CHAPTER 3

Indicating the Future Labour Market Prospects of Occupational Groups and Types of Education in the Netherlands

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1. Introduction

The activities of the Research Centre for Education and the Labour Market (ROA) focus on increasing the transparency of the match between education and the labour market. A special effort is made to generate information on the labour market prospects of occupational groups and the graduates from various types of education. This information is primarily intended to assist young people in choosing an occupation or training course. The information can also play a role in answering policy questions as regards tuning training facilities to the needs of the labour market and how best to harness the potential of the population’s qualifications to achieve economic growth.

ROA seeks to realize this transparency of the match of between education and the labour market by providing a differentiated, representative and coherent picture of the training and occupational structure of the labour market, and of current developments. With this goal in mind, the labour market information generated by ROA is a systematic whole: the information system on education and the labour market. Because the information is intended primarily to be used in relation to
educational and vocational choices, and the implications of these choices in the labour market will only appear at the end of training courses which often last for several years, this system focuses, apart from information on the current labour market situation of each occupational group, on data on the future labour market prospects of occupational groups and types of education. The system also contains indicators that say something about the structural labour market risks that are associated with certain occupational groups and/or types of education. These relate to information on the width of the occupational domains which these educational varieties are directed at and the cyclical sensitivity of employment in the occupations which can be practised with each type of education.

In developing the methodology for drawing up labour market forecasts, a link was sought with the old familiar manpower-requirements approach. This approach is today more promising than was the case in the past, because of the more frequent availability of the labour market data required for estimating the forecasting models. This data comes from the Labour Force Survey, which supplied crucial labour market data every two years from 1975 to 1985 and, as of 1988, every year. Even though the frequency has increased in comparison to the censuses which were used before, the degree of detail obtainable has become smaller because the Labour Force Survey is based on random samples.

Realizing that labour market forecasts are never perfect, ROA bore a number of principles in mind in developing the information system:
- The forecasts will for the time being be limited to the medium term, that is, for a period of about five years. Within this horizon, changes in the labour market are less uncertain than in the long term and the forecast results will still be appropriately usable for those choosing a course of study which will last some years.
- As much use as possible will be made of the existing insights into the volumes of future changes in employment levels and of the flow from education onto the labour market. This applies especially to the employment changes for each sector of industry, which can be derived from forecasts from the Dutch Central Planning Bureau (CPB), and the flow from education, which can largely be derived from forecasts made by the Ministry of Education and Science.
- Instead of fixed coefficients for the occupational and training structures of employment, explanatory models will be used as much
as possible in an attempt to take shifts in these structures over time into account.

- No detailed comparison of demand and supply for each forecasting year will be given, but rather an impression of the broad relations of demand and supply over the entire forecasting term on the basis of a qualitative categorization of labour market prospects.

- The forecasts will be drawn up every two years, so that developments can be kept up with. Observed differences between forecasts and events can then be used to improve the forecasting approach.

- The forecasts will be supplemented with labour market indicators that give an idea of the labour market risks of occupational groups and types of education (alternative job possibilities on the labour market, cyclical sensitivity).

Given these points of departure, the methodology for forecasting changes in employment levels is as follows. The medium term forecasts of the working population for each of 14 sectors of the economy, made by the CPB, are taken as the starting point. Then forecasts are made of the shifts in the occupational structure of employment in the various sectors. Finally, taking into account the expected shifts in industrial and occupational class structures, the employment forecasts for the different types of education are determined. This approach guarantees that the educational and occupational employment forecasts are consistent with the CPB forecasts of employment by sector.

The economic models that underlie the forecasts of the occupational and educational structure of employment differ from the traditional manpower planning models in that they, in accordance with the basic approach outlined above, are not based simply on extrapolations from perceived trends, but are drawn up on the basis of explanatory models.

The assumption in the design of the occupational models is that the occupational structure of a sector is an aspect of the demand side of the labour market. The development of the occupational structure of employment in each sector is therefore explained in the model by factors that influence especially the demand for labour. The educational model on the other hand assumes that the educational structure of an occupation may be influenced by demand as well as supply factors.
Along with increases in employment levels, the future replacement demand because of the departure of personnel is also very important in determining the number of jobs that become available for new entrants on the labour market. The replacement demand is on the one hand the result of permanent withdrawals from the labour force because of retirement, early retirement, and on the other hand the result of often temporary withdrawals, especially by married women who care for and raise their own children. The replacement demand is therefore closely related to the age structure and sexual composition of occupations and types of education. In forecasting the replacement demand these two factors therefore play an important role.

The forecasts of the supply of school leavers are based on external estimates from the Ministry of Education and Science. These forecasts are completed by incorporating figures for non-regular education and then disaggregated to the more detailed classification of types of education which is used in the information system.

For each occupational class and type of education, the employment level forecasts are combined with the forecasts of replacement demand, to produce the number of expected future job openings. For the types of education, this figure is matched with the number of school leavers entering the market plus the number of short-term unemployed at the beginning of the forecasting period, to indicate their labour market prospects. Figure 3.1 gives an overview of the forecasts used in the information system on education and the labour market.

