Labour market, income formation and social security in the microsimulation model NEDYMAS

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The paper presents the labour market module, the income formation module and the social security and tax module of the dynamic cross-sectional microsimulation model NEDYMAS. With this model it is possible to simulate (future) social security benefits and contributions. Comparison with the actual figures shows that the model reconstructs the socioeconomic development in the field of wage income and social security benefits and contributions very well.

Keywords: Microsimulation; Income; Social security

In a previous article (Nelissen [119]) we described the household and education module of the microsimulation model NEDYMAS.[1] NEDYMAS is a dynamic cross-sectional microsimulation model, which has been developed to analyse the lifetime redistributive impact of Dutch social security schemes. It is a comprehensive model for the Dutch household sector, consisting of three main modules: a demographic module, a labour market and income formation module, and a social security module.

This article gives a description of the labour market and income formation module and the social security module in NEDYMAS. We start with a short overview of the development of microsimulation models. Then we give an overall overview of NEDYMAS. Next a description of the two modules will be given, followed by some simulation results with these modules.

A short history of the development of microsimulation models

In the 1960s and early 1970s a number of purely demographic oriented microsimulation models were developed. Hyrenius and others developed a repro-

duction model at the University of Gothenburg.[2] Their model has a demographic–physiological framework. The well known POPSIM model was constructed at the University of North Carolina and was used for the evaluation of family planning campaigns.[3] At the University of Toronto, Howell and Lehotay [71] constructed a microsimulation model for exploring small human populations, AMBUSH. Emphasis was on kinship ties and similar kinds of connectivity within small communities. Other contributions are from Ridley and Sheps [130] – who developed REPSIM to study the effects of demographic and biological effects on natality – from Barrett [6], from Foster and Yost [39] – focusing on population and rural development – from Dyke and McCluer [31] and from Crafts and Ireland [24]. Most of these models had only academic applications and seem to have disappeared (Hellwig [64], p 5).

Microsimulators which also contain socioeconomic variables were implemented in particular in the 1970s. The first application of dynamic microsimulation in a socioeconomic context dates from 1961 (Orcutt *et al*

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[1] The NEtherlands' DYnamic Micro-Analytic Simulation model.
In the mean time, the demographic module has been extended by the modelling of institutional households. For a description, see Nelissen [121].
[2] See Hyrenius and Adolfsen [73], Hyrenius [121] *et al* [74], Hyrenius and Holmberg [75] and Holmberg [68, 69].
[3] See Horvitz *et al* [70] and Shah [135].

[127]). This application, however, was rather limited. It was primarily developed to prove that this kind of model was possible. It was limited to population simulations. The model was a dynamic one, but modelling was too rough for real applications. A first real proof of the applicability was given by Orcutt *et al* [125], almost twenty years after the introduction of the concept. Data and hardware limitations were important problems.

A second large microsimulation project started in 1972 in West Germany (see Krupp [79]): the SPES project and its successor, the Sfb3 project. In this case, the first important result was published in 1981 (Krupp *et al* [80]). Both projects refer only to the household sector. This holds for almost all microsimulation models; the most important exception is the MOSES project in Sweden (eg Eliasson [32]).

During the last fifteen years more and more – often partial – microsimulation models were developed. Especially during the Carter administration, microsimulation models were applied to analyse the distributional and financial effects of changes in state programmes in the USA (see Heike [56, 57]). An overview of microsimulation models can be found in Geurts [45], Orcutt *et al* [125], Krupp and Wagner [81], Fallows [34], Smith [136], Haveman ([51] Chapter 11), Merz [86] and Hellwig [64, 65].

The first applied (static) microsimulation model was TAX, developed at the Treasury Department (see Pechman [128]) and applied from 1963. This model led to a number of more complex models in the USA and Canada.[4] Microsimulation became the 'dominant quantitative technique for forecasting the impacts of policy changes in the social welfare policy area' (Fallows [34], p 2) from about 1969 in the USA. Its start was given by the development in 1969 of the RIM model.[5] RIM was also a static model. It was aimed especially at calculating eligibility for public assistance programmes (see Wilensky [153] and McClung [82]). RIM was developed under great time pressure at the President's Commission on Income Maintenance Program. The dissolution of this Commission led to the transfer of many researchers in the field of microsimulation – among them Nelson McClung, Gail Wilensky and Robert Harris – from the federal government to the Urban Institute. This institute has played a major role in the further development of microsimulation since then (1970). At the Urban Institute, RIM – which was too costly to run, very difficult to modify and which contained programming errors as a consequence of continual

reprogramming – was significantly revised. This resulted in a new static microsimulation model, called TRIM.[6] TRIM had to be more efficient and flexible than RIM, which resulted in very complicated software. As a consequence, modifications were difficult to programme and flexibility was lost. The system was therefore redesigned later on.[7] TRIM has been used in many projects and is still in operation.

Two key individuals in developing TRIM, Jodie Allen and Harold Beebout, left the Urban Institute after some problems and went to Mathematica Policy Research. There they developed a second generation model of TRIM, called MATH.[8] This model was still in use in the 1980s. See Beebout [8] for the evaluation of two of the Reagan administration social programme changes: reductions in federal income support to low income families (the Omnibus Budget Reconciliation Act) and a proposal for a private individual alternative to institutional retirement schemes (Incentives for Private Household Retirement Savings). On the basis of TRIM and MATH, Betson *et al* [11] built the KGB model within one month. The KGB model has been used to analyse various versions of the Program for Better Jobs and Income, and to evaluate negative income tax, credit income tax and wage subsidy plans.[9] A special model to explore the use of energy was developed from TRIM: CHRD.[10] STATS is also based on TRIM. STATS (see Wertheimer *et al* [150], p 9) was especially used for the simulation of the use of welfare programmes. Other models from the Urban Institute are the UI (Unemployment Insurance) model to analyse unemployment insurance and the NHI (National Health Insurance) model.[11]

Independently of the foregoing models, the OTA model was developed in order to simulate personal income taxes.[12] Thousands of proposals for tax changes have been simulated with this model! A summary of behavioural simulation methods in tax policy analysis can be found in Feldstein [38].

