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2 ISAM: A FORECASTING MODEL FOR THE NORTHERN NETHERLANDS

2.1 Introduction

In this chapter the forecasting model ISAM for the northern Netherlands is discussed. First, in section 2.2 the main economic characteristics of the region and a brief history of its development are given. Section 2.3 is devoted to the institutional background and development history of ISAM and its present general outline. In section 2.4 detailed attention is paid to the set of northern input-output tables on which the model is build. The sections 2.5 and 2.6 subsequently describe the production/labour demand block and the labour supply block. In the final section 2.7 the forecasting results are evaluated over the past ten years.

2.2 Economic structure and historical development

The northern region of the Netherlands consists of the three provinces Groningen, Friesland and Drenthe, which together take up about 25% of the area and 11-12% of population and employment (see Figure 2.1). The relatively low density of economic activity and population is reflected in a traditionally high share of agriculture and agribusiness-type activities such as dairy production (Friesland, Drenthe) and potatoes/sugar related production (Groningen).

Figure 2.1 The northern region of the Netherlands

It is interesting to note that this structure was basically different at the end of the 19th century when the city of Veendam in Groningen was the second most important

9 Parts of this chapter are published in Stelder & Oosterhaven (1995a)
industrial centre of the country (Roland Holst, 1977). At that time the region had a comparative advantage due to the abundant local supply of turf as the main energy source for textile, leather and many other manufacturing activities. As turf started to be replaced by other fuel from 1910-1920 onwards the region gradually lost its economic importance and never regained it. The modernisation of agriculture was not lagging behind compared to the rest of the country (especially dairy farming in Friesland was taking a lead) but the decline of agricultural employment was not matched by an equally fast growth of manufacturing employment as in the rest of the country. After 1950 the post war economic recovery caused substantial labour migration flows from the North to the western centres of economic activity reducing northern labour supply but also regional income which led to a further lagging behind.

The discovery of the world’s second largest reserve of natural gas in Groningen around 1960 gave rise to new hope for the region to catch up with the rapid industrialization in the rest of the Netherlands, which by that time was considered to be almost completed. In 1963 the 8th and last government report on industrialization stated that the Netherlands were industrialized now and that only some bottlenecks remained, such as building capacity, research efforts and regional problems (Oosterhaven & Folmer, 1983). The earnings of this natural gas have been huge up to around 30% of the total government budget in the mid 1970’s but ambitious plans of an intensified build-up of related chemical and other activities in the North were cancelled after the oil crisis and the slowing down of economic growth in the second half of the 1970’s. The most dramatic result of this ambitious regional policy is the Eemshaven, opened in 1973, a large brand new deep sea harbour build at the north coast of Groningen surrounded by large industrial sites, which have stayed practically empty until today (see Figure 2.2).

**Figure 2.2 The Eemshaven in 1999**

![Figure 2.2 The Eemshaven in 1999](Photo: Aero photo Eelde)
Other major regional policy instruments for the North have been investment subsidies (IPR) and incidental attempts to relocate major (semi)government institutions from The Hague to the North (FNEI, 1975). The success of the latter has been modest. Original plans involved the relocation of 6000 jobs of the central bureau of the former national telecommunication company PTT to the city of Groningen, but mainly due to strong resistance of the company and its employees only 2300 jobs actually moved to Groningen. The IPR is still operational today with a total annual budget for the North of around 25 million euro. Since 1995, the number of newly created jobs related to economic activities subsidized by the IPR is in the range of 1200-1400 per year (NOM, 2001).

In 2000 a new special policy program for the North has started called *Kompas voor het Noorden* (Compass for the North), aimed at reducing regional unemployment and increasing labour force participation to national average levels in 2010. It is estimated that achieving these goals will acquire the creation of 43,000 extra jobs over the period 2000-2010 on top of the expected autonomous trend of regional development (SNN, 1999). The program is spread over 14 themes grouped in three main policy areas: economic structure, urban planning and rural development. The main new element compared with past policy is the goal of concentrating economic growth and employment in core zones. For this reason our annually published *Regionaal Economische Verkenningen* (REV) has recently started to specifically monitor economic development in these zones (REV, 2000-2002).

**Figure 2.3 Unemployment 1960-2002**

Source: adapted from CBS: registered unemployment from 1987 onwards; recalculated back to 1960 with labour market bureau data.
From Figure 2.3 it is clear that all regional past policy efforts have yet been unsuccessful when it comes to reducing Northern unemployment to national levels. For 40 years regional unemployment in Groningen and Friesland has been above the national average and has only moved up and down with the national trend. In Drenthe unemployment has been close to the national average during 1986-1996, but in recent years it is close to Groningen and Friesland unemployment again. The figure shows that in absolute terms regional unemployment rates for the North as a whole have been about 2 %-points above the national average up until 1980, rising to around 4 %-points in the second half of the period. In relative terms the regional unemployment difference has diminished until 1973, stayed constant until 1996 and has risen slightly in the most recent years. However, relative differences have little meaning at low unemployment levels like in the early sixties.

Regional GDP accounts are not sufficiently available to give a good picture of regional development since 1950 but we do have long time series of employment (see Figure 2.4). The slowing down of employment growth in the 50’s has been more dramatic in the North than is shown in the graph because the numbers do not include self-employed workers, which are mainly found in agriculture. Apart from an upswing in the 60’s it is striking that when the national economy slows down, the regional economy slows down even more.