The methods for determining the demand and supply forecasts will be elaborated and explained as follows. In section 2 the basic data and classifications used will be briefly described. Section 3 discusses the forecasts of expansion demand by occupational classes and types of education, and section 4 deals with the forecasts of replacement demand. Section 5 indicates how the forecasts of the flow of school leavers onto the labour market from the different types of education are drawn up. The way in which the correlation of these inflows with the job openings is made is explained in section 6, which also discusses two labour market risk indicators. Finally in section 7 some conclusions are drawn.
Figure 3.1. Forecasts in the information system on education and the labour market
2. Data sources and classifications

In the employment model 14 economic sectors are distinguished. These correspond with the economic sector classification used in the Athena model, with which the CPB makes forecasts of medium term changes in the labour volume and the numbers of workers for each sector (CPB, 1990). The classification corresponds to the standard industry classification of the CBS. The data on each sector which is used in the Athena model and by ROA, such as the employment levels, the level of investment and the value added, are obtained from the CPB.

The data on employment by occupational classes and types of education are expressed in numbers of workers. This data, further differentiated by sector, age and sex, are taken from the Labour Force Survey (AKT) of the CBS. The Labour Force Surveys are random samples from 2.5 to 5% of the total labour force. They were undertaken every two years from 1975 to 1985, at the same time in each year. After that the CBS changed to a somewhat smaller continuous random sample, the so-called EBB. However, this gives usable data only as from 1988.

The main sources of data for the forecasts of the flows of school leavers are forecasts made by the Ministry of Education and Science ('SKILL' forecasts and the WORSA and RHOBOS forecasts made by the Student Estimates Task Force). Various other data sources have also been used: the 'Complete student count' for apprenticeship training, the educational matrix of students flows, and miscellaneous data sources on students in more regular (adult) education. Unemployment rates are based upon the registration at the Employment Exchange.

A total of 93 occupational classes are distinguished. These were originally based on the 320 three-digit occupational groups according to the standard occupational classification of the CBS, which in turn links up with the international ISCO-code. ROA consolidated these 320 occupational groups, using among other methods a statistical cluster procedure, into 93 classes and then into 48 segments which are as homogenous as possible as regards their training structures (De Grip, Groot and Heijke, 1991 and Van de Loo, Dekker and De Grip, 1992).
Some 49 educational categories are distinguished. This classification was taken from the three-digit classification of the Standard Education Classification (SOI) of the CBS, which again links up with the ISCED of UNESCO. The first digit of the original SOI code refers to the educational level, ranging from 2 (Elementary Education) to 6 (Academic Education). The various fields of study, such as ‘general’, ‘technical’ or ‘medical’, are indicated by the second and third digits of the same code.

3. Employment forecasts

The employment forecasts are probably the most difficult element of ROA’s information system on education and the labour market. This section will describe the construction of the model that is used for our most recent medium-term forecasts for occupational classes and types of education. In contrast to the traditional manpower-requirements approach no fixed relations between occupations and types of education are assumed. As in some earlier studies by ROA, a somewhat more flexible relationship is assumed. Another difference from the traditional models is that an attempt is made to find explanatory variables for the changes in both the occupational and educational structures of employment. In doing so the data is pooled over occupational classes, sectors of industry, and time.

The starting point of the forecasts are the employment projections by sector which are made by the CPB with help of their Athena model. This means that the more detailed forecasts, which distinguish the prospects of particular types of education and occupations, are consistent with the broadly accepted intermediate and macro-level economic forecasts of the CPB. Moreover this makes it possible to put more effort into constructing employment models for occupations and types of education, rather than reproducing a model of the economy divided into sectors.

The Athena model of the CPB is a multi-sector model of the Dutch economy which distinguishes 14 sectors (CPB, 1990). For each sector a clay-clay production function with heterogeneous vintages (annual cohorts) is used. Disequilibrium may arise in the production process and the labour market, which then feeds back into prices, wage rates, investment, the demand for labour, etc. The employment equation for
the industrial sectors is derived from the model for production capacity and consists of three parts. One part describing the vintage effect on labour volume, one part describing the ‘disembodied’ changes in the number of jobs and one part describing the short term adaptation processes. The employment level equations for the remaining economic sectors are not derived from a formal production function but were formulated ad hoc on the basis of studies for each sector.

Starting from the CPB forecasts of employment by sector, a two-step model is estimated to explain the occupational structure of the sectors. This occupational structure is the starting point for modelling the educational structure of occupations, which is also split up in two steps. The changes in educational disciplines are analyzed first, followed by an analysis of changes in the educational level of employment. Figure 3.2 gives an overview of the structure of the ROA employment forecasts.

To maintain consistency with the employment projections by economic sectors made by the CPB, distributional or choice models are used for both the occupational and the educational structure of employment. In the estimations the Modified Multinomial Logit (MML) model as described by Parks (1980) is used. This model has previously been used for the estimation of manpower coefficients in the Netherlands, by Van Opstal (1988) and Peeters (1990). This method takes into account both the specification and measurement error, whereas standard logit models only consider measurement errors. Another advantage of choice models is that the sum of shares necessarily adds up to one, as each category is estimated in relation to a reference category. ROA’s earlier models on this topic did not have this consistency automatically, requiring elaborate corrections after the estimation.