All these models are static and do not have a link to the national economy. To tackle the last problem, Golladay and Haveman [46] and Haveman *et al* [53] added a consumption function, an input–output model for the production sector and a model for the income distribution to a version based on the TAX

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[4] See Okner [124], Pechman *et al* [129] and Bossons [15].
[5] Reforms in Income Maintenance.

[6] TRansfer Income Model: see McClung *et al* [83], Beebout and Bonina [7] and Sulvetta [143].
[7] This resulted in TRIM2: see Webb *et al* [149].
[8] MicroAnalysis of Transfers to Households: see Beebout [7].
[9] See Betson *et al* [11, 12] and Betson and Bishop [10].
[10] Comprehensive Human Resources Data: see King [77].
[11] See Vroman [148] for unemployment insurance; see Devine and Wertheimer [29] for National Health Insurance.
[12] Office of Tax Analysis: see Wyscarver [157] and Cilke and Wyscarver [19].

model. But the static nature continues to give problems.

The first applicable dynamic microsimulation model – which went beyond demographic simulations – was developed between 1969 and 1976 at the Urban Institute and is called DYNASIM.[13] The first implementation, MASH (see Sadowsky [131]), was a user friendly interactive programme, but too slow for practical applications. Therefore, two other systems were implemented: MASS (see Orcutt and Glazer [126]) and MICROSIM (see McKay [84]).[14] Both models are quite flexible, but user comfort is almost absent. They are still in use. Applications of DYNASIM have been taking place in the field of the effect of expected changes in work behaviour of women and of divorce patterns on the distribution of earnings and transfer income, in the field of forecasting the future costs and caseloads of public transfer programmes and in the field of the distributional impact of reforms in retirement income policy.[15] For computational reasons a combined cross-sectional and longitudinal microsimulator, DYNASIM2, has been developed (see Wertheimer et al [151]). DYNASIM2 consists of two connected models: the Family and Earnings History model (FEH) and the Jobs and Benefit History model (JBH). DYNASIM2 has been used for very different applications, such as the creation of alternative demographic and economic scenarios to 2030, the simulation of public sector costs of teenage childbearing and – in combination with the ICF Macroeconomic Demographic Model – the analysis of issues concerning the elderly population.

A more limited (longitudinal) microsimulation model, but incorporating a number of dynamic elements, was developed by Schulz in 1968.[16] It was aimed at simulating some alternative pension systems. However, no interactions were possible between individuals, even in the same household.

As we remarked, a second large microsimulation development project started in the early 1970s in West Germany. It was initiated by the Social Policy Research Group Frankfurt-Mannheim (Sozial-politisches Entscheidungs- und Indikatorensystem (SPES) and later on adopted by the Special Collaborative Programme 3 (Sonderforschungsbereich 3, Sfb3).[17] Both a dynamic and a static model were initiated at the SPES. The static model (see Klanberg [78]) was

developed to analyse proposals for tax reforms and changes in the old age pension system. A variant of this model was used to study the distributional implications of the contributions for the Sickness Act.[18] At the Sfb3, the model was developed further and used, for example, for the simulation of medical services (Brennecke [17]). The dynamic model was first developed by Hecheltjen [55]. This model did not contain links between household members, which limited its possibilities. The household mobility was improved by Steger [142],[19] whereas the socio-economic aspects were improved first at the SPES and later at the Sfb3 (see Krupp et al [80] and Galler and Wagner [42]). In addition to the cross-sectional model, a longitudinal model was developed to study the distributional aspects of the pension insurance and the financing of the educational system.[20] The dynamic version has only one major application (see Krupp et al [80] and Müller and Steeger [94]). Recently, a PC version of the static microsimulation model (called MICSIM) has become available.[21]

To study the methodological aspects of micro modelling and microsimulation software, 'DPMS was developed at Darmstadt University:[22] see eg Appendino [3], Heike et al [58] and Hellwig [61,66]. The model has not been used for applications in West Germany. It has been transferred to the Hungarian Central Statistical Office (HCSO), which used the model as a basis for developing the HCSO model, a dynamic microsimulation model for Hungary.[23] The HCSO model will serve various purposes: policy exploration and forecasting, substitution for surveys, correction and merging of survey data. The same model concept will also be used to construct a microsimulation model for the Australian household sector (see Hellwig [62]).[24]

At Leeds University a comprehensive microsimulation model has been developed to update the characteristics of households and individuals who reside in small geographical areas. Its main purpose is to provide information for intercensal years. The model, called UPDATE, has been used for many applications in the pilot study area (the Leeds Metropolitan District). The methodology is described in Clarke and Holm [21] and an application can be found in Clarke et al [20].

Statistics Canada is also developing a dynamic cross-sectional microsimulation model (Wolfson [156]),

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[13] DYNAmic Simulation of Income Model: see Orcutt et al [127] and Haveman and Lacker [54] for an extensive description.
[14] Micro Analytic Simulation System (MASS); MICROanalytic Simulation Model (MICROSIM).
[15] See Wertheimer and Zedlewski [152] and Schieber and George [133].
[16] See Schulz [134].
[17] See Galler and Wagner ([43], p 229) for an overview of the development of the Sfb3 micromodels.

[18] See Hamacher [48].
[19] See also Galler and Steger [41].
[20] Helberger [59] and Helberger and Wagner [60].
[21] Merz and Buxmann [87].
[22] Darmstadt Pseudo-MicroSimulator.
[23] See Zafir [158] and Cicsman and Papp [18].
[24] The project began in January 1990.

which is based on a static one (Statistics Canada, [141]). A longitudinal demographic simulation model is still present (Wolfson [154, 155]).[25]

From this overview it is clear that most microsimulation models for the household sector are developed for specific applications. Nationwide models exist only in limited numbers. And most of these are static. The only dynamic models in use are DYNASIM (and its derivation PRISM), the Sfb3 model, DPMS and NEDYMAS; the HCSO model and the model at Canadian Statistics are still being developed. However, in these models, too, the number of applied behavioural assumptions are limited. They are mainly used in the determination of labour supply, income and consumption and much less sophisticated or even absent from the field of demographic transitions and educational decisions (eg migration and unmarried cohabitation in most models). Long-term income developments are difficult to model and most microsimulation models are therefore actually short-term models.