**Figure 2.4 Employment growth 1955-1998**

![Employment growth graph](image)

Source: adapted from CBS

One of the factors that have been unfavourable to growth in the North is the fact that its industrial structure has been lagging behind the national trend. During the 1950’s and 1960’s, employment growth largely took place in the manufacturing sector, which was still relatively small in the northern region. Figure 2.5 shows that in 1960 agriculture still had a relatively large share. By 1970 employment growth started to shift towards the service sectors while in the North manufacturing had just caught up with the
industrialization process. As the figures for 2000 show, the structural adjustment process from manufacturing to services is still lagging behind\textsuperscript{10}. Agriculture and manufacturing have dramatically shrunk in relative size but the region's share in these sectors is still above the national average.

Net migration is available as another long-term welfare indicator (see figure 2.6). The regional industrialisation process and rapid economic growth in the 60's have been able to stop the net out migration trend of the 50's but Friesland and Groningen hardly achieve any net immigration until 1970. High income growth and expectations have lead to more migration movements throughout the country with a peak in 1973 when national mobility was at its post-war top, but when unemployment starts to rise from 1980 onwards Friesland and Groningen fell back into a negative trend. This net out migration consisted mainly of highly participating people in the age of 25-40 leading to a substantial reduction of the regional growth of labour supply. After 1986 net migration in these two provinces improved again due to a decline of unemployment. Drenthe has shown a more stable trend with a small net in migration from 1980 onwards which is heavily influenced by retired people who bring their wealth but do not need a job (Stelder & Broersma, 2000). In addition, during the 1970's some sub urbanisation effects have taken place from the city of Groningen to Drenthe, which is its direct adjacent northern neighbour.

\textsuperscript{10} See also Oosterhaven and Pellenbarg (1994) for a discussion on the regional industrial structure in the 1970’s and 1980’s.
Figure 2.6  Migration 1960-2003

Source: CBS

Around 1998 net out migration has temporarily increased due to a reverse labour market effect: Dutch unemployment in the West had dropped dramatically even below friction level with increasing shortages and rapidly rising wages, which caused the North to lose high educated labour to the West due to better career opportunities and higher salaries (REV, 2002).

In a long-term perspective northern employment growth and migration to the North may become increasingly boosted by spreading of economic activities from the West to other parts of the Netherlands. The northern regions have a good natural and living environment and an overcapacity of industrial sites. They are also the only provinces left without traffic congestion. It is expected that these characteristics will become a more important comparative advantage every year. In chapter 4 this issue is discussed in more detail.

2.3 ISAM: model history and general outline

Despite the long macro-econometric tradition in the Netherlands, econometric bottom-up specifications are hardly found in Dutch regional models due to the lack of sufficient regional economic data. Only in the field of interregional migration a substantial amount of econometric research has been stimulated by the very detailed registration of migration at the municipal level by the Central Bureau of Statistics since 1950. Regional cross-section research and input-output analysis, however, is well developed, especially for the Northern region, which has built up a long tradition of regional economic modelling and input-output table construction (FNEI, 1974, 1977a; Oosterhaven, 1981; Oosterhaven, Piek & Stelder, 1986; Boomsma & Oosterhaven, 1992). As early as the 1930’s regional labour market projections were published by the NETO, a northern

An econometric model for Friesland (Boomsma, 2004) is just about the only exception.
economic research institute, and since 1948 by the three provincial ETI’s (Economic Technological Institute).

Systematic research and input-output table construction began in 1974 when the Federation of Northern Economic Institutes (FNEI) was founded by the University of Groningen, the three ETI’s and the three provincial administrations (FNEI, 1974). Its purpose was to give more academic background for regional policy-orientated research and to develop and support regional research expertise for provincial and ETI analysts by joint research projects and providing adequate databases and regional economic models. Regional input-output tables by province have been published for 1965, 1975, 1980, 1986 and 1990 and for the northern region as a whole for 1970, 1977 and 1990 (Oosterhaven 1981; Eding, Stelder & Oosterhaven, 1995). Several impact studies for government investment projects have been published (FNEI, 1975, 1977b) and after 1980 regional labour market projections have been published regularly (FNEI, 1981). From 1986 onwards a Regional Economic Outlook (Dutch abbreviation REV) for the three northern provinces has been published annually (REV, 1986-2002; NAV, 2004-2005).

The building of an integrated labour market model based on the i-o tables started in the early 1980s. The first version (FNEI, 1986) consisted of different modules for production, employment, population and migration with little feedback or interaction. The second version was more integrated with feedback mechanisms between migration, consumption, employment and unemployment and contained an econometric bottom-up specification of migration (Stelder, 1991). The evolution to the present version has been reported occasionally in REV (1992-2002) whenever new elements have been introduced. The general model structure of today’s version is given in figure 2.7.

At the core of the employment block is an interregional input-output model, which is fed with national exogenous final demand and partly endogenous regional final demand specified by categories and/or product depending on the data available.

Figure 2.7 General outline of ISAM

![Diagram of ISAM model structure](image-url)
The resulting regional production is combined with labour productivity growth rates and part-time labour rates by industry in order to get regional employment in persons. The labour supply block combines bottom-up forecasts of regional population and domestic migration with a top-down forecast of regional labour participation rates and foreign migration. The national exogenous variables are the outcomes of a large national econometric model of the Central Planning Bureau, which publishes a yearly national economic outlook (CPB, 2001, 2002). ISAM has several feedback mechanisms most of which are related to migration. The migration model predicts regional net migration for each province. Indicators on the regional labour market and the regional housing market are the independent variables, whereas migration itself co-determines regional labour supply and consumption expenditures. Each model block will be discussed in more detail below.

