A TIME SERIES ANALYSIS OF REGIONAL MIGRATION IN FINLAND

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FOREWORD

Sharply reduced rates of population and industrial growth have been projected for many of the developed nations in the 1980s. In economies that rely primarily on market mechanisms to redirect capital and labor from surplus to deficit areas, the problems of adjustment may be slow and socially costly. In the more centralized economies, increasing difficulties in determining investment allocations and inducing sectoral redistributions of a nearly constant or diminishing labor force may arise. The socioeconomic problems that flow from such changes in labor demands and supplies form the contextual background of the Manpower Analysis Task, which is striving to develop methods for analyzing and projecting the impacts of international, national, and regional population dynamics on labor supply, demand, and productivity in the more-developed nations.

The determinants of internal migration in Finland are analyzed in this paper. Simple models, based on human capital theory, are proposed describing in-, out-, and net-migration flows using such factors as income and employment. The models are then tested with time series 1962-1977 data for the richest and the poorest regions of Finland.

Publications in the Manpower Analysis Task series are listed at the end of this paper.

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ABSTRACT

The aim of this study is to formulate simple models for in-, out-, and net-migration flows among regions and to test such models by using time series data from two Finnish regions. The formulations begin with human capital theory, emphasizing economic factors such as incomes and employment possibilities as a means for explaining migration patterns.

Human capital theory includes many more aspects than just those related to migration. For this study, however, only the factors relevant to migratory flows will be dealt with in depth. The developed basic models are made suitable for empirical time series analysis, which is then carried out using time series data between 1962 and 1977 for the Pohjois-Karjala and Uusimaa regions.

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1. INTRODUCTION

Typical features of population trends in Finland during recent decades have been:

1. strong migratory movements toward southern Finland until the mid-1970s
2. a drop in the birth rate in all parts of the country
3. a high rate of emigration, especially to Sweden, causing a decrease in the population except during the first half of the 1970s

Regionally the Finnish population is concentrated in the four southern provinces where at present almost 60% of the total population lives. Since income and labor market conditions are not adequate to explain these past migration patterns and disequilibrium in the Finnish regional labor market, a study was started at the beginning of 1980 in Finland to better understand labor market behavior.

This paper is a part of the Finnish labor market study concentrating on the factors that affect the magnitudes and directions of total in-, out-, and net-migration flows among regions. Most of the ideas and implications are derived from migration analysis in human capital theory and rough assumptions are made to formulate testable migration models that will explain in-, out-, and net-migration flows among regions.

In the last part of this paper, the simple models that have been formulated are tested using data from two Finnish regions, Pohjois-Karjala and Uusimaa, and first estimation results are given.

2. FACTORS AFFECTING MIGRATION FLOWS

2.1 Migration According to Human Capital Theory

Migration can be studied as purely an individual decision-making process based on the expected utility maximization behavior of the individual. It can also be studied from the standpoint of the region: the causes and consequences the in- and out-migration will have to the region. The analysis here begins with the ideas of the individual's behavior, but since decisions to move depend on opportunities available, regional opportunities must be considered.

In a basic economic human capital model that takes migration into account, it is assumed that an individual considers the expected benefits and costs of a move to all possible destinations and selects a destination where there are more expected benefits than costs (Sjaastad, 1962). Assuming maximizing behavior, an individual will choose the region where his expected net gain is greatest. Even though discounted benefits cover costs, however, there remains the possibility of not moving due to the lack of sufficient funds for the move. The costs and benefits of migration are both economic and noneconomic. Noneconomic costs and benefits are difficult to measure and even to identify. Thus in this paper we only consider the migrant's pecuniary costs and income.

We assume further that a typical migrant is a rational one, and we assume that the only benefit from a move is an increase in expected real, disposable income. In addition we assume that the costs of moving are incurred only at the time of the move.

When our possible migrant calculates his expected future income, he must have some information about labor market conditions, nominal incomes, tax rates, and cost-of-living indexes in different regions. Because the migrant is making his calculations for a future period of time, the discount rate and duration of working life enter into the analysis. The duration of working life represents the remaining number of years of active working life a person can expect to have plus the possible inclusion of the pensionary years, which is justified if one has a pension tied to his yearly income.

If we assume only two regions i (origin) and j (destination), the present value of net gain to the typical migrant moving from i to j is as follows:

$$NV_{ij} = \sum_{t=0}^{T^e} \frac{(Y^e_{jt} - Y^e_{it})}{(1+r)^t} - C_{ij} \qquad (1)$$

where

NV_{ij}	= discounted present value of the net gain from moving from i to j
Y^e_{jt}, Y^e_{it}	= expected labor income in i and j ($i \neq j$) at time t
r	= discount rate ($0<r<1$) assumed to be the same in both regions and over all future years
T^e	expected length of remaining lifetime
C_{ij}	costs of moving from i to j

A typical potential mover is assumed to move from i to j when $NV_{ij} > 0$, and if there are any destinations available to the migrant he will select the region j where his NV_{ij} is maximized.*

2.2 Implications from Human Capital Theory

2.2.1 Age and Duration of Working Life

Our simple human capital model suggests that since younger individuals have longer expected lifetimes and therefore greater expected returns on migration, they are more mobile. Further we can assume that younger people have less place attachment and less seniority rights invested in a specific job and usually they do not have many dependents or much property, which makes their moving costs lower (Sjaastad, 1962). Overall we can say that younger people have less location-specific capital** than older people and that is why younger individuals are more movable. Younger people also tend to be less risk averse, which results in a lower discount rate and therefore higher expected future earnings from migration.

As previously noted the influence of age on migration depends upon the time period over which these future earnings are expected. We have assumed that earnings can be expected over the entire lifetime, but it is possible that the migrant makes his calculations only over the period of his active working life. This reduces the period of future earnings due to migration, thus favoring younger people and/or greater expected income after moving. Discounting over the whole lifetime is reasonable if we consider a pension as a certain proportion of the last year of income while employed and we assume that this proportion is the same for all regions. If, on the other hand, we assume a fixed-sum pension (also the same for all regions) the relevant discount

*Of course we must assume that a migrant is able to finance his moving costs from i to j.

**Da Vanzo (1980) has used the term location-specific capital from all factors that tie a person to a particular place and influence his decision to move.

period that should be considered by the migrant is only over the active working life. In our analysis we prefer the former consideration because if the cost of living between regions differs the real values of pensions also differ. It therefore becomes reasonable for a mover to make his calculations of expected gains over the whole lifetime. Another point concerning pension incomes is that when on receives the same income over his entire remaining lifetime, the amount of the pension does not vary. So if a pensioner is maximizing his real value of the pension he should move to a region where, *ceteris paribus*, the cost of living is the lowest.

Of course the pension may be tied to the cost-of-living index, usually a national average, but there still exists the optimum location for the pensioner if there are fluctuations in the costs of living between regions. The pensioner residing in a region where the cost of living is rising faster than the national average has a decrease in the real value of the pension, whereas the pensioner in a region where the cost of living is rising at a slower rate than the national average finds his real value of the pension increasing.

This kind of development suggests successive moves as a means for maximizing the value of pensions, but if we take into account the moving costs due to the location-specific capital, the pensioner may find these costs are usually high and may be high enough to cancel out the gains of the migration caused by an increase in the real value of the pension.

2.2.2 Education and Training

Employment information and job opportunities are both expected to increase with higher education therefore raising the likelihood of better educated individuals migrating more often than other individuals. A better education, as well, may guarantee a higher expected salary and reduce the risk and uncertainty of migration since the more educated tend to weigh alternative possibilities more thoroughly (Bowles, 1970). Education also reduces the importance of traditions and family ties thus weakening the forces that hold a potential mover to his present locality (Greenwood, 1973). At the same time his value of the location-specific capital is lowered as are his costs of moving.

The above suggests that when the educational level of a region increases, the out-migration from the region also increases. It would decrease, however, if a student were to remain in a particular educational system in order to earn a higher degree; the migration of younger people would then decrease. Of course at the same time, migration of families with school aged children may decrease, causing the total migration flow to temporarily decrease as well.

In this analysis, training is restricted to vocational training, which is arranged and paid for by the public sector and is offered to unemployed people. Since only people who have been registered as unemployed are able to receive this training, the effect on the number of registered unemployed persons may increase without any increase in out-migration from the region. Another effect of this training is that it may postpone the decision to migrate until the training is over, thereby causing a temporary decrease in out-migration from the region. Afterward, however, these trained individuals are better job searchers and their probability of moving rises, thus influencing the total outmovement from the region. We therefore assume that the effects of training on migration are quite similar to the effects of a better education.*

2.2.3 Income Differences

Variations in expected incomes among regions may be caused by differences in productivities, tax rates, and costs of living as well as by the migrant's own expectations of labor market conditions and by his attitudes toward risk.**

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*The problems that arise due to the costs of higher education and vocational training and the effects of such financing are omitted at this point in our discussion.

**We assume so far, however, that our migrant is risk-neutral in his behavior toward risk and uncertainty.

We assume that the relevant income variable for a rational possible migrant is the expected disposable real income difference between the area of origin and destination. When this income difference increases in the area of destination, the expected net gain from moving increases and, *ceteris parabus*, his probability of moving also increases. Now our simple human capital model (1) correctly predicts that migrants go from low disposable real income regions to regions where such incomes are higher.

Before a potential mover can make any calculations pertaining to expected real disposable incomes, he must have some information about labor market conditions, nominal incomes, tax rates and costs of living in different regions. Of course he must have some knowledge as well of how these factors affect his disposable real income, and since he is making his calculations for the future, he needs to have some idea of how these factors might expect to change over time.

One point the migrant should take into consideration in connection with disposable real incomes is the amount of public expenditures in different regions.* Since some public goods are substitutes for private ones, additional publicly paid goods increase an individual's total disposable income. Our migrant should therefore include these expenditures in his disposable income calculations and according to our human capital model should choose the area in which he finds his disposable income to be the highest, if all the other factors among regions are equal.

2.2.4 Costs of Moving

Costs of moving include both monetary and nonmonetary costs. Monetary costs are direct moving costs**, such as transportation,

*It is assumed that the increase in expenditure per head also means an increase in the quality and/or quantity of public goods available in the region.

**Direct moving costs concerning differences in cost of living and tax expenditures are taken into account by the migrant when calculating his disposable real income. We assume that cost of living includes all costs of housing.

opportunity and search costs, and financing the move.* Nonmonetary costs are psychic costs which are very difficult to quantify and are therefore not specifically considered here. Family and friends or the value of a pleasant climate or a beautiful landscape are examples of psychic costs.

The common proxy which has been used as a measure of these monetary and nonmonetary costs is distance. All costs of moving are assumed to increase with distance and thus we can find that our simple human capital model correctly predicts a decline in migration as distance and costs increase.

Distance also decreases the amount of information available and increases the risk and uncertainty of the new destination. Of course we can assume that when the distance between areas increases, the number of alternative opportunities among the origin and possible destinations increases; distance serves as a proxy for these increased opportunities as well.

2.2.5 Family Considerations

On the preceding pages we have not made such distinction between individual and family decisions to move or stay. Since the members of a family will usually move together, we must say something about family decisions to migrate.**

Presumably families tend to be less mobile than single persons. As the size of the household increases, the cost of migration tends to exceed the benefits. Demographic research shows that especially the presence of school aged children inhibits family migration (Lang, 1975). This is caused by the increase in location-specific capital, which makes family moving

*Opportunity costs are earnings foregone while traveling, searching for, or learning a new job. Costs of financing are interest paid in the money one must borrow for moving or interests receipts foregone because of the financing of the movement with one's own earlier savings.

**This part is based very heavily on ideas of Mincer (1978) and Da Vanzo (1980).

costs higher. On the other hand, better schooling possibilities may well be a factor that accelerates the mobility of a family with pre-school aged children.*

In some studies it has been shown that a wife's working status, family earnings, and presence of school aged children are the major reasons for the difference in migration behavior between married and unmarried persons (Sandell, 1977). Marital status has a statistically significant negative effect on migration in a simple correlation analysis, but this significance disappears when the aforementioned factors are included in the analysis (Mincer, 1978).

3. BASIC MODELS

We have been discussing the factors that affect an individual's decision to migrate. They can be classified into two groups: personal and environmental. A migrant's age, education, family status, employment status, and his attitude toward risk can be classified as personal factors. Labor market conditions, average income levels, average tax rates, costs of living expenditures, and other activities of the public sector are environmental factors. When an individual is deciding if a migration is a reasonable investment or not, he will take these environmental factors into account, but the ability to use the opportunities offered by different environments depends on the possible migrant's personal characteristics.

In order to make testable models of in-, out-, and net-migration flows for different regions we must make several assumptions. For example, what will our criterion be for a typical potential mover to decide to migrate; how will we aggregate individual migrants; how will personal characteristics be taken into account at an aggregate level?

*Of course there are questions such as who will pay for this education and how difficult is it to assess the new schooling system? The regions where the public sector pays the costs of this higher education are more attractive to families with children if all the other factors are equal.

3.1 Income and Unemployment Effects on Migration

If we assume that the typical migrant bases the calculations of his expected disposable real income only on present labor market conditions, nominal incomes, taxes, and costs of living among regions, we can omit the discount rate and time factor in our analysis.*

We can postulate now that the expected real disposable income depends on the possibility of obtaining work, nominal income levels, tax levels, and costs of living in the various regions. The possibility of employment depends on prevailing labor market conditions, and differences in nominal incomes are caused by differences in productivities.

