Regional Impacts of Migrants' Expenditures: An Input-Output/Vacancy-chain Approach

J VAN DIJK, J OOSTERHAVEN
University of Groningen

1 Introduction

Migration of human beings has been an issue of major interest in regional science, economics, and geography. This interest is quite understandable because migration may have substantial effects on the region of origin, the region of destination, and the nation as a whole, as well as on the migrant. Not all aspects of migration, however, have been given equal attention. Sjaastad (1962) noted that migration research dealt mainly with the forces which affect migration and that little has been done to determine the influence of migration as an equilibrating mechanism. This point was confirmed by Greenwood in 1975. In a recent review, Clark (1982) also notes that only scanty attention is paid to the consequences of migration, in particular to its economic effects.

Only the relation between migration and economic growth has been examined to any great extent. This research has concentrated mainly on the question: does migration cause economic growth or does economic growth cause migration? This 'chicken-or-egg' problem is analysed by means of simultaneous equation models. (For details see, among others, Muth, 1971; Greenwood, 1975; 1981; Steinnes, 1978; Dahlberg and Holmlund, 1978; Salvatore, 1984.) In these macroadjustment models, migration is seen as an equilibrating mechanism which optimally allocates the demand and supply of labour and equalises wage rates across regional labour markets. These models rely heavily on aggregate relationships between migration and (un)employment. In reality, however, these are rather complex multidirectional relations with forward and backward linkages that sometimes counteract. Empirical evidence from these kinds of models often shows contradictory or insignificant relations between migration and (un)employment. This is possibly a result of the aggregated nature of macromodels, which are not sufficiently sensitive because of the questionable interaction between the demographic and economic systems (for instance, see Greenwood, 1975; Clark, 1982). Hence, a disaggregated approach seems to be preferable.

A more careful examination of the relation between migration and (un)employment is not only of scientific interest, but is also important from a policy point of view. This may be illustrated by a case study for the northern region of the Netherlands. This region is one of the two regions on which the regional economic policy of the Dutch central government is concentrated (compare Oosterhaven and Folmer, 1983).

The northern region is characterised by a structural shortage of jobs, a situation which has existed almost continuously since World War 2.

Directly after 1945 one of the purposes of regional policy was to move labour from the northern to the western region which had labour shortages. At the end of the 1960s, central government switched to a policy which was intended to spread population and employment more evenly over the country in such a way that congestion in the western regions could be avoided and employment opportunities in the problem regions could be improved. Notwithstanding severe doubts about the effectiveness of this policy of dispersal, the actual migration flows turned around: for the western region from net in-migration to net out-migration and for the northern region from net out-migration to net in-migration. In spite of investment incentives for private firms, relocation of governmental institutions, and migration subsidies, the northern region still shows regional unemployment rates above the national average (for instance, see Oosterhaven and Stol, 1984).

Van Dijk and Bartels (1982) show that, during the period 1973-1979, unemployment in the northern region increased by 7900 persons and the labour force increased by 6400 because of net in-migration of labour. Under the assumptions of homogeneous labour and an ideal matching process, these figures imply that 81% of the rise in unemployment in the north was caused by in-migration. To reach a more realistic conclusion a research project was begun in which the relation between migration and (un)employment was examined at a disaggregated level. A general theoretical framework was developed and applied to the case of the northern region of the Netherlands for 1979. Theoretically, the relation between migration and (un)employment can be disentangled in the following way.

Direct effects Migration of workers directly affects employment and unemployment. The magnitude of the effects depends not only on the number of migrants but also on the type of labour migrant. Three types may be distinguished:
type a: employed migrants who fill jobs for which native unemployed are *also* suited and available. In this case, migration indirectly prevents a decrease in unemployment as migrants preempt the native unemployed;
type b: employed migrants who fill jobs for which *no* native unemployed are suited and available. In this case there is no preemption and without migration, vacancies remain open and employment cannot increase;
type c: unemployed migrants who directly cause an increase in unemployment.

These direct effects were investigated by Van Dijk and Folmer (1985; 1986) who came to the conclusion that in 1979 12% of the migrants who belonged to the labour force were unemployed. Furthermore, they made a comparison between the labour-market characteristics of the age, education, and work experience of the employed migrants and the native unemployed. Individual data were analysed by means of logistic regression.

The results indicate that there are strong differences with respect to these characteristics between the migrants and the unemployed. On the basis of these results it appears that preemption will probably be less than 30% and thus is only of minor importance.

Indirect effects The indirect effects can be split in two parts:
Supply effects The regional labour force increases through labour migration and this affects location decisions of firms. Furthermore, vacancies filled by migrants can be key functions. When such vacancies remain unfilled, other complementary jobs, for which native unemployed are suited, will not become available. The magnitude of these effects is hard to measure, but it seems certain that the indirect supply effects of migration positively influence regional unemployment. This relation is, for example, incorporated in the regional model of the Dutch Central Planning Bureau (CPB, 1981).
Demand effects Because of the expenditure of migrants, regional demand will increase and additional employment will be created in the north.

The measurement of this effect is the problem we focus on in this paper.

When the relation between migration and (un)employment is unravelled in the manner referred to above, it is obvious that the impact of migration on the regional economy is not merely dependent on the magnitude of migration. The effects also depend heavily on the characteristics of the migrants, such as family size and composition, labour-market status, age, education, income, and expenditure pattern. Hence, a disaggregated approach is preferable, in which the above-mentioned effects are investigated at the level of relatively homogeneous subgroups.

The purpose of this paper is to quantify the employment effects of migrants' expenditure. As different groups of migrants exhibit different levels and compositions of consumption expenditure, an input–output approach is required to capture effectively the differences in expenditure impacts. The classical input–output approach, however, has several drawbacks, some of which are especially important in our context.

First, it normally takes no account of the interaction with the labour market. The traditional way of accounting for induced consumption effects is to make an implicit assumption that all new jobs are filled by migrants. In fact, however, some of these jobs are filled by local unemployed who lose their unemployment benefits because of the change in their labour-market status. More generally, it is the way in which vacancies are filled that determines the size and composition of the primary and secondary income changes that cause the changes in endogenous consumption expenditure. In this paper we will remedy this drawback by linking a vacancy-chain model to an input–output model.

Second, besides additional private expenditure, migrants also call for the provision of additional public services. Normally, this effect is not incorporated in the input–output model. Given the size of the public sector this 'demand' effect ought not to be neglected. Hence, our model will also be extended to account for the population-induced effects on public consumption.

Finally, the preemption of native unemployed by migrants will influence the size of the consumption effects. The effect of migrants' expenditure has to be decreased by the effect that would have occurred if the new jobs had been filled by local unemployed. Preemption, in fact, prevents this from happening. Provisionally, however, the rate of preemption is assumed to be zero, as it is quite small in the study area (see Van Dijk and Folmer, 1986). In an extended version of our model preemption will also be included.

The outline of the paper is as follows. In section 2 the size and composition both of the private and of the public consumption demands of migrants to the northern region will be estimated. This gives the exogenous impulses that will be fed into the regional input–output/vacancy-chain model which is described in section 3. In section 4 the estimated endogenous effects for different types of in-migrants will be presented. In section 5 the indirect employment effects due to migrants' expenditure are compared with the direct effects of labour migration on labour supply. The paper ends with some conclusions and some policy recommendations.

2 Consumption demand of in-migrants

In this section the estimation of *exogenous* final demand for the products of twenty-seven northern industries and for government services located in the north is described. From the introduction it is clear that the effects of migration have to be studied for more or less homogeneous subgroups. Therefore, final demand is estimated for eleven subgroups, which are chosen on the basis of characteristics which appeared to be the most important determinants of the level and composition of consumption demand (CBS, 1984; Van Weeren and Van Praag, 1984).

The level of total consumption demand for these eleven types of migrant families is estimated by means of three types of data which are all provided by the Dutch Central Bureau of Statistics (CBS). First, the total number of migrants is extracted from the Labour Force Survey 1979 (CBS, 1983a; 1983b), which contains individual data. Expenditure patterns, however, are only available for families. Hence, the individual migrants have to be translated into migrant families. Fortunately, it is possible to distinguish between family heads (including singles), on the one hand, and remaining family members, on the other hand. Furthermore, for each individual, information about family size, employment status, and education is available. Therefore, in this section the number and characteristics of family heads are used to identify the number and type of consumption units (that is, families) for the calculation of total demand. In contrast, the labour-market model in the next section is based on individuals as measurement units.

Second, the average level of private consumption expenditure per type of family is derived from the Budget Survey 1978–1981 (CBS, 1984) which, as pointed out above, contains only data on the spending of whole families and not that of individual consumers. In using these data, we do, of course, make the (plausible) assumption that migrant families consume as much as the average families having the same characteristics.