2.4 An input-output growth rate approach

Clearly, due to its constant coefficients the basic input-output model is less suitable for forecasting applications when final demand developments of the total economy need to be estimated over longer periods of time. From 1960 onwards, Gosh (1964), Theil (1966), Polenske (1970), Ehret (1970), Evers (1974) and others experimented with these kinds of input output applications at the national level, but they have been gradually replaced by stochastic/econometric time-series techniques. By the end of the 1960's a certain consensus emerged from the empirical and theoretical work of many authors from many countries that an input-output-forecasting model should be firmly embedded in a larger econometric framework. As a result, at the macro level input-output has only continued to play a modest role as a multisectoral block in some national macro models (Kuper, 1988).

At the regional level, however, input-output still is a prominent tool of analysis (Hewings & Jensen, 1986; Rey, 2000). The possibilities of building econometric models based on time series remain limited because of the lack of the necessary data. When time-series data are scarce it may be more worthwhile to use input-output models that give a detailed picture of the regional economy at one moment of time rather than to rely on poorly estimated econometric models that do not use available input-output information. Standard i-o forecasting with the basic Leontief model, however, would imply an exogenous estimate of future final demand with which production and employment of the total regional economy can be calculated. Such a straightforward implementation has rarely been used because input-output forecasts of absolute productions levels made with absolute levels of exogenous final demand become unreliable when the forecasting is done over 5 years or more (Theil, 1966). A more fruitful approach is to look only at the change of production resulting from a change of final demand without worrying about the errors of the absolute levels themselves. The analysis of input-output forecasting errors with national i-o tables carried out by Theil (1966) and Tilanus and Rey (1964) is relevant in this respect because it shows that under certain conditions input-output forecasting errors can be subtracted from one another.
Theil defined for a table construction year $t$ and a forecasted year $s$:

$$\hat{x}_{ts} = (I - A_t)\cdot f_s$$

(2.1)

with:

- $\hat{x}$ = predicted output
- $f$ = exogenous final demand
- $A$ = matrix of input coefficients

and calculated $\hat{x}$ from (2.1) with $f_s$ both in constant and current prices using the annual Dutch national input-output tables over the period $T=1948-1959$. For each $t \in T$ and $s \in T$ a series of $\hat{x}_s$ was estimated using $A_t$ and $f_s$ in (2.1). In order to analyse the forecasting errors correctly, the exogenous part $f_s$ was subtracted from the predicted $\hat{x}_s$ leaving only intermediate production $\hat{z}_{ts}$ as the variable being actually predicted:

$$\hat{z}_{ts} = [(I - A_t)^{-1} - I] f_s$$

(2.2)

The forecasting error vector is defined by its typical element $\varepsilon_{its}$:

$$\varepsilon_{its} = \log \frac{\hat{z}_{its}}{z_{its}}$$

(2.3)

with $\hat{z}_{its}$ being the typical element of $\hat{z}_s$, and $z_{its}$ of the actual $z_s$ as observed in the dataset.

One of the most interesting results that Theil found was what he called the "cumulation rule" of input-output prediction errors. According to this rule $\varepsilon_{its}$ can be approximated by the sum of all one-year-ahead prediction errors over the period $t \rightarrow s$:

$$\varepsilon_{its} \approx \sum_{j=t}^{s-1} \varepsilon_{ij,j+1}$$

(2.4)

The practical implication of (2.4) is that input-output prediction errors can be reduced using observed prediction errors from the past. For instance, if $\varepsilon_{i,s-1}$ is known because we know the actual values of $z_{s-1}$, an improved prediction $z_{i,s}$ is obtained by

$$z_{i,s} = \hat{z}_{is} \left( \varepsilon_{i,s-1} / \hat{z}_{i,s-1} \right)$$

(2.5)
Here, the error is then reduced to $\varepsilon_{it}^* = \varepsilon_{it} - \varepsilon_{it-1}$. Theil found that this error term is very close to the one-year-ahead error $\varepsilon_{it-1}$, which we would obtain if we would have a table for the year s-1 (Theil,1966, p228).

If we rewrite (2.5) slightly as

$$z_{it}^* = z_{it,s-1} \left( \frac{\hat{z}_{it,s} / \hat{z}_{it,s-1}} {\hat{z}_{it,s-1}} \right)$$

we can interpret (2.6) as being an i-o growth rate model that does not use the endogenous values $\hat{z}$ themselves, but only their growth rates. Values are derived from some exogenous observed $z$, as we will see below. This is usually the most recently available vector $z$ or $x$ at the start of the projection period.

The demand block of ISAM is formulated in this way. In the following notation we will return to the total output vector $x$ in stead of $z$ because (2.4), (2.5) and (2.6) clearly also hold for $x$. Furthermore, because only one matrix $A$ is used for the most recent available year we will delete the double suffix $ts$ and simply write $x_t$ for output predicted in year $t$ with $A$. The disaggregated matrix of final demand by sector and final demand category is denoted as $F$. For the moment, all vectors and matrices as defined in a national model without any regional dimension. The empirical implementation has been done with an interregional model as will be described in the next section. All vectors have $i$ entries of the implemented number of $i$ industries. Matrix $F$ has $i$ rows and $k$ columns in which $k$ is the number of final demand categories. Finally, as most variables are endogenous we also delete the hat ($\hat{}$) in order to simplify things. It will be clear from the text later on which variables are exogenous.