The aim of the expansion demand models is to describe the changes in the employment structure of occupations and training types over time. At the moment however, only four time-series observations are at our disposal. In order to be able to use an explanatory model on the basis of this data and also to improve the reliability of the estimations, the observations are pooled over the sectors in the occupations model and over sectors and occupations in the training model. This pooling is justified if for the different sectors, or for the sectors
and occupations, the same mechanisms are affecting the employment structure. Because of the short time series and the assumption entailed in pooling the data, extra attention will be given to the plausibility of the results.

Figure 3.2. Structure of the employment forecasts
Causes of shifts in the occupational structure

As noted in section 1, the assumption in the design of the occupational models is that the occupational structure of a sector forms an aspect of the demand side of the labour market. The development of the occupational structure of employment in each sector is therefore explained in the model by factors that influence especially the demand for labour (see for the occupational model also: Dekker, De Grip and Heijke, 1990).

One of the most important factors to be investigated is technological development. Technological development may well cause substitution of occupations within sectors of industry. Note that the effect of technological development on the relative growth in employment in different sectors of the economy will not be considered. Differences in sectoral growth are already incorporated in the sectoral forecasts of the CPB. The present analysis only considers changes in the shares of employment within a given sector.

The second factor of interest is the degree of capital utilisation within a sector. Employment in some occupations can be more sensitive to the business cycle than others (e.g. ‘overhead’ occupations). Moreover cyclic effects could be the motive for hiring workers of some occupations or dismissing others at a faster rate then before. This does not have to happen within a firm. The same phenomenon also occurs when firms employing many clog-makers go bankrupt and are replaced by new firms which employ many shoemakers.

Relative wage costs are not included in the model for lack of adequate data. Consequently, it is assumed that the wage structure as such does not change, or that the influence of the wage structure on the occupational structure of employment within economic sectors is constant.

Causes of shifts in the educational structure of employment

It is obvious that technological advances can also play an important role in the changing educational structure of an occupation within a sector. The final effect of technological progress, whether upgrading or downgrading effects prevail, cannot be assessed unequivocally in advance, as is shown by Spener (1985). Therefore technological advance is explicitly included in the educational model, without making a
priori statements about its expected results (see for the educational model also: Beekman et al., 1991).

However, shifts in the educational structure of occupations may be initiated by supply factors as well as demand factors. In a labour market with high unemployment, for instance, the competition for jobs may be such that more highly qualified workers displace the less skilled from their 'occupational territory'. The result of this 'crowding-out' (see Teulings and Koopmanschap, 1989) is that persons with a high level of education occupy jobs previously held by persons with a lower level of education. Typically, this type of displacement is a one-way process: only persons with a higher level of education are able to push the less skilled from their jobs.

Economists may prefer the (neo-)classical procedure, by which the phenomenon of displacement is described with the help of the relative scarcity of a certain level of education as expressed in the relative wages (see also CPB, 1987). However, for lack of adequate information about the wages earned by persons with a given education, an approximation for the influence of wage factors will be resorted to. Assuming that a relatively large proportion of workers with a given educational level in the potential labour force will correspond to a relatively generous supply of that category of labour on the labour market, the price of such labour will be relatively low and, ceteris paribus, the persons involved will be more likely to obtain work than others (in new occupations and sectors). The difference between this and the hypothesis of downward displacement is that, while the latter includes only the displacement of the less skilled by the more highly skilled, the neoclassical approach also recognises the possibility of the less educated replacing the more highly educated.

Although strongly aggregated data is used, an attempt will be made to include these phenomena explicitly in the model as variables explaining the shifting educational structure of occupations. To that end we will follow the CPB (1987) in adding the share of persons with a given level of education in the total potential labour force as a regressor in our model. To distinguish it from the variable generated by technological developments (demand factor), this regressor will be referred to as the 'displacement variable', even though it is evidently not a displacement variable in the narrow sense, but rather an attempt
at modelling substitution processes set in motion by supply factors.

**Specification of variables**

The first variable to be incorporated in both the occupational and the educational model is the technology variable $CEI$ (Capital to Employment Index), measured as the capital to labour ratio in a particular sector. This variable represents the capital intensity of production for each sector, relating the volume of investment in equipment, transportation, and engineering work in the past ten years (as a measure of the stock of capital goods), to the five-year moving average of employment (as a measure of the 'structural' workforce, controlled for business cycle fluctuations).

\[
CEI_{s, t} = \left[ \sum_{h=-9}^{0} INV_{s, t+h} \right] \left/ \left[ \sum_{h=-2}^{2} EMP_{s, t+h} \right] \right.
\]

(3.1)

$INV_{s, t}$ = investments in sector $s$ in year $t$;

$EMP_{s, t}$ = volume of employment in sector $s$ in year $t$.

The second variable to be incorporated in the occupational model is the capacity utilization variable ($DCU$) indicating sector-specific business-cycle effects. To that end, the actual production in the year concerned must be related to the production capacity available. That variable is difficult to construct, however, because there are difficulties in determining a sector’s capacity. The solution has been found in a variable assumed to fluctuate in positive proportion to the degree of capacity utilization: the value added in a particular year in relation to the five-year moving average of value added.

\[
DCU_{s, t} = VA_{s, t} / \left[ 1/5 \sum_{h=-2}^{2} VA_{s, t+h} \right]
\]

(3.2)

$VA_{s, t}$ = value added in sector $s$ in year $t$.