We can therefore say that disposable real income differences between regions i and j are:

$$DRI_{ij} = (DRI_j - DRI_i) \tag{2}$$

where

$DRI = (Y-T)/I$ = disposable real income

Y = nominal income

T = taxes

I = cost-of-living index

DRI_{ij} = differences in disposable real incomes between i and j and we assume $DRI_{ij} > 0$

*For our purposes the assumption is made that moving costs are not considered in the decision to migrate.

Letting p_j be the possibility of obtaining work $(0 \leq p \leq)$ (Harris and Torado, 1970) at income level Y in region j, the expected real disposable income for a typical migrant to region j is:

$$EDRI_j = p_j DRI_j \tag{3}$$

where EDRI is the expected real disposable income, which is assumed to be positive. We must now formulate how our typical migrant makes his calculations. We assume that labor market conditions affect the possibility variable, p, so that

$$p_j = \left(1 - \frac{U_j - AV_j}{L_j}\right) \tag{4}$$

where

U = number of unemployed

AV = number of unfilled vacancies

L = total labor force

$0 \leq p \leq 1$ so that $p = 0$ if $(U - AV) = L$

$p = 1$ if $(U - AV) \leq 0$

$0 < p = 1$ if $0 < (U - AV) < L$

To have expected real income differences between i and j, we must note that there may be two kinds of typical migrants: one who is employed in i and seeks a better paying job in j and another who is unemployed and seeks any job available in j.

If our mover is employed in region i, he has a certain income level $DRI_i = (Y_i - T_i)/I_i$. Since the migrant makes his income calculations using only prevailing factors we can assume that the expected increase in income after moving for an employed possible typical mover from i to j is

$$EDRI^{e}_{ij} = EDRI_{j} - DRI_{i} \quad (5)$$

where

$$EDRI^{e}_{ij} = EDRI_{j} - DRI_{i} = p_{j}\, DRI_{j} - DRI_{i}$$

$$= \left[\left(1 - \frac{U_{j} - AV_{j}}{L_{j}}\right)\left(\frac{Y_{j} - T_{j}}{I_{j}}\right) - \left(\frac{Y_{i} - T_{i}}{I_{i}}\right)\right]$$

= expected real disposable income increase for employed movers from i to j ($EDRI^{e}_{ij} > 0$)

Since an unemployed mover has no certain income in area i, he can automatically expect an income increase in area j

$$EDRI^{U}_{ij} = p_{j}\; DRI_{j} = EDRI_{j} \quad (6)$$

where

$EDRI^{U}_{ij}$ = increase in disposable real income from moving i to j for unemployed in i ($EDRI^{U}_{ij} > 0$)

From (5) and (6) we have $EDRI^{U}_{ij} > EDRI^{e}_{ij}$, or an unemployed mover from i to j can expect a higher income increase than an employed person. Since the probability of moving increases as the income difference increases, we assume that unemployed individuals are more moveable than employed ones. At the aggregate level when the unemployment in the region i increases, *ceteris paribus*, the total out-migration from i increases as well. Along with the assumption that unemployed individuals receive no income in i, we must include the possibility of unemployment compensation. Such a compensation would then be regarded as a certain income for the unemployed* and his income gain due to the migration would decrease, therefore decreasing his probability of moving. At the macro level we can now assume that if the number of compensated unemployed individuals and/or the value of *per capita* compensation increases, the migration flow from i to j will decrease.

Thus far we have assumed that all migrants make similar considerations regarding incomes in region j, but it is quite reasonable to think that employed migrants move only to have better incomes. They probably have different kinds of expectations than unemployed migrants, who often move only to obtain any job available no matter what the income.

The unemployed individual** has exhausted all working possibilities in his own region, i, and so he begins to calculate his chances of employment in region j by taking into account the competition he faces with the unemployed individuals already in j.

We assume the typical unemployed person in i calculates his chances of obtaining work in j by using the proportion a_j as a measure for his employment possibilities. This proportion is

$$a_j = \left(\frac{AV_j}{U_j}\right) \tag{7}$$

where

a_j = possibility of obtaining work in j for an unemployed person who is considering a move from i to j and $0 \leq a_j \leq 1$ and

$a_j = 0 \quad \text{if} \quad AV_j = 0$

$a_j = 1 \quad \text{if} \quad AV_j \geq U_j$

$0 < a_j < 1 \quad \text{if} \quad 0 < AV_j < U_j$

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*If the unemployment compensation is for a limited period only, the decision to migrate may be postponed until the compensation ceases.

**Unemployed individuals in region i, refer to the so-called involuntary unemployment, or $UN_i = U_i - AV_i$, that affects migration from i to j and only when there is $UN_i > 0$.

Aggregating all typical unemployed migrants in region i, we have

$$PUN_i = a_j \; UN_i \tag{8}$$

where $PUN_i = a_j \; (U_i - AV_i)$, that is, the number of potential unemployed migrants in i.

Now we have two kinds of typical migrants from i to j; migrants, who are trying to seek better disposable real incomes, and migrants who are seeking any kind of available work. So we can formulate the migration flow from i to j as a function of income difference and of unemployment if there are no other factors affecting migration. We assume that the aggregation is made correctly over all migrants

$$M_{ij} = f(\underset{+}{EDRI^e_{ij}}, \underset{+}{PUN_i}) \tag{9}$$

where f = function (continuous), M_{ij} = total number of migrants from i to j*, and hypothesized signs of the independent variables are represented below these variables.

When we only consider migration between two regions, we know that gross out-migration from i is at the same time gross in-migration to j, and if there is no migration from j to i the migration flow from i to j is also the net-migration between these areas. Since we usually have a migration flow from j to i we must try to formulate what causes this migration. We have assumed that $EDRI^e_{ij} > 0$, and so there are no migrants from j to i

*If we are using the income difference ($EDRI^e_{ij}$) alone, we assume implicitly that both origin and destination have a symmetric effect on migration. If this is not true we have $M_{ij} = f(\underset{+}{EDRI_j}, \underset{-}{DRI_i}, \underset{+}{PUN_i})$ and we assume that $\frac{\partial M_{ij}}{\partial EDRI_{ij}} \neq - \frac{\partial M_{ij}}{\partial DRI_i}$.

who are seeking better incomes. There may be, however, potential unemployed migrants from j to i, and we assume that the migration from j to i depends only on the number of potential unemployed migrants in j

$$M_{ji} = \underset{+}{g}(PUN_j) \qquad (10)$$

where

g = function (continuous)

M_{ji} = total number of migrants from j to i

$PUN_j = a_i UN_i = \left(\frac{AV_i}{U_i}\right)\left(U_j - AV_j\right)$ = number of potential unemployed migrants in j

From (9) and (10) we have

$$M_{ij}^{net} = (M_{ij} - M_{ji})$$

$$= m(\underset{+}{EDRI_{ij}^{e}}, \underset{+}{PUN_i}, \underset{-}{PUN_j}) \qquad (11)$$

where

m = function (continuous)

M_{ij}^{net} = net migration from i to j and expected partial effects of independent variables are represented below these variables assuming that $M_{ij}^{net} > 0$ and that region j is receiving a migration gain from region i*

*When $M_{ij}^{net} < 0$ we have $M_{ij}^{net} = \bar{m}(\underset{-}{EDRI_{ij}}, \underset{-}{PUN_i}, \underset{+}{PUN_j})$ because of the symmetry $-M_{ij}^{net} = M_{ji}^{net} = (M_{ji} - M_{ij}) > 0$.

3.2 Effects of Noneconomic Factors on Migration

For a more realistic migration model, we must also take into account migratory flows that are caused by factors other than disposable real income and potential unemployment. Thus far we have implicitly assumed that there are no other cost differences between the two regions than cost of living and opportunity costs caused by earnings foregone if one moves. Now we will consider the direct and psychic costs of moving as well as personal characteristics and other noneconomic factors affecting migration.

In previous empirical studies it has been shown that several personal characteristics influence an individual's decision to migrate (Bowles, 1970; Greenwood, 1969 and 1975). On the preceding pages we have concluded that when a migrant's age increases, his probability to move decreases since older persons have a shorter expected working period in which to receive a net gain from a move. Gallaway (1969) has pointed out that job security and family ties are also likely to be more important for older persons, therefore contributing to location-specific capital and further discouraging persons from migrating (DaVanzo, 1980). We thus expect that out-migration is lower from regions where the share of older people is greater, if all the other factors affecting migration between regions are equal.

From gravitation models we learn that there is an increase in out-migration from a region when the total population in the region increases. Since we have assumed that people who are retired may have so much location-specific capital that they are not eager to move, we can take the population group between ages 0-64 as the potential age group that affects migration.* We assume that when the number of potential migrants in this age group increases in the region, *ceteris paribus*, the number of out-migrants from the region increases too. We can also assume

*In Finland during the period 1961-1975 only 2% of the total number of internal movers were over age 64 [Statistical Yearbook of Finland (1962-1977)].

that the 15-34 age group has the greatest migration potential because these are the ages of higher education, seeking first jobs, then marrying, and beginning families. In our model the potential age group affecting migration is the 0-64 group and is referred to as the population pressure variable, P^{64}.

In previous studies it has been shown that where in-migration flows are strong there tend to be also strong out-migration flows from the region (Ravenstein, 1885; Lee, 1966). The explanation that has been offered for this phenonomenon is that since migration is selective, people who have migrated once are more mobile than those who have never moved (Goldstein, 1964; Miller, 1967). Similarly, people who have moved before should find it easier (and oftentimes less costly) to move again (Bowman-Myers, 1967; DaVanzo, 1980).

Location-specific capital left behind may be one important factor affecting out-migration if this move is in fact a return migration to the previous place of residence (Speare, 1971; DaVanzo, 1980). Imperfect information can attribute to an unwise move resulting in lower earnings than expected, no available job at all, bad housing, or unpleasant environmental conditions. These disappointed people may decide to move again within a year to two. After a longer time away from the origin region, however, the value of location-specific capital in this region decreases and increases in the region of destination in proportion to the amount of time lived in the new region (Hamberg, 1976, DaVanzo, 1980).

3.3 Distance and Migration

When we talked about assumptions based on human capital theory, we found that the distance between two regions can be used not only as a measure of direct moving costs but also as a proxy of imperfect information, risk, and psychic costs. Further we assumed that the distance is a measure for intervening opportunities available between origin and destination (Stouffer, 1940). We now have many factors affecting a move that are captured by distance. The question is how to treat or measure this distance.

We assume that migration between regions depends inversely on the distance between these regions (Ravenstein, 1885; Zipf, 1946). If D_{ij} is the distance between two regions i and j the $d_{ij} = 1/D_{ij}$ is the inverse distance between those regions.* When we have more than two regions we can calculate the so-called total distance inverse for every region i as follows

$$\bar{d}_i = \sum_{k \neq i}^{n-1} d_{ik} \tag{12}$$

where

$\bar{d}_i$ = total distance inverse for region i

n = total number of regions

k = all possible alternative destinations

When we think of migration between two regions i and j, we know that the inverse distance from i to j is d_{ij} and the total inverse distance for i is $\bar{d}_i$. Now we can formulate "weights" (w) for different alternatives of out-migrations from i is follows

$$\begin{aligned} w_{ij} &= d_{ij}/\bar{d}_i && \text{(for region j; j} \neq \text{i)} \\ w_{ik} &= d_{ij}/\bar{d}_i && \text{(for region k} \neq \text{i, j)} \end{aligned} \tag{13}$$

where the following holds true:

$$\sum_{k \neq i}^{n-1} w_{ik} = 1 \qquad \text{and} \qquad \partial w_{ik}/\partial D_{ik} < 0$$

*If we take into consideration possible emigration outside our own country, we should add perhaps some extra barrier to our distance such as languages and culture.

We use weights as the measure of imperfect information and direct and psychic costs of migration; we take these weights into account in our expected disposable real incomes.* Since we now have more than two areas, our typical income mover from region i should take into account not only area j but also all other possible alternative destinations, k. So our mover makes his weighted expected income calculations as follows:

$$EDRI_{ij}^{ew} = (w_{ij}EDRI_j - DRI_i)$$

$$\overline{EDRI}_{ik}^{ew} = \left(\sum_{k \neq i,j}^{n-2} w_{ik} \frac{EDRI_k}{n-2} - DRI_i \right) \tag{14}$$

where

$EDRI_{ij}^{ew}$ = weighted expected disposable real income increase for an employed mover from i to j

$\overline{EDRI}_{ik}^{ew}$ = weighted expected average disposable real income difference between i and all other possible destination $k(\neq j)$

We must now make assumptions on how an unemployed migrant will assess other possible destinations $k(\neq j)$ in his decision to move from i. The average number of open vacancies in regions k is

$$\overline{AV}_k = \sum_{k \neq i,j}^{n-2} AV_k/n-2 \tag{15}$$

and the average number of unemployed persons is

$$\overline{U}_k = \sum_{k \neq i,j}^{n-2} U_k/n-2 \tag{16}$$

*Since $\partial w_{ij}/\partial D_{ij} < 0$, the more distant places are less attractive to our typical migrant. See also Feder (1980).