Using "." and "/" for cell-to-cell multiplication and division we will define any growth rate vector like $x_t/x_{t-1}$ as $x_{t}^\prime$. The first step in the demand block is given for any projection period $t=1,...,n$ by:

$$F_t = F_{t-1} \cdot \hat{F}_t$$

(2.7)

$$f_t = F_t \cdot i$$

(2.8)

$$x_t = (I - A)^\top f_t$$

(2.9)

$$\dot{x}_t = x_t / x_{t-1}$$

(2.10)

$$\dot{v}_t = \dot{v}c_t \cdot \dot{x}_t$$

(2.11)

$$\ddot{v}_t = \dot{v}c_t \cdot \dot{v}_{t-1}$$

(2.12)

$$\dot{e}_t = \dot{e}c_t \cdot \dot{v}_t$$

(2.13)

$$e_t = \dot{e}_t \cdot e_{t-1}$$

(2.14)
with

\[ \begin{align*}
F & = \text{final demand (matrix)} \\
f & = \text{final demand (vector of horizontal totals of } F) \\
\mathbf{x} & = \text{output} \\
i & = \text{ones} \\
v & = \text{value added (GDP)} \\
v_{\text{C}} & = \text{GDP/output ratios } v / \mathbf{x} \\
e & = \text{employment} \\
e_{\text{C}} & = \text{employment/GDP ratios } e / v
\end{align*} \]

The series of values \( F_t \) and \( v_t \) for \( t=1..n \) is derived from some actually observed exogenous \( F_0 \) and \( v_0 \) at the start of the projection period. The endogenous values \( x_t \) in fact serve no other purpose than to calculate \( x_t \) from them. According to the accumulation rule mentioned above, the error levels of the predicted series \( x_0, x_1, \text{ etc.} \) are unimportant as they disappear in (2.10). Once \( x_t \) is calculated, \( v_t \) can be derived directly from \( x_t \) using changes in GDP/output ratios by sector \( v_{\text{C}} \). If information about these changes is not available the entries of \( v_{\text{C}} \) are set to 1, which assumes that GDP growth per industry is identical to its output growth.

In the same way, employment \( e_t \) is derived from \( v_t \), adjusted for labour productivity growth \( e_{\text{C}} \). The exact content of \( e_{\text{C}} \) depends on the situation and has been different for various versions of ISAM over time. Sectoral employment growth \( e_t \) is usually lower than GDP growth \( v_t \), due to productivity growth, but must be adjusted upward again when part-time labour increases. Until about 1997 changes in part-time labour contributed substantially to the growth of Dutch employment measured in the number of people employed. Over the period 1985-1995 about 30% of total employment growth was due to redistribution of existing labour demand only. The average person to labour volume ratio rose from 1.21 in 1985 to 1.26 in 1995 and slightly further up to 1.28 in 2003 (CPB, 1999, 2003). In REV (1990-1995) \( e_{\text{C}} \) was adjusted with exogenous national sector specific estimates of the expected growth of part-time labour. After 1995, the rise of part-time labour has only been entered as a small upward adjustment of total national macro employment growth.

Apart from the error reduction achieved, the growth rate specification has an important second advantage in that the separate model components \( F_0, \mathbf{x}_0 \) and \( \mathbf{A}_0 \) can be used independently from each other. First, since the absolute levels \( x_t \) do not need to reflect the actual output level in year \( t \), there is no need for the initial final demand structure \( F_0 \) to be a consistent representation of any specific year. \( F_0 \) can be updated with any recent information that is available as long as the updated \( F' \) gives a better description of the final demand structure at the beginning of the forecasting period.

For example, in our case, the current \( F_0 \) is taken from the most recent i-o table available and is updated with more recent data on national final demand totals and region/sector specific export columns. In doing so, the growth rates of final demand in \( F_t \) are given a more appropriate weight than they would have got with an unadjusted original \( F_0 \). Using such an updated \( F'_0 \) will of course produce endogenous levels of \( x_t \) that have no
empirical meaning anymore because they no longer refer to any specific year. Again, that does not matter because it is only \( x_t \) that counts.

What is also important is that the GDP starting vector \( v_0 \) can be used independently from \( F_0 \) because there is no necessary relation between the two. In most national accounts a full \( v_0 \) vector will be available for more recent years than the latest i-o table. It should be also noted here that, although absolute levels of GDP are given in (2.12), they are only used to calculate GDP per capita. The main purpose of \( v_0 \) is to serve as a weighing vector in order to calculate the aggregated GDP growth rate \( \dot{v}_t \).

Finally, the same arguments hold for matrix \( A \) itself. An outdated table may be updated with any available information at any aggregation level in order to get the closest approximation possible for the starting year \( t=1 \).

### 2.5 An interregional implementation

Figure 2.8 shows the general outline of a fully specified interregional i-o table. Matrix \( Z \) has intermediate trade flows \( z_{ij}^r \) from industry \( i \) in region \( r \) to industry \( j \) in region \( s \). The same holds for interregional final demand categories in \( F \) such as household consumption or investment. \( F^* \) contains the other final demand categories that have no region of destination, such as change in stocks and foreign exports. Matrix \( V \) contains the primary costs categories such as wages, profits etc. by regional industry. Primary costs of regional final demand are given by \( VF \) and of other final demand by \( VF^* \).