The third variable to be incorporated in the educational model is the supply-push 'substitution or displacement variable', measured as the potential labour force of a particular skill category as an indicator of the relative supply of a given type of education and thus (for a given demand structure) of the relative wages.
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\[ \text{PLF}_{j,t} = \frac{PF_{j,t}}{PF_{\text{ref},t}} \quad (3.3) \]

\[ PF_{j,t} = \text{number of persons in potential labour force with type of education } j \text{ in year } t \text{ (ref is the reference educational category).} \]

**The occupational model**

In earlier research with regard to the occupational model of employment a modified multinomial logit model was used with a lagged endogenous variable, the degree of capital utilization and the capital to employment index by occupation as explanatory variables (Peeters, 1990).

\[ \ln \frac{f_{bat}}{f_{\text{ref},st}} = \alpha \cdot \ln \frac{f_{bs,t-1}}{f_{\text{ref},s,t-1}} + \beta_{1b} \cdot CEI_{st} + \beta_{2b} \cdot DCU_{st} \quad (3.4) \]

\[ f_{bs} = \text{number of employed persons in occupational segment } b, \text{ in sector of industry } s, \text{ in year } t \]

However, this specification does not fit well for occupations which have very large shares in some sectors and very small shares in other sectors. This is caused by the (rather) inflexible specification of the model and by the big differences in the capital to employment index (CEI) between sectors. Problems arose especially for occupations with a small number of observations and a small number of persons.

Therefore, the model was re-estimated with a coefficient for the lagged endogenous variable which differs by occupation (in equation 3.4 \( \alpha \) can be different for each occupation: \( \alpha_b \)). This led to big differences in coefficients but not to a better fit. Apparently a specification with a lagged endogenous variable and explanatory variables not specific to occupations is likely to cause problems. Therefore a different specification was chosen, with an intercept differing by occupational class and sector, to replace the lagged endogenous variable (see equation 3.5).

\[ \ln \frac{f_{bat}}{f_{\text{ref},st}} = \alpha_{bat} + \beta_{1b} \cdot CEI_{st} + \beta_{2b} \cdot DCU_{st} \quad (3.5) \]

Lower residuals result when this specification of the model is estimated. However, to achieve these lower residuals, a great many
extra parameters for the intercepts are used.

To determine the explanatory power of the two exogenous variables (the technology and the degree of capital utilization variables), an F-test is performed. This F-test compares the residual sums of squares, with or without the exogenous variable, corrected for the degrees of freedom which are used with each variable. Of the two exogenous variables, only the technology variable (i.e., the capital to employment index) has a significant influence on the endogenous variable, resulting in the following final model specification:

\[
\ln \frac{f_{bt}}{f_{ref}} = \alpha_{bt} + \beta_{1b} \cdot CEI_{st} \tag{3.6}
\]

Only if this technology variable is significant for an occupational segment and the forecast on the basis of the model complies with the set plausibility border, is the model accepted as a starting point for the forecast for the segment concerned.

Finally, within the occupations model, a conversion is made from occupational segments to occupational classes, which is the aggregation level at which the information system for education and the labour market makes occupational forecasts. For the occupational segments consisting of several occupational classes, a simple trend model is used to test whether the relative importance of the occupational classes within a segment changes significantly over time.

\[
\ln \frac{f_{ibt}}{f_{ref}} = \alpha_{ib} + \beta_{1ib} \cdot T_{i} \tag{3.7}
\]

\(f_{ibt}\) = number of persons in occupational class \(i\) within occupational segment \(b\) in year \(t\).

If there is such a time effect, the trend factor found is extrapolated over the forecasting period. If the results are implausible a ceiling can be put on the extrapolation. This adaptation is especially important because the time series consists of only four observations. An extrapolation of the trend can then easily go awry.

The educational model

The estimation of the model for the educational structure of occupations is divided into two steps. In the first step employment
shifts by educational discipline are explained, in the second step the changes in educational level are explained. These two steps have a different order from that employed by Beekman et al. (1991). In that study the changes in employment by educational level are analyzed first and the changes in employment by educational discipline second. The disadvantage of that approach is the assumption that all educational disciplines have the same ‘crowding out’ or substitution processes. To circumvent this, the order of the steps has been reversed.

As explanatory variables we tried the technology variable (the capital to employment index) and the substitution/displacement variable (the potential labour force), with the latter differentiated by sector of education ($PLF_r$).

\[
\ln \frac{f_{rbst}}{f_{refbst}} = \alpha_{rb} + \alpha_{rs} + \beta_{1r} \cdot CEI_{st} + \beta_{2r} \cdot PLF_{rt}
\]  
(3.8)

$s_{rs}$ = number of persons from educational discipline $r$ working in sector $s$, practising occupation $b$ (i.e., segment $b$) in year $t$.