From (15) and (16) we have the average possibility of our typical unemployed mover obtaining work in regions k

$$\bar{a}_k = \frac{\overline{AV}_k}{\bar{U}_k} \tag{17}$$

where

$\bar{a}_k$ = average possibility of obtaining work in some region $k(\neq j)$ for an unemployed person in i. We assume perfect information of open vacancies and unemployment to be available for our migrant

From (7) we know that the possibility of obtaining work in region j was $a_j = AV_j/U_j$. Now the total amount of potential unemployed migrants from i to j will be

$$p_j^v UN_i = a_j^v UN_i$$

where

$p_j^v UN_i$ = number of potential unemployed migrants for j living in i when all other possible destinations $k(\neq j)$ are considered. Only the values $p_j^v UN_i > 0$ are relevant*

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*If $p_j^v UN_i = a_j^v UN_i = a_j(1 - \bar{a}_k)UN_i > 0$ this means that $a_j(1 - \bar{a}_k) > 0$ and $UN_i = U_i - AV_i > 0$. We specify further that

$a_j^v = 0$ if $a_j = 0$

$a_j^v = 1$ if $a_j = 1$ and $\bar{a}_k = 1$

$a_j^v = a_j$ if $0 < a_j < 1$ and $\bar{a}_k = 1$

$0 < a_j^v = a_j(1 - \bar{a}_k) < 1$ if $0 < a_j < 1$ and $0 < \bar{a}_k < 1$.

We can also correct our possibility of obtaining work by introducing distance weights in the calculations as we did previously for income expectation.

3.4 Formulations of the Basic Models

By collecting all the factors that we have assumed to affect migration, we can now represent the total migration from i to j as well as other destinations, $k(\neq i,j)$, for our typical mover*

$$M_{ij} = f\left(\underset{+}{EDRI^{ew}_{ij}},\ \underset{-}{\overline{EDRI}^{ew}_{ik}},\ \underset{+}{P^{v}_{j}UN_{i}},\ \underset{+}{P^{64}_{i}}\right) \qquad (19)$$

where

f = function (continuous)

M_{ij} = total number of migrants from i to j

$EDRI^{ew}_{ij}$ = distance weigthed expected disposable real income difference between i and j ($EDRI^{ew}_{ij} > 0$)

$\overline{EDRI}^{ew}_{ik}$ = distance weighted expected average disposable real income difference between i and other region $k(k \neq i,j)$ ($\overline{EDRI}^{ew}_{ik} > 0$)*

$P^{v}_{j}UN_{i}$ = potential amount of unemployment migrants for j living in region i

In a similar way we have total out-migration from j to i as follows**

$$M_{ji} = g\left(\underset{+}{P^{v}_{i}UN_{j}},\ \underset{+}{P^{64}_{j}},\ \underset{+}{M^{SD}_{ij}}\right) \qquad (20)$$

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*We also assume that $EDRI^{ew}_{ij} > \overline{EDRI}^{ew}_{ik}$. If we assume symmetrical effects of incomes on migration we can use $\overline{EDRI}^{ew}_{ijk} = (EDRI^{ew}_{ij} - \overline{EDRI}^{ew}_{ik})$ as only an explanatory income variable.

**There are no income variables in our equation because we have assumed before that the weighted expected disposable real incomes are greatest in region j. We also assume that disappointment is caused by unfulfilled income expectations only, so the amount of disappointed individuals affects out-migration from j to i only.

where

M_{ij}^{SD} = possible return migrants from j to i: those migrants disappointed in j who originally moved from i to j

The net migration from region i to region j will now be

$$M_{ij}^{net} = m\left(\underset{+}{EDRI_{ij}^{ew}},\ \underset{-}{\overline{EDRI}_{ik}^{ew}},\ \underset{+}{P_j^v UN_i},\ \underset{+}{P_i^{64}},\ \underset{-}{P_i^v UN_j},\ \underset{-}{P_j^{64}},\ \underset{-}{M_{ij}^{SD}}\right) \quad (21)$$

where it is assumed that region j is receiving a net gain in migration from region i, and $M_{ij} > 0$.

3.5 Public Sector Influence on Migration Flows Among Regions

We have assumed that migrants consider better incomes in their decision to move. The public sector, therefore, influences the migration flow by affecting the disposable real income differences among regions. Expected income differences between i and j was denoted as

$$EDRI_{ij}^{e} = \left[\left(1 - \frac{U_j - AV_j}{L_j}\right)\left(\frac{Y_j - T_j}{I_j}\right) - \left(\frac{Y_i - T_i}{I_i}\right)\right]$$

The public sector can change this income difference by controlling nominal incomes, taxes, and costs of living.

An income and price policy that would reduce income differences among regions could begin in the public sector with a minimum wage law causing all employed people to receive this minimum income. But it may also happen that unemployment would increase in the regions where productivities are low if the minimum wage is high enough. This unemployment increase would then result in an out-migration from these areas.

If the minimum income law increases unemployment in all regions, it could happen that unemployment would increase everywhere without any significant effect on migration flows. We have assumed that those migrants moving to increase their income respond only to expected disposable real income difference among areas no matter how this difference has developed. We can now include public sector influences by decreasing disposable income in j or increasing disposable income in i. Then, *ceteris paribus*, migration between regions i and j will decrease.*

The public sector can also affect the migration caused by potential unemployment by giving unemployment compensations and by offering vocational training to the unemployed. Working possibilities may arise for the unemployed from firm subsidies, which may increase labor demand especially in regions of high unemployment.** Again out-migration would then decrease. It is not necessary, however, to include all these public sector policies into our migration model because all that affect disposable real incomes are captured in the expected disposable real income difference, and the action that decreases unemployment is captured by our potential unemployment variable.

If unemployment compensation is limited, it may only postpone the decision to migrate. We should assume, therefore, some time lag when we are treating the unemployment effect on migration flows. The lag effect may be also true for vocational training. Since both unemployment compensation and vocational training are usually restricted to one year, we assume a one-period time lag between unemployment and migration in our time series model.

3.6 Proposals for Time Series Models

Until now we have been discussing migration flows between two regions taking other possible regions into consideration as well. We will now make some reformulations to these models to look at total out-migration, total in-migration, and net-migration for region i over time. Migration flows of one region do not need

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*The change in expected income difference is $ERRI^e_{ij} < 0$ if $\Delta Y_j < 0$ or $\Delta Y_i > 0$ or $\Delta T_j > 0$ or $T_i < 0$ or $\Delta I_j > 0$ or $\Delta I_i < 0$.

**An active, regional public sector policy may have this kind of activity.

distance weights since the distance between region i and all other regions remains the same over time. But it may happen that our region i changes its place with respect to the comparative regional income distribution, and so we must have some kind of weight variable for this situation. Since new factors affecting migration may also enter the picture and the effects of old factors may change over time, we need some variable that is dependent on time to compensate for these effects. In our equation such a variable is called an *autonomous* migration variable.

We assume further that there is a one-period lag between unemployment in region i and out-migration.* This one period lag also holds for "population pressure" and migration. The population pressure is represented by the number of people between ages 0-64 at the end of the previous period who are living in the origin region in the period in question. Disappointed migrants are assumed to move back within one or two periods. Our model reflects the lag between disappointed in-migrants and out-migrants as one or two periods or no lag at all. There is no lag between migration and our income variable since we assume that migrants respond immediately to expected income differences and that they have information of these differences without any lag time.

Now we can represent in-migration to region i during period t as follows

$$M_{it}^{in} = \underset{\pm}{M_{oi}^{in}(t)} + f\left(\underset{+}{\overline{EDRI}_{it}^{nl}}, \underset{+}{\overline{PUN}_{t-1}}, \underset{+}{\bar{P}_{t-1}^{64}}, \underset{+}{M_{it-h}^{out}}\right) \qquad (22)$$

where

M_{it}^{in} = total in-migration to region i from all other regions during t

$M_{oi}^{in}(t)$ = autonomous in-migration to i from all other regions during t

*Obtaining work in the destination area is considered without any lag since we assume perfect information from labor market.

$\overline{EDRI}^{nl}_{it}$ = $\left(\frac{n^{1}}{n-1}\right)\left(\overline{EDRI}_{it} - \overline{DRI}_{t}\right)$, the average expected difference in real disposable income available in region i compared with regions where there are lower incomes than $\left(i\ \overline{EDRI}^{nl}_{it} > 0\right)$ during t

n^{l}_{t} = number of lower income regions during t

n = total number of regions

$P\overline{UN}_{t-1}$ = $a_{it}\ \overline{UN}_{t-1}$, the average number of total potential unemployed migrants in the regions other than i during the previous period

$\overline{P}^{64}_{t-1}$ = population pressure outside i (measured as the number of people between ages 0-64 at the end of previous period outside i)

M^{out}_{it-h} = number of disappointed out-migrants from i to the other regions during period t-h (h=0,1,2). These migrants are return migrants who have location-specific capital in region i

In a similar way, gross out-migration from region i during period t is

$$M^{out}_{it} = \underset{\pm}{M^{out}_{oi}(t)} + g\left(\underset{+}{\overline{EDRI}^{nh}_{it}},\ \underset{+}{\overline{P}UN_{it-1}},\ \underset{+}{P^{64}_{it-1}},\ \underset{+}{M^{in}_{it-h}}\right) \quad (23)$$

where

M^{out}_{it} = total gross out-migration from i during t

$M^{out}_{oi}(t)$ = autonomous total out-migration from i during t

$\overline{EDRI}^{nh}_{it}$ = $\left(\frac{n^h}{n-1}\right)\left[\left(\overline{EDRI}^h_t\right) - \left(DRI_{it}\right)\right]$, the average expected difference in real disposable income available in the regions that have higher incomes than $\overline{EDRI}^{nh}_{it} > 0$ during t

n^h_t = number of higher income regions during t

$\overline{P}UN_{it-1}$ = $\overline{a}_t UN_{it-1}$, the number of potential unemployed migrants in region i during the previous period

P^{64}_{it-1} = population pressure in i at the end of the previous period

M^{in}_{it-h} = number of possible disappointed in-migrants from other regions to i during the period t-h (h=0,1,2). These migrants have location-specific capital outside i

Since net-migration is the difference between total in-migration and total out-migration, from (22) and (23) we have the net-migration for i during t

$$M^{net}_{it} = \underset{\pm}{M^{net}_{oi}(t)} + m\Big(\underset{+}{\overline{EDRI}^{nl}_{it}},\ \underset{+}{P\overline{UN}_{t-1}},\ \underset{+}{\overline{P}^{64}_{t-1}},\ \underset{+}{M^{out}_{it-h}}, \qquad (24)$$

$$\underset{-}{\overline{EDRI}^{nh}_{it}},\ \underset{-}{\overline{P}UN_{it-1}},\ \underset{-}{\overline{P}^{64}_{it-1}},\ \underset{-}{M^{in}_{it-h}}\Big)$$

where

M^{net}_{it} = net-migration to i during t ($M^{net}_{it} > 0$)

$M^{net}_{oi}(t)$ = autonomous net-migration to i during t

M^{out}_{it-h} = number of possible disappointed out-migrants is now limited to the period where $h = 1,2$

M^{in}_{it-h} = number of possible disappointed in-migrants is now limited to the period where $h = 1,2$

4. EMPIRICAL ANALYSIS FOR TWO FINNISH REGIONS

4.1 Testable Models for Pohjois-Karjala

In the following analysis, we will estimate models for different migration flows by using a yearly time series analysis for two Finnish provinces: Pohjois-Karjala and Uusimaa. The time period is from 1962 to 1977, and the two provinces have opposite levels of incomes; Pohjois-Karjala is the poorest region, and Uusimaa is the richest one.

Since Pohjois-Karjala is the poorest region, there are no in-migrants who are seeking better incomes. Assuming a logarithmic relationship between in-migration and independent factors, we can represent our in-migration model for Pohjois-Karjala for time series estimation as follows

$$\ln M^{in}_{PKt} = \ln M^{in}_{o} + \alpha_1 \ln P\overline{UN}_{Mst-1} + \alpha_2 m\overline{P}^{64}_{Mst-1} + \alpha_{3+h} \ln M^{out}_{PKt-h} + \alpha_6 t + \varepsilon_{1t} \qquad (25)$$

where

M^{in}_{PKt} = total in-migration from other provinces to Pohjois-Karjala during the year*

$P\overline{UN}_{Mst-1}$ = potential average unemployment during the previous year in the other provinces

*For complete information about variables see Appendix A.

$\bar{P}^{64}_{Mst-1}$ = population pressure outside Pohjois-Karjala, that is, the number of people between the ages 0-64 at the end of previous period in the other provinces

M^{out}_{PKt-h} = potential number of disappointed return movers, that is, the out-migrants from Pohjois-Karjala h years earlier (h=0,1,2)

t = time (year)*

ε_{it} = error term**

$\alpha_1, \alpha_2, \alpha_{3+h}$ = parameters that are assumed positive, and parameter $\alpha_6 \neq 0$

In a similar manner our out-migration estimation from the province of Pohjois-Karjala to the other provinces for the time series is

$$\ln M^{out}_{PKT} = \ln M^{out}_{O} + \beta_1 \ln \overline{EDRI}_{Mst} + \beta_2 \ln \overline{PUN}_{PKt-1} + \beta_3 \ln P^{64}_{PKt-1} + \beta_4 t + \varepsilon_2 t \qquad (26)$$

where

M^{out}_{PKt} = total out-migration from Pohjois-Karjala to the other provinces during year t

*We have added the time trend variable since we are going to use only an ordinary least squares technique, and we cannot have autonomous migration that varies over time in the estimation results of the model.