In figure 2.7 foreign imports can show up in various ways. In many tables \( Z \) and \( F \) are presented with foreign imports included. When \( Z \) and \( F \) are specified as domestic flows, foreign imports can be presented as a full sub matrix of \( V \) with dimension \( i \times j \) or, as is done in the Dutch interregional i-o tables, as an aggregated row in \( V \). A third possibility is to have \( Z \) and \( F \) in domestic flows, but with an extra negative column in \( F^* \) that contains total foreign imports specified by industry of origin. In this case the definition of \( x \) will change from total output into domestic use c.q. supply.

An important advantage of this interregional framework is that it implicitly contains the national i-o table, which can simply be derived from aggregation over the \( r \) regions of origin and the \( s \) regions of destination. The growth rate approach discussed in the previous section thus not only leads to regional forecasts by industry, but implicitly also to a national forecast by industry as well as at the macro level. This gives the growth rate model the option of constraining its results to exogenous national forecasts at the macro or industry level, as well as at the macro level to final demand totals by category, such as total national consumption, total national exports etc. With a full link with national growth rates it is then not the regional growth rates themselves that are forecasted, but their deviation from the national trend. This option has extensively been used in the Indonesian version of the model, which will be discussed in the next chapter.
Figure 2.8 General outline of an interregional i-o table

\[ Z_{ij} \quad Z_{ik} \quad \ldots \quad Z_{ij} \]

\[ F_{1i} \quad F_{2i} \quad \ldots \quad F_{ri} \]

\[ F^*_1 \quad F^*_2 \quad \ldots \quad F^*_r \]

\[ V_1 \quad V_2 \quad \ldots \quad V_s \]

\[ f_{ik} \quad \ldots \quad f_{ik} \]

\[ f^*_i \quad \ldots \quad f^*_i \]

\[ Z = \text{intermediate flows, interregional} \]

\[ F = \text{final demand flows, interregional} \]

\[ F^* = \text{other final demand flows, by region of origin} \]

\[ V = \text{primary costs, by region of destination} \]

\[ VF = \text{primary costs of final demand} \]

\[ r = \text{region of origin} \]

\[ s = \text{region of destination} \]

\[ i = \text{sector of origin} \]

\[ j = \text{sector of destination} \]

\[ k = \text{final demand category, regional} \]

\[ k^* = \text{final demand category, other} \]

\[ l = \text{primary costs category} \]
In the first years of the implementation of ISAM three separate models for each province Groningen, Friesland and Drenthe were used, based on biregional i-o tables for 1975, 1980 and 1986 in which region 1 is the province and region 2 is the rest of the Netherlands (FNEI, 1986). In 1995 for the first time a 4x4 integrated interregional table was constructed for the three regions Groningen, Friesland and Drenthe and the rest of the Netherlands as the fourth region (Eding, Stelder & Oosterhaven, 1995)\(^{12}\). Using this table a 4x4 ISAM version was build which is still operational for the REV, although updated with a third generation of biregional i-o tables for all Dutch provinces published in CBS & RuG (1999).

### 2.6 Labour supply and unemployment

The supply side of the labour market in ISAM consists of three blocks: population, migration and labour market participation. Only the participation block uses exogenous national CPB forecasts, which makes the bottom-up content of the supply side of ISAM more substantial than that of the demand side.

#### 2.6.1 Population

National forecasts of labour supply by the CPB are rather implicit and poorly documented (CPB, 2002). In our annual Regional Economic Outlook we compare these national forecasts with our own independent regional forecasts. First, a population forecast is made for each region using standard cohort-survival methods with regional and national birth and mortality rates.

The cohort-survival method as such is well known and will not be described here (see e.g. Rogers, 1975). We will restrict ourselves to discussing the way in which the migration effects are incorporated into the forecast of the potential labour force. If we denote the region with superscript \(r\) and \(s → t\) is the forecasting period, the regional population forecast is made in the following way:

\[
\begin{align*}
\rho^*_t = (B^r + S^r)^{t-s} \rho^*_s + \sum_{r=s+1}^{t} (S^{t-r} m^*_r.
\end{align*}
\]

with

\[
\begin{align*}
\rho^*_r &= 2a \text{ vector of regional population per age/sex group (a=nr of age groups)} \\
B^r &= 2ax2a \text{ matrix of regional birth rates} \\
S^r &= 2ax2a \text{ matrix of regional survival rates} \\
m^*_r &= 2a \text{ vector of regional net domestic migration}
\end{align*}
\]

\(^{12}\) A 5x5 version of the table was constructed for a research project about the regional importance of EDON, the main public utility company in the North. In this table Overijssel was inserted as an extra region. See Cras et al. (1995).
The first term of (2.15) describes the standard cohort-survival forecast of the resident population from s to t. The second term is a little more complicated and refers to the net domestic migration effects of the years s+1 to t that have to be added to the resident population \( p_t \) in each year subsequent to the starting year s.

### 2.6.2 Migration

#### Domestic Migration

In regional economics as well as in geography an extensive amount of literature on migration has developed since Lowry's original gravity model formulation (Lowry, 1966; Greenwood, 1985; Weidlich & Haag, 1988). As Mueller (1982) summarized, economic factors do not play the same role in the decision to leave a region and the decision which region to move to. This asymmetry is also found in two earlier versions of the present migration model in ISAM that where already developed in FNEI (1981) and FNEI (1986). For the northern regions, regional unemployment and housing market conditions turned out to be the decisive factors. As is the case in many migration studies, however, both models performed satisfactory for migration flows, but poor for the resulting net migration, especially in FNEI (1986). Hence, in ISAM II it was decided to move to a model aimed at net migration directly (Stelder, 1991). From a theoretical point of view this is not consistent with any micro level behavioural theory because “there is no such thing as a net migrant” (Rogers, 1989). At the macro level, however, regional net migration can be seen as an indicator of the relative attractiveness of a region with respect to labour market and housing market conditions. In addition, regional policy is much interested in the development of net migration, and net migration models can produce a better performance than flow models (Somermeyer, 1961; Suycker, 1981; Kwaak, 1985).