When both explanatory variables were used in the model of the shares of educational disciplines in occupations, the parameters estimated showed significant, but implausible results. It was therefore decided to use a model with only a trend variable ($T_t$).

\[
\ln \frac{f_{rbst}}{f_{refbst}} = \alpha_{rb} + \alpha_{rs} + \beta_{1r} \cdot T_t
\]  
(3.9)

This trend variable has a significant negative coefficient for discipline 1 (general education), and significant positive coefficients for discipline 5 (medical education), 6 (commercial education), 7 (social studies), 8 (education in health care), and 13 (education in business security and surveillance training). This result is not unsatisfactory. Because the educational structure within occupational segments is being analyzed it is indeed probable that the major substitution process between educational disciplines is the substitution of persons with a general education for persons with a specific vocational education for a particular occupation. It is very likely that this result is reinforced by the occupational classification used. In this classification occupational classes are constructed by applying a clustering procedure to the
educational profile of occupational classes.

In the second step, the model of changes in educational levels, the same explanatory variables (CEI and PLF) were used to start with. Both PLF and CEI have some significant correlations, but again show in some instances very high and therefore implausible values. It was therefore decided to use a lagged endogenous variable for reasons of stability, and the only explanatory variable used was the potential labour force by level and educational discipline (PLF_{r,l}).

Because there were now no sector-specific variables in the model equations, and due to the limited cell filling in the data matrix, the data were aggregated over the business sectors. The sector dimension thus disappears from the model, but a better cell filling is obtained.

\[
\ln \frac{f_{lbrt}}{f_{lbrt}} = \rho_{lbr} \ln \frac{f_{lbr t-1}}{f_{lbr t-1}} + \beta_{lbr} \cdot PLF_{lbrt}
\]

(3.10)

\(f_{lbrt}\) = number of employed persons with educational level \(l\) in discipline \(r\), practising an occupation in occupational segment \(b\) in year \(t\).

Here as well plausibility thresholds were set for the calculations of the shares of the different levels within a certain educational direction. Special attention was given to preventing certain levels being completely crowded out due to the explosive growth forecast for other educational levels.

In most cases the educational types follows immediately from the combination of the educational discipline and level. For the technical, medical, commercial and nursing fields, however, a further specification according to educational type is made within the levels. As in the occupations model, a simple trend model was used to verify whether the shifts over time in the employment shares of the educational types within the educational level and discipline combinations have been significant:

\[
\ln \frac{f_{elrt}}{f_{elrt}} = \alpha_{elr} + \beta_{elr} \cdot T_t
\]

(3.11)

\(f_{elrt}\) = number of employed persons of educational type \(e\), at educational level \(l\) and discipline \(r\) at time \(t\).
4. Replacement demand forecasts

Replacement demand is an important component of the future demand for newcomers on the labour market. It can be a result of permanent departures from the labour force due to retirement, early retirement figures, other temporary withdrawals such as married women stopping work due to birth and child-rearing, etc. Moreover, replacement demand for a particular occupational category can also be due to occupational mobility. As in the previous section we will describe first the methodology used in the forecasts of replacement demand by occupational class and then by type of education.

Occupational classes

In Figure 3.3 an input-output table for the entire population is presented, in which the mobility processes listed above are schematically reproduced at an aggregated level (see also Willems and De Grip, 1990). The inner part of the input-output table contains the flows of mobility within the labour market. Some of these flows are indicated by the capital letters A to G. 'Flow' A, indicates the number of employees that kept working in occupation 1 during the period (t-n,t). The flows B and E represent job-to-job mobility. The flows C and D represent departures from employment, to unemployment and non-availability respectively. The latter indicates changes such as retirement and the voluntary exit of, in particular, married women. The unemployed who have found a job during the period (t-n,t), are indicated by the letter F. Finally, flow G refers to new positions gained by those who were not available for the labour market at time t-n, such as school leavers who find a job and women who re-enter the labour market.

The replacement demand should be defined in relation to changes in the level of employment. Where there is an increase in employment, the replacement demand is equal to the number of workers who leave a certain job during the period (t-n,t). The vacancies that thus appear will have to be filled before there can be a rise in the total numbers employed. If there is a decrease in employment, not all of the vacancies created by departing employees are filled. Therefore the replacement demand is then not equal to the total number of the departures from a certain job, but rather to the number of vacancies
that are actually refilled, that is, the total inflow of labour to the job in question. The concept of replacement demand can be explained further using Figure 3.3. If there is an increase in employment, the replacement demand for occupation 1 is equal to the sum of the flows B, C and D (the total outflow). However, if employment in occupation 1 decreases, the sum of the flows E, F and G (the total inflow) gives the replacement demand.