Third, we need data on the amount of consumption by migrants of public goods and quasipublic goods for which the employment effects cannot be related to individual expenditure. The figures from the Budget Survey show only the consumption of government products as far as direct full payments are concerned. For our purpose we are especially interested in the level of public services that is directly related to the size of the regional population and in the number of civil servants needed to produce these services.

This part of total government employment was estimated by means of the so-called 'minimum requirements technique', which is traditionally used to estimate the size of the nonbasic sector in economic base models (compare Richardson, 1978, page 90). For the years 1977 to 1979 for each of the eleven Dutch provinces, the number of civil servants per thousand inhabitants was calculated. No outlying low rates were found. Hence, the lowest rate of thirty-seven civil servants per thousand inhabitants (which occurred twice) was accepted as the minimum population-induced amount of public-sector employment. Because of the linear nature of the minimum requirements technique this implies that the average effect equals the marginal effect. To make this number of thirty-seven civil servants comparable with the private consumption demand figures, it is multiplied by the average production per civil servant in 1979. This leads to a consumption of northern government services of Dfl.3182 per inhabitant per year.

Differences in this figure between various types of families, however, need to be considered. Families without children, for instance, hardly use educational services unless they are students. In the latter case they will consume a relatively high amount of educational services. The use of facilities such as police and local government administration, however, will differ only with the size of the family. Studies by the Social-Cultural Planning Bureau (SCPB) indicate that some 60% of all government production consists of public goods which cannot be related to specific individuals or households (SCPB, 1981; 1983). The use of the other 40% is directly attributable and depends on the characteristics of households and individuals. From the SCPB studies we derive that students consume 2.14 times the average consumption of government services per capita, whereas the low-income group, which accounts for approximately 63% of the inactive and for all of the employed and unemployed singles group, consumes only 0.49 times the average. The remaining family types consume 1.06 times the average of Dfl.3182 multiplied by family size.

Table 1 contains the main results of the above estimation procedure. The number of migrant families with inactive heads is quite small. Therefore, this group will be aggregated throughout the paper. The column for consumption per family clearly shows the significance of disaggregation according to family type, as large differences in total consumption demand are shown.

Next, the way in which total consumption is spent by each type of family is of importance, because it determines which regional industries will be affected by the migrants' consumption shown in table 1. Unfortunately, the only available budget data show consumption expenditures over groups of goods (CBS, 1984). They contain no data on the industrial and regional origin of the goods concerned. Furthermore, no distinction is made between the factory price (fob—free on board), the retail margin, and the value added tax (VAT).

Figure 1 shows the three major steps that are needed to transfer the budget data into patterns of consumption demand that fit into the input-output framework. The lower right-hand corner represents the data on exogenous final demand of migrant families—these data are actually needed as model input in the next section.

Table 1. Number of migrant families and total private and public (northern government services) consumption demand per type of family in 1979 in the north of the Netherlands [sources: own calculations from data which are described in CBS (1983a; 1983b; 1984) and SCPB (1981; 1983)].

Type of family	Migrant families		Consumption per family (Dfl.)
	number	average size	
Head in the labour force			
1 single	779	1.0	24284
2 family of two persons	1137	2.0	38776
3 family of three or more, head with low education	724	4.1	48181
4 family of three or more, head with medium education	918	4.2	54375
5 family of three or more, head with high education	729	4.0	62807
Total	4287	3.0	45155
Heads, who are students	1466	1.0	17533
Heads, who are inactive[a]	889	2.4	34668
Total	6642	2.5	37624

[a]These figures are aggregated from detailed data for five types of migrants of which the head is inactive: (1) retired singles, (2) families of two or more with retired head, (3) singles who are not in the labour force, (4) families of two or more of which the head is not in the labour force, (5) miscellaneous.

First, the available consumption data for a hundred groups of goods have to be rearranged in consumption patterns over twenty-seven industries. Expenditure on a specific group of goods has to be assigned to the industry in which most of these goods are produced. The construction of such a 'wiring diagram' is a subjective activity. With such a scheme it is possible to show which part of the migrants' consumption is spent on the products of a specific industry.

Second, VAT, foreign imports, and the retail margin are subtracted with the aid of National Account data for 1979 (CBS, 1981). This leads to an estimation of the proportion of total consumption demand going to the twenty-seven domestic industries and to domestic retail margin.

Last, regional import shares for the northern household sector are derived from the regional input–output tables for the northern region for 1975 (CBS, 1982; FNEI, 1983). When these shares are applied to the shares of domestic industries in total consumption demand, the corresponding northern shares result.

The results of the above procedure are presented in table 2 for the three main types of migrant families. The results for five subgroups of the employed plus unemployed group are shown in the appendix. The consumption of northern government services is divided into a small part for which the northern consumers actually pay and a large part which is financed through the national tax system. The paid part is derived from the budget data, where it is seen as a part of total private consumption.

The public part is calculated as the difference between the estimated minimally required government services and those government services for which an actual payment is made. The public part is also expressed as a ‰ of total private consumption expenditures, which equals 1000‰. These figures show that the neglect of public consumption leads to a significant underestimation of total consumption in the north. Public

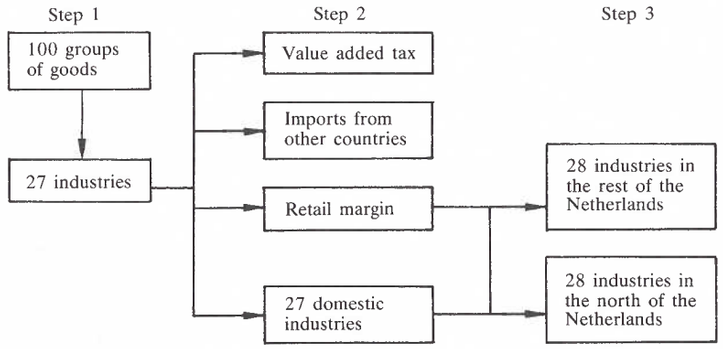

Figure 1. Construction procedure for migrant consumption patterns over regional industries.

Table 2. Consumption expenditure by three types of migrant families for twenty-eight industries in 1979 [in ‰ of total private spending; source: own computations from raw data of 1979 survey of family expenditure patterns; for information about the data see CBS (1984)].

SIC[a]	Industry	Type of migrant family		
		employed plus unemployed[b]	students	inactive[c]
0	Agriculture	9.7	9.6	10.6
19	Mining, quarrying	0.1	0.2	0.1
20.1–20.2	Food (animal products)	18.2	8.4	22.6
20.3–21.3	Other food products	12.7	12.3	15.2
21.4–21.7	Beverages, tobacco	2.2	2.3	2.2
22	Textiles	0.0	0.0	0.0
23–24	Clothing, leather	1.5	1.1	1.5
25	Wood, furniture	2.0	0.9	1.9
26	Paper	0.0	0.0	0.0
27	Printing, publishing	4.4	7.2	4.2
12, 28	Oil, gas, refineries	0.0	0.0	0.0
29–31	Chemical, rubber	0.5	0.3	0.6
32	Building materials	0.8	0.9	0.7
33	Basic metals	0.0	0.0	0.0
34–35	Metal processing, machinery	0.1	0.1	0.1
36	Electrical equipment	0.4	0.6	0.4
37	Transport equipment	0.5	0.2	0.4
38–39	Other manufacturing	0.1	0.0	0.1
40	Electricity, gas, water	34.1	20.5	41.5
51–52	Construction, installation	14.5	11.8	14.3
6	Trade, hotels, repair	139.7	157.4	143.5
7	Transport, communication	41.4	59.4	38.8
81–82	Banks, insurance	1.1	0.8	1.1
83–85	Real estate, business	126.5	165.0	139.6
93	Medical, other health	70.2	45.6	64.6
95–96	Culture, recreational services	62.7	77.1	55.3
9	Other services	38.0	46.0	32.1
	Paid government services	20.3	10.0	18.1
Subtotal northern industries[d]		606	638	609
Value added tax		78.1	66.7	76.4
Import from other countries		120.2	86.8	119.0
Import from rest of The Netherlands		198.7	207.9	195.7
Total private consumption expenditure[d]		1000	1000	1000
Northern public government services for which no direct payments are required		230.2	345.3	217.9
Total[d,e]		1230	1345	1218

[a]SIC Standard Industrial Classification.
[b]These are average figures for all families with a head who is in the labour force (employed or unemployed) which are based on detailed data for five types of migrant families (see appendix).
[c]These average figures for all families with an inactive head are also based on five types of migrant families (see note table 1). These are available upon request from the authors.
[d]Discrepancies in the totals are caused by a cumulation of weighting and rounding errors.
[e]These totals correspond to the figures for total consumption in guilders reported in table 1.

consumption by students equals 54% of their private spending on northern products and for the other two groups (employed and unemployed, and inactive) it is 38%.