In the first version of the net migration model, besides indicators of the housing market, both employment and unemployment were used as explanatory variables (REV, 1990), but employment had to be abandoned later, because when the available time series data expanded over the 1990s employment did not show any significant effect on net migration anymore. Since 1996 the general form of the ISAM net migration model is as follows:

\[
m^*_t = \psi_t^r + \psi_t^h h_{t-1}^r + \psi_t^u (u_{t-1}^r - u_{t-1}^n) \tag{2.16}
\]

with

- \( m^*_t \) = total net migration
- \( h \) = regional share in national number of finished new dwellings
- \( u \) = unemployment rate
- \( \psi_t^r \) = regression coefficients

and \( r \) and \( n \) referring respectively to regional and to national variables.
Figure 2.9 Net migration models for Groningen, Friesland and Drenthe.
Table 2.1 Net migration model fit

<table>
<thead>
<tr>
<th>sign and T-value</th>
<th>Groningen</th>
<th>Friesland</th>
<th>Drenthe*</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\psi_1$</td>
<td>+</td>
<td>-</td>
<td>$\pm$ 0.92</td>
</tr>
<tr>
<td>$\psi_2$</td>
<td>-5.75</td>
<td>-2.84</td>
<td></td>
</tr>
<tr>
<td>$\psi_3$ (dummy 1982)</td>
<td>-1.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.79</td>
<td>0.62</td>
<td>0.16</td>
</tr>
</tbody>
</table>

* variable $h_t$ instead of $h_{t-1}$, 1978-2001

Table 2.1 shows that the model performs pretty well for Groningen and Friesland over the period 1975-2001 with only these two independent variables. Remarkably, both variables do not explain anything about net migration in Drenthe, or even have the wrong sign. Only $h_t$ shows some synchronous variation with net migration, but the T-value is below 1, even if a dummy for 1982 is added, which corrects for administrative changes in that particular year. Figure 2.9 shows the model fit for the three separate models. The scale of the Y-axis is chosen proportional to total population for each region. This enables us to see immediately that the bad model performance for Drenthe may also have something to do with its relatively low levels of net migration. When net migration is close to zero, annual volatility increases with small changes in the inflow and/or outflows. Clearly, a net migration model performs better for regions with structural migration deficits or surpluses.

An interesting thing to note is that there are large differences in the net migration structure between the three regions and between different age groups. As is shown in figure 2.10, the situation in Groningen is substantially different from the other two.

Figure 2.10 Net migration by age groups

average 1996-2000

![Net migration by age groups](image-url)
regions. The large net inflow for the age group 15-19 and net outflow for 25-29 is related to first-year students and graduates respectively for higher education institutions concentrated in the city of Groningen. Apart from this, the northern regions in general have a small net inflow of older people and a net outflow of younger ages groups above 15. The migration patterns in figure 2.9 show no significant difference by gender.

As is generally know from the migration literature, labour market factors are more important for young migrant behaviour while older migrants take regional housing market conditions more into account. This reflects the life-cycle theory in migration research, which predicts that job migration diminishes as people become older and housing factors becoming more important (Evers & van de Veen, 1986; Weidlich & Haag, 1988). In this respect figure 2.9 shows that these findings are consistent with the migration patterns in the Northern regions, which have a relatively poor labour market situation and a relatively good housing market situation.

It is clear that the population model in (2.15) needs a detailed age/sex-specific forecast of net migration. The net migration model, however, only predicts total aggregate net migration. This inconsistency in aggregation levels is solved in a two-step procedure. First, we disaggregate total net migration into 10x2 age/sex groups using the assumption that the forecasted net migration may be divided over these subgroups according to net migration data for the most recent year. Next, the resulting net migration by age and sex groups is disaggregated further into individual cohorts for a=15..64 assuming that the age structure within each of the 20 groups is the same as that for the corresponding resident population.

*Foreign migration*

Besides domestic migration, international migration also plays a role. In particular the late 1990s show a growing inflow of asylum seekers (see table 2.2).

**Table 2.2 Net foreign migration by region**

<table>
<thead>
<tr>
<th></th>
<th>Groningen</th>
<th>Friesland</th>
<th>Drenthe</th>
<th>Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>823</td>
<td>1200</td>
<td>586</td>
<td>32778</td>
</tr>
<tr>
<td>1996</td>
<td>1199</td>
<td>2164</td>
<td>1043</td>
<td>43424</td>
</tr>
<tr>
<td>1997</td>
<td>1390</td>
<td>2534</td>
<td>1734</td>
<td>47642</td>
</tr>
<tr>
<td>1998</td>
<td>2402</td>
<td>3145</td>
<td>1635</td>
<td>61966</td>
</tr>
<tr>
<td>1999</td>
<td>2190</td>
<td>2928</td>
<td>1435</td>
<td>60128</td>
</tr>
<tr>
<td>2000</td>
<td>3672</td>
<td>4102</td>
<td>2714</td>
<td>71649</td>
</tr>
<tr>
<td>2001</td>
<td>3849</td>
<td>4396</td>
<td>2952</td>
<td>71825</td>
</tr>
</tbody>
</table>

In ISAM exogenous regional short-term forecasts for net foreign migration are based on the latest regional share and national forecasts from the CPB or other institutions. Due to long bureaucratic procedures and sharpened immigration policy it is estimated that only 15% of net foreign migration enters the regional labour force (CBS, 2003).
Finally, a feedback effect from the forecasted total net domestic and foreign migration is entered into regional household consumption in $F_t$. Total regional household consumption is given an additional growth component equal to total net migration as a percentage of the total regional population.