Figure 3.3. Input-output table of labour market flows

<table>
<thead>
<tr>
<th>t</th>
<th>Occupation 1</th>
<th>Occupation 1</th>
<th>Unemployed</th>
<th>Outside labour force</th>
<th>Outflow population</th>
<th>Total</th>
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<tr>
<td>Occupation 1</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>W_{i,t-i}</td>
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<tr>
<td>Occupation 1</td>
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<tr>
<td>Unemployed</td>
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<td>Outside labour force</td>
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<td>Inflow population</td>
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<td>Total</td>
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The first step in modelling future replacement demand per occupational class is a description of the inflow and outflow patterns by occupational class in a historical period. Because there is no appropriate data for mobility flows on the labour market, stock data will be used. By means of the so-called cohort components method we calculate _cohort-change rates_ based on the number of persons of the same birth cohort who were employed at two different times (see Shryock and Siegel, 1980). These cohort-change rates can be rewritten as average annual net inflow or outflow percentages.7
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\[ k \hat{W}^n_{o,a} = \sqrt{n \frac{W^t_{o,a} - n}{W^t_{o,a}}} - 1 \]  

4.1

\[ k \hat{W}^n_{o,a} \] = the average annual net inflow or outflow ratio of workers in occupational class \( o \) of age group \( a \) (with class-width \( k \)) at time \( t-n \) during the period \((t-n,t)\);

\[ W^t_{o,a} \] = the number of workers in occupational class \( o \) of age group \( a \) (with class-width \( k \)) at time \( t \).

If \( k \hat{W}^n_{o,a} > 0 \) there is a net outflow for a certain age group from an occupational class and if \( k \hat{W}^n_{o,a} < 0 \) there is a net inflow.

The second step in modelling is the translation of these inflow and outflow percentages into the replacement demand by occupational class. As stated above, for occupational classes with an increase in employment in the period \((t-n,t)\), replacement demand is equal to total net outflow in this period. However, for occupational classes which faced a decrease in employment, not all vacancies due to the outflow of workers were filled. Therefore replacement demand for these occupational classes equals the number of vacancies that were actually refilled, that is, the total inflow of workers in the occupational class. In this way the more or less 'structural' replacement demand is derived.

This methodology measures only the net flow to or from an occupational class. This means that replacement demand satisfied by re-entering workers of the same age cohort is not measured. So replacement demand is actually measured for newcomers on the labour market. However, this is exactly what is intended, in as much as the ROA information system focuses on the prospects for newcomers on the labour market.

The third step is to project the historically measured net replacement demand rates per age-sex group for a particular occupational class onto the age-sex structure of the workers at the beginning of the forecasting period. Moreover, the historically observed cohort change rates are corrected for trade cycle effects and for expected changes in participation rates.

The trade cycle correction is equal to the difference between the change in the total number of working persons and the change in the
labour force in the historical period. This correction neutralizes the outflow of workers who become unemployed due to cyclical fluctuations in employment. The correction for changes in the participation rate is the difference between the growth in the labour force in the historical and the forecasting period. Both correction factors are sex and age specific.

If the cyclical correction and the participation rate correction are combined, the forecast future outflow ratio by age category will be:

\[ kW_{a}^{in} = kW_{a}^{in} + kL_{a}^{im} - kW_{a}^{in} + kL_{a}^{im} - kW_{a}^{in} \]

\[ = kW_{a}^{in} - kW_{a}^{in} + kL_{a}^{im} \]  

(4.2)

- \( kW_{a}^{in} \) is the expected average annual net inflow or outflow ratio of workers in occupational class \( a \) of age group \( a \) (with class-width \( k \)) at time \( t \) during the forecast period \( (t, t+m) \);
- \( kL_{a}^{im} \) is the average annual growth ratio of the total labour force of age group \( a \) (with class-width \( k \)) at time \( t-n \) during the period \( (t-n, t) \);
- \( kL_{a}^{im} \) is the expected average annual growth ratio of the total labour force of age group \( a \) (with class-width \( k \)) at time \( t \) during the forecast period \( (t, t+m) \);
- \( kW_{a}^{in} \) is the average annual growth rate of the total number of working persons of age group \( a \) (with class-width \( k \)) at time \( t-n \) during the period \( (t-n, t) \).

Future replacement demand is further determined in the same way as replacement demand in the historical period. That means that for occupational classes with an expected increase in employment replacement demand equals net outflow. For occupational classes for which a decrease in employment is expected, replacement demand is equal to the total net inflow.

The average rate of replacement demand found for occupational classes is 11\%, varying from 3\% for painters to 21\% for the occupational classes 'vocational advisors, employment agents and personnel officers' and 'student nurses and home nursing personnel'.

Types of education

Replacement demand by type of education must be interpreted
differently from replacement demand by occupational class, as net mobility between occupational classes must also be taken into account in the latter. However, when a worker with a certain educational background changes occupation, this does not create a vacancy for a newcomer on the labour market with the same educational background. Therefore this does not influence replacement demand for the type of education in question.

There is another difference between the replacement demand by occupational class and by type of education. If someone leaves a certain occupational class and is replaced by an employee with another (e.g. higher) educational background, there is a replacement demand for the occupational class in question. When such displacement or substitution effects occur, however, there is no question of replacement demand for the type of education in question, but rather of an employment decrease for one type of education and an employment increase for the other.

Due to these differences the average rate of replacement demand for types of education is indeed somewhat lower than average replacement demand for occupational classes: 10%, varying from 2% for Lower Vocational Education, Transport & Harbour to 25% for Higher Vocational Education in Theology.

5. Forecasts of inflow of school leavers

For each type of education, forecasts have been made of the potential flow of school leavers onto the labour market. Several data sources have been used for these forecasts. The Ministry of Education and Sciences makes annual forecasts of the number of school leavers from full-time education. These so-called 'SKILL' forecasts (since 1991 'Reference forecasts') are differentiated by sex and age, but they are at a higher level of aggregation than ROA’s categorization of types of education.