**The constant term in our equations (25)-(27) measures the autonomous migration flow and therefore takes into account other factors that affect migration as well as those specified in the model.

$\overline{EDRI}_{Mst}$ = average expected difference in real disposable income available outside Pohjois-Karjala during t*

$\overline{P}UN_{PKt-1}$ = potential number of unemployed people affecting out-migration from Pohjois-Karajala during t

P^{64}_{PKt-1} = population pressure in Pohjois-Karjala, that is the number of people between ages 0-64 living in Pohjois-Karjala at the end of the previous year

ε_{2t} = error term

$\beta_1, \beta_2, \beta_3$ = parameters assumed to be positive and parameter $\beta_4 \neq 0$

There are no disappointed in-migrants from other provinces to Pohjois-Karjala since we assume that such migrants are mainly caused by income expectations.

Net-migration** in the case of Pohjois-Karjala results in a migration loss, which may now be represented by the following model for time series estimation

$$\ln M^{net}_{PKt} = \ln M^{net}_{o} + \beta_1 \ln \overline{EDRI}_{Mst} + \beta_2 \ln \overline{P}UN_{PKt-1} +$$

$$\beta_3 \ln P^{64}_{PKt-1} + \alpha_1 \ln P\overline{UN}_{Mst-1} + \alpha_2 \ln \overline{P}^{64}_{Mst-1} \quad (27)$$

$$+ \alpha_{3+n} \ln M^{out}_{PKt-h} + \alpha_6 t + \varepsilon_{3t}$$

*If we classify our provinces from the poorest to the richest Pohjois-Karjala will be first and Uusimaa will be last. We have 12 provinces and so $\overline{EDRI}_{Mst} = \left[\sum_{k=2}^{12} EDRI_{kt}/11 - DRI_{PKt}\right]$. For more detailed information see Appendix A.

**$M^{net}_{PKt} = M^{out}_{PKt} - M^{in}_{PKt} > 0$ which means there is a migration loss in the Pohjois-Karjala area.

where

M_{PKt}^{net} = net-migration from Pohjois-Karjala during t

$\beta_1, \beta_2, \beta_3$ are parameters assumed to be positive

$\alpha_1, \alpha_2, \alpha_{3+h}(h=1,2)$ are parameters assumed to be negative, and parameter $\alpha_6 \neq 0$

4.2 Testable Models for Uusimaa

During the entire 1962-1977 period Uusimaa has been our richest province. We can formulate the estimated model for in-migration to Uusimaa by using a time series analysis

$$\ln M_{Ut}^{in} = \ln M_{oU}^{in} + \beta_1^v \ln \overline{EDRI}_{Ut} + \beta_2^v \ln P\overline{UN}_{MsUt-1} + \beta_3^v \ln \overline{P}_{MsUt-1}^{64} + \beta_4^v t + \varepsilon_{2t}^v \quad (28)$$

where

M_{Ut}^{in} = total in-migration to the province Uusimaa from the other provinces during the year t

$\overline{EDRI}_{Ut}$ = average expected difference in real disposable incomes between Uusimaa and the other provinces during t*

$P\overline{UN}_{MsUt-1}$ = potential average number of unemployed outside Uusimma in the previous period t-1

$\overline{P}_{MsUt-1}^{64}$ = population pressure outside Uusimaa at the end of the previous period

$\beta_1^v, \beta_2^v, \beta_3^v$ are parameters assumed to be positive and the parameter $\beta_4^v \neq 0$

*For complete information on independent variables see Appendix A.

Out-migration from Uusimaa is now possible to formulate in a similar manner as in-migration to Pohjois-Karjala since nobody from Uusimaa moves out for better incomes. We now have the following time series model for out-migration

$$\ln M_{Ut}^{out} = \ln M_{oU}^{out} + \alpha_1^v \ln \bar{P}UN_{Ut-1} + \alpha_2^v \ln P_{Ut-1}^{64} + \alpha_{3+h}^v \ln M_{Ut-h}^{in} + \alpha_6^v t + \varepsilon_{1t}^v \qquad (29)$$

where

M_{Ut}^{out} = total out-migration from Uusimaa to the other provinces during t

$\bar{P}UN_{Ut-1}$ = potential number of unemployed in Uusimaa affecting out-migration during the previous period

P_{Ut-1}^{64} = population pressure in Uusimaa at the end of the previous period

M_{Ut-1}^{in} = potential number of disappointed return movers to the other provinces, that is the number of in-migrants from the other provinces to Uusimaa during the year t-h (h = 0,1,2)

$\alpha_1^v, \alpha_2^v, \alpha_{3+h}^v$ are parameters assumed to be positive and the parameter $\alpha_6^v \neq 0$

Since Uusimaa has a migration gain from the other provinces during the whole 1962-1977 period*, we postulate the net-migration time

*$M_{Ut}^{net} = M_{Ut}^{in} - M_{Ut}^{out} > 0$ which means there is a migration gain in Uusimaa.

series model for Uusimaa in the following way

$$\ln M_{Ut}^{net} = \ln M_{UO}^{net} + \beta_1^v \ln \overline{EDRI}_{Ut} + \beta_2^v \ln P\overline{UN}_{MsUt-1}$$
$$+ \beta_3^v \ln \overline{P}_{MsUt-1}^{64} + \alpha_1^v \ln \overline{P}UN_{Ut-1} \qquad (30)$$
$$+ \alpha_2^v \ln P_{Ut-1}^{64} + \alpha_{3+h}^v \ln M_{Ut-h}^{in}$$
$$+ \alpha_6^v t + \varepsilon_{3t}^v$$

where

M_U^{net} = net migration to Uusimaa from other provinces during t

β_1^v, β_2^v, and β_3^v are parameters assumed to be positive

α_1^v, α_2^v, and α_{3+h}^v(h=1,2) are parameters assumed to be negative and parameter $\alpha_6^v \neq 0$

4.3 Empirical Results of In-, Out-, and Net-Migration Models for Pohjois-Karjala and Uusimaa

4.3.1. Some Statistical Facts of Pohjois-Karjala and Uusimaa

Before we present the estimation results of our simple migration models for Pohjois-Karjala and Uusimaa, we will briefly review migration flows, the labor market, incomes, and population in both regions.

Figure 1, which illustrates the total in- and out-migration flows for Pohjois-Karjala, shows the declining trend for out-migration between 1962 and 1977 and a similar trend for in-migration after 1974. The difference between out- and in-migration

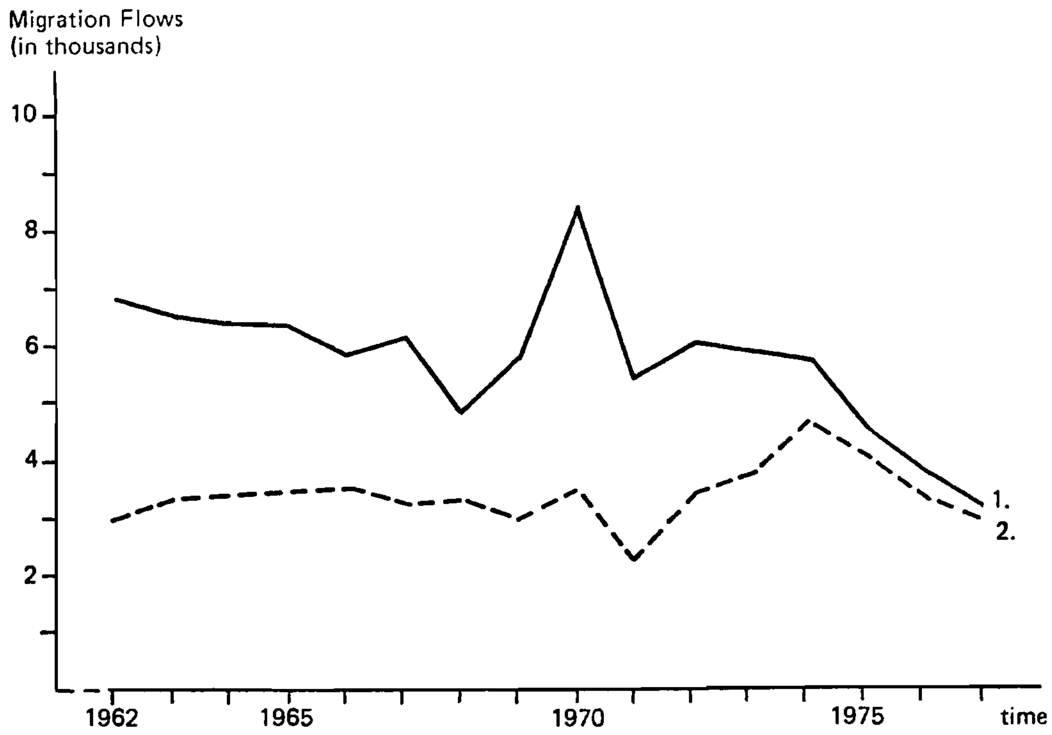

Figure 1. Out-migration flow (1) and in-migration flow (2) for Pohjois-Karjala from 1962 to 1977.

from and to Pohjois-Karjala (net-migration) has decreased over time.*

If we look at in- and out-migration for Uusimaa (Figure 2), we can see that out-migration from Uusimaa increased until 1974, and after that it started to decline. In-migration to Uusimaa had a slight declining tendency until 1968, and after that it increased until 1970. After a short but rapid decline in 1971, in-migration to Uusimaa increased until 1974 at which point it

*In 1970 there is a peak in all migration figures which is partly due to exceptionally high internal migration, and partly to statistical reasons. Migration statistics have been changed, counting some migrants as 1970 migrants rather than as 1971 migrants. This also partly explains the sharp decline in 1971 migration figures.

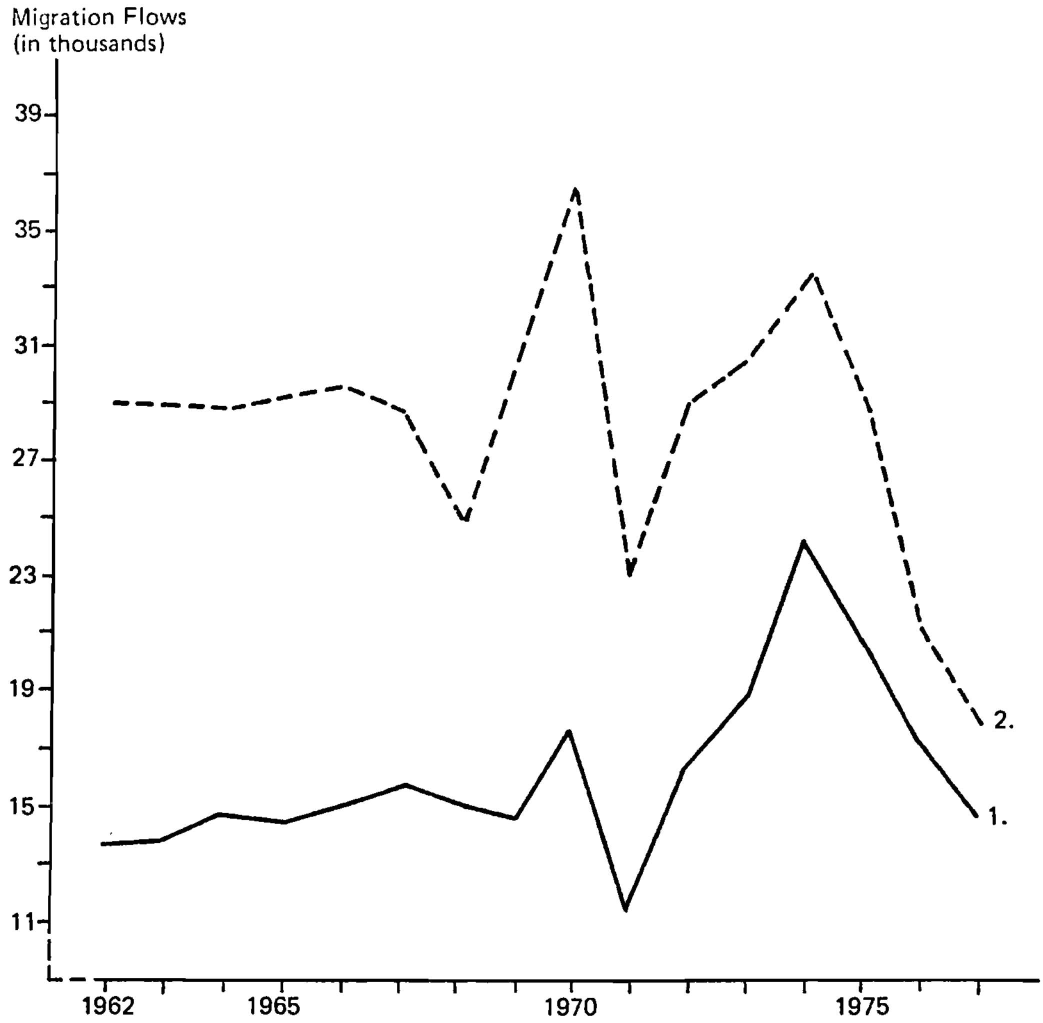

Figure 2. Out-migration flow (1) and in-migration flow (2) for Uusimaa from 1962 to 1977.

dropped rapidly. The in- and out-migration patterns seem to be similar after 1968 and the difference between in-migration and out-migration to and from Uusimaa (net-migration) decreased over the period. The net-migration gain to Uusimaa and the net-migration loss from Pohjois-Karjala are shown in Figure 3.