### 2.6.3 Labour force participation

In order to translate the domestic population forecast into a labour force forecast, sex and age groups extrapolate regional participation rates. Especially female participation rates have been traditionally low in the Northern region compared to the national average, but they are converging to the national rates (see table 2.3.)

#### Table 2.3 Labour participation rates 1994-2000

<table>
<thead>
<tr>
<th>age</th>
<th>Groningen</th>
<th>Friesland</th>
<th>Drenthe</th>
<th>Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15-24</td>
<td>25-34</td>
<td>35-44</td>
<td>45-54</td>
</tr>
<tr>
<td>male</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>average</td>
<td>40.7</td>
<td>91.7</td>
<td>91.7</td>
<td>87.0</td>
</tr>
<tr>
<td>1998-2000</td>
<td>47.0</td>
<td>94.0</td>
<td>93.0</td>
<td>88.0</td>
</tr>
<tr>
<td></td>
<td>50.0</td>
<td>96.0</td>
<td>93.7</td>
<td>90.7</td>
</tr>
<tr>
<td></td>
<td>48.7</td>
<td>94.0</td>
<td>94.7</td>
<td>90.0</td>
</tr>
<tr>
<td>total</td>
<td>74.3</td>
<td>76.3</td>
<td>77.7</td>
<td>78.7</td>
</tr>
<tr>
<td>growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994-2000</td>
<td>2.0</td>
<td>4.0</td>
<td>0.7</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>1.3</td>
<td>0.7</td>
<td>1.3</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>4.0</td>
<td>1.0</td>
<td>4.3</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>2.4</td>
<td>1.2</td>
<td>1.8</td>
<td>6.6</td>
</tr>
<tr>
<td>female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>average</td>
<td>38.0</td>
<td>72.3</td>
<td>65.3</td>
<td>50.0</td>
</tr>
<tr>
<td>1998-2000</td>
<td>40.0</td>
<td>71.3</td>
<td>59.7</td>
<td>46.3</td>
</tr>
<tr>
<td></td>
<td>46.7</td>
<td>73.0</td>
<td>59.7</td>
<td>50.7</td>
</tr>
<tr>
<td></td>
<td>44.7</td>
<td>73.7</td>
<td>63.7</td>
<td>53.3</td>
</tr>
<tr>
<td>total</td>
<td>51.3</td>
<td>49.0</td>
<td>51.0</td>
<td>54.0</td>
</tr>
<tr>
<td>growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994-2000</td>
<td>5.0</td>
<td>5.3</td>
<td>12.3</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>-1.0</td>
<td>12.3</td>
<td>13.3</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>0.0</td>
<td>9.0</td>
<td>6.0</td>
<td>11.0</td>
</tr>
<tr>
<td></td>
<td>0.7</td>
<td>7.6</td>
<td>7.7</td>
<td>8.9</td>
</tr>
<tr>
<td>total</td>
<td>8.3</td>
<td>8.3</td>
<td>5.7</td>
<td>6.2</td>
</tr>
</tbody>
</table>

* not available

Source: adapted from CBS: EBB
Regional differences for male participation are small. For the age group 15-24, Groningen again shows the influence of high education participation leading to relative low rates of both males and females for 15-24 year olds. Regional female participation is still 3 to 5%-points below the national average, but the last row of table 2.3 shows that in Groningen and Friesland it has grown over 8%-points compared to around 6%-point for Drenthe and the national average. The participation data are available from 1987 onward based on the Enquête Beroepsbevolking of the CBS. For ISAM a simple forecast is made through a straightforward extrapolation using a three-year moving average over the period 1988-2000.

### 2.6.4 Commuting, total labour supply and unemployment

Finally, commuting needs to be considered. Ideally, because of their close interrelation a simultaneous approach of migration and commuting should be preferred. Evers and van der Veen (1984) for instance distinguish complementary commuting that results from residential migration without job mobility, and substitution commuting that results from the opposite mix. Present data on regional commuting in the North, however, are extremely poor and do not allow any form of modelling. In recent years ISAM uses just a simple macro assumption: the commuting balance between Groningen and Drenthe is assumed to change slowly in favour of Groningen due to sub urbanisation of the Groningen working force to surrounding residential areas. Because the border between Groningen and Drenthe lies very close south of the city of Groningen, some of these residential areas lie in Drenthe. The other relatively small commuting flows between the Northern regions and the rest of the Netherlands are assumed to remain constant.