Next, we will discuss how the exogenous final demand of migrants and the expenditure coefficients are used to estimate employment and income effects.

3 A regional input–output labour-market model

In the above section it should have become clear that different types of migrants not only have different levels of income but also have different ways in which they spend their income and different needs for government services. Furthermore, consumption goods and services are provided locally in different proportions. Last, the industries (including government services) that produce these items have different input patterns, with different proportions of each input being purchased locally. To take account of these differences when we estimate the impacts of the consumption demand of migrants, we need to use a regional input–output model.

Besides intermediate inputs, industries also need primary (factor) inputs. Of these, labour is the most important, not only because it is the yardstick against which we wish to measure the significance of the consumption demand effects, but also because workers need inputs (consumption) too, and this causes further indirect effects. The traditional way to deal with these consumption-induced effects is to add an extra row and column for households to the input–output model (compare Richardson, 1972).

Elsewhere, we have indicated that this way of treating households as an industry ignores the functioning of the regional labour market and this leads to incorrect estimates of income and employment. The presumed additional income and consumption, for instance, has to be corrected for the decrease in income because less social security benefits are paid, because there exists a (negative) institutional relation between labour incomes and those social security benefits that depend on a person's labour-market status (Oosterhaven, 1981, chapter 6).

In this paper we wish to remedy this neglect of the labour market more fundamentally than has been done in other interindustry models that are used for impact and projection analysis (see Batey, 1985, for a review of a series of demographic–economic impact models). To this end, we will make a systematic distinction between the number of vacancies to be filled in the period under consideration and the number of new jobs. This is because very often a vacancy is filled by someone who was employed and the filling of the first vacancy will cause a second vacancy and so on. At the end of this Markovian process the last vacancy in a chain will be filled by an unemployed worker, or a new participant will enter the labour force, or the vacancy will remain open. It should be clear that job-to-job changes as well as the entry of unemployed or new participants will cause various types of income changes.

Below we will describe this process by means of an 'integrated input–output/vacancy-chain model'. We will discuss the model equation by equation, indicating the empirical sources used and presenting the main results.

3.1 *The input–output equation*

We start with the definition equation of input–output analysis, which in our case explains the change in the total production per regional industry (Δx_i; $i = 1, ..., N$) from the changes in five components of total demand, namely

$$\Delta \boldsymbol{x} = \mathbf{A}\Delta \boldsymbol{x} + \boldsymbol{q}^{w}\Delta c^{w} + \boldsymbol{q}^{u}\Delta c^{u} + \boldsymbol{q}^{n}\Delta c^{n} + \Delta \boldsymbol{f}_{ex} , \qquad (1)$$

where

- $\Delta \boldsymbol{x}$ is an N-dimensional vector of changes in sectoral production levels,
- $\mathbf{A}$ is an $N \times N$ matrix of regional intermediate input coefficients per industry,
- $\boldsymbol{q}^{w}$ is an N-dimensional vector of regional consumption expenditure coefficients that relate to people with (relatively high) labour incomes,
- Δc^{w} is the change in total consumption from labour incomes,
- $\boldsymbol{q}^{u}$ is an N-dimensional vector of expenditure coefficients that relate to people with (medium–high) unemployment benefits,
- Δc^{u} is the change in total consumption from unemployment benefits (that is, in our case the Dutch WW, WWV, and WAO schemes that are tied to previous labour incomes),
- $\boldsymbol{q}^{n}$ is an N-dimensional vector with expenditure coefficients that relate to people with (subsistence-level) nonactive benefits,
- Δc^{n} is the change in total consumption from nonactive benefits (that is, in our case the Dutch RWW and ABW schemes that are *not* tied to any labour income),
- $\Delta \boldsymbol{f}_{ex}$ is an N-dimensional vector of changes in exogenous final demand (that is, in our case the consumption demand of in-migrants).

A description of the Dutch social security schemes has been given by Grais (1983).

Matrix $\mathbf{A}$ stems from the most recent input–output table for the northern Netherlands, which was constructed for 1975 by the Federation of Northern Economic Institutes [FNEI (1983); see Oosterhaven (1984) for a review of the construction procedures and reliability of Dutch regional and interregional input–output tables]. This table, and hence our model, contains twenty-eight sectors (including government services).

We assume that the $\boldsymbol{q}$ vectors for employed and unemployed individuals are the same and are equal to the $\boldsymbol{q}$ vectors for employed and unemployed families. The vectors $\boldsymbol{q}^{w}$ and $\boldsymbol{q}^{u}$ are calculated in the same way as the $\boldsymbol{q}$ vectors in table 2 (see figure 1), but are based on the consumption pattern of average employed and unemployed families, instead of migrant families.

The consumption pattern for the inactive with subsistence benefits is assumed to be equal to the pattern for students in table 2, because this group of inactive people consists mainly of school-leavers, who have more or less the same consumption patterns as students.

Traditionally, a distinction is made between types of income growth: *intensive* growth for workers with increases in labour income; *extensive* growth for migrants and people with no previous labour incomes; and *redistributive* growth for unemployed losing their benefits because of obtaining work (see Oosterhaven, 1981; Batey, 1985). This distinction is made because average consumption coefficients need to be used in the case of extensive growth, whereas marginal coefficients are required in the two other cases.

It should be noted that this distinction is *not* necessary when the household sector is disaggregated in the same manner as in equation (1). When a person's labour-market status changes, the effect of this change on his or her consumption behaviour is estimated as the difference between the corresponding two terms of equation (1). Hence, in fact, marginal expenditure coefficients are used, as in the case with redistributive and intensive growth. In the case of a migrant or of people who lose no benefits, only one term of equation (1) applies, at least if we assume that no preemption takes place. So, the average $\boldsymbol{q}$ vectors are used as in the case with extensive growth.

3.2 *The vacancy-chain model*

Next, the number of new jobs or job closures per regional sector (Δe_i) is determined as a function of the change in production level and the increase in labour productivity, that is,

$$\Delta \boldsymbol{e} = \hat{\mathbf{L}}\Delta \boldsymbol{x} - \hat{\mathbf{P}}^{\mathrm{w}}\boldsymbol{e}_{t-1} , \tag{2}$$

where

$\Delta \boldsymbol{e}$ is an N-dimensional vector of changes in employment in each industry,

$\hat{\mathbf{L}}$ is an N-dimensional diagonal matrix of marginal employment coefficients,

$\hat{\mathbf{P}}^{\mathrm{w}}$ is an N-dimensional diagonal matrix of increases in labour productivity,

$\boldsymbol{e}_{t-1}$ is an N-dimensional vector of base-year employment levels in each industry.

Equation (2) is necessary to determine the total number of vacancies in each industry (v_i) that may be filled during the period under consideration. This total equals

$$\boldsymbol{v} = \mathbf{T}\boldsymbol{v} + \Delta \boldsymbol{e} + \Delta \boldsymbol{v}_{\mathrm{ex}} , \tag{3}$$

where

$\boldsymbol{v}$ is an N-dimensional vector of the total number of vacancies that may be filled during the period under consideration,

$\mathbf{T}$ is an $N \times N$ matrix of transition probabilities (t_{ij}) of people leaving industry i to take up jobs in industry j,

$\Delta \boldsymbol{v}_{\mathrm{ex}}$ is an N-dimensional vector of exogenous changes in $\boldsymbol{v}$.

Exogenous changes in the number of vacancies are influenced by two basically different causes. First, vacancies may be created because people leave their jobs for jobs in other regions (that is, emigrants), because of (early) retirements, and because of industrial disability. Such vacancies might be explained by means of the equation

$$\Delta \boldsymbol{v}_{\mathrm{ex}} = \hat{\mathbf{R}}\boldsymbol{e}_{t-1} , \tag{4}$$

where $\hat{\mathbf{R}}$ is an N-dimensional diagonal matrix with departure rates per regional sector.

Second, the number of vacancies caused by frictions in the matching process on the labour market might change.

Rogerson and MacKinnon (1982), for example, show with a simulation model that migration lowers the number of frictional vacancies. For ease of exposition, however, we will assume the number of frictional vacancies to be constant. This implies that we assume that all endogenously created vacancies will be filled during the period under consideration and that all existing vacancies remain unfilled.