The general structure of NEDYMAS

Our model NEDYMAS is a dynamic cross-sectional model. Demographic processes are explicitly simulated, which implies that the size of the microdata base changes during the simulation period. The sample passes through time year by year. For each person in the micro database we investigated which personal characteristics changed, and to what extent, each year. The heart of microsimulation modelling is formed by its state representation of the components of the system of interest. This is executed by drawing up a list of attributes for each individual in the sample. The attributes for each individual, used by NEDYMAS, are given in Appendix 1.

The storage of this list of attributes requires 512 bytes per individual. Each time one of the attributes is changed, the attribute in question is overwritten. If it is desirable to keep some data for further analysis, they have to be transferred to tape. The next step, after the adaptation of a microrepresentation, is the specification of an initial population. We would prefer to use a real sample of individuals and households, together with their attributes. However, such a sample is not available. A first usable sample can be derived from the 1947 census data.[26] The construction of this initial population is described in Nelissen [119]; see also below. As a consequence, the first birth generation which can be followed over time is the generation born in 1930.

Once the initial population has been determined, our analysis can be carried out by updating the characteristics of individuals (and thus of households) during the period under investigation. Here, the Monte Carlo sampling procedure is applied. NEDYMAS has been organized modularly. So we do not have a massive program, but rather a set of subprograms, which can be used – partly or completely – at will. For example, the demographic modules can be used to generate the household structure. The modules which are used in the current version of NEDYMAS and the sequence of treatment are given in Table 1.

This means that – like all microsimulation models – NEDYMAS is a recursive model. First, all demographic transitions are made in the model. Next education is considered, and thereafter changes in economic activity, with the resulting labour income. Lastly, the income transfers and taxes are modelled. As a consequence, changes in, for example, current year labour income do not affect the education process or the demographic block. There is one (partial) exception: labour income in the current year partly affects the possible change in economic activity.[27] This is graphically shown in Figure 1.

Another problem in programming the model is the simultaneity of the processes. Generally, the periodicity of the data is one year, whereas the periodicity of the processes in the real world is much less. The processes can take place at any time within the year, also within one block, eg the demographic module. Therefore, more processes can take place simultaneously within one year. This simultaneity influences the calculation of the transition probabilities, when opting for a sequential ordering of events. In NEDYMAS the problem is solved by using the appropriate occurrence exposure rates, so that the sequence in which the processes are simulated has been taken into account. This means that a random determination of the sequence in which the processes and the individuals to be simulated are executed, as proposed by Hellwig ([63], pp 11–12), is unnecessary.

Carrying out an analysis with the aid of NEDYMAS requires some simple control modules. The specification of a simulation requires the writing of a number of these control modules (to determine the simulation process and the desired output), compiling them (transition of the program into machine code) and linking them with the other modules needed. Unlike macroeconomic models, no simple computer software

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[25] See also Kennedy [76].
[26] See eg NCBS [101–104].

[27] The decision which refers to labour supply uses the expected labour income for the current year. The changes in economic growth are taken into account in this exception. However, the changes in the working population in proportion to the total population are not considered.

Table 1. Programme module sequencing for each individual in NEDYMAS, version 1991/B.ᵃ

Order	Programme module	Eligibility
A. Demographic main module		
1.	Incrementation	Each person
2.	Immigration	Adding persons who have not yet lived in the Netherlands to the datafile
3.	Family reunification	Adding persons whose partner or parent(s) immigrated earlier to the datafile
4.	Emigration	Each family and each person over 16
5.	Return immigration	Each family and each person over 16 who had emigrated before
6.	Homes for the aged	Each couple and each person over 60
7.	Nursing homes	Each person
8.	Institutions for the mentally disabled	Each person
9.	Psychiatric institutions	Each person
10.	Other institutions	Each person
11.	Death	Each person
12.	Frist marriage selection	Each never married person over 14
13.	Remarriage selection	Each previously married person
14.	Divorce	Each married couple
15.	Dehabitationᵇ	Each couple living together without being married
16.	Cohabitation selection	Each person over 14 who is not living with someone, married or not married
B. Labour, consumption and income main module (first part)		
17.	Education	Each person over 5
18.	Scholarship	Each person in vocational college or at university
19.	Income percentile	Each employed person
20.	Transitions from school	Each person who leaves school
21.	Transitions from disablement	Each disabled person
22.	Transitions from military service	Each compulsory military servant
23.	Transitions from being employed	Each employed person
24.	Transitions from being umemployed	Each unemployed person
25.	Transitions from the state househusband/housewife	Each househusband/housewife
26.	Retirement	Each person aged 65
27.	Labour income	Each person employed for part of the year
C. Social security main module		
28.	Private pension premiums	Each employee
29.	Pension premiums for civil servants	Each civil servant
30.	Deduction civil servants	Each civil servant
31.	AOW benefits	Each person over 64
32.	AWW benefits	Widows and widowers and their children
33.	Widow, widower and orphan pensions under the ABP	Each person, whose partner or father or mother has been insured under the ABP
34.	Family allowances	Each family with children
35.	AWW benefits	Each disabled person
36.	ZW/DSO benefits	Each employee and civil servant
37.	WAO benefits	Each disabled former employee
38.	Disablement pensions under the ABP	Each disabled former civil servant
39.	Old age pensions under the ABP	Each person who has ever been insured under the ABP
40.	Unemployment benefits under the ABP	Each person who was a civil servant before becoming unemployed
41.	WW/NWW benefits	Each person who was an employee before becoming unemployed
42.	WWV benefits	Each person who was an employee before becoming unemployed and who cannot (any longer) claim a WW benefit
43.	TW benefits	Each person who receives an NWW, a WAO, an AAW or a ZW benefit
44.	IOAW benefits	Older and partly disabled unemployed employees
45.	ABW benefits	Each family
46.	ZFW premiums (compulsory)	Each employee and some groups of benefit receivers
47.	DGV/IZA/IZR premiums	Some groups of civil servants
48.	ZFW premiums (voluntary)	A subgroup of non-compulsory insured persons
49.	ZFW premiums for the aged	Persons over 64 years old
50.	Private health costs insurance	Non-compulsory insured persons, not falling under 48, or 49
51.	Employers' contributions	Non-compulsory insured employees and civil servants
52.	ZW premiums	Each employee
53.	WAO premiums	Each employee
54.	WW/NWW premiums	Each employee
55.	AOW premiums	Each person aged 15 to 65
56.	AWW premiums	Each person aged 15 to 65
57.	Family allowances premiums	Each person aged 15 to 65 (up to 1 July 1988)
58.	AAW premiums	Each person aged 15 to 65
59.	AWBZ premiums	Each person aged 15 and over
B. Labour, consumption and income main module (second part)		
60.	Medical consumption	Each family
61.	Taxes	Each person

