups are shown.

Table 1: The population in Denmark, 1996

	Students	Labour force	Outside labour force	Total
Population, January 1996	550,266	2,492,777	2,207,586	5,250,629
Correction	-21	-161	-189	-371
Emigrants	6,161	9,602	12,556	28,319
Deceased	275	7,181	53,176	60,632
To *student* group	327,184	98,720	120,405	546,309
To *labour force* group	184,026	2,249,428	79,285	2,512,739
To *outside labour force* group	32,599	127,685	1,941,975	2,102,259
Immigrants	4,826	13,563	27,975	46,364
Births	-	-	67,450	67,450
Population, December 1996	551,135	2,526,302	2,197,684	5,275,121

Due to the definitions in the demographic model as described in section 2.2, these numbers cannot directly be compared to published numbers (as in, e.g. Statistics Denmark, 1998). This is so for example for new-borns, since only new-borns alive and living in Denmark at the end of the year are included in the numbers above.

The aggregate numbers as described in table 1, only reflect a tiny part of the numbers in the demographic model. In the model similar numbers exist for each municipality in Denmark (of which there are 275).

Data on the propensity to migrate (according to the definitions in this model stated in section 2.2) are shown in table 2. The individuals are partitioned into the nine groups estimated on, i.e. the groups on varying status at the beginning and at the end of the year.

Children (i.e. those between 0-14 years of age) are excluded.

Table 2: The migration intensity, 1996. Adult population (0-14-year-old excluded)

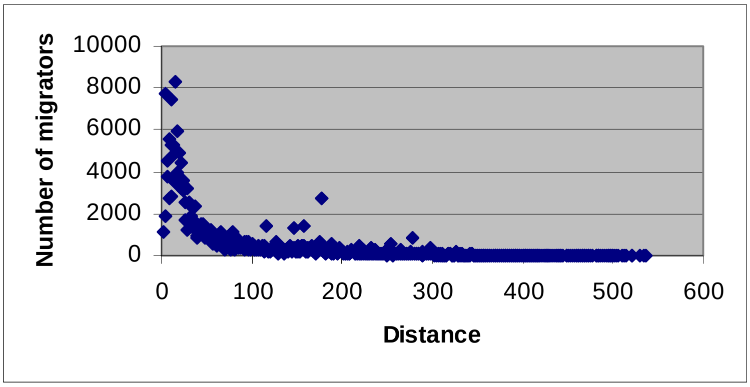
Status at the beginning of the year	Status at the end of the year	Persons able to migrate in the model [1]	Persons migrating [2]	Persons migrating (per cent)
Labour force	Labour force	2,246,971	104,391	4.65
Student	Labour force	184,026	28,377	15.42
Outside labour force	Labour force	73,975	7,378	9.97
Labour force	Student	92,587	13,593	14.68
Student	Student	327,171	31,671	9.68
Outside labour force	Student	71,404	6,133	8.59
Labour force	Outside labour force	126,432	8,069	6.38
Student	Outside labour force	32,597	4,406	13.52
Outside labour force	Outside labour force	1,141,729	25,320	2.22
Total adult population		4,296,892	229,338	5.33

Note: Christiansø is excluded.
1) I.e. the population at the beginning of the year minus deceased and out-migrants.
2) I.e. the persons living in another municipality at the end of the year than at the beginning.

It is seen that in average 5.33 per cent of the population migrated between municipalities in 1996. The share is lowest for those either staying in the labour force or outside the labour force (4.65 and 2.22 per cent respectively). They are the largest groups, comprising nearly 80 per cent of the adult population. The migration propensity is substantially larger in some of the smaller groups, especially the groups where the individuals shift from labour force to students or the other way around (the shares are 14.68 and15.42 per cent respectively). Also the group containing the shift from students to outside the labour force has a high share of migrators, i.e. 13.52 per cent.

Using distances between municipalities (as defined in section 3.2) the average migration distance (counting migrations as described above) can be determined to be 65 km. The distribution of migration distances is shown in figure 2. Here, the number of migrators are plotted to migration distance. There is a clear pattern showing many short-distance migrations and fewer migrations the longer the distance. There are a few outliers though, representing migrations between pairs of large municipalities. The typical migration distance is therefore much smaller than the average distance.