Next, we turn to the way in which these vacancies are taken up. First, workers from the same or from other regional industries take up some of the vacancies [that is, $\mathbf{T}\boldsymbol{v}$, compare equation (3)]. The other vacancies are filled up as follows:

$$\boldsymbol{m} = \hat{\mathbf{T}}^{\mathrm{m}}\boldsymbol{v} , \tag{5}$$

$$\Delta \boldsymbol{u} = -\hat{\mathbf{T}}^{\mathrm{u}}\boldsymbol{v} , \tag{6}$$

$$\Delta n = -(\boldsymbol{t}^{\mathrm{n}})^{\mathrm{T}}\boldsymbol{v} , \tag{7}$$

$$\Delta r = -(\boldsymbol{t}^{\mathrm{r}})^{\mathrm{T}}\boldsymbol{v} , \tag{8}$$

where

$\hat{\mathbf{T}}^{\mathrm{m}}$, $\hat{\mathbf{T}}^{\mathrm{u}}$ are N-dimensional diagonal matrices of transition probabilities for regional industry, corresponding to:

$\boldsymbol{m}$ a vector of in-migrants obtaining jobs, and

$\Delta \boldsymbol{u}$ a vector of unemployed who received unemployment benefits;

the in-migrants and unemployed are specified for each regional sector where they take up vacancies because their incomes differ by sector (see section 3.3);

$(\boldsymbol{t}^{\mathrm{n}})^{\mathrm{T}}$, $(\boldsymbol{t}^{\mathrm{r}})^{\mathrm{T}}$ are N-dimensional vectors of transition probabilities for regional industry, corresponding to:

the number of economically inactive persons who received (subsistence) inactive person benefits;

Δr is the number of economically inactive persons who had no benefits at all.

In the last two cases only the total number of people is needed.

As we assume that all endogenous vacancies are taken up by the above-mentioned five categories of people, the following condition must hold

$$\boldsymbol{i}^{\mathrm{T}}\mathbf{T} + (\boldsymbol{t}^{\mathrm{m}})^{\mathrm{T}} + (\boldsymbol{t}^{\mathrm{u}})^{\mathrm{T}} + (\boldsymbol{t}^{\mathrm{n}})^{\mathrm{T}} + (\boldsymbol{t}^{\mathrm{r}})^{\mathrm{T}} = \boldsymbol{i}^{\mathrm{T}}, \tag{9}$$

that is, the column sums of all transition probabilities equal 1.

When all endogenous vacancies are filled, the change in the number of people working in each industry (Δl_i) will have to equal the change in the number of jobs (Δe_i). This is easily proven as the first number equals the difference between the numbers of vacancies taken up and the vacancies created by people leaving for jobs in (other) regional industries:

$$\Delta \boldsymbol{l} = \boldsymbol{v} - \mathbf{T}\boldsymbol{v}. \tag{10}$$

From equation (3) it may be derived that:

$$\boldsymbol{v} = (\mathbf{I} - \mathbf{T})^{-1}(\Delta \boldsymbol{e} + \Delta \boldsymbol{v}_{\mathrm{ex}}), \tag{11}$$

(where $\mathbf{I}$ is the identity matrix). If the exogenous change in vacancies ($\Delta \boldsymbol{v}_{\mathrm{ex}}$) is equal to 0, substitution of equation (11) into equation (10) gives

$$\Delta \boldsymbol{l} = \Delta \boldsymbol{e}. \tag{12}$$

From equation (11) it also follows that the vacancy-chain model is a submodel that can be solved independently of the rest of the model, because equation (11) can be substituted into equations (5)–(8), which gives

$$\boldsymbol{m} = \hat{\mathbf{T}}^{\mathrm{m}}(\mathbf{I} - \mathbf{T})^{-1}(\Delta \boldsymbol{e} + \Delta \boldsymbol{v}_{\mathrm{ex}}), \tag{13}$$

$$\Delta \boldsymbol{u} = -\hat{\mathbf{T}}^{\mathrm{u}}(\mathbf{I} - \mathbf{T})^{-1}(\Delta \boldsymbol{e} + \Delta \boldsymbol{v}_{\mathrm{ex}}), \tag{14}$$

$$\Delta \boldsymbol{n} = -(\boldsymbol{t}^{\mathrm{n}})^{\mathrm{T}}(\mathbf{I} - \mathbf{T})^{-1}(\Delta \boldsymbol{e} + \Delta \boldsymbol{v}_{\mathrm{ex}}), \tag{15}$$

$$\Delta \boldsymbol{r} = -(\boldsymbol{t}^{\mathrm{r}})^{\mathrm{T}}(\mathbf{I} - \mathbf{T})^{-1}(\Delta \boldsymbol{e} + \Delta \boldsymbol{v}_{\mathrm{ex}}). \tag{16}$$

Table 3 gives the values of the transition probabilities for the north for 1979 for nine aggregated sectors and the above five groups. It is clear that the industrial sector is the most important sectoral source from which all sectors draw new workers. Furthermore, it is clear that intrasectoral moves provide a lot of new workers (from approximately 25% to approximately 65%). Of all categories of formerly nonemployed in the north, those with subsistence benefits (mainly school-leavers) are the most important new suppliers of labour. Migrants take up 5–17% of the vacancies filled.

Table 3. Origin of workers who got a job in 1979 by sector in the north of the Netherlands in percentages [source: these figures are our own computations from the raw data of the Labour Force Survey 1979 from the Dutch Central Bureau of Statistics (for details about these data see CBS, 1983a)].

Origin of workers:	Sector of employment in 1979[a]								
sector[a]	1	2	3	4	5	6	7	8	9
1	13	0	1	8	3	1	0	1	0
2	0	9	0	0	0	0	0	0	0
3	1	9	24	13	13	8	13	8	4
4	0	0	0	9	0	0	0	0	0
5	5	0	5	28	39	1	6	3	1
6	3	0	10	0	4	26	17	3	3
7	1	0	1	0	1	1	22	3	0
8	1	9	2	8	1	2	0	15	3
9	0	19	3	0	2	6	7	3	22
Subtotal[b]	24	46	46	65	62	44	65	36	33
In-migrants	7	18	7	17	4	5	10	13	14
Unemployed	11	10	6	0	6	7	5	5	6
Economically inactive with benefits	42	20	37	18	26	34	17	41	38
Economically inactive without benefits	15	6	3	0	1	9	3	5	9
Subtotal[b]	74	54	54	35	38	56	35	64	67
Total[b]	100	100	100	100	100	100	100	100	100

Note. The percentages are based on man-years. Therefore, part-time workers are reduced to full-time equivalents. This is done by multiplying the number of workers in each category by the ratio of number of workers to number of full-time jobs at the sector of destination. This can be justified because for these groups the characteristics of the sector determine the number of part-time jobs. An exception is made for the inactive persons without benefits. Now the man-years are calculated by using the ratio of number of workers to number of full-time jobs for this specific group. For this group, which consists mainly of spouses, we assume that the number of part-timers is determined by characteristics of this specific group and not by the sectoral characteristics.

[a]Sectors are 1 agriculture, 2 mining and quarrying, 3 industry, 4 electricity, gas, and water, 5 construction, 6 trade, hotels, and repair, 7 transport and communication, 8 commercial services, 9 other services.

[b]Discrepancies in the totals are caused by a cumulation of weighting and rounding errors.

3.3 *The income–consumption model*

The last part of our integrated model ties the above vacancy-chain model to the input–output equation. First, we determine the change in total consumption of employed people, viz,

$$\Delta c^{\mathrm{w}} = (\boldsymbol{c}^{\mathrm{q}})^{\mathrm{T}}\hat{\mathbf{W}}\Delta \boldsymbol{e} + \Delta c^{\mathrm{w}}_{\mathrm{ex}}, \tag{17}$$

where

Δc^{w} is the change in total consumption expenditures of employed people;

$\boldsymbol{c}^{q}$ is an N-dimensional vector of average consumption quotes per industry (FNEI, 1983). The quotes depend on the average wage level per industry and account for taxes, social security premiums, and private savings.

$\hat{\mathbf{W}}$ is an N-dimensional diagonal matrix of average gross labour incomes per industry;

Δc^{w}_{ex} is the consumption change originating from changes in exogenous incomes of workers.