ᵃ See Appendix 2 for the acronyms.
ᵇ We use the term 'cohabitation' only for people living together without being married. If they decide to separate we call this 'dehabitation'.
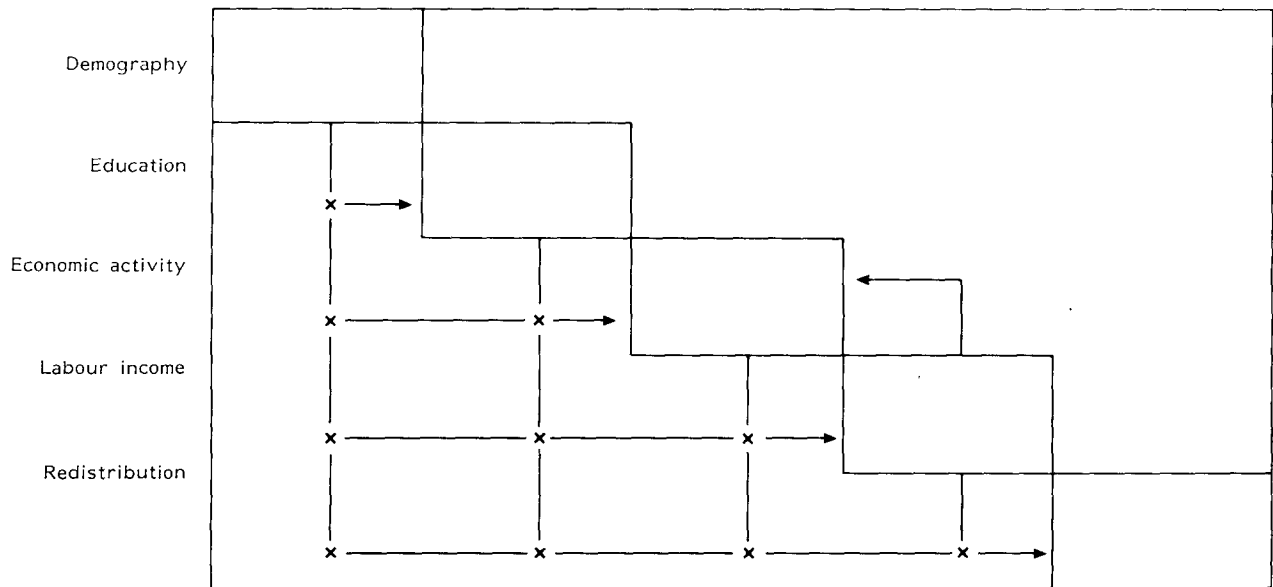
Figure 1. The recursive structure of NEDYMAS.

for microsimulation exists. The existing models are implemented in an *ad hoc* manner. This is understandable, since microsimulation programming requires more effort than the management of the structure of time series data. We also opted for an *ad hoc* approach. The most recent version of NEDYMAS has been programmed in Fortran. The source code of both amounts to about 45 000 lines.

Analyses with NEDYMAS can only be run under batch, not interactively. However, testing and debugging the program can be executed interactively. The disadvantage of this method of organization is that the program is not really user friendly. An experienced programmer, who knows the program, is needed to carry out modifications. The advantage, on the other hand, is that program development is rather simple. Moreover, flexibility is greater and the user can write his own routines.

NEDYMAS needs a six pass per year system until 1990, a seven pass per year system in 1990 and a nine pass per year system from 1991.[28] This large number of passes is needed because various probabilities can only be computed after the execution of certain modules (this holds, for example, for leaving the parental home), or because some checks and – if required – some corrections have been made (eg the number of immigrants) and so on. The way in which the model runs through the various modules is shown in Table 2.

The external data required – eg for the calculation of transition probabilities – are stored sequentially, whereas the list of attributes of the sample population members is stored using random access capability. This random access capability makes it very easy to execute interactions. If the receipt of a benefit depends on the characteristics of other household members, it is almost impossible to determine the eligibility for a benefit when applying sequential storage.[29]

The labour market and income formation module

The labour market and income formation module contains the following submodules: education, scholarship, the determination of the income percentile, labour income, taxes and the transitions between the several possible economic activities (employed, unemployed, disabled, househusband/housewife, conscript, retired).

The way in which the labour market and income formation module is passed through is shown in Figure 2. When everyone has passed through the demographic module, they enter the labour market and income formation module. Educational decisions are made first. If an individual is 6 years old, it is decided

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[28] A pass is defined as a sequence of (sub)modules through which each individual goes, before the next individual is treated.

[29] For that reason benefit eligibility can only be treated in the first operating version of DYNASIM – DYNASIM/MASH – which uses a random access method in the right way and is less sophisticated in the second version – DYNASIM/MASS – which uses a sequential method (see Devine and Wertheimer ([29], p 55).