Figure 2: Distribution of migration distances



Of special interest is the migration pattern to and from rural districts. In table 3 the migration pattern between rural municipalities, urban municipalities and the metropolitan region is shown. The shares of out-migration to the different types of municipalities are calculated and shown in the table as well. The metropolitan region is here defined as Copenhagen with suburbs,[i] while rural municipalities are those with less than 3,000 inhabitants in the largest town within the municipality. The remaining municipalities are defined as urban municipalities.

[i] I.e. København, Frederiksberg, the municipalities in Københavns Amt plus Allerød, Birkerød, Farum, Fredensborg-Humlebæk, Hørsholm and Karlebo in Frederiksborg Amt, and Greve and Solrød in Roskilde Amt (cf. a division from Statistics Denmark (*Geokode 1*)).

Table 3: Migrations between different types of municipalities in 1996. Adult population

To From	Metropolitan Region	Urban Municipalities	Rural municipalities	Total
Number of migrations				
Metropolitan region	49,138	16,687	4,332	70,157
Urban municipalities	22,044	75,007	24,313	121,364
Rural municipalities	4,057	26,987	6,773	37,817
Total	75,239	118,681	35,418	229,338
Shares of out-migration				
Metropolitan region	0.70	0.24	0.06	1.00
Urban municipalities	0.18	0.62	0.20	1.00
Rural municipalities	0.11	0.71	0.18	1.00
Total	0.33	0.52	0.15	1.00

Note: Christiansø is excluded.

It is seen that there was a net migration *to* the metropolitan region, and *from* the rural municipalities in 1996, while there has been out-migration from the urban and rural municipalities. In general, there are major flows also in the opposite directions, indicating the necessity of analysing not only net flows, but gross flows. Looking at the shares, it is seen that approximately two thirds of the migrations starting in the metropolitan region also ends up here. There is more interaction between urban and rural municipalities. A possible explanation is of course that they are closer geographically.

3.2 Explanatory Variables in the Migration Model

As touched upon in the beginning, there is a broad range of different explanations for migration behaviour. In the spatial interaction model set up, the explanatory variables should reflect the different reasons. Argumentation for the included variables is given below as are specific definitions of the variables.

The different groups of migrators have different needs and different reasons for migration. Therefore, not all explanatory variables are included for all the groups of migrators, as will appear from the following.

The costs of migrations tend to be higher the longer the distance of the move. This is true for the money costs as well as for the social costs (loss of social networks, distance to family etc.). Furthermore, the knowledge of job opportunities, housing markets etc. at locations further away is typically smaller than the similar knowledge for locations nearby.

Therefore *distance* is included as an explanatory variable, with an expected negative sign.

When estimating the migration behaviour, the actual focal point is the *demand* for housing. In the demand for housing there is a trade-off between location qualities and housing costs, i.e. the housing prices. To reflect this fact, *housing costs* are included as an explanatory variable with an expected negative sign. The costs are per square metre per year and reflect three different markets: owner-occupied, private rented housing and subsidized housing. Especially for the owner-occupied housing, the prices of course reflect the quality of housing, implying that the price estimate could be positive. The inclusion of proper variables should hamper this to happen.

Most people wish to reside in nice surroundings, for example nearby recreational areas. The share of forest in the municipalities reflects recreational areas. The expected sign of the estimate is positive. The existence of forest is, however, to a certain degree correlated with non-centrality, implying that the estimate can be negatively biassed.

The opportunities for education vary throughout the country. For example, the universities are located in Copenhagen as well as in Århus, Odense, Aalborg, Roskilde etc. For people in the process of education, of course the existence of universities and other schools is important for their choice of location. An index representing the number of students is therefore included, with an expected positive sign. Also for other groups than students, the education possibilities could be important. This could be true for newly graduated persons, who like to live in areas with a university atmosphere or for families who want to give their children easy access to education.