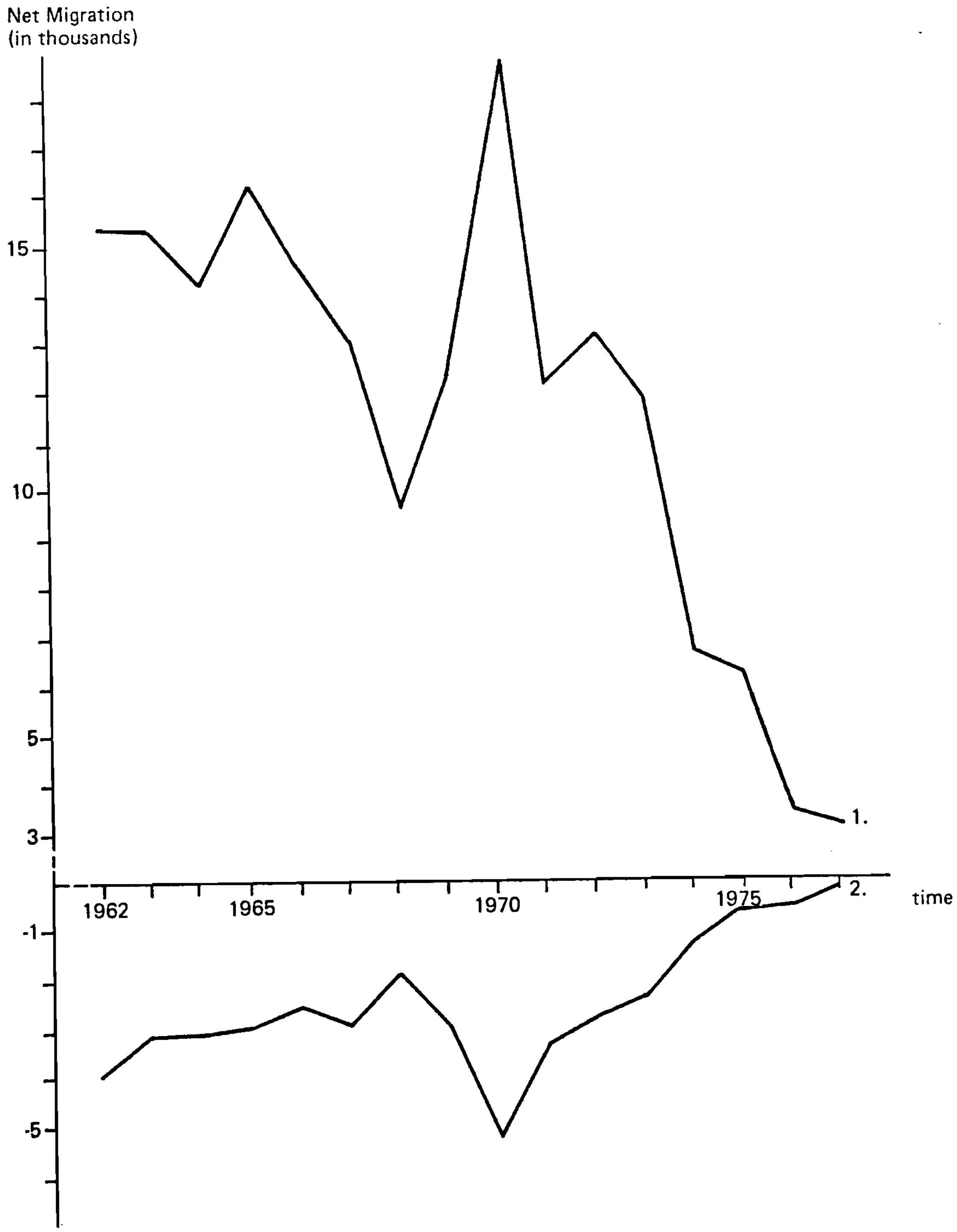

Figure 3. Net-migration flows for Uusimaa (1) and Pohjois-Karjala (2) from 1962 to 1977.

The proportional tightness of job possibilities is represented in Figure 4. This tightness is measured by the possibility of obtaining work in the province divided by the possibility of obtaining work outside the province. Between 1963 and 1977 there have been better possibilities of employment in Uusimaa than elsewhere. In Pohjois-Karjala, on the other hand, since 1966 the working possibilities have been far better outside.

Figure 5 illustrates the yearly nominal incomes after taxes per income earner. Until 1969 this increase was quite slow but afterward it became more rapid. The income difference between Uusimaa and Pohjois-Karjala has also increased over time as has the difference between Uusimaa and other provinces and the difference between other provinces and Pohjois-Karjala.

Total population and population pressures (the number of people between the ages of 0-64 living in the area) are represented in Figures 6 and 7.

From these figures we see that Uusimaa has increased its total population and population pressure during the whole 1962-1977 period. But the growth rates of total population and of population pressure have declined over the course of time. In Pohjois-Karjala both total population and population pressure have decreased, but the total population has decreased more slowly between 1970 and 1977 than the population pressure.

4.3.2 Estimated In-, Out-, and Net-migration Models for Pohjois-Karjala

All estimated models are double logarithmic, and all estimations are made by using ordinary least squares.* We assume constant elasticities of explanatory variables when we use double logarithmic models. If this were not the case, we would use semilogarithmic models in our estimations.

*Basic data for estimation is represented in Appendix B.

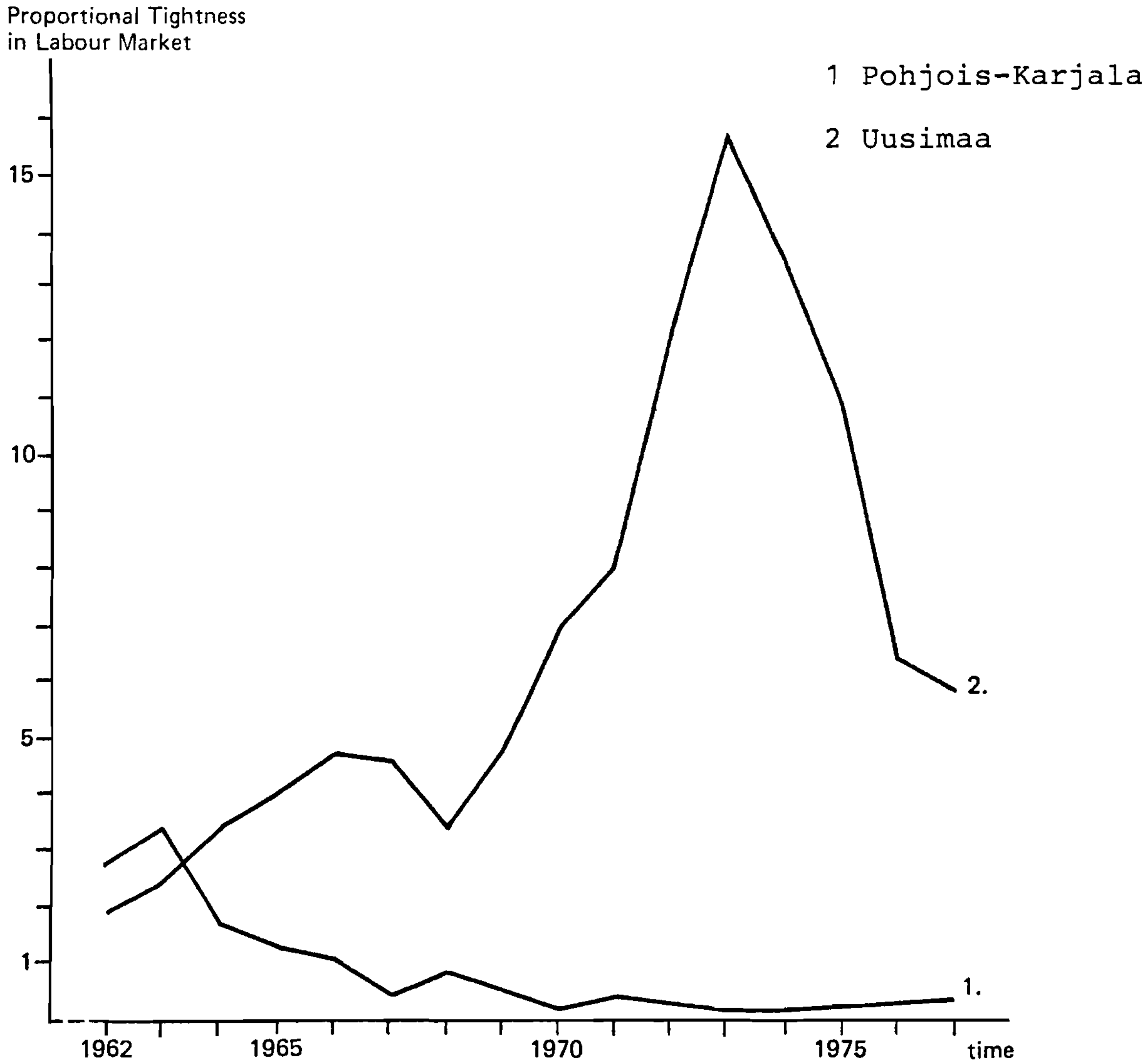

Figure 4. The tightness in the labor market in Pohjois-Karjala and Uusimaa between 1962 and 1977. The proportional tightness is measured by the possibilities of obtaining work in either Pohjois-Karjala or Uusimaa divided by the average possibility of obtaining work outside of the province in question.

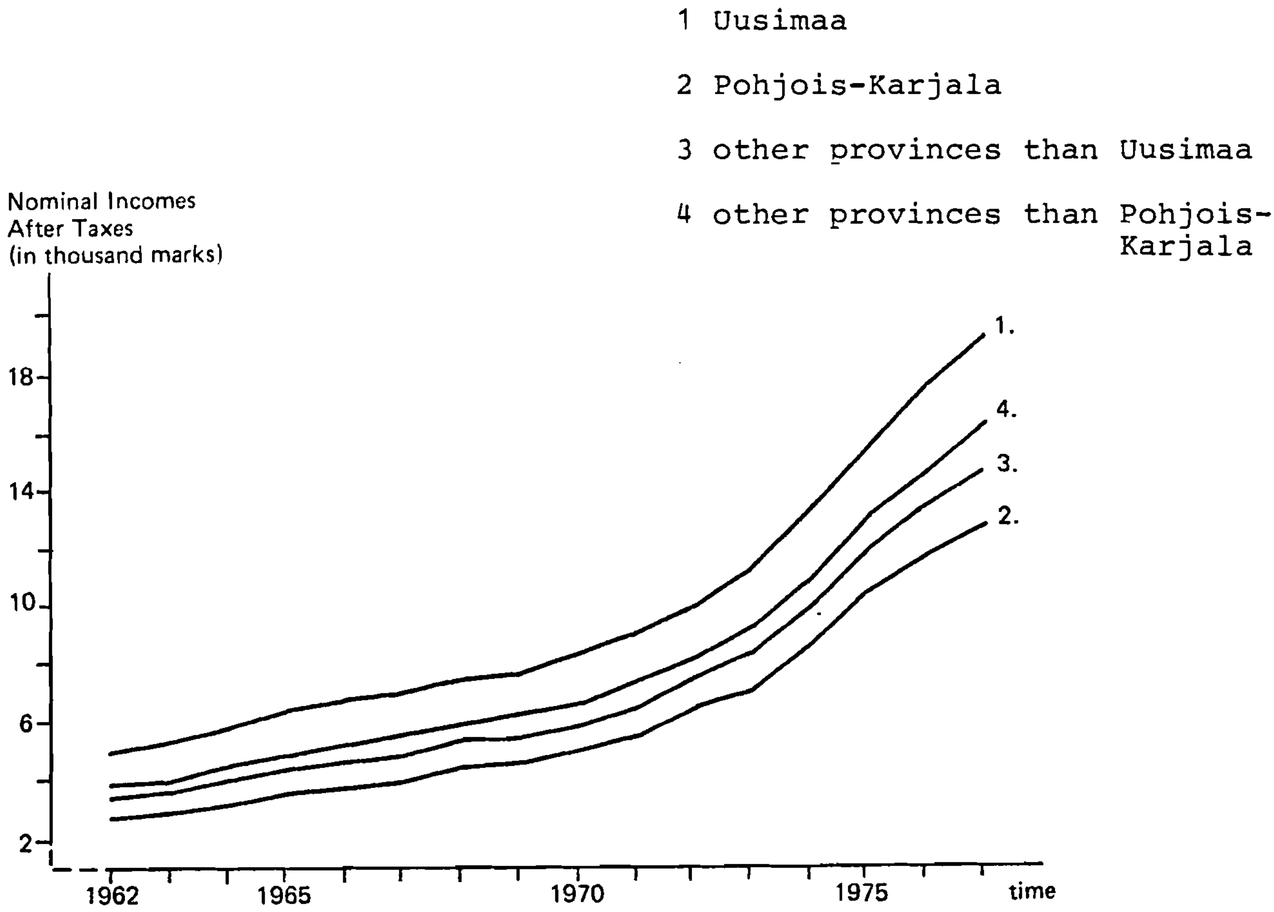

Figure 5. Yearly nominal incomes after taxes per income earner from 1962 to 1977.