Table 2. The six/nine pass system of NEDYMAS.

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	Start	Initializations – new immigrants – calculating various demographic transition rates
PASS 1		Family reunification new immigrants – new emigration – return emigration – return immigration
	Break	Adding any remaining immigrants (married women and children)
PASS 2		Old people's home – mortality – marriage – divorce – dehabitation – cohabitation
	Break	Matching individuals for marriage and cohabitation – calculating birth rates and leaving parental home rates – calculating inflow, outflow and throughflow probabilities for the education submodule
PASS 3		Fertility – children leaving home – entering school – repeating, removing and outflow from school
	Break	Initializations for the labour market and income formation module
PASS 4		Income percentile – scholarship – transitions between the various socioeconomic positions – determination term of office
	Break	Comparison between numbers of simulated employed and unemployed persons and the observed (or forecast) numbers respectively and possible adaptations
PASS 5		Labour income – private pension premiums – pension premiums for civil servants – deduction civil servants – determination of labour [1] up to and including labour [6]
	Break	Determination of level of benefits (only from 1991 on) and the new division in percentiles
PASS 6/5		Benefits AOW, AWW, ABP pensions, child allowances, AAW, ZW, WAO, WW, WWV and NWW
	Break	(Necessary because the following benefits can only be calculated if all household members have gone through pass 6/5)
PASS 7/6		Benefits TW, IOAW and ABW
	Break	Determination of premium percentages of the employee insurances (from 1992 on)
PASS 8/6		Premiums for the employee insurances (from 1992 on) and determination of the transfer of tax allowances between partners (from 1990 on)
	Break	Determination of premium percentages of the social insurances
PASS 9/6		Premiums for the social insurances and determination of taxes
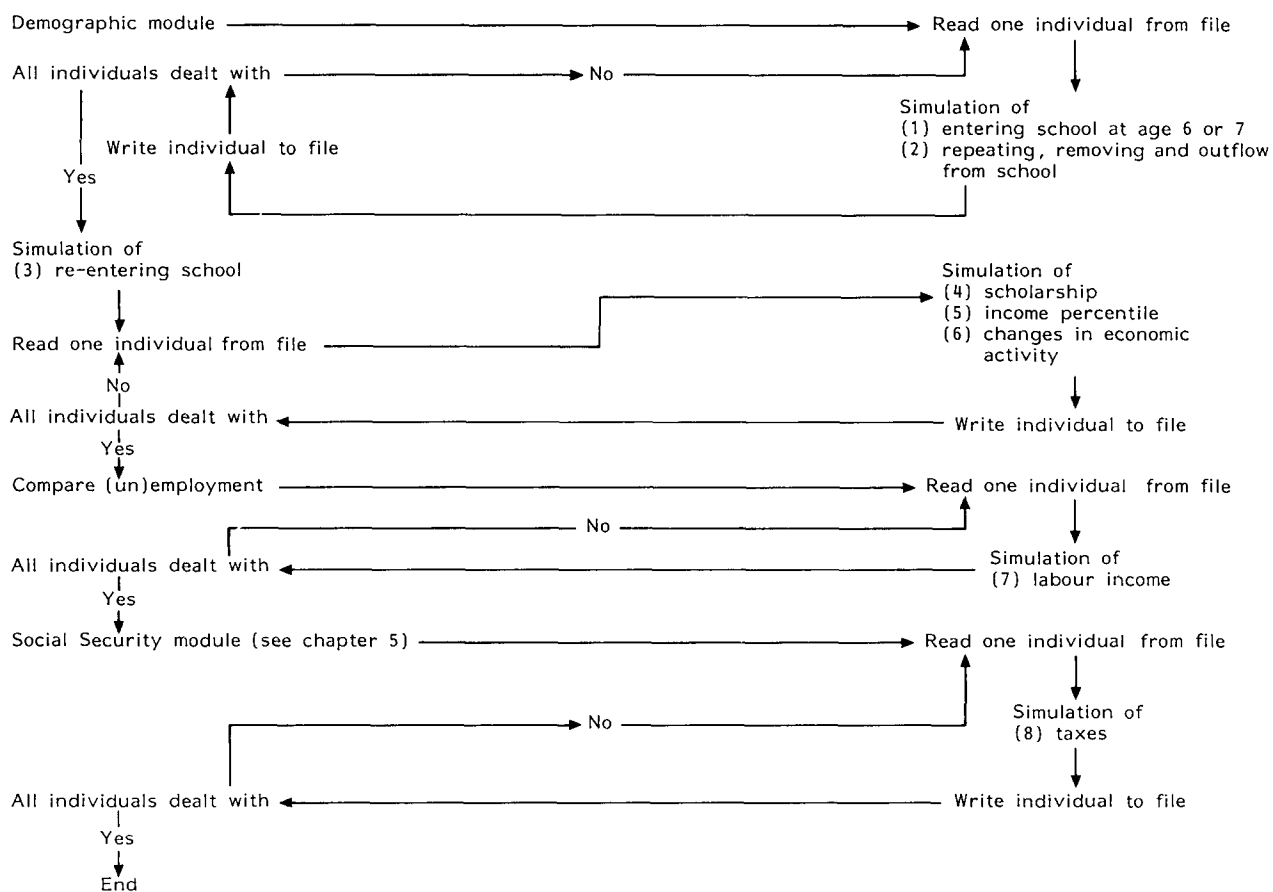
Figure 2. The labour market and income formation module.

whether he or she enters school at that age or at the age of 7. If the individual is already at school, it is decided whether he or she repeats, moves up, goes to another type of school or ends education. When all 6- or 7-year-old children and all students have gone through this part of the model, the re-entering of education is simulated (part-time or full-time).

Next, scholarship is simulated if the individual is at a vocational college or at university. The income percentile of people who have already finished the education process and are not yet 65 years old or who are part-time students, is adapted and it is investigated whether changes in their economic activity take place. If the year under consideration is 1988 or before, the number of simulated employed and unemployed men and women is compared with the real numbers and adjustments, if any, are executed.