The municipalities collect taxes and provide different kinds of service to the inhabitants. A ratio between the tax level and the service provided in each municipality is included in the analysis. It reflects "value for money" for the taxpayers, but also the economic situation for the municipalities since the level for the tax base and the need for expenses are reflected. The lower the ratio, the better service compared to the tax level. The expected sign is therefore negative.

Some value easy access to different cultural experiences (theatres, cinemas etc.) higher than, e.g. forest or other types of nature. To capture this fact, the number of people working in cultural sectors per inhabitant in each municipality is included as an explanatory variable. The expected sign is positive.

As described in section 1, according to the neoclassical theory, migrations occur due to opportunities on the labour market. To capture this fact, the unemployment rate is included as an explanatory variable. The expected sign is negative, i.e. the higher the unemployment, the smaller is the propensity to in-migrate, at least for the individuals in the labour force. The variable is only included for the groups being in the labour force at the end of the year. For all the groups, the sign turns out to be positive, however. Similar unexpected results are obtained by Dilling-Hansen and Smith (1996). They state different possible explanations such as women's high participation on the job market and the inflexible residence market. According to Kupiszewski and Rees (1999) the relationship between internal migration and unemployment differs largely in different European countries, dependent on as well the degree of which the market forces are allowed to intervene in the economy and the size of the country and the infrastructure. In the United Kingdom and Germany there is excellent fit between unemployment and net migration, while in the Netherlands, for example, there is only a weak relationship. The latter is probably due to small distances and excellent infrastructure, enabling substitution between commuting and migration. Denmark is not discussed in the article, but due to the high level of social benefits as well as short distances, the situation could very well be similar in Denmark.

The specific definitions and data sources for the variables are as follows:

Distance*:* The distance in kilometres, between the centres of the municipalities, following the roads. Within a municipality, the distance is defined relative to the size of the municipality. Between municipalities in two different parts of the country, the distance is approximated by the price of the ferry trip. *Source:* Distances from Vejdirektoratet, and own calculations.

Housing costs: An index is calculated for average housing costs per square metre. The index is weighted according to the existence of the different types of housing in each municipality. *Source*: Statistics Denmark and own calculations.

Share of forest: The percentage of the area of the municipality which is covered by forest. *Source:* Skovregistreringen, 1986.

Education possibilities: The number of students at schools and universities in the municipality per inhabitant. *Source*: Statistics Denmark and own calculations.

Tax/service ratio: An index measuring the ratio between need for expenses and level of tax base. *Source:* Ministry of the Interior (Indenrigministeriets nøgletal), 1996.

Culture**:** The number of employees in culture and places of entertainment per inhabitant. *Source:* Statistics Denmark, KRNR-education and own calculations.

Unemployment: The share of the workforce which is unemployed, average over 12 months. *Source*: StatBank Denmark, Statistics Denmark

The explanatory variables are as far as possible for 1996, but due to difficulties on obtaining data, some few variables are for former years. This is only so for variables expected to be rather constant, e.g. amount of forest.

4. Estimation

4.1 Estimation Technique

Maximum likelihood is used for estimations of the model. Let, as above, q_{ab} be the number of individuals migrating from municipality a to municipality b, i.e. the actual numbers, and let $V_a(b)$ be the deterministic part of the utility function. The log-likelihood is then given by:

$$\log L = \Sigma_{ab}\, q_{ab}[V_a(b) - \log(\Sigma_b \exp V_a(b))] \qquad (6)$$

(for a derivation, see e.g. Andersen, 1999). The appropriate expression for the utility function, $V_a(b)$, is inserted in the expression. The log-likelihood is maximized numerically with Newton's algorithm, using the GAUSS package.

4.2 Estimation Results

In table 4 to table 6, main estimation results are shown. The values of the parameters are shown, as are their corresponding *t*-values (in parentheses). To validate the model, two different measures of fit are reported.