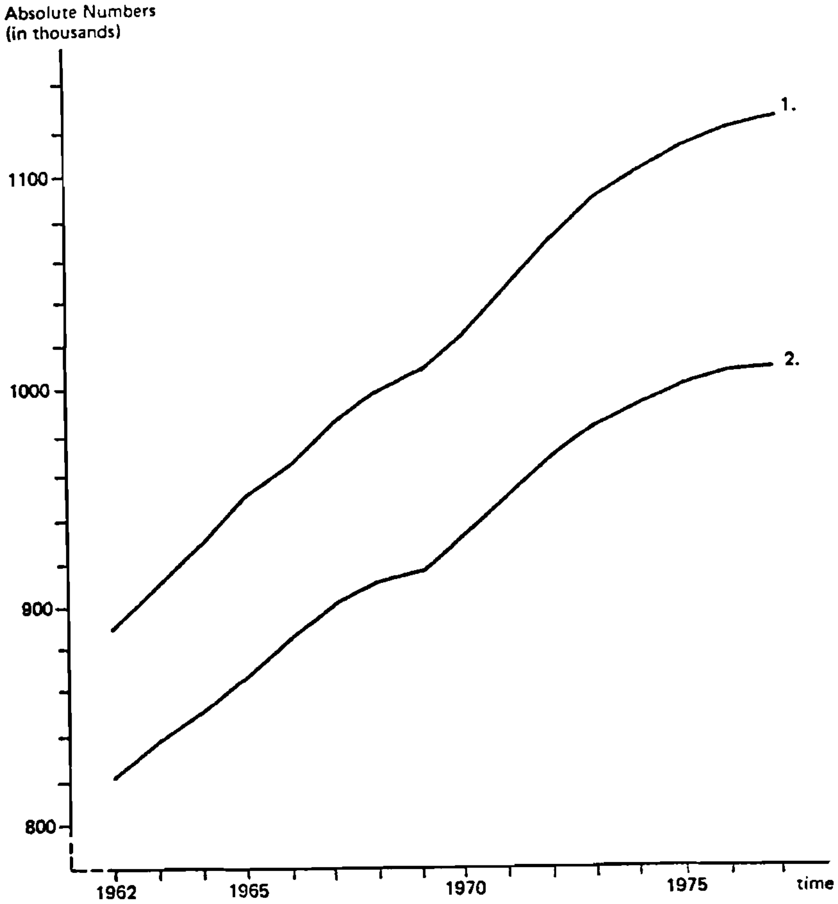

Figure 6. Total population (1) and population pressure (2) in Uusimaa from 1962 to 1977.

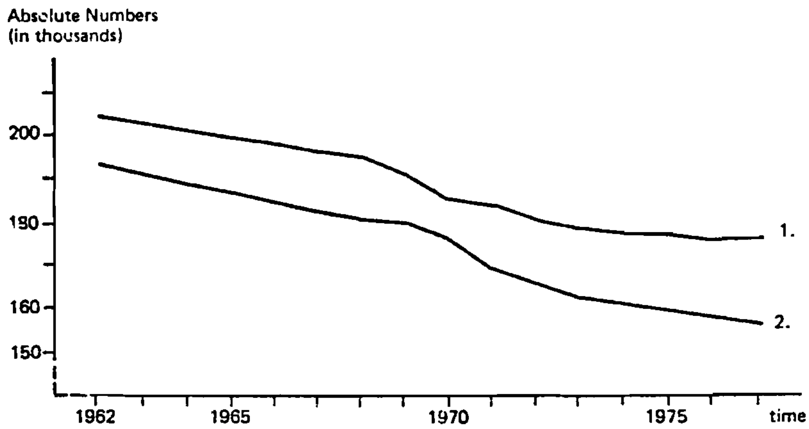

Figure 7. Total population (1) and population pressure (2) in Pohjois-Karjala from 1962 to 1977.

In-migration to Pohjois-Karjala

In the basic model (25), we assume that in-migration to Pohjois-Karjala (M^{in}_{PKt}) can be explained by the average number of potential unemployed outside of Pohjois-Karjala ($\overline{PUN}_{Mst-1}$), the population pressure outside of Pohjois-Karjala (P^{64}_{Mst-1}), the potential number of disappointed out-migrants (M^{out}_{PKt-1}, $h = 0,1,2$), and the time trend (t). The best estimation results are presented in Table 1. As we can see, none of our variables are significant to explain in-migration to Pohjois-Karjala.

Since model (25) did not adequately explain in-migration to Pohjois-Karjala, we made small changes to the basic model. We changed potential unemployment outside Pohjois-Karjala to the possibility of obtaining work in Pohjois-Karjala with the measure of the proportion being a_{PKt}: the number of open vacancies divided by the number of unemployed in Pohjois-Karjala during the in-migration period ($AV_{PKt}/U_{PKt} = a_{PKt}$).

The estimation results of this new model are presented in Table 2. We find that we can explain 54% of the in-migration to Pohjois-Karjala. Furthermore, the possibility of obtaining work in Pohjois-Karjala together with the population pressure outside the region have significant coefficients and the signs of these coefficients are positive as expected. By looking at the Durbin-Watson statistic d (represented as D) in Tables 1 and 2 we find that in every model there remains the possibility of a first degree serial correlation since all D values remain in the region of indeterminacy.*

Out-migration from Pohjois-Karjala

In model (26) we assume that it is possible to explain out-migration from Pohjois-Karjala (M^{out}_{PKt}) by the average expected real disposable income difference between other provinces and Pohjois-Karjala ($\overline{EDRI}_{Mst}$), the average number of potential

*In all econometric problems the common reference for this is Intriligator (1978).

Table 1. In-migration to Pohjois-Karjala: logarithmic regression coefficients.

Number of equation	Constant	Explanatory variables $\overline{PUN}_{Mst-1}$	P^{64}_{Mst-1}	M^{out}_{PKt}	M^{out}_{PKt-1}	M^{out}_{Pkt-2}	t	R^2	F	D
(31)	-136.0 (-1.3)	-0.026 (-0.6)	16.5 (1.4)	0.429 (1.5)	-0.07 (-0.2)	0.467 (1.3)	0.007 (0.5)	37	0.9	1.25
(32)	-117.0 (-1.6)	-	14.2 (1.7)	0.341 (1.5)	-	0.486 (1.4)	0.009 (0.7)	34	1.4	1.23

$\overline{PUN}_{Mst-1}$ = average number of potential unemployed during previous year outside Pohjois-Karjala

P^{64}_{Mst-1} = population pressure measured by number of population between ages 0-64 outside Pohjois-Karjala at the end of the previous year

M^{out}_{PKt-h} = potential return migrants = number of out-migrants from Pohjois-Karjala to the other provinces during year t-h (h = 0,1,2)

t = time (year)

R^2 = percentage of explanation by model

F = test of significance of the model and under coefficients are represented by their respective t - values

D = Durbin-Watson statistic d

\- = variable not included in equation

Table 2. In-migration to Pohjois-Karjala: logarithmic regression coefficients.

Number of equation	Constant	Explanatory variables a_{PKt}	P^{64}_{Mst-1}	M^{out}_{PKt}	M^{out}_{PKt-1}	M^{out}_{PKt-2}	t	R^2	F	D
(33)	-211.0 (-2.7)	0.145 (2.1)	25.7 (2.8)	0.298 (1.5)	-	0.439 (1.5)	0.023 (1.7)	54	2.4	1.76

a_{PKt} = (AV_{PKt}/U_{PKt}), the probability of obtaining work in Pohjois-Karjala measured as the number of open vacancies per number of unemployed persons in Pohjois-Karjala

P^{64}_{Mst-1} = population pressure measured by number of population between ages 0-64 outside Pohjois-Karjala at the end of the previous year

M^{out}_{PKt-h} = potential return migrants = number of out-migrants from Pohjois-Karjala to the other provinces during year t-h (h = 0,1,2)

t = time (year)

R^2 = percentage of explanation by model

F = test of significance of the model and under coefficients are represented by their respective t - values

D = Durbin-Watson statistic d

\- = variable not included in equation

unemployed in Pohjois-Karjala ($\overline{P}UN_{PKt-1}$), the population pressure in Pohjois-Karjala (P^{64}_{PKt-1}) and the time trend (t). Since the time variable and population pressure variable are highly correlated we dropped the time variable from our analysis and the result of the estimation is in Table 3. We can see from Table 3 that our simple model explains 83% of all out-migration from Pohjois-Karjala, all explanatory variables have significant coefficients, and the signs of coefficients are all positive as expected. According to the Durbin-Watson statistic d, the absence of a first order serial correlation is indicated.

Net-migration in Pohjois-Karjala

Absolute net-migration in Pohjois-Karjala (M^{net}_{PKt}) is the difference between out- and in-migration. In model (27) this net-migration is assumed to have positive relationships to the average expected real disposable income difference between other provices and Pohjois-Karjala ($\overline{EDRI}_{Mst}$), to the average number of potential unemployment in Pohjois-Karjala ($\overline{P}UN_{PKt-1}$), and to the population pressure in Pohjois-Karjala (P^{64}_{PKt-1}). The negative relationship is assumed between net-migration and the average number of potential unemployed outside Pohjois-Karjala ($P\overline{UN}_{Mst-1}$), the population pressure outside Pohjois-Karjala (P^{64}_{Mst-1}), and the potential disappointed out-migrants from Pohjois-Karjala (M^{out}_{PKt-h}, h = 1,2).*

Since we could not explain in-migration to Pohjois-Karjala adequately by model (25), we estimated first the net-migration model for Pohjois-Karjala by using the same explanatory variables that explained out-migration from Pohjois-Karjala. The results are presented in Table 4. From equation (35) we can see that all variables have significant coefficients and the expected signs. This model explains 82% of total net-migration loss from Pohjois-Karjala.

*Net-migration was also assumed to have some time trend but in our empirical estimation, time was not included in the models because of its heavy correlation with population pressure.

Table 3. Out-migration from Pohjois-Karjala: logarithmic regression coefficients.

		Explanatory variables						
Number of equation	Constant	$\overline{EDRI}_{Mst}$	$\overline{PUN}_{PKt-1}$	P^{64}_{PKt-1}	t	R^2	F	D
(34)	-8.28 (-2.8)	0.802 (4.5)	0.054 (3.2)	2.15 (3.1)	-	83	19	2.12

$\overline{EDRI}_{Mst}$ = average expected real disposable income difference per income earner between other provinces and Pohjois-Karjala during t

$\overline{PUN}_{PKt-1}$ = average number of potential unemployed in Pohjois-Karjala during previous year

P^{64}_{PKt-1} = population pressure in Pohjois-Karjala at the end of the previous year

t = time (year)

R^2 = percentage of explanation by model

F = test of significance of the model and under coefficients are represented by their respective t - values

D = Durbin-Watson statistic d

\- = variable not included in equation

Table 4. Net-migration (loss) from Pohjois-Karjala: logarithmic regression coefficients.

		Explanatory variables								
Number of equation	Constant	$\overline{EDRI}_{Mst}$	$\overline{PUN}_{PKt-1}$	P^{64}_{PKt-1}	$\overline{PUN}_{Mst-1}$	P^{64}_{Mst-1}	t	R^2	F	D
(35)	-57.5 (-5.0)	2.02 (3.2)	0.183 (3.1)	9.70 (4.0)	-	-	-	82	18.5	1.05
(36)	341.0 (1.9)	1.04 (1.5)	0.256 (4.2)	10.1 (4.8)	-	-47.5 (-2.2)	-	87	19.0	1.65

$\overline{EDRI}_{Mst}$ = average expected real disposable income difference per income earner between other provinces and Pohjois-Karjala during t

$\overline{PUN}_{PKt-1}$ = average number of potential unemployed in Pohjois-Karjala during previous year

P^{64}_{PKt-1} = population pressure in Pohjois-Karjala at the end of the previous year

$\overline{PUN}_{Mst-1}$ = average number of potential unemployed during previous year outside Pohjois-Karjala

P^{64}_{Mst-1} = population pressure measured by number of population between ages 0-64 outside Pohjois-Karjala at the end of the previous year

t = time (year)

R^2 = percentage of explanation by model

F = test of significance of the model and under coefficients are represented by their respective t - values

D = Durbin-Watson statistic d

\- = variable not included in equation

We also used different explanatory variables in model (35) to make estimations but only the variable measuring population pressure outside of Pohjois-Karjala generated significant coefficients and the assumed negative sign [see (36) in Table 4].

By using equation (36) we can explain 87% of the net-migration in Pohjois-Karjala, but we also find that in this model when population pressure outside Pohjois-Karjala is present, our income difference variable looses its significance. In both equations (35) and (36) the Durbin-Watson test statistic d falls in the region of indeterminancy, which allows for the possibility of first order serial correlation.

4.3.3 Estimated In-, Out-, and Net-migration Models for Uusimaa

In-migration to Uusimaa

According to model (28) in-migration to Uusimaa (M^{in}_{Ut}) is assumed to be a positive function of the average expected real income difference between Uusimaa and other provinces ($\overline{EDRI}_{Ut}$), the average number of potential unemployed outside Uusimaa ($P\overline{UN}_{MsUt-1}$), and the population pressure outside Uusimaa (P^{64}_{MsUt-1}). Also the time trend is assumed to be different from zero.* We succeeded in explaining 57% of all in-migration to Uusimaa (Table 5) by equation (37). Also all explanatory variables included have significant coefficients and their signs are all positive as assumed. Since in equation (37) the Durbin-Watson statistic is almost 2, the absence of first order serial correlation is indicated.