In our impact study we have to reckon with the fact that the extra consumption expenditure of migrants is already treated exogenously (compare section 2). Hence, that part of the change in labour incomes that accrues to migrants has to be deducted from equation (17) to avoid double counting the expenditure of migrants, because migrants who take up endogenous vacancies have already been included within exogenous final demand. So, for the purpose of our impact study equation (17) has to be replaced by

$$\Delta c^{w} = (\boldsymbol{c}^{q})^{T}\hat{\mathbf{W}}(\Delta \boldsymbol{e} - \boldsymbol{m}) . \tag{18}$$

Second, we determine the decrease in total consumption expenditure of those who received unemployment benefits before they filled an endogenously created vacancy. For this category it appears that their unemployment benefits equal about 80% of the average wage of all sectors (SCPB, 1981, page 59). In line with this figure we assume that their unemployment benefits are equal to approximately 80% of the average sectoral labour income in the sector in which they become employed,

$$\Delta c^{u} = 0.80(\boldsymbol{c}^{qu})^{T}\hat{\mathbf{W}}\Delta \boldsymbol{u} + \Delta c^{u}_{ex} , \tag{19}$$

where

$\boldsymbol{c}^{qu}$ is an N-dimensional vector with consumption quotes for unemployed; these depend on the level of the former unemployment benefits ($0.80\hat{\mathbf{W}}$)—hence, they are larger than the corresponding $\boldsymbol{c}^{q}$ in equation (17);

Δc^{u}_{ex} is the consumption change originating from exogenous changes in numbers of unemployed or exogenous income changes of unemployed.

Last, we have to determine the decrease in consumption expenditure of economically inactive persons with benefits. For this category an equal (subsistence) social benefit of Dfl.12 227 at 1979 prices (computed from CBS, 1980) is assumed to apply to all economically inactive persons who get a job. Because people with a subsistence benefit are assumed to be unable to save any money, the average consumption propensity that

corresponds to this income will be equal to 1.

$$\Delta c^{n} = 12\,227\Delta n + \Delta c^{n}_{ex} , \tag{20}$$

where Δc^{n}_{ex} is the consumption change originating from exogenous changes in the incomes of economically inactive persons and in their number.

Furthermore, we assume that, apart from their new labour incomes, migrants and economically inactive persons without benefits experience no other endogenous changes in income.

This completes our model. The structural equations of the model are equations (1)–(3), (6)–(8), and (17)–(20). Insight into the workings of the model as well as the ease of solving its structural form are improved by reducing its size.

3.4 *The solution of the integrated model*

The first step towards a solution of the model may best be taken by substituting the employment equation (2) into equations (3) and (17), respectively; and substituting equations (6) and (7) into equations (19) and (20), respectively. This leads to the following partially reduced form

$$\Delta \boldsymbol{x} = \mathbf{A}\Delta \boldsymbol{x} + \boldsymbol{q}^{w}\Delta c^{w} + \boldsymbol{q}^{u}\Delta c^{u} + \boldsymbol{q}^{n}\Delta c^{n} + \Delta \boldsymbol{f}_{ex} , \tag{1}$$

$$\boldsymbol{v} = \mathbf{T}\boldsymbol{v} + \hat{\mathbf{L}}\Delta \boldsymbol{x} - \hat{\mathbf{P}}^{w}\boldsymbol{e}_{t-1} + \Delta \boldsymbol{v}_{ex} , \tag{21}$$

$$\Delta c^{w} = (\boldsymbol{c}^{q})^{T}\hat{\mathbf{W}}(\hat{\mathbf{L}}\Delta \boldsymbol{x} - \hat{\mathbf{P}}^{w}\boldsymbol{e}_{t-1}) + \Delta c^{w}_{ex} , \tag{22}$$

$$\Delta c^{u} = -0.80(\boldsymbol{c}^{qu})^{T}\hat{\mathbf{W}}\hat{\mathbf{T}}^{u}\boldsymbol{v} + \Delta c^{u}_{ex} , \tag{23}$$

$$\Delta c^{n} = -12\,227(\boldsymbol{t}^{n})^{T}\boldsymbol{v} + \Delta c^{n}_{ex} . \tag{24}$$

Equations (1) and (21)–(24) may be written in one large matrix:

$$\begin{array}{c} \\ (1) \\ (21) \\ (22) \\ (23) \\ (24) \end{array}
\begin{array}{c}
\begin{array}{cccccc} (28) & & (28) & & (1) & (1) & (1) \end{array} \\
\left[\begin{array}{cc|ccc}
(\mathbf{I}-\mathbf{A}) & 0 & -\boldsymbol{q}^{w} & -\boldsymbol{q}^{u} & -\boldsymbol{q}^{n} \\
-\hat{\mathbf{L}} & (\mathbf{I}-\mathbf{T}) & \mathbf{0} & \mathbf{0} & \mathbf{0} \\
\hline
-(\boldsymbol{c}^{q})^{T}\hat{\mathbf{W}}\hat{\mathbf{L}} & \mathbf{0}^{T} & 1 & 0 & 0 \\
\mathbf{0}^{T} & 0.80(\boldsymbol{c}^{qu})^{T}\hat{\mathbf{W}}\hat{\mathbf{T}}^{u} & 0 & 1 & 0 \\
\mathbf{0}^{T} & 12\,227(\boldsymbol{t}^{n})^{T} & 0 & 0 & 1
\end{array}\right]
\end{array}
\left[\begin{array}{c} \Delta \boldsymbol{x} \\ \boldsymbol{v} \\ \Delta c^{w} \\ \Delta c^{u} \\ \Delta c^{n} \end{array}\right]$$

$$= \left[\begin{array}{c} \Delta \boldsymbol{f}_{ex} \\ \Delta \boldsymbol{v}_{ex} - \hat{\mathbf{P}}^{w}\boldsymbol{e}_{t-1} \\ \Delta c^{w}_{ex} - (\boldsymbol{c}^{q})^{T}\hat{\mathbf{W}}\hat{\mathbf{P}}^{w}\boldsymbol{e}_{t-1} \\ \Delta c^{u}_{ex} \\ \Delta c^{n}_{ex} \end{array}\right] \tag{25}$$

where the numbers on the left-hand side are the equation numbers, the numbers along the top are the dimensions of the symbols, the entries in the second column on the left-hand side are endogenous variables, and the

entries in the right-hand column are exogenous and lagged endogenous variables.

The upper left-hand quadrant of the first matrix shows the direct interindustry relations. Sectors purchase each other's products (**A**) and hire each other's workers (**T**). The upper left-hand quadrant has, however, a block-triangular structure. Production changes influence the vacancy chains, but there does not exist a direct reverse influence. The influence of the vacancy-chain process runs via the lower left-hand quadrant, where production changes and the filling of vacancies codetermine the size and nature of regional income changes. Via the upper right-hand quadrant, the resulting changes in consumption expenditure again influence regional production levels.

The final solution of our model runs along the same lines. First, the vacancy equation (21) is substituted into equations (23) and (24). Next, equations (22)–(24) are substituted into equation (1), which gives

$$\Delta \boldsymbol{x} = \mathbf{A}\Delta \boldsymbol{x} + \boldsymbol{q}^{w}(\boldsymbol{c}^{q})^{T}\hat{\mathbf{W}}\hat{\mathbf{L}}\Delta \boldsymbol{x} - \boldsymbol{q}^{u}0.80(\boldsymbol{c}^{qu})^{T}\hat{\mathbf{W}}\hat{\mathbf{T}}^{u}(\mathbf{I}-\mathbf{T})^{-1}\hat{\mathbf{L}}\Delta \boldsymbol{x} - \boldsymbol{q}^{n}12\,227(\boldsymbol{t}^{n})^{T}(\mathbf{I}-\mathbf{T})^{-1}\hat{\mathbf{L}}\Delta \boldsymbol{x} + \Delta \boldsymbol{f}_{ex} + \boldsymbol{r}_{ex}\,, \tag{26}$$

where $\boldsymbol{r}_{ex}$ represents the exogenous and the lagged endogenous variables, that is,

$$\boldsymbol{r}_{ex} = \boldsymbol{q}^{w}[\Delta c^{w}_{ex} - (\boldsymbol{c}^{q})^{T}\hat{\mathbf{W}}\hat{\mathbf{P}}^{w}\boldsymbol{e}_{t-1}] + \boldsymbol{q}^{u}[\Delta c^{u}_{ex} + 0.80(\boldsymbol{c}^{qu})^{T}\hat{\mathbf{W}}\hat{\mathbf{T}}^{u}(\mathbf{I}-\mathbf{T})^{-1}(\hat{\mathbf{P}}^{w}\boldsymbol{e}_{t-1} - \Delta \boldsymbol{v}_{ex})] + \boldsymbol{q}^{n}[\Delta c^{n}_{ex} + 12\,227(\boldsymbol{t}^{n})^{T}(\mathbf{I}-\mathbf{T})^{-1}(\hat{\mathbf{P}}^{w}\boldsymbol{e}_{t-1} - \Delta \boldsymbol{v}_{ex})]\,. \tag{27}$$