Total labour supply is then simply derived as:

\[
I^r_t = (l^p_t)^r p^r_t + \Delta \text{com}^r_{st} + \text{im}^r_t \tag{2.17}
\]

where

- \(I^r_t\) = labour force
- \((l^p_t)^r\) = vector with regional labour force participation rates per age/sex group
- \(\Delta \text{com}^r_{st}\) = change in net workforce commuting into region \(r\) over the period \(s \rightarrow t\)
- \(\text{im}^r_t\) = change in labour supply due net international migration

Finally, the supply and demand side of ISAM meet in the projection of the main policy objective, the unemployment rate. For each region this result is found through

\[
u^r_t = \left\{ e^r_t - I^r_t \right\} / I^r_t \tag{2.18}
\]
2.7 Performance and evaluation

As has become clear from the previous sections, ISAM has been a model in constant development since 1985. A judgement of its performance can therefore not be an evaluation of one single model but of modelling approach. In principle, ISAM produces forecasts for GDP, employment, labour force and unemployment that can be confronted with reality in later years when data become available. For some parts of the model the fit can be measured directly such as for the migration block discussed in the previous section. In REV (1996) an evaluation of the overall model performance was carried out over the period 1987-1994. The regional forecasts turned out to be too pessimistic for economic growth and employment, but more than half of the forecasting errors were due to errors of the national forecasts that were used as inputs for ISAM.

Even after correcting for these errors, the regional employment forecasts were still too pessimistic which was an indication that structural changes were taking place in the Northern regions that were not accounted for in the model. In REV(1999) and later, regional shifts were added from several time-series, in particular about the regional housing market and foreign exports.

As Figure 2.11 and 2.12 indicate, a structural trend can be detected towards a more outward orientation of the northern economy and a continued rise of its share in the national newly build dwellings. These shift results were used for making upward adjustments in the columns for total export growth and investment in housing in matrix $F_t$. Whether these adjustments have led to better forecasts is still unknown because regional deflated GDP figures at the time of this writing were still not available after 1999.
Further tracing of forecasting errors in the model is complicated by the fact that there are no deflated regional GDP data before 1991 so we would need to construct our own deflated time-series as a benchmark for model performance. The model input through matrix $F_j$ cannot be compare with reality either because no new regional tables have been constructed after book year 1992, and even if they would be available, they would face the same deflation problem as for the GDP data. In addition, for employment there is no check available on whether the regional forecast has been wrong in terms of regional productivity, part-time work developments or both. Finally, at the supply side of the labour market, due to the relatively small size of the northern provinces regional CBS-data on the labour force are not accurate enough for a comparison with the ISAM forecasts (REV, 2002).

Regardless of these difficulties, however, the most relevant judgement for the model is whether the regions economic performance relative to the national trend is predicted correctly. In general, regional policy institutions are more interested in the question if the region is doing better or worse than the national average then in the absolute numbers themselves. The key indicator that is usually of most interest is regional unemployment and its regional component, which is the difference with the national level of unemployment. Clearly the relevance of a judgement of the unemployment forecast is limited because unemployment is the net result of the forecasts for demand and supply of labour, which in their turn are the result of the forecasts for GDP, productivity, population, migration, participation etc. On top of that, the regional unemployment component forecast is a net result of the model's unemployment forecast and the exogenous national unemployment forecast.

Table 2.4 shows the direction of the forecasts and reality of regional unemployment and its regional component over the period 1989-2001. The plus (+) or minus (-) indicate whether the unemployment rate has increased or decreased compared with the previous year. A plus or minus in the lower half of the table indicates whether the difference between regional and national unemployment has increased or decreased. For the unemployment rate itself ISAM has predicted the correct direction in 30 out of 39 cases. The direction of the regional component however, was only predicted correctly in 19 out of 39 cases.

If we leave out 1989 and divide the remaining 12 years into two equal groups of 6 years (18 cases in each group), the performance of the unemployment prediction remains about the same over time: 14 correct predictions in the first period and 13 in the second period. For the regional unemployment component, however, the model performance has improved: 7 out of 18 correct predictions in the first period and 12 out of 18 in the second period.
Table 2.4 Forecasts and reality unemployment 1989-2001

<table>
<thead>
<tr>
<th>Year</th>
<th>Groningen</th>
<th>Friesland</th>
<th>Drenthe</th>
<th>Groningen</th>
<th>Friesland</th>
<th>Drenthe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>decrease/increase unemployment rate</td>
<td></td>
<td></td>
<td>decrease/increase regional component</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>1990</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
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<td>1991</td>
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<td>+</td>
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<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>1993</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>1994</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>1995</td>
<td>+</td>
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<td>+</td>
<td>+</td>
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</tr>
<tr>
<td>1996</td>
<td>+</td>
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<td>-</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>2001</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

2.8 Conclusion

Despite these limited options for measuring the model’s performance it is clear that the detailed structure of ISAM allows us to take into account the major part of all economic information available for the region which is of obvious importance for regional economic development. Detailed exogenous information about consumer spending on specific goods, exports by sector, labour productivity and part-time development by sector etc. all give their specific weights to the expected macro-regional growth of GDP and employment, and the interregional specification captures all interregional interdependence and trade relations. This is a much more complete treatment of the region and its relation with the outside world than is done in most other Dutch regional forecasting models that are largely based on shift-and-share techniques applied on GDP.
and/or employment directly without any treatment of regional expenditures by type or sector (Kwaak, 1985; van der Laan, 1996). Moreover, in shift-and-share analysis regional shifts are treated independently from one another, while in an interregional setting as in ISAM extra growth in one region can boost economic growth in other regions with close trade relations with that region.

From the regional policy point of view, the important relevance of ISAM is its concentration on deviations of the region from national development. The interregional structure of the production block enables the adding up and rescaling of all regional variables to national totals, which keeps the ISAM results consistent with national CPB forecasts policy makers are familiar with.

The model has primarily been used for the annual short-term forecasts published in REV (1986-2002). For long term forecasting some important model modification are required. These will be discussed in chapter 3 and 4.