The exogenous variables in the equation for the mean and variance of labour income for the various cohorts are now known, and wage income can be determined for each employed person.

The last element in the module under consideration is the determination of taxes. This is executed after the benefits from and contributions to social security have taken place.

The educational submodule has been described in Nelissen [119]. Here, we successively present the changes in economic activity, labour income and taxes.

Changes in economic activity

Sixteen categories of economic activity are distinguished: employee, self-employed, civil servant, retired, unemployed employee, unemployed civil servant, unemployed others, conscript, disabled employee, disabled civil servant, disabled others, student, housewife or househusband, unemployed ex-disabled employee, unemployed ex-disabled civil servant and unemployed ex-disabled others.

The *Labour Force Survey 1977* (*Arbeidskrachten-telling*)[30] is the starting point for the determination of the transition probabilities between the different states of economic activity. This survey contains information on the economic activity in 1976 and 1977 for men and women of all ages between 14 and 66 years. We have transformed the states used in the *Labour Force Survey* into six states: disabled, employed, unemployed, conscript, student and retired or working in own household (househusbands and housewives). Using these data, it is determined for each year for each individual whether his or her economic activity

changes. In this process, additional data are used, eg data referring to unemployment.

In this process, the determination of the labour supply is an important element. Labour supply is determined with a labour supply equation, modelled by Van Soest *et al* [139], which explicitly takes account of demand-side restrictions. The labour supply of individual household members is considered in a neoclassical framework, in which after-tax wages, unearned income, the social security and tax system and household composition are taken into account.

The starting point is a modified version of the model introduced by Hausman [52] in which the random preferences are included in the constant term rather than in the income coefficient. Instead of the error term that represents, among other things, the deviations from the preferred number of hours due to demand-side restrictions, the demand-side restrictions are modelled via distributional assumptions about job offers. Moreover, the number of hours of work is not a continuous variable, but a discrete one. The authors use four-hour intervals (0, 4, 8 and so on). It is assumed that employers offer jobs with fixed numbers of hours and workers face the market distribution of these employment opportunities. This market distribution of job offers does not differ between workers. The number of job offers for an individual (called N) is a drawing from a binomial distribution $B(10, P_{\text{offer}})$. So, the labour supply decision is a discrete choice between those N job offers and the decision not to work.

The main idea of the model is that an individual is only observed to work h_k (>0) hours if (s)he received at least one job offer h_k and prefers this job offer to all different job offers which were received and to unemployment. The individual is unemployed if (s)he prefers zero hours of work to all job offers received or if (s)he received zero offers [Van Soest *et al* [139], p 533].

For an extended description and the estimation results, see Van Soest *et al* ([139], pp 532–537). Here, we only indicate in which way we used these results in NEDYMAS.

For each individual whose labour supply has to be determined, we calculate for which labour supply the utility was highest. For that purpose, utility is calculated when an individual does not work, and the N numbers of hours belonging to the job offers. For each of these numbers, we have to calculate his or her after-tax wage rate. The pre-tax wage rate is determined as indicated below. Then, we investigate which benefits (s)he receives from social security taking into account the partner's income, if present. Last, the resulting tax and social security payments are calculated. Now the after-tax wage rate is known and the individual's utility can be calculated using the

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[30] See NCBS [113].

estimated coefficients.[31] In doing this, we keep in mind the stochastic nature of the process.

We will now deal with the possible transitions in the various states of economic activity. Transitions to the state of student are not considered here. These transitions take place in the education submodule and are described in Nelissen [119]. Transitions are only considered up to the age of 65 years old. From that age on, we assume that people are retired, do not work and consequently do not receive any labour income.

Transitions from the state 'student'. If individuals leave full-time education, their new state is assigned by lot. The first step is to become disabled, unemployed, househusband/housewife or a conscript. In this process, we use the transition probabilities, given age and sex, from the *Labour Force Survey 1977*. This means that we assume that the transition probabilities into the states 'conscript', 'househusband/housewife' and 'disabled' are constant during the period under consideration. If someone becomes disabled (which implies state 11, 'disabled others') the degree of disability is determined. For that goal the distribution of WAO or AAW receiving persons by degree of disability has been used.[32] The attribute disabled becomes true and the year of disablement becomes the current year. If someone becomes a conscript or househusband/housewife, we have to fix the date at which that happens. If someone leaves the education process without a certificate, a randomly chosen date is taken in the current year. In the other case, we limit outselves to a randomly chosen date in the second half of the year.

If the individual is unemployed (s)he becomes 'unemployed others' (state 4) and labour supply has been determined. It is assumed that (s)he has been looking for a job since 1 May of the current year and that (s)he starts working after 1 August. So, the month of unemployment becomes month 5 (May) and the year of unemployment is the current year. If and when the individual finds a job is determined below.

For people leaving part-time education, the state (which had not changed as a consequence of entering part-time education) remains the same. Only their percentile is again determined.

Transitions from the state 'disabled'. Using the transition probabilities derived from the *Labour Force Survey 1977* for age and sex, we determined whether disabled persons stay disabled or not. If we determine

that the individual is no longer disabled, we have to determine whether he or she becomes unemployed (state 14, 15 or 16) or becomes a househusband/housewife (state 13).

If the individual becomes a househusband or housewife then (s)he either becomes state 13 or else labour supply has been determined and (s)he becomes state 14 if (s)he was an employee, before becoming disabled, state 15 if a civil servant before becoming disabled and state 16 otherwise. It is also assigned by lot when disability ends and unemployment or working in the household starts. In the case of becoming unemployed, the month drawn becomes the month of unemployment, whereas the year of unemployment becomes the current year. The attribute 'disabled' is now false and the 'percentage disabled' becomes zero. If the individual could claim an AAW or a WAO benefit (see below), these benefits are paid until the moment of leaving the disablement state.