Equation (26) is easily solved:

$$\Delta \boldsymbol{x} = [\mathbf{I} - \mathbf{A} - \boldsymbol{q}^{w}(\boldsymbol{c}^{q})^{T}\hat{\mathbf{W}}\hat{\mathbf{L}} + \boldsymbol{q}^{u}0.80(\boldsymbol{c}^{qu})^{T}\hat{\mathbf{W}}\hat{\mathbf{T}}^{u}(\mathbf{I}-\mathbf{T})^{-1}\hat{\mathbf{L}} + \boldsymbol{q}^{n}12\,227(\boldsymbol{t}^{n})^{T}(\mathbf{I}-\mathbf{T})^{-1}\hat{\mathbf{L}}]^{-1}(\Delta \boldsymbol{f}_{ex} + \boldsymbol{r}_{ex}) \equiv (\mathbf{I} - \mathbf{A} - \mathbf{Q}^{w} + \mathbf{Q}^{u} + \mathbf{Q}^{n})^{-1}(\Delta \boldsymbol{f}_{ex} + \boldsymbol{r}_{ex})\,, \tag{28}$$

where $\mathbf{Q}^{w}$, $\mathbf{Q}^{u}$, and $\mathbf{Q}^{n}$ are defined implicitly in equation (28).
With equation (28) all other model equations may be solved by subsequent substitution. The solutions for employment and endogenous in-migration of workers, for instance [compare equations (2) and (5)] have the following forms:

$$\Delta \boldsymbol{e} = \hat{\mathbf{L}}(\mathbf{I} - \mathbf{A} - \mathbf{Q}^{w} + \mathbf{Q}^{u} + \mathbf{Q}^{n})^{-1}(\Delta \boldsymbol{f}_{ex} + \boldsymbol{r}_{ex}) - \hat{\mathbf{P}}^{w}\boldsymbol{e}_{t-1}\,, \tag{29}$$

$$\boldsymbol{m} = \hat{\mathbf{T}}^{m}(\mathbf{I}-\mathbf{T})^{-1}\hat{\mathbf{L}}(\mathbf{I} - \mathbf{A} - \mathbf{Q}^{w} + \mathbf{Q}^{u} + \mathbf{Q}^{n})^{-1}(\Delta \boldsymbol{f}_{ex} + \boldsymbol{r}_{ex}) + \hat{\mathbf{T}}^{m}(\mathbf{I}-\mathbf{T})^{-1}(\Delta \boldsymbol{v}_{ex} - \hat{\mathbf{P}}^{w}\boldsymbol{e}_{t-1})\,. \tag{30}$$

Finally, we will evaluate the empirical significance of our more elaborate treatment of the way in which regional income increases are influenced by the functioning of the labour market and the social security system. This will be done by comparing the normalised employment multipliers.

Table 4. Normalised regional employment multipliers for twenty-eight sectors for the northern Netherlands.

SIC[a]	Classical models			Our models	
	type 1		type 2	general	excluding migration
	1975	1979			
0	1.35	1.28	1.65	1.44	1.40
19	1.22	1.65	2.69	2.22	1.93
20.1–20.2	4.84	5.37	6.83	6.00	5.83
20.3–21.3	1.97	1.92	2.44	2.16	2.09
21.4–21.7	1.29	1.40	1.89	1.61	1.55
22	1.10	1.07	1.24	1.14	1.11
23–24	1.06	1.07	1.42	1.17	1.13
25	1.18	1.18	1.48	1.30	1.26
26	1.45	1.52	1.98	1.72	1.66
27	1.30	1.28	1.59	1.41	1.37
12,28	1.58	1.47	1.88	1.68	1.61
29–31	1.22	1.28	1.73	1.49	1.42
32	1.18	1.15	1.43	1.28	1.24
33	1.55	1.43	1.92	1.70	1.60
34–35	1.15	1.15	1.44	1.27	1.23
36	1.29	1.28	1.63	1.45	1.40
37	1.27	1.26	1.55	1.38	1.34
38–39	1.07	1.11	1.50	1.25	1.20
40	1.10	1.14	1.61	1.45	1.25
51–52	1.27	1.28	1.64	1.42	1.38
6	1.13	1.13	1.47	1.27	1.23
7	1.13	1.13	1.46	1.30	1.22
81–82	1.28	1.26	1.58	1.43	1.36
83–85	1.30	1.30	1.73	1.50	1.42
93	1.09	1.08	1.35	1.21	1.16
95–96	1.09	1.10	1.49	1.29	1.21
9	1.01	1.01	1.28	1.11	1.05
PGS	1.20	1.15	1.47	1.33	1.27

[a]SIC Standard Industrial Classification; see table 1 for definition of industries; PGS paid government services.
Note: The employment coefficients for 1975 ($\hat{\mathbf{L}}$) are directly derived from FNEI (1983). The available coefficients for 1979 only relate to wage-earner employment (CBS, 1983b). They have been augmented by the national ratio of number of self-employed and wage earners to number of wage earners. In the case of agriculture and trade the northern 1975 ratios are slightly decreased in accordance with the national decrease for those industries. The other regional ratios are held constant because the national change is negligible. Normalised regional employment multipliers reflect the total change in regional employment divided by the direct change in employment corresponding to a change in exogenous final demand.
Type 1 multiplier = $\hat{\mathbf{l}}^{T}(\mathbf{I}-\mathbf{A})^{-1}\hat{\mathbf{L}}^{-1}$; type 2 multiplier = $\hat{\mathbf{l}}^{T}(\mathbf{I}-\mathbf{A}-\mathbf{Q}^{w})^{-1}\hat{\mathbf{L}}^{-1}$.
Our general model multiplier = $\hat{\mathbf{l}}^{T}(\mathbf{I}-\mathbf{A}-\mathbf{Q}^{w}+\mathbf{Q}^{u}+\mathbf{Q}^{n})^{-1}\hat{\mathbf{L}}^{-1}$.
Our migration impact model multiplier = $\hat{\mathbf{l}}^{T}(\mathbf{I}-\mathbf{A}-\mathbf{Q}^{w}+\mathbf{Q}^{u}+\mathbf{Q}^{n}+\mathbf{Q}^{m})^{-1}\hat{\mathbf{L}}^{-1}$.

Before we do so, the importance of a correct estimation of the employment coefficients ($\hat{\mathbf{L}}$) needs to be emphasised. The first two columns of table 4 show the so-called type 1 multipliers as calculated with employment coefficients for 1975 (the year from which the input-output table stems) and 1979 (the year of our case study), respectively. It is clear that the differential growth of prices and of labour productivity between various industries is of great empirical significance and should not therefore be neglected.

Next, the traditional so-called type 1 and type 2 multipliers may be compared (compare Richardson, 1972). Table 4 shows that the indirect and induced effects (type 2) are one to five times as high as the indirect effects (type 1) only. This is not surprising, as the type 2 multiplier incorrectly assumes that all new jobs are being filled up by migrants (see Oosterhaven, 1981, chapter 6).

Now, we turn to the multipliers from our general model [equation (29)]. Our multipliers lie roughly halfway between the type 1 and type 2 multipliers. The empirical reasons for this result may be found in table 3 and equations (19) and (20). Directly or indirectly [that is, $(\hat{\mathbf{T}}^{m} + \hat{\mathbf{T}}^{r})(\mathbf{I} - \mathbf{T})^{-1}$] only a small fraction of the new jobs are taken up by migrants and people without benefits. A larger proportion are directly or indirectly taken up by unemployed and by formerly economically inactive persons [that is $(\hat{\mathbf{T}}^{u} + \hat{\mathbf{T}}^{n})(\mathbf{I} - \mathbf{T})^{-1}$] who lose unemployment and subsistence benefits, respectively.

Next, we turn to the variant of the general model that is specifically designed for estimation of the expenditure effects of in-migrants.