In table 4, estimation results are shown for the group of migrators who at the end of the year are in the labour force. At the beginning of the year, they can be either in the labour force, in the group of students, or in the group outside the labour force. Furthermore, two of these three groups are divided into two subgroups, depending on their obtained level of education at the beginning of the year. This is done to reflect expected different patterns in migration. From the table it is seen that for all groups distance matters, i.e. the longer the distance, the smaller the probability of choosing that migration destination. It is also seen that for all groups the housing costs per square metre have the expected sign: negative. The more expensive housing, the smaller probability of choosing that destination. The sign of the forest variable is positive for all groups in the table - the migrators wish to live in nice surroundings. For one group the result is not significant though. For education possibilities there are differences in the sign for the respective groups, however. Two of the groups have negative signs, reflecting that they do not value access to education. The groups with high attained education do, as do those shifting from being students to being in the labour force. The tax-service ratio estimate is negative as expected. Culture is relevant for some groups, i.e. those coming from either the group of students or from outside the labour force, while culture is not valuated for those who are in the labour force at both points in time. It can be due to the fact, that the migrators in the latter group possibly are older than the migrators from at least the student group. People who have recently finished their studies move more often to a large city with culture etc., while later they have children and value other things more. Finally, the signs for unemployment turn out to be positive. As discussed in section 3.2 this is the unexpected result, but it is not unfamiliar.

Table 4: Estimation results, migration model for those who are in the labour force at the end of the year

		From labour force to labour force		From student to labour force		From outside labour force to labour force
		low edu.	High edu.	low edu.	h igh edu	
Number of persons migrating		81,280	23,111	22,716	5,661	7,378
Variable	Unit					
Distance	km	-2.50	-1.63	-1.74	-1.14	-1.57
		(-287)	(-132)	(-140)	(-56)	(-78)
Housing costs	100 DKK	-0.39	-0.14	-0.24	-0.06	-0.23
		(-60)	(-12)	(-20)	(-3)	(-11)
Forest	%	0.002	0.02	0.0002	0,005	0.007
		(3)	(22)	(-0.2)	(2)	(4)
Education possibilities	%	-0.54	1.01	1.87	2.83	-0.31
		(-8)	(9)	(15)	(14)	(-1)
Tax-service ratio	index	-1.67	-2.06	-1.86	-2.66	-1.42
		(-23)	(-15)	(-14)	(-10)	(-6)
Culture	%	-3.52	-4.63	15.72	10.25	11.77
		(-5)	(-4)	(12)	(4)	(5)
Unemployment	%	0.02	-0.004	0.07	0.03	0.10
		(12)	(1)	(20)	(5)	(18)
Pseudo R^2		0.27	0.23	0.29	0.27	0.24
□^{2}		0.39	0.35	0.43	0.41	0.39

Table 5: Estimation results, migration model for those who are students at the end of the year (t-values in parentheses)

		From labour force to student	From student to student	From outside labour force to student
Number of persons migrating		13,593	31,671	6,133
Variable	Unit			
Distance	km	-1.51	-1.72	-1.59
		(-101)	(-161)	(-70)
Housing costs	100 DKK	0.05	0.04	-0.02
		(3)	(4)	(-0.7)
Forest	%	-0.02	-0.006	-0.009
		(-11)	(-7)	(-4)
Education possibilities	%	4.18	3.62	3.17
		(29)	(38)	(14)
Tax-service ratio	index	2.33	1.57	2.29
		(14)	(15)	(9)
Culture	%	32.28	28.53	32.66
		(20)	(27)	(13)
Pseudo R^2		0.38	0.37	0.34
□^{2}		0.56	0.52	0.53

In table 5 estimation results are shown for the groups who are students at the end of the year. Again, the distance is important for all groups - the longer the distance, the smaller probability of choosing the destination. The housing costs, on the other hand, do not determine the choice of migration destinations for those people who are students at the end of the year. This is probably due to the fact that universities etc. mostly are located in urban areas with high housing costs. The same argument can be used to explain why forest is not valued for students, as is seen in the table. The education possibilities are, on the other hand, of importance for all three types of students. The tax-service ratio has an unexpected positive sign, showing that it is not valued while the existence of culture is important.

In table 6 the estimation results for those who are outside the labour force at the end of the year are shown. As for all other groups, distance is important. Also, the housing costs have the expected sign: the higher the costs of housing, the smaller the probability of choosing the destination for the migration. Existence of forest is only significantly valued for the group who was also outside the labour force at the beginning of the year. The tax-service ratio is not important for any of the groups.