Transitions from the state 'conscript'. The duration of being a liable military servant is fixed. For the period up to 1964, it is assumed that conscription lasts 18 months. Between 1964 and 1975 a duration of 16 months is assumed, and from 1976 on 14 months. Those who become officers stay three months longer and non-commissioned officers two months longer. The probability of becoming an officer is about 0.5% and the probability of becoming a non-commissioned officer is 5%. If the period of conscription ends in the current year, we determine whether the individual becomes disabled, househusband or unemployed. We again use the transition probabilities derived from the *Labour Force Survey 1977*.

If a person becomes disabled – state 11 (disabled others) – the percentage of disability is assigned by lot, the year of disability becomes the current year and the attribute 'disabled' becomes true. The month of disability has been drawn randomly. If someone becomes a househusband, the date at which that happens equals the month in which conscription ends. If an individual becomes unemployed, he acquires the state 'unemployed others' (state 4) and labour supply has been determined. The month of unemployment is set equal to the month in which conscription ends. It is also assumed that he is already looking for a job during the last three months of his conscription, but that the job does not start before the end of the conscription period. If and when he finds a job is again determined below.

Transitions from the state 'employed'. First we decide using the transition probabilities from the *Labour Force Survey 1977*, whether a person becomes disabled (self-employed persons only), housewife/househusband

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[31] The coefficients that refer to prices (eg wages) are deflated by the price index number for the gross national income: see NCBS [95].
[32] Social and Cultural Planning Agency ([137], p 48).

or conscript. The transition rates for the state 'housewife/househusband' for the years 1977 and after are adjusted using Theeuwes *et al* ([146], p 45).

If an individual becomes disabled, he or she acquires state 11, disabled others. Employees and civil servants only pass into the state disabled via the Sickness Benefit Law (ZW).[33] It is assumed that a person becomes disabled on 1 July of the current year. This means that (s)he receives (labour) income for half a year. The attribute 'disabled' becomes true, the percentage of disablement is assigned by lot and the year of disablement becomes the current year. If a person is conscripted, then the date of conscription is assigned by lot. Economic activity becomes 'conscript' (state 8) and wages are paid up to the date of conscription. If the individual becomes a househusband or housewife then (s)he acquires state 13. Until the date at which (s)he falls into this category, which is assigned by lot, labour income has been paid.

If labour supply remains positive we investigate whether someone becomes unemployed or not. For that purpose we have to determine the unemployment probability from the state 'employed'. The starting point is the corresponding probability by age and sex in 1977, which can be determined from the *Labour Force Survey 1977*. In the light of the probability of becoming employed again by duration of unemployment in 1977 and the number of persons at work in 1976, but unemployed in 1977 (51 000 men and 21 000 women according to the Labour Force Survey) we calculated that 220 000 men and 74 000 women lost their jobs.[34] The number of persons who were laid off in the current year is determined up to 1988 by the 1977 number, the change in the unemployment rate, the change in the probability of finding a job and a correction factor for the size of the labour force. For the period 1988–2020 we assume that unemployment declines by an annual growth in employment of 0.5%.[35] After 2020, the number of lost jobs is assumed to remain at 130 000 men and 130 000 women. So the probability of becoming unemployed for men (women) by age in the current year is determined as the probability in 1977, multiplied by the number of men (women) who lost their jobs in the current year and the size of the (fe)male labour force in 1977 (3 478 000 men and 1 191 000 women) and divided by the number of (wo)men dismissed in 1977 (220 000 men and 74 000 women) and the size of the (fe)male labour force in the current year. This probability is adjusted for being a civil servant or not. Civil servants have a lower probability of being laid off. The correction factor is

derived from Meesters [85]. Until 1956 a female civil servant is also dismissed if she marries. Corrections are also made for the level of education. The effect of the level of education on the probability of losing one's job is derived from Spannenburg [140]. For both the last adjustments, a correction is executed for changes in the structure of the level of education of the labour force and the proportion of persons working as civil servants, to guarantee consistency.

Next, we decide by lot whether people are laid off or not. If they become unemployed, they acquire the economic activity 'unemployed employee' (state 6), 'unemployed civil servant' (state 7) or 'unemployed others' (state 4), depending on the former state. We again assign by lot at which date they are dismissed. That date becomes the 'month of unemployment' and up to that date labour income has been paid. The 'year of unemployment' becomes the current year.

Transitions from the state 'unemployed'. If a person is unemployed, we first decided whether (s)he remains unemployed or not. For that goal the exit probabilities out of the state unemployed are calculated for both men and women. For the period 1953–86 we know the number of new registrations at the labour exchange.[36] From NCBS [96], we have the number of registered unemployed persons, unemployed for less than three months, on 1 February, May, August and November of each year. Using these figures, we can calculate the exit probability out of the state 'unemployed' during the first three months of unemployment. These two sources give us the proportion of people who became unemployed between two of the above dates and were no longer unemployed at the end of that period. Suppose that this is x%. Let $100*\exp(q)$ be the probability of being still unemployed after one day and assume that this probability does not change during the first three months and that the inflow is distributed uniformly over time. Let d be the number of days between two dates. Then we see that:

$$x = d^{-1} \int_0^d \exp(d-t)*q \,.\mathrm{d}t = [\exp(d*q)-1]/(q*d)$$

(1)

From Equation (1) we can determine q numerically. The monthly exit probability during the first three months of being unemployed (p) is now:

$$p = 1 - \exp(q*d)$$

(2)

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[33] When sickness lasts one year.
[34] See Corpeleijn ([23], p 651).
[35] See Departementale Werkgroep SZW [28].

[36] See for the period 1953–77 Hartog [50] and for later years NCBS [96].

Using the data from NCBS [96] we can also derive the probability of moving out of the state of being unemployed between three and six months and the exit probability in the second half year of unemployment. Up to 1978, this last exit probability was also applied to persons who were unemployed for one year, one and a half years, and so on. For the years 1978 and after, the yearly exit probabilities are also known for persons who are unemployed for one year, two years and three years.[37] While data before 1953 are lacking, the 1953 probabilities are also applied to the years 1947 up to and including 1952. For the years 1987 and after, we assume that the exit probabilities remain constant at the 1986 level.