4 Economic effects of the consumption of in-migrants

To estimate impacts of the consumption expenditure of migrants into the north, solutions (28) or (29) are not adequate. First, we are not interested in the effects of other exogenous or lagged endogenous variables. Hence, the $\boldsymbol{r}_{ex}$ vector in equation (26) is set equal to $\boldsymbol{0}$. Second, and more importantly, the consumption effects of endogenous in-migrants are double counted in equation (17). Hence, we have to use equation (18). These two adaptations to our more general model result in the following purpose-specific impact model [compare equations (28) and (29)]:

$$\Delta \boldsymbol{x} = (\mathbf{I} - \mathbf{A} - \mathbf{Q}^{w} + \mathbf{Q}^{u} + \mathbf{Q}^{n} + \mathbf{Q}^{m})^{-1}\Delta \boldsymbol{f}_{ex} , \tag{31}$$

$$\Delta \boldsymbol{e} = \hat{\mathbf{L}}(\mathbf{I} - \mathbf{A} - \mathbf{Q}^{w} + \mathbf{Q}^{u} + \mathbf{Q}^{n} + \mathbf{Q}^{m})^{-1}\Delta \boldsymbol{f}_{ex} , \tag{32}$$

where $\mathbf{Q}^{m}$ corrects for double counting, since

$$\mathbf{Q}^{m} = \boldsymbol{q}^{w}(\boldsymbol{c}^{q})^{T}\hat{\mathbf{W}}\hat{\mathbf{T}}^{m}(\mathbf{I} - \mathbf{T})^{-1}\hat{\mathbf{L}} . \tag{33}$$

Here it should be remembered that equation (9) still holds. This implies that

$$(\boldsymbol{t}^{u} + \boldsymbol{t}^{n} + \boldsymbol{t}^{r} + \boldsymbol{t}^{m})^{T}(\mathbf{I} - \mathbf{T})^{-1} = \boldsymbol{i}^{T}(\mathbf{I} - \mathbf{T})(\mathbf{I} - \mathbf{T})^{-1} = \boldsymbol{i}^{T} , \tag{34}$$

that is, all (new) jobs are either directly or indirectly filled by unemployed economically inactive persons (with and without benefits) and migrants (see table 3 for their direct shares). Hence $\mathbf{Q}^{m}$ forms a direct, although sectorally different, proportion of $\mathbf{Q}^{w}$. The last column of table 4 shows the significance of subtracting the influence of endogenous consumption expenditure of migrants. All employment multipliers for our migration-impact model are slightly lower than the multipliers from our general model.

Besides employment effects and employment multipliers, *income* effects and income multipliers may also be calculated. This is simply done through replacing $\Delta \boldsymbol{e}$ and $\hat{\mathbf{L}}$ in equation (32) by the change in regional income and the income/production ratios per regional industry, respectively.

Next, the exogenous expenditure of the eleven different categories of migrants are calculated for twenty-eight industries for each family type by multiplying the total consumption per family by the number of families and the corresponding $\boldsymbol{q}$ vectors, which are all derived in section 2. These results are substituted in the income-generation equation [compare equation (32)]. Table 5 summarises the results of this operation. It appears that Dfl.249.9 million of migrants' consumption demand (inclusive of nonpaid government services) causes total regional value added to rise by Dfl.157.6 million. Per guilder of expenditure on northern products, the regional income effect of students and school-leavers and large families with heads with medium education is clearly larger than that of the other categories of migrants.

Table 5. Endogenous income effects (in millions of guilders) due to the expenditure of migrants into the north of the Netherlands in 1979.

Family type[a]	Exog. final demand[b]	Endogenous effects on			Total value added effect	Total as % of exog. effect[e]
		gross wages	social security[c]	incomes and deprec.[d]		
Working head						
1	18.9	4.9	1.4	4.6	10.9	58
2	44.1	12.4	3.8	10.5	26.7	61
3	34.9	11.1	3.5	7.5	22.1	63
4	49.9	15.6	4.9	12.9	33.4	67
5	45.8	13.7	4.2	10.6	28.5	62
Subtotal	193.6	57.7	17.8	46.1	121.6	63
Student head	25.7	8.5	2.7	6.0	17.2	67
Inactive head	30.6	8.9	2.7	7.2	18.8	61
Total	249.9	75.1	23.2	59.3	157.6	63

[a]See table 1 for full description of types of family.
[b]Exogenous final demand on products produced in the north (compare table 1).
[c]Employers' premiums for social security.
[d]Remaining incomes and depreciation.
[e]Total endogenous effect as percentage of exogenous final demand.

The results of the substitution of the same eleven Δf_{ex} vectors into equation (32) are shown in table 6. In 1979 the consumption demand of 6642 migrating families (16 500 persons) caused an extra regional employment of 2421 man-years. Obviously, large families with heads with a higher education induce relatively more endogenous employment. The largest part of this employment effect is created in the service industries, which is not too surprising as it concerns the impacts of consumption expenditure. The second largest part is created in the form of government employment, of which only a small part depends on the purchasing power of the migrant. The largest part of this government employment depends on provision of collective services related to population size (compare table 2).

In fact, part of the assumed exogenous inflow of migrant workers is endogenously induced by the consumption demand of the remaining migrants. The endogenous consumption of endogenously caused migration [compare equation (5)] is Dfl.13.5 million, that is, about 5% of total exogenous final demand due to migration. This also implies that roughly about 5% (that is, 260) of the 5061 incoming labour migrants fill jobs created through the expenditure of the remaining migrants.

Table 6. Endogenous employment effects (in man-years) of the expenditure of migrants to the north of the Netherlands in 1979.

Family type[a]	Number of in-migrant families	Endogenous effects on			Total employment effect	Total per 100 exogenous families
		goods sector[b]	service sector	public sector		
Working head						
1	779	21	123	25	169	22
2	1137	52	268	90	409	36
3	724	41	190	115	347	30
4	918	58	287	150	496	54
5	729	52	277	115	444	61
Subtotal	4287	224	1145	496	1865	43
Student head	1466	27	160	81	268	18
Inactive head	889	38	176	74	288	32
Total	6642	289	1481	651	2421	36

[a]See table 1 for full description of types of family.
[b]Primary and secondary sectors, SIC 0–5.

5 Conclusions

As mentioned in the introduction, we have a special interest in the relation between migration and (un)employment. In the foregoing sections, a methodological framework is developed for one of these relations, viz, the production, income, and employment effects of consumption demand of in-migrants. This framework is then applied to the northern Netherlands, a region characterised by relatively high unemployment rates and net in-migration.

The model used is of the demoeconomic type. The economic system is modelled in the input–output tradition. A traditional input–output model with a consumption function is extended with a public sector which accounts for changes in government production arising from changes in the size of the population and with a labour-market model which makes it possible to reckon with sectoral wage differentials and feedbacks with the social security system.

The labour-market submodel explicitly uses information on the filling of vacancies. This process is modelled with a Markov-chain approach applied at the industry level of the input–output model. It reckons with vacancies being filled by workers from regional industries, in-migrants and local unemployed of three types. First, unemployed with unemployment benefits which depend on former labour incomes, second, unemployed with subsistence inactive person benefits and, third, unemployed who were inactive without benefits. The final part of the model ties the changes in labour-market status of different population groups to the corresponding changes in their consumption expenditures.

Our general model is slightly adapted to estimate the impacts of migrants' consumption demand. In 1979, 6642 families entered the northern region of the Netherlands, embodying 16 500 individuals of which 5061 became employed in the region[1]. Their consumption demand caused a rise in final demand of Dfl.250 million. By means of our combined input–output/labour-market model we estimated that this expenditure led to the creation of 2421 man-years of employment.

In table 7 the employment effects of the consumption demand of *all* migrants are compared with the increase in labour supply from *in-migration*. Hence, we compare the indirect employment effects of expenditure of the average mix of in-migrants with the direct labour-supply effects of migrants entering the region. The results indicate that when *two* employed migrants (plus four not employed) enter the north this leads to the creation of *one* additional job in the north. Of these additional jobs, 90% are filled by native job seekers. The remaining 10% are filled by endogenously induced migrants. From table 7 it is obvious that the demand, as well as the supply effects of migration, are heavily concentrated in the service sector and in the public sector.

The foregoing leads to the conclusion that average in-migration increased employment and lowered unemployment in the north in 1979. It should be

[1]The figure of 5061 embodies all persons (heads and other family members) who belong to the labour force, minus the unemployed. By means of industry-specific ratios of full-time equivalents to part-time jobs, the 5061 persons correspond to the 4796 man-years of employment shown in table 7 (see also the first note of table 3).

stressed that our positive conclusion with regard to the economic consequences of in-migration is related to the *total migration* to the northern region of the Netherlands in 1979. The effects of course differ strongly for the various types of migrant families with which we have dealt. The 779 employed single people, for instance, create only 169 man-years of employment. Inactive persons and students, on the other hand, have a more favourable effect because they do not fill any jobs at all.

Table 7. Employment effects per sector of in-migration to the north of the Netherlands in 1979.