Table 6: Estimation results, migration model for those who are outside the labour force at the end of the year

		From labour force to outside labour force	From student to outside labour force	From outside labour force to outside labour force
Number of persons migrating		8,069	4,406	25,320
Variable	Unit			
Distance	km	-1.87	-1.59	-1.98
		(-88)	(-61)	(-159)
Housing costs	100 DKK	-0.45	-0.17	-0.37
		(-25)	(-8)	(-36)
Forest	%	-0.0001	0.0008	0.006
		(-0.05)	(0.4)	(7)
Tax-service ratio	index	0.70	0.88	0.42
		(3)	(3)	(4)
Culture	%	11.43	22.57	3.72
		(5)	(8)	(3)
Pseudo R^2		0.23	0.25	0.23
$\square^2$		0.36	0.40	0.34

As noted above, some of the estimation results are unexpected and difficult to interpret. That applies for example for the negative sign for forest for students. As also noted, there are quite straightforward explanations for the sign, e.g. that the forests are not near by universities - but still, it is difficult to use the estimate in the migration model. Therefore, additional estimations are carried out - excluding the variables with unexpected signs in each group. The results are shown in table 7 to 9.

Education possibilities and culture have been removed from some of the subgroups, while unemployment has been removed for all subgroups, cf. table 7. For three groups removing these variables means that the estimated sign for forest changes from being positive to negative. Therefore, in the reported results, also forest has been removed, since the conclusion must be that for threse groups the existence of forest is not valuated.

Table 7: Revised estimation results, migration model for those who are in the labour force at the end of the year

		From labour force to labour force		From student to labour force		From outside labour force to labour force
		low edu.	high edu.	low edu.	high edu.	
Number of persons migrating		81,280	23,111	22,716	5,661	7,378
Variable	Unit					
Distance	km	-2.50	-1.63	-1.73	-1.13	-1.55
		(-288)	(-132)	(-139)	(-56)	(-77)
Housing costs	100 DKK	-0.43	-0.15	-0.22	-0.06	-0.24
		(-87)	(-14)	(-19	(-2)	(-13)
Forest	%	----	0.02	---	0.0005	----
			(25)		(0.2)	
Education possibilities	%	---	0.93	1.94	2.84	---
			(9)	(16)	(14)	
Tax-service ratio	index	-1.62	-1.97	-1.13	-2.39	-0.54
		(-24)	(-15)	(-9)	(-9)	(-3)
Culture	%	---	---	24.32	13.36	22.24
				(21)	(6)	(11)
Pseudo R^2		0.27	0.24	0.29	0.27	0.24
$\square^2$		0.39	0.35	0.43	0.41	0.38

Table 8: Revised estimation results, migration model for those who are students at the end of the year (t-values in parentheses)

		From labour force to student	From student to student	From outside labour force to student
Number of persons migrating		13,593	31,671	6,133
Variable	Unit			
Distance	km	-1.50	-1.71	-1.60
		(-100)	(-161)	(-69)
Housing costs	100 DKK	---	---	---
Forest	%	---	---	---
Education possibilities	%	4.59	3.87	3.30
		(38)	(49)	(18)
Tax-service ratio	index	---	---	---
Culture	%	30.12	26.5	24.37
		(24)	(32)	(13)
Pseudo R^2		0.38	0.37	0.34
$\square^2$		0.55	0.52	0.52

In table 8 the revised estimates for the group of people who are students at the end of the year are shown. For all three subgroups, housing costs, forest and tax-service ratio have been removed. The remaining variables are all still significant, and still with the expected sign.

Table 9 Revised estimation results, migration model for those who are outside the labour force at the end of the year

		From labour force to outside labour force	From student to outside labour force	From outside labour force to outside labour force
Number of persons migrating		8,069	4,406	25,320
Variable	Unit			
Distance	km	-1.86	-1.59	-1.97
		(-88)	(-60)	(-159)
Housing costs	100 DKK	-0.47	-0.20	-0.38
		(-29)	(-10)	(-42)
Forest	%	----	----	0.01
				(6)
Tax-service ratio	index	----	----	----
Culture	%	11.17	21.45	3.52
		(5)	(8)	(3)
Pseudo R^2		0.23	0.25	0.23
$\square^2$		0.36	0.40	0.34

In table 9 revised estimates are shown for the subgroup that is outside the labour force at the end of the year. The tax-service ratio has been removed from all subgroups. Forest has been removed for two of the subgroups. All other variables are kept, and still have the expected signs.