The SKILL forecasting model (Kuhry and Passenier, 1986) is based on a transition-matrix based on the make-up of full-time education and a classification of the population by level of education. Flow coefficients relate the ‘origin’ of students in year $t$ to the ‘destination’ of these students in year $t+1$. By means of these flow
coefficients future numbers of students from each educational category can, step-by-step, be forecast. However, such a straightforward approach would suppose that students’ choices remain unchanged during the entire forecasting period. Therefore, the flow coefficients of students who get a certain qualification, in particular, are considered as strategic flow coefficients. These strategic flow coefficients are the dynamic elements of the model as they are determined by (modified) trend extrapolations.

As the SKILL forecasts of school leavers are at a higher level of aggregation with regard to the types of education, distribution keys are needed to break down the SKILL forecasts. These distribution keys are formulated from various data sources (WORSA and RHOBOS forecasts with regard to Higher Education and various CBS student statistics).

Besides those leaving school with a qualification, SKILL differentiates students who end their studies without a diploma. With the help of the education matrix these school leavers can be re-assigned to any preliminary course they had crowed with a diploma.

Moreover, data about non-regular education (apprenticeships, recognized correspondence courses, training in medical care etc.), have to be taken from available additional statistics, or obtained directly from the training courses concerned. A forecast is also made of the flow from that category onto the labour market. However, enrolment in non-regular courses changes the qualification profile of ‘school leavers’. For that reason, the number of students who have successfully completed such courses has to be proportionally subtracted from their preliminary regular educational groups. Another correction is needed to prevent students enrolling in several non-regular courses or in a regular course of the same type being counted twice. In this way a forecast can be drawn up of the flow from both regular and non-regular educational groups onto the labour market.9

6. The match of supply and demand, and other labour market indicators

By matching labour demand with labour supply an ‘indicator of the future labour market situation’ (IFL) can be constructed. This indicator
of labour market prospects is constructed for each of the types of education which are distinguished.

Labour supply consists on the one hand of the expected inflow in the period 1989-1994 and on the other hand of the number of unemployed with the same educational background who had been unemployed for less than one year in 1989 (see also Figure 3.1). The exclusion of those unemployed for more than one year is based on the supposition that they do not compete on the labour market with school leavers from that type of education.

Labour demand is the sum of the expansion and replacement demand, characterized as an indicator of the 'job openings' by type of education (see Figure 3.1).

In formulaic form, the indicator for a specific type of education is as follows:

\[
IFL = \frac{\text{employment ('89)} + \text{inflow school leavers ('89-’94)} + \text{unemployment ('89)}}{\text{employment ('89)} + \text{expansion demand ('89-’94)} + \text{replacement demand ('89-’94)}}
\] (6.1)

The indicator of the future labour market situation is translated into a 'qualitative characterization' of the expected labour market prospects on a 4-point scale: good, reasonable, moderate and poor prospects, respectively. Such a qualitative characterization in quite broad terms suffices for various purposes, including vocational and educational guidance counselling. Moreover, it prevents too much significance being attached to the exact numbers produced by the equation, which also increases the reliability of the forecasts.

**Risk indicators**

However, an unfavourable labour market indicator does not automatically mean that school leavers will be confronted with unemployment, any more than a clear demand surplus will automatically lead to unfilled vacancies. The final consequences of a demand or supply surplus depend also on the market position of a particular type of education and occupational class, for instance on whether school leavers can switch to other sectors of the labour market or on the substitution possibilities between the types of education within an occupational class.
Therefore, in addition to the labour market forecasts, two risk indicators are entered in the information system. These risk indicators give an indication of the cyclical sensitivity of employment in a certain occupational class and of the possibilities of switching to another occupation (lateral mobility) or another economic sector (inter-sectoral mobility), indicating the labour market flexibility of the educational type concerned. The trend of the dispersion index is also entered into the information system.

The *cyclical sensitivity* of occupations is measured as follows. For every economic sector the following fluctuation index is calculated:

\[
FI_s = \frac{100}{H} \sum_{t=1}^{H} \frac{|F_{st}|}{T_s}
\]

\[\text{(6.2)}\]

- \(FI_s\) = cyclical sensitivity index for sector \(s\);
- \(F_{st}\) = divergence of employment in sector \(s\), year \(t\) from the trend value;
- \(T_s\) = trend value of employment for sector \(s\);
- \(H\) = number of observation years.

The trend values are determined by taking the five-year moving average of employment in the sector, over the period 1950-1988.

Supposing that employment in the various occupations within an occupational class fluctuates to the same degree as the total employment in the economic sector, a fluctuation index for each occupation may be derived by weighting the fluctuation-indices of the various sectors by the sector share in the occupational class.

\[
FI_o = \sum_{s=1}^{S} \alpha_{os} FI_s
\]

\[\text{(6.3)}\]

- \(FI_o\) = cyclical sensitivity index for occupation \(o\);
- \(\alpha_{os}\) = sector share in occupation \(o\);
- \(S\) = number of sectors.