Out-migration from Uusimaa

When we formulated the out-migration model for Uusimaa (equation 29) we assumed that the potential unemployment in Uusimaa ($\overline{P}UN_{Ut-1}$), the population pressure in Uusimaa (P^{64}_{Ut-1}), and the potential disappointed in-migrants to Uusimaa (M^{in}_{Ut-h}, h=0,1,2) all have a positive relationship to

*The time variable was excluded from our empirical analysis since it correlated quite strongly with the population pressure variable.

Table 5. In-migration to Uusimaa: logarithmic regression coefficients.

		Explanatory variables						
Number of equation	Constant	$\overline{EDRI}_{Ut}$	$P\overline{UN}_{Mst-1}$	P^{64}_{MsUt-1}	t	R^2	F	D
(37)	-78.3 (-3.6)	0.673 (2.4)	0.164 (3.4)	9.43 (3.7)	-	57	5.3	2.03

$\overline{EDRI}_{Ut}$ = average expected real disposable income difference per income earner between Uusimaa and other provinces

$P\overline{UN}_{MsUt-1}$ = average number of potential unemployed outside Uusimaa during the previous year

P^{64}_{MsUt-1} = population pressure outside Uusimaa at the end of the previous year

t = time (year)

R^2 = percentage of explanation by model

F = test of significance of the model and under coefficients are represented by their respective t - values

D = Durbin-Watson statistic d

\- = variable not included in equation

out-migration. A time effect other than zero was postulated.* The estimated results are in Table 6. See that only population pressure and in-migration to Uusimaa during the same period have significant coefficients and that their signs are as previously assumed. Together these two variables explain 66% of the out-migration from Uusimaa to other provinces. Both in equation (38) and (39) the first order positive serial correlation is essential.

Net-migration in Uusimaa

The number of net-migrants (M_{Ut}^{net}) for each year is calculated as the difference between in-migration and out-migration. When we formulated the net-migration model for Uusimaa, we assumed that there is a positive relationship between net-migration and the average expected real disposable income difference ($\overline{EDRI}_{Ut}$), the average number of potential unemployed outside Uusimaa ($\overline{PUN}_{MsUt-1}$), and the population pressure outside Uusimaa (P_{MsUt-1}^{64}). The average number of potential unemployed in Uusimaa ($\overline{PUN}_{Ut-1}$), the population pressure in Uusimaa (P_{Ut-1}^{64}), and the in-migration to Uusimaa (M_{Ut-h}^{in}, $h = 1,2$) was suggested as having negative effects on net-migration to Uusimaa, and the time effect was assumed to differ from zero.**

The results of the estimated equations are in Table 7. We did not use population pressure in Uusimaa (P_{Ut-1}^{64}) and population pressure outside Uusimaa (P_{MUt-1}^{64}) as explanatory variables in the same equation because they were highly correlated. We see that coefficients for our expected real disposable income difference variable are not significant in any equation. Also the coefficients of the average number of potential unemployed in Uusimaa are insignificant. Population pressure outside Uusimaa and population pressure in Uusimaa have significant coefficients in the respective equations, and also the signs of coefficients are as assumed.

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*Again the time variable was omitted in our estimated models.
**The time variable was dropped.

Table 6. Out-migration from Uusimaa: logarithmic regression coefficients.

Number of equation	Constant	Explanatory variables								
		$\overline{PUN}_{Ut-1}$	P^{64}_{Ut-1}	M^{in}_{Ut}	M^{in}_{Ut-1}	M^{in}_{Ut-2}	t	R^2	F	D
(38)	-13.5 (-3.5)	0.0002 (0.02)	2.06 (4.0)	0.696 (3.4)	-	-	-	66	7.6	.90
(39)	-13.5 (-4.1)	-	2.06 (4.6)	0.695 (3.5)	-	-	-	66	12.4	.90

$\overline{PUN}_{Ut-1}$ = average number of potential unemployed during previous year in Uusimaa

P^{64}_{Ut-1} = population pressure in Uusimaa at the end of the previous year

M^{in}_{Ut-h} = potential disappointed out-migrants, the number of in-migrants to Uusimaa from other provinces during year t-h (h = 0,1,2)

t = time (year)

R^2 = percentage of explanation by model

F = test of significance of the model and under coefficients are represented by their respective t - values

D = Durbin-Watson statistic d

\- = variable not included in equation

Table 7. Net-migration to Uusimaa: logarithmic regression coefficients.

Number of equation	Constant	Explanatory variables $\overline{EDRI}_{Ut}$	$\overline{PUN}_{MsUt-1}$	P^{64}_{MsUt-1}	$\overline{PUN}_{Ut-1}$	P^{64}_{Ut-1}	t	R^2	F	D
(40)	-349 (-5.2)	0.874 (1.2)	0.352 (2.8)	42.5 (5.2)	-0.070 (-1.8)	-	-	75	8.0	1.64
(41)	80.3 (8.6)	-0.246 (-0.5)	0.426 (5.5)	-	-0.040 (-1.7)	-11.4 (-9.6)	-	91	27	1.75

$\overline{EDRI}_{Ut}$ = average expected real disposable income difference per ince earner between Uusimaa and other provinces

$\overline{PUN}_{MsUt-1}$ = average number of potential unemployed outside Uusimaa during the previous year

P^{64}_{MsUt-1} = population pressure outside Uusimaa at the end of the previous year

$\overline{PUN}_{Ut-1}$ = average number of potential unemployed during previous year in Uusimaa

t = time (year)

R^2 = percentage of explanation by model

F = test of significance of the model and under coefficients are represented by their respective t - values

D = Durbin-Watson statistic d

\- = variable not included in equation

The number of potential unemployed outside Uusimaa has also significant and positive coefficients in all equations as assumed. The best model (41) explains 91% of the net-migration to Uusimaa.

The Durbin-Watson test statistic d remains in both models (40) and (41) in the region of indeterminacy, which allows for the possibility of first order serial correlation.

4.4 Conclusions of Empirical Results

We could explain 57% of the in-migration to Uusimaa by our explanatory variables, expected real disposable income difference, potential unemployment, and population pressure. These same variables formulated for Pohjois-Karjala explained 83% of the out-migration from Pohjois-Karjala and also 82% of the net-migration from Pohjois-Karjala.

By using potential unemployment, population pressure, and possible return migrants, we could explain 66% of the out-migration from Uusimaa, but these variables explained only 37% of the in-migration to Pohjois-Karjala, and none of these variables were significant. The reformulated model for in-migration to Pohjois-Karjala had possible employment in Pohjois-Karjala, population pressure outside Pohjois-Karjala, disappointed return migrants, and a time trend as explanatory variables. This model succeeded in explaining 54% of the in-migration to Pohjois-Karjala, but only possible employment and population pressure had significant coefficients.

The best net-migration model for Pohjois-Karjala explained 87% of the net-migration loss from Pohjois-Karjala. In this model we used four explanatory variables: expected real disposable income difference, potential unemployment in Pohjois-Karjala, population pressure in Pohjois-Karjala, and population pressure outside Pohjois-Karjala. All other factors except real disposable income differences had significant coefficients. We succeeded in explaining 91% of the net-migration gain to Uusimaa by using the expected real disposable income difference and potential unemployment both in and outside of Uusimaa and population pressure in Uusimaa.

It seems clear from the above empirical results that we can explain quite satisfactorily in-, out-, and net-migration flows for Pohjois-Karjala and Uusimaa by simple models. But according to the Durbin-Watson test statistic d, the first order serial correlation is indicated in some models. This may be a hint of misspecification in the model; we have excluded some relevant variables.

By looking at the first order serial correlations of the estimated models, we found that the serial correlation between residuals is quite high in the out-migration models for Uusimaa and the basic in-migration model (31) for Pohjois-Karjala.* Only final models that have a high first order serial correlation between respective residuals can be used as out-migration models for Uusimaa. This means that we should reformulate these models by adding new explanatory variables.

Possible candidates for new explanatory variables are measures of possible employment outside Uusimaa, government regional and educational policy, and tightness of housing (supply of housing).** Of course we can use government regional and educational policy variables to obtain a better explanation for in-migration to Pohjois-Karjala as well. If we can properly measure the tightness of housing, we probably can improve the results of in-migration to Uusimaa by adding a housing supply variable. We must also remember that if we add explanatory variables to in- or out-migration models, we must also estimate their effects on net-migration flows if these added new variables are significant in explaining in- or out-migration.

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*To correct this serial correlation effect without including new explanatory variables in the analysis, we should use a transformed model where instead of the original variables, we use their corresponding differences. The first order serial correlations are represented for different models in Appendix C

**In our models we have measured the tightness of housing only by rent differences, which have effects on real disposable incomes in different regions. But since in Finland we have a kind of rent control, it may be true that the rents do not describe the tightness of the housing market efficiently.

5. CONCLUSIONS

The main idea of this paper was to construct theoretical single-equation models that explain why people move and to test these models empirically at the aggregate level. The models were based on ideas of human capital theory and of course many restrictive and simplifying assumptions were made. However, as a first rough attempt to explain different migratory flows, these models may serve as a proxy. Much work remains to be done and the further development of this study is, moreover, to reject single-equation models and to tie migration into one part of the simultaneous equation system of labor market modeling.

APPENDIX A: VARIABLES USED IN EMPIRICAL MODELS

Pohjois-Karjala

M^{in}_{PKt} = total number of in-migration to Pohjois-Karjala from other provinces during the year t measured as an absolute number of in-migrants

$P\overline{UN}_{Mst-1}$ = $a_{PKt}\ \overline{UN}_{Mst-1}$, the average number of potential unemployed in other provinces affecting migration to Pohjois-Karjala

a_{PKt} = (AV_{PKt}/U_{PKt}), the possibility of employment in Pohjois-Karjala for unemployed mover

AV_{PKt} = average number of open unfilled vacancies in Pohjois-Karjala (yearly average)

U_{PKt} = average number of unemployed persons in Pohjois-Karjala (yearly average)

$\overline{UN}_{Mst-1}$ = $\sum_{k=2}^{12} (U_{kt-1} - AV_{kt-1})$, the average number of natural unemployed in the other provinces (outside Pohjois-Karjala) measured as the yearly average during the previous period ($k \neq$ Pohjois-Karjala)*

$\bar{P}^{64}_{Mst-1}$ = population pressure outside Pohjois-Karjala, that is, the number of potential migrants for Pohjois-Karjala measured as an absolute number of population between ages 0-64 at the end of the previous living outside Pohjois-Karjala

M^{out}_{PKt-h} = absolute number of out-migrants from Pohjois-Karjala to the other provinces during the period $t - h$ $(h = 0,1,2)$

$\overline{EDRI}_{Mst}$ = $\left[\sum_{k=2}^{12} (EDRI_{kt}/11) - DRI_{PKt}\right]$, the average expected difference in disposable real incomes between other provinces and Pohjois-Karjala measured as Finnish marks per income earner

$EDRI_k$ = $\left[(1 - U_{kt})(Y_{kt} - T_{kt})/I_{kt}\right]$, the expected disposable real income in the province k ($k \neq$ Pohjois-Karjala) measured as Finnish marks per income earner

U_{kt} = $\left[(U_{kt} - AV_{kt})/L_{kt}\right]$, the natural unemployment rate in the province k ($k \neq$ Pohjois-Karjala)

L_{kt} = labor force in k, measured by the number of population between the years 15-64 minus the number of people receiving invalid compensation within the same age group

$INVA^{15-64}_{kt}$ = number of recipients of invalid compensation in k (within the age group 15-64)

Y_{kt} = average nominal income per income earner in k measured as Finnish marks (yearly average)

*In Finland we have 12 provinces, and as mentioned before we classify all provinces by income from the poorest to the richest; Pohjois-Karjala is number 1 and Uusimaa is number 12.