4.3 Elasticities

In order to interpret the model and the estimation results, it is useful to consider the elasticities. An elasticity of a function is defined as the percentage change in the function due to a 1 per cent change in a variable. In the logit model case it corresponds to the percentage change in the probability of choosing an alternative due to a 1 per cent change in a variable related to that alternative.

Elasticities in logit models are discussed by Ben-Akiva and Lerman (1985). The appropriate elasticities for the model applied here are discussed in Andersen (1999). They are given by:

$$E_{x_i} = \Sigma_b[(\Sigma_a n_a * p_a(b) * E_{x_{iab}}^{p_a(b)})] \tag{7}$$

where:

$$E_{x_{iab}}^{p_a(b)} = \beta_i x_{iab}[1 - p_a(b)] \tag{8}$$

and n_a is the share of the total number of individuals originally living in municipality a, i.e.

$$n_a = \frac{q_a}{\sum_a q_a} \tag{9}$$

The individual elasticities as given by (8) are simply weighted by the probabilities of choosing to move to specific residential municipalities for the given initial municipalities, multiplied by the probabilities of these initial residential municipalities.

In table 10 elasticities from the revised estimations (i.e. table 7 to 9) are shown. It is seen that the elasticities differ quite a lot for the different subgroups. The interpretation of an elasticity should be as in the following example related to the group of people who are in the workforce at the beginning as well as at the end of the year with high education: Let the amount of forest increase by 1% in a municipality, while the amount of forest is unchanged in the other municipalities. That will increase the probability of choosing to migrate to this municipality by 0.15%. This is an average number. It could be that the change in the probability of choosing the municipality for residence is higher for individuals initially living nearby, and the change is smaller for individuals living far away. This fact is taken into account via the weighting with the probabilities. The interpretation is straightforward in the forest example, as it is for most of the other variables. For distances, however, it is a bit unlikely that only the distance between these two specific municipalities is changed.

Table 10: Elasticities for the estimations reported in table 7-9

Group	Dis-tance	Housing costs	Forest	Educa-tion	Tax-service	Culture
From labour force to labour force (low)	-1.29	-1.48	----	----	-1.52	----
From labour force to labour force (high)	-1.08	-0.58	0.15	0.11	-1.86	----
From student to labour force (low)	-1.23	-0.74	----	0.19	-1.07	0.19
From student to labour force (high)	-0.98	-0.21	0.003	0.37	-2.26	0.14
From outside labour force to labour force	-1.20	-0.80	----	----	-0.52	0.18
From labour force to student	-1.14	----	----	0.45	----	0.22
From student to student	-1.19	----	----	0.38	----	0.21
From outside labour force to student	-1.20	----	----	0.32	----	0.18
From labour force to outside labour force	-1.27	-1.61	----	----	----	0.09
From student to outside labour force	-1.24	-0.67	----	----	----	0.16
From outside labour force to outside labour force	-1.32	-1.27	0.05	---	---	0.03

5. Conclusion

As described in the paper, a demographic model has been built up, using data for 1996. In the demographic model, a migration model is included. The migration pattern is analysed for different subgroups of the population, dependent on their status at the beginning and at the end of the year, respectively. Different variables matter for different subgroups when choosing the destination for migration. Distance is a hampering factor for all groups though. Housing prices are of importance for most groups while not for students. The same is true for existence of forest and the tax-service ratio. On the other hand, existence of culture and education possibilities are important for students. To validate the estimation two measures of fit are calculated, as are elasticities for the different variables.

Next, the demographic model should be included in a regional economic model: LINE. Doing that, it becomes possible to determine the consequences of, e.g. additional forest in a municipality - not only for the migration pattern, but for central economic variables like, e.g. employment, income etc.

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