The *possibility of lateral mobility* from a given education to other occupations is calculated by means of the ‘Gini-Hirschman’ coefficient, as follows:
$GH_e = (1 - \sum_{o=1}^{o} \frac{\beta_{oe}^2}{O}) \frac{O}{O-1}$  

$GH_e$ = dispersion index of educational type $e$;  
$\beta_{oe}$ = portion of occupational class $o$ in educational type $e$;  
$O$ = number of occupational classes.

This indicator can take values between 0 and 1. The value is 0 if the educational type is found in only one occupation, and 1 if the education is dispersed equally over all occupations.

These risk indicators are a very important addition to the labour market forecasts. For example, high occupational dispersion will make medium to long-term forecasts rather conditional, because, in the event of excess supply, it would be expected to be relatively easy for those in this educational group to shift to other segments of the labour market. The cyclical sensitivity indicator may also relativize medium to long term forecasts. If high employment growth is forecast for an occupational class with high cyclical sensitivity, the possibility has to be taken into account that this growth could be sharply reduced in the longer term, or even that it could turn into a decrease of employment.

7. Conclusion

In this paper the methodology with which ROA makes medium-term labour market forecasts of the prospects of occupational classes and educational types has been explained. We have also indicated how two indicators are calculated, relating to the long-term employment risks of the different occupations and educational types. These indicators concerned the cyclical sensitivity of occupations and the possibilities of educational types switching to other occupations.

The labour market forecasts and risk indicators are developed in such a way that the information supplied should play an especially useful role in vocational and educational guidance. The extent to which this is really so will be shown by a further evaluation of the use of this information in practice.

In any case it can already be determined that the clustering of educational types used is in many cases insufficiently detailed to be able to make a direct link between the specific educational direction to
be taken by the pupils and their labour market prospects. It has to be asked whether the labour market prospects of a specific educational direction corresponds with those of the educational cluster as a whole. The random-sample basis of the labour market data which we have used, however, makes it impossible to draw up very specific forecasts or redefine the educational clusters so that the labour market prospects within each cluster would be more homogenous.

The surveys of the labour market position of secondary school leavers and graduates of higher education which ROA helped set up, can perhaps contribute to solving the aggregation problem sketched above. Moreover, these new data sources could make it possible to extend the ROA information system with new indicators. For instance, information on career path possibilities and perhaps also the pass rates and unemployment durations of the different educational types could be added. Whether these would be useful data for giving vocational and educational guidance may also be shown by the evaluation study already mentioned.

The methodology for forecasting labour market prospects which has been developed consists of a logically designed structure of procedures and models. Yet this methodology has not in any sense found its final form. This applies in particular to the modelling of the expansion demand. In the economic literature there are many indications pointing to the possibility of a more theoretically justifiable descriptions of the employment effects of technological development and of the changing occupational and educational structures of employment (including substitution effects).

An important precondition for any more theoretically justifiable specification of these models is the successful linking of the old AKT series of labour market data (1979 - 1985) with the new EBB series (1988 - 1991). This would substantially lengthen the analysis period, so that more reliable estimations of the developments over time could be obtained.

Specification of the models on a sounder theoretical basis does not necessarily have to lead to an increase in the forecasting quality. It seems sensible to also test these new specifications against the forecasting results of 'naïve' extrapolation techniques. For the time being ROA intends to develop model structures in which explanatory
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models are used at relatively high aggregation levels while simple extrapolation techniques suffice for disaggregating the results. We will also be considering seeking substantive pre-publication comments from the contact persons of institutions with expertise in a particular segment of the labour market.

Notes

1. Many of these are defined in terms of the kind of raw material being extracted or processed, e.g. 'Agriculture, fishing, forestry', 'Foodstuffs manufacture', 'Textiles and leather industry', 'Chemicals and rubber industry', etc., while the service sectors are defined by type of service: 'Banking & insurance and other tertiary services', 'Medical and veterinary and other quaternary services', 'Public administration and Education', etc.

2. Reliable EBB data classified by type of education are only available as of 1990. The Labour Force Surveys from 1975 and 1977 have not been used for generating information on education types, due to the introduction of a new educational classification in 1978.

3. To provide a comparison, the model has also been estimated using WLS. The covariance matrix of the MML-method is being replaced by a diagonal matrix. The differences in estimated coefficients using the MML and WLS methods are very small as absolute values. Considering the standard errors of the estimated coefficients the difference is negligible. Because the MML method for large models has a lot of related problems, it is not clear that the MML method offers any advantages when using the current specification. It would probably be advantageous to use the MML method when a larger time series is available. In that case it would also be easier to identify the relevant explanatory factors.

4. This plausibility border is determined as a maximum deviation of 15% of the employment change in the analysis period.

5. In the educational model the educational dimension is added. Because of computational difficulties in applying MML, and the small differences between MML and WLS noted in the estimates of the occupational model, the MML method was not used in the educational model. Instead a distributional model was estimated, with the cell count as weighting factor.

6. We used technical education as the category of reference.

7. Flow rates for male and female workers are differentiated.

8. For more details see Willems and De Grip (1990).
Models and Methods

9. See Berendsen, et al. (1992) for detailed information about the method and the required data.

References

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