T_{kt} = average taxes per income earner in k measured as Finnish marks (yearly average)

I_{kt} = $(\overline{CI}_t\, HI_{kt})$, the cost-of-living index in k measured as consumer price index in the whole country connected by housing costs in k

$\overline{CI}_t$ = consumer price index in Finland the base year 1962

HI_{kt} = $(H_{kt}/\overline{H}_t)$, the cost-of-housing index for province k

H_{kt} = housing cost in k measured as an average rent paid per square meter for centrally heated houses in urban centers (Finnish provinces)

$\overline{H}_t$ = average housing cost in Finland, measured as the average rent paid per square meter for centrally heated houses in urban centers in all Finnish provinces

DRI_{PKt} = $(Y_{PKt} - T_{PKt})/I_{PKt}$, the average real disposable income in Pohjois-Karjala per earner (Finnish marks)

Y_{PKt} = average nominal income per income earner in Pohjois-Karjala (Finnish marks)

T_{PKt} = average taxes per income earner in Pohjois-Karjala (Finnish marks)

I_{PKt} = $(\overline{CI}_t \cdot HI_{PKt})$, the housing connected cost-of-living index in Pohjois-Karjala

HI_{PKt} = $(H_{PKt}/\overline{H}_t)$, the cost-of-housing index for Pohjois-Karjala

H_{PKt} = housing cost in Pohjois-Karjala measured as the average rent paid per square meter for centrally heated houses in urban centers (Finnish provinces)

$\bar{P}UN_{PKt-1}$ = $\bar{a}_{Mst}(U_{PKt-1} - AV_{PKt-1})$, the average number of potential unemployed affecting out-migration from Pohjois-Karjala

$\bar{a}_{Mst}$ = $\left(\sum_{k=2}^{12} AV_{kt}/U_{kt}\right)$ average possibility of obtaining work outside Pohjois-Karjala (in other provinces) for potential unemployment in Pohjois-Karjala

$U_{PKt-1} - AV_{PKt-1}$ = average number of natural unemployed in Pohjois-Karjala during t - 1 (yearly average)

P^{64}_{PKt-1} = population pressure in Pohjois-Karjala, (that is, the number of potential age group migrants in Pohjois-Karjala measured as the number of people between ages 0-64 at the end of the previous period living in Pohjois-Karjala)

M^{net}_{PKt} = $M^{out}_{PKt} - M^{in}_{PKt}$, the net-migration (loss) from Pohjois-Karjala during t

α_i = parameter (i = 1,...,6)

β_j = parameter (j = 1,...,4)

ε_{rt} = error term (r = 1,...,3)

t = time period (year)

ln = natural logarithm

PK = Pohjois-Karjala (subscript)

Ms = other provinces than Pohjois-Karjala (subscript)

Uusimaa

M^{in}_{Ut-h} = total in-migration to Uusimaa from other provinces measured as the absolute number of in-migrants from other provinces during the year t-h (h = 0,1,2)

$\overline{EDRI}_{Ut}$ = $\left[\left(EDRI_{Ut} - \sum_{l=1}^{11} DRI_{lt}\right) /11\right]$, the average expected difference in disposable real incomes between Uusimaa and other provinces per income earner (Finnish marks)

$\overline{EDRI}_{Ut}$ = $\left[(1 - U_{Ut})(Y_{Ut} - T_{Ut})/I_{Ut}\right]$, the expected disposable real income in Uusimaa per income earner (Finnish marks)

U_{Ut} = $\left[(U_{Ut} - AV_{Ut})/L_{Ut}\right]$, the natural unemployment rate for Uusimaa

U_{Ut} = average number of unemployed in Uusimaa during t (yearly average)

AV_{Ut} = average number of open unfilled vacancies in Uusimaa during t (yearly average)

L_{Ut} = labor force in Uusimaa measured as number of people between ages 15-64 minus number of people getting invalid compensation within the same age group

Y_{Ut} = average nominal income per income earner in Uusimaa (Finnish marks, yearly average)

T_{Ut} = average taxes per income earner in Uusimaa (Finnish marks, yearly average)

I_{Ut} = $(\overline{CI}_t\, HI_{Ut})$, the housing connected cost-of-living index in Uusimaa

$INVA_{Ut}^{15-64}$ = number of recipients of invalid compensation in Uusimaa (within the 15-64 age group)

$\overline{CI}_t$ = consumer price index in Finland the base year 1962

HI_{Ut} = $(H_{Ut}/\overline{H}_t)$, the cost-of-housing index for Uusimaa

H_{Ut} = housing cost in Uusimaa measured by the average rent paid per square meter for centrally heated houses in urban centers (Finnish provinces)

$\bar{H}_t$ = average housing cost in Finland measured by the average rent paid per square meter for centrally heated houses in urban centers in all Finnish provinces

DRI_1 = $\left[(Y_{1t} - T_{1t})/I_{1t}\right]$, the average real disposable income per income earner in province 1 (1 ≠ Uusimaa) (Finnish marks)

Y_{1t} = average nominal income per income earner in province 1 (Finnish marks, yearly average)

T_{1t} = average taxes per income earner in province 1 (Finnish marks, yearly average)

I_{1t} = $(\overline{CI}_t \, HI_{1t})$, the housing connected cost-of-living index in province 1

HI_{1t} = $(H_{1t}/\bar{H}_t)$, the cost-of-housing index for province 1

H_{1t} = housing costs in province 1 measured by the average rent paid per square meter for centrally heated houses (Finnish provinces)

$P\overline{UN}_{MsUt-1}$ = $a_{ut} \, \overline{UN}_{MsUt-1}$, the average number of potential unemployed outside Uusimaa affecting migration to Uusimaa

a_{Ut} = (AV_{Ut}/U_{Ut}), the possibility of obtaining work in Uusimaa for the unemployed possible mover

$\overline{UN}_{MsUt-1}$ = $\left(\sum_{1=1}^{11} U_{1t-1} - AV_{1t-1}\right)$, the average number of natural unemployed in the other provinces measured as an absolute number during the previous period (yearly average)

P^{64}_{MsUt-1} = population pressure outside Uusimaa at the end of t - 1

M^{out}_{Ut} = total amount of outmigration from Uusimaa to other provinces during the year t measured as an absolute number of out-migrants

$\bar{P}UN_{Ut-1}$ = $\bar{a}_{lt}\, UN_{Ut-1}$, the average number of potential unemployed in Uusimaa affecting out-migration

$\bar{a}_{lt}$ = $\left[\sum_{l=1}^{11} (AV_{lt}/U_{lt})\right]$, the possibility of obtaining work outside Uusimaa for the unemployed out-migrant in Uusimaa

UN_{Ut-1} = $(U_{Ut-1} - AV_{Ut-1})$, the average number of natural unemployed in Uusimaa during t-1 (yearly average)

P^{64}_{Ut-1} = population pressure in Uusimaa at the end of t - 1

M^{net}_{Ut} = $M^{in}_{Ut} - M^{out}_{Ut}$ = net-migration (gain) to Uusimaa from other provinces measured as the absolute number of net-migrants during t

α^{v}_{i} = parameter (i = 1,...,6)

β^{v}_{j} = parameter (j = 1,...,4)

ε_{rt} = error term (r = 1,...,3)

t = time perid (year)

ln = natural logarithm

U = Uusimaa (subscript)

MsU = other provinces (subscript)

APPENDIX B: THE BASIC DATA USED IN ESTIMATIONS*

*See Appendix A for symbols.

Year	M^{in}_{PKt}	M^{out}_{PKt}	P^{64}_{PKt} [a]	P^{15-64}_{PKt} [a]	P^{64}_{Mst} [a]	P^{15-64}_{Mst} [a]	AV_{PKt}	U_{PKt}	AV_{Mst}
1960	*b*	7750	*b*	*b*	*b*	*b*	*b*	*b*	*b*
1961	*b*	7590	192	121.7	3948	2702	1000	240	7900
1962	2923	6814	190	121.8	3976	2750	600	280	7900
1963	3318	6455	188	122.4	4000	2793	510	500	5190
1964	3311	6388	186	123.2	4009	2822	230	610	4870
1965	3426	6417	184	123.5	4015	2847	210	730	5100
1966	3410	5839	182	123.6	4028	2874	220	1040	5780
1967	3234	6205	180	123.7	4048	2908	120	2150	5100
1968	3215	4971	179	124.3	4053	2929	180	2640	4800
1969	2898	5745	176	123.6	4023	2926	260	2700	8240
1970	3362	8435	169	120.6	4001	2932	240	2100	13060
1971	2227	5495	166	120.1	4002	2968	260	2120	11440
1972	3337	6071	163	119.5	4032	3000	280	3600	15520
1973	3666	5975	161	119.1	4044	3027	240	3200	23160
1974	4566	5871	160	119.1	4051	3037	380	2800	29420
1975	3958	4590	158	119.3	4054	3062	270	3600	18230
1976	3332	3987	157	119.4	4057	3070	170	5000	11030
1977	2858	3115	156	119.3	4063	3076	120	7300	6280

[a] Thousands
[b] Nil

Year	U_{Mst} [a]	$INVA^{15-64}_{PKt}$	$INVA^{15-64}_{Mst}$ [a]	Y_{PKt}	T_{PKt}	$\bar{Y}_{Mst}$ [c]	$\bar{T}_{Mst}$ [c]	HI_{PKt}	$\overline{CI}$
1960	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]
1961	7.9	7675	109.2	[b]	[b]	[b]	[b]	[b]	[b]
1962	10.0	7770	111.5	3319	501	4562	739	1.148	1.000
1963	17.6	7810	113.9	3351	347	4912	819	1.139	1.052
1964	28.8	7880	113.8	3986	668	5566	1014	1.082	1.157
1965	24.3	7945	117.0	4472	757	6075	1106	1.039	1.217
1966	27.7	8434	121.7	4750	839	6476	1254	1.038	1.261
1967	43.0	9351	131.4	5009	967	6888	1434	1.048	1.330
1968	58.4	10263	141.5	5849	1214	7647	1692	1.002	1.443
1969	50.0	10930	149.5	6067	1333	7997	1888	1.024	1.478
1970	35.6	11530	160.9	6552	1484	8792	2174	1.019	1.522
1971	42.0	12367	174.6	7377	1739	9810	2515	1.021	1.617
1972	55.9	13379	194.2	8628	2098	11067	2982	1.062	1.730
1973	47.0	14085	209.3	9742	2685	12875	3761	1.036	1.939
1974	37.1	14905	224.9	11763	3323	15430	4593	1.034	2.270
1975	47.3	15100	233.7	14709	4307	18817	5816	1.011	2.678
1976	75.2	15175	240.5	16384	4694	20959	6338	0.977	3.050
1977	126.2	14930	240.7	17897[c]	4978[c]	22872[c]	6807[c]	0.983	3.460

[a] Thousands

[b] Nil

[c] Data collected from preliminary table. They may differ slightly from final figures.

Year	M^{in}_{Ut} [a]	M^{out}_{Ut} [a]	P^{64}_{Ut} [a]	P^{15-64}_{Ut} [a]	P^{64}_{MsUt} [a]	AV_{MsUt} [a]	P^{15-64}_{MsUt} [a]	U_{MsUt} [a]
1960	28.6	[b]	[b]	[b]	[b]	[b]	[b]	
1961	28.4	[b]	783	572.6	3358	7.3	2251	6.5
1962	28.2	13.4	801	590.2	3365	6.2	2282	8.5
1963	29.2	13.8	819	606.5	3369	3.9	2309	15.1
1964	28.9	14.8	833	617.6	3363	3.1	2328	19.7
1965	30.8	14.6	845	630.3	3350	3.2	2340	21.3
1966	29.5	15.0	865	643.3	3345	3.3	2354	24.4
1967	28.8	15.7	882	657.3	3346	3.0	2374	38.8
1968	25.0	15.3	892	666.4	3340	3.2	2386	52.5
1969	27.1	14.7	897	671.8	3302	5.3	2377	46.7
1970	36.6	17.9	913	689.4	3258	7.7	2363	34.1
1971	23.5	11.3	930	702.7	3254	6.6	2386	40.3
1972	29.3	16.2	946	719.2	3248	8.7	2400	55.8
1973	30.8	18.9	963	734.4	3241	12.4	2412	47.5
1974	31.1	24.4	974	745.0	3237	16.4	2422	37.8
1975	27.3	21.0	982	752.5	3230	10.2	2429	47.3
1976	21.3	17.8	985	756.5	3229	6.7	2437	72.5
1977	18.0	14.8	988	759.4	3231	3.7	2436	117.4

[a] Thousands
[b] Nil

Year	AV_{Ut} [a]	U_{Ut} [a]	$INVA^{15-64}_{MsUt}$ [a]	$INVA^{15-64}_{Ut}$ [a]	Y_{Ut}	T_{Ut}	$\bar{Y}_{MsUt}$ [c]	$\bar{T}_{MsUt}$ [c]	HI_{Ut}
1960	*b*	*b*	*b*	*b*	*b*	*b*	*b*	*b*	*b*
1961	1.6	1.7	99.9	17.0	*b*	*b*	*b*	*b*	*b*
1962	2.4	1.8	101.8	17.5	5985	1049	4075	635	.979
1963	1.8	3.0	103.6	18.1	6436	1159	4383	699	1.016
1964	2.0	3.7	103.3	18.4	7248	1441	4973	867	1.020
1965	2.2	3.8	106.3	18.6	7920	1565	5425	948	1.105
1966	2.7	4.3	110.7	19.5	8496	1794	5760	1065	1.079
1967	2.2	6.3	119.3	21.4	9001	2044	6125	1217	1.089
1968	1.8	8.5	127.9	23.8	9822	2339	6856	1460	1.114
1969	3.2	6.0	134.7	25.6	10293	2603	7175	1634	1.093
1970	5.6	3.7	144.4	28.0	11397	3054	7857	1862	1.098
1971	5.1	3.8	156.6	30.3	12504	3435	8817	2178	1.107
1972	7.2	3.8	173.7	33.9	13907	3995	10017	2608	1.038
1973	11.0	2.7	186.3	37.0	16173	5000	11634	3299	1.077
1974	13.4	2.3	200.4	39.4	19321	6080	13971	4042	1.055
1975	8.4	3.7	207.9	40.9	23124	7593	17193	5154	1.042
1976	4.6	7.7	213.2	42.5	25787	8239	19132	5627	1.029
1977	2.8	15.1	212.7	43.0	28084 [c]	8753 [c]	20840 [c]	6004 [c]	1.018

[a] Thousands

[b] Nil

[c] Data collected from preliminary table. They may differ slightly from final figures.

APPENDIX C: FIRST ORDER SERIAL CORRELATION FOR ESTIMATED MODELS IN TABLES 1-7

Number of equation	R_{-1}
(31)	0.399
(32)	0.376
(33)	0.080
(34)	-0.070
(35)	0.463
(36)	0.117
(37)	-0.111
(38)	0.548
(39)	0.540
(40)	0.126
(41)	-0.199

R_{-1} = first order serial correlation between residuals

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