Sector	Employment effects due to migrants' expenditure (man-years) (1)	Number of migrants who found a job (man-years) (2)	(1) as percentage of (2)
Agriculture	76	142	54
Industry	123	887	14
Construction	90	480	19
Services	1481	3287	45
Government	651		
Total	2421	4796	51

The policy implications of this conclusion are that a policy of stimulating migration to problem regions will in general equalise regional unemployment differences. This will especially be the case when a migration policy is selective. Actual Dutch policy encourages the migration to the north of workers who fill jobs for which no natives are available, hence, for which no preemption occurs. Stimulating the in-migration of unemployed workers or workers who crowd out natives will negatively affect the regional economy because the positive indirect expenditure effect is more than offset by the negative direct effect on unemployment. A possible successful extension of the present policy may be the stimulation of in-migration to the north of inactive persons, such as students, retired people and, as was suggested recently, prisoners.

Acknowledgements. We gratefully acknowledge the help of Ronald Stoffelsma for gathering and compiling the consumption data and for research assistance. Because of space limitations only limited information about the data is given. More details are available from the authors upon request. This research has been supported by a grant from the Regiopool of the University of Groningen.

References

Batey P W J, 1985, "Input-output models for regional demographic-economic analysis: some structural comparisons" *Environment and Planning A* **17** 73-99

CBS, 1980 *Sociale Maandstatistiek* (Bulletin of Social Statistics) Central Bureau of Statistics (CBS, Voorburg)

CBS, 1981 *Nationale Rekeningen 1979* (National Accounts) Central Bureau of Statistics (Staatsuitgeverij, The Hague)

CBS, 1982 *Regionale Input-Output Tabellen 1975* (Regional Input-Output Tables) Central Bureau of Statistics (Staatsuitgeverij, The Hague)

CBS, 1983a, "Arbeidskrachtentelling 1979" (Labour Force Survey) Central Bureau of Statistics (Staatsuitgeverij, The Hague)

CBS, 1983b *Regionale Economische Jaarcijfers 1979* (Annual Regional Economics Figures) Central Bureau of Statistics (Staatsuitgeverij, The Hague)

CBS, 1984, "Budgetonderzoek 1978-1981" (Budget Survey) Central Bureau of Statistics (CBS, Voorburg)

Clark W A V, 1982 *Progress in Planning, Volume 18, Part 1. Recent Research on Migration and Mobility: A Review and Interpretation* (Pergamon Press, Oxford)

CPB, 1981 *REGAM* (Regional Labour Market Model) Central Planning Bureau (CPB, The Hague)

Dahlberg A, Holmlund B, 1978, "The interaction of migration, income, and employment in Sweden" *Demography* **15** 259-266

FNEI, 1983 *De constructie van de Input-Output Tabel Noorden 1975* (The construction of an input-output table for the North) Federation of Northern Economic Institutes (FNEI, Groningen)

Grais B, 1983 *Lay-offs and Short-time Working in Selected OECD Countries* (OECD, Paris)

Greenwood M J, 1975, "Research on internal migration in the United States: a survey" *Journal of Economic Literature* **13** 397-433

Greenwood M J, 1981 *Migration and Economic Growth in the US: National, Regional and Metropolitan Perspectives* (Academic Press, New York)

Muth R F, 1971, "Migration: chicken or egg?" *Southern Economic Journal* **37** 295-306

Oosterhaven J, 1981 *Interregional Input-Output Analysis and Dutch Regional Policy Problems* (Gower, Aldershot, Hants)

Oosterhaven J, 1984, "Dutch regional and multiregional interindustry tables" RM 160, Faculty of Economics, State University of Groningen, Groningen, The Netherlands

Oosterhaven J, Folmer H, 1983, "Review and evaluation of Dutch regional socio-economic policy" in *Dilemmas in Regional policy* Eds A Kuklinski, J G Lambooy (Mouton, The Hague) pp 227-244

Oosterhaven J, Stol K, 1984, "De positie van het Noorden in het stimuleringsbeleid en het ontwikkelingsbeleid" (The position of the North with regard to regional economic policy in The Netherlands) RM 144, Faculty of Economics, State University of Groningen, Groningen, The Netherlands

Richardson H W, 1972 *Input-Output and Regional Economics* (Weidenfeld and Nicolson, London)

Richardson H W, 1978 *Regional and Urban Economics* (Penguin Books, Harmondsworth, Middx)

Rogerson P, MacKinnon R D, 1981, "A geographical model of job search, migration and unemployment" *Papers of the Regional Science Association* **48** 89-102

Salvatore D, 1984, "An econometric model of internal migration and development: extensions and tests" *Regional Science and Urban Economics* **14** 77-88

SCPB, 1981 *Profijt van de Overheid in 1977* (Gain of public policy) Social-Cultural Planning Bureau (Staatsuitgeverij, The Hague)

SCPB, 1983 *Profijt van de Overheid* Social-Cultural Planning Bureau (SCPB, Rijswijk)

Sjaastad L A, 1962, "The costs and returns of human migration" *Journal of Political Economy* **70** 80-93

Steinnes D M, 1978, "Causality and migration: a statistical resolution of the 'chicken or egg' fowl up" *Southern Economic Journal* **45** 218-226

Van Dijk J, Bartels C P A, 1982, "Internal labour migration and its effects on regional labour markets in The Netherlands" paper presented at the 22nd European Congress of the Regional Science Association, RM 109, Faculty of Economics, State University of Groningen, Groningen, The Netherlands

Van Dijk J, Folmer H, 1985, "Entry of unemployed into employment: theory, methodology and Dutch experience" *Regional Studies* **19** 243-256

Van Dijk J, Folmer H, 1986, "The consequences of interregional migration for the regional labour market: theory, methodology and Dutch experience" *Review of Economics and Statistics* (forthcoming)

Van Weeren H, Van Praag B M S, 1984, "The inequality of actual incomes and earning capacities between households in Europe" *European Economic Review* **24** 239-256

APPENDIX

Table A1. Consumption expenditure by five types of migrant families whose head belongs to the labour force, for twenty-eight industries in the north of the Netherlands in 1979 (in ‰ of private total spending).

SIC[a]	Type of migrant family[b]					Total[c]
	1	2	3	4	5	
0	7.6	9.2	10.8	10.9	9.9	9.7
19	0.2	0.1	0.1	0.1	0.1	0.1
20.1-20.2	13.2	18.3	24.3	19.7	15.5	18.2
20.3-21.3	9.3	11.5	16.6	15.0	11.4	12.7
21.4-21.7	2.1	2.5	2.6	2.1	1.8	2.2
22	0.1	0.0	0.1	0.0	0.0	0.0
23-24	1.4	1.5	1.8	1.7	1.4	1.5
25	2.5	1.8	1.9	1.5	2.3	2.0
26	0.0	0.0	0.0	0.0	0.0	0.0
27	6.1	4.5	3.7	3.6	4.0	4.4
12,28	0.0	0.0	0.0	0.0	0.0	0.0
29-31	0.5	0.5	0.5	0.6	0.4	0.5
32	0.7	0.8	0.7	0.7	0.7	0.8
33	0.0	0.0	0.0	0.0	0.0	0.0
34-35	0.1	0.1	0.1	0.1	0.1	0.1
36	0.4	0.4	0.3	0.3	0.3	0.4
37	0.5	0.5	0.4	0.5	0.5	0.5
38-39	0.1	0.0	0.1	0.1	0.1	0.1
40	31.7	34.3	37.6	34.3	32.6	34.1
51-52	14.4	14.9	12.9	15.4	14.5	14.5
6	148.4	138.5	143.8	139.7	128.2	139.7
7	48.1	44.4	35.4	36.6	41.6	41.4
81-82	0.9	1.2	0.9	1.2	1.2	1.1
83-85	131.6	129.9	111.7	118.0	140.8	126.5
93	72.5	76.9	70.6	69.7	57.4	70.2
95-96	58.6	64.8	57.0	60.4	72.2	62.7
9	33.4	29.7	36.2	45.5	48.3	38.0
PGS	19.9	21.6	20.2	19.0	20.4	20.3
Subtotals						
northern industries[d]	604	608	590	597	606	606
value added tax	78.8	77.0	79.6	79.1	76.4	78.1
import from other countries	121.1	116.9	125.1	123.8	115.2	120.2
import from rest of the Netherlands	194.8	199.1	201.3	199.4	198.9	198.7
Total private consumption expenditure[d]	1000	1000	1000	1000	1000	1000
Northern public government services[e]	94.1	176.3	354.3	310.6	235.1	230.2
Grand total[d]	1094	1176	1354	1311	1235	1230

[a]SIC Standard Industrial Classification; PGS paid government services.
[b]1 single person families; 2 families of two persons; 3 three or more persons, head with low level of education; 4 three or more persons, head with medium level of education; 5 three or more persons, head with high level of education.
[c]Weighted average of 1 to 5. The shares of each type of migrant family are used as weights.
[d]Discrepancies in totals caused by a cumulation of weighting and rounding errors.
[e]For which no direct payments are required.