These general exit probabilities are corrected for individuals for their level of education. The correction factors are determined on the basis of the *Labour Force Survey 1977* and *1985*.[38] Between these two years, the correction factors are interpolated. For the years 1976 and before, the correction factor for the year 1977 is the starting point. The figures for 1977 are adjusted for the changes in the level of education of the unemployed in comparison with 1977. For the years 1986 and after the procedure is analogous, with 1985 as the year of departure. From 1973 on, we also adjusted the exit probability if the person was disabled before becoming unemployed (now acquiring state 14, 15 or 16). The *Labour Force Surveys* show that exit probabilities have decreased relatively since that year.

On the basis of this exit probability, it is assigned by lot whether an individual will leave unemployment or not in the current year. If he or she leaves unemployment, it is also assigned by lot at which date (between the dates in question) this happens. Until this date, any possible unemployment benefit has been paid. Using the transition probabilities derived from the *Labour Force Survey 1977*, we again investigated whether the person becomes disabled (only for persons in state 4 or 16), becomes a househusband/housewife (state 13) or enters the state of conscript. If he or she becomes disabled the state becomes 11, the year of disablement becomes the current year, the attribute 'disabled' is now true and the percentage of disablement is assigned by lot. If he is conscripted, the assigned date is the date of conscription. If the person does not become disabled, a househusband/housewife or a conscript, his or her labour supply is determined. We assume that (s)he has found a job, for the number of hours that follow from the optimization of the labour supply. The year and month of employment are given by the aforementioned date. Next the state

the individual acquires – civil servant, employee or self-employed – is assigned by lot. This depends on the income percentile in which he or she is classified. The distribution of self-employed persons, employees and civil servants over the different percentiles is based on the income distribution for the year 1979.[39] For the period 1947–65, a correction is made for the fact that married women were not considered for jobs as civil servants. Another correction was made for the relative size of the three groups, in which we assumed that no changes took place in this distribution after 1986.[40]

Transitions from the state 'househusband/housewife'. If an individual is in state 13, househusband or housewife, we decide for each year, using the transition probabilities from the *Labour Force Survey 1977*, whether the person becomes disabled (self-employed persons only) or is conscripted. If (s)he becomes disabled, (s)he acquires state 11, otherwise is disabled. It is assumed that the person becomes disabled on 1 July of the current year. The attribute 'disabled' becomes true, the percentage of disablement is assigned by lot and the year of disablement becomes the current year. If the individual has to do military service, then the date of conscription is assigned by lot. Economic activity becomes 'conscript' (state 8).

Adjustments in the economic activity of the population. When the above mentioned transitions have taken place, the simulated number of employed and unemployed persons will generally differ from the actual or predicted number of employed and unemployed persons. One reason for this is that we did not take account of the possibility of transitions from the state househusband/housewife to the state unemployed. Therefore we compare the simulated numbers with the actual or predicted figures. For the period 1990–2029 we use the forecasts of Departementale Werkgroep SZW [28]. For the years 2030 on we assume that the number of unemployed persons remains constant and that the labour force participation rates remain constant at the 2029 level. Now we are able to compare the simulated numbers (corrected for the sample size) with the actual numbers and to adjust the economic activity of the population if the numbers differ too much. We carry out this correction while the estimation of the parameters of the labour supply function is executed with data referring to the year 1985. It is quite debatable whether people in, for example, the 1950s show the same employment behaviour.

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[37] See for example Social and Cultural Planning Agency, SCP ([138], p 311).
[38] See NCBS [113, 117].

[39] See NCBS [115].
[40] See NCBS [95].

First, the simulated and the true numbers of unemployed men and women are compared. If the simulated number is less than the actual one, the simulated number is then raised by giving persons who are househusband/housewife or employed, the state 'unemployed'. This process continues until the simulated number of unemployed persons equals the true number. If the simulated number is larger than the true number of unemployed persons, then the simulated number is reduced by giving the corresponding number of unemployed persons in the sample the state 'househusband/housewife'. This also happens randomly.

The simulated and actual numbers of employed men and women are now compared. The procedure is analogous. If the simulated number is less than the true one, the simulated number is increased by randomly giving people who are househusband or housewife, the state 'employed'. If after this operation the simulated number is still less than the true number, persons are randomly drawn from the pool of people who are disabled. Using the labour supply function, we determine whether their labour supply is positive and, if so, they are added to the employed population. This process continues until the simulated number of employed persons equals the true number. If the simulated number is larger than the real number of employed persons, then the simulated number is reduced by giving the corresponding number of employed persons in the sample, the state 'househusband/housewife'. This is done randomly.

Finally we test whether the employed population is correctly subdivided between the categories employees, civil servants and self-employed persons. If this is not the case, economic status is adjusted to obtain the right numbers.

The economic activity of the initial population and immigrants. If a person left education before 1947, the income percentile is fixed in the way described below. First the required number of conscripts is drawn from the population. For the remaining persons, it is simulated whether they were in the labour force or not, using the participation rates from the 1947 census.[41] We differentiate by age, sex and marital status. The unemployment rate by sex in 1947 is used to simulate whether (s)he has a job or not. If it is decided that a person is unemployed, the status becomes 'unemployed others' (state 4), the year of unemployment is 1946 and the month of unemployment is assigned by lot. If the individual has a job, it is assigned by lot (using his or her income percentile) whether (s)he is an employee, civil servant

or self-employed. If a person is not in the labour force, he or she acquires state 13, househusband or housewife. This means that we do not consider the state 'disabled' in the initial simulation.

If a person has immigrated in the current year and (s)he has already reached school age, his or her level of education is simulated up to the year in question. If we have to deal with a 'new' immigrant, (s)he flows twice through the education process and the lowest level of education is assigned to this person. This procedure results in a level of education that is quite near the real level.

If education was completed before the current year and the person is younger than 65 years (otherwise he/she acquires state 3, retired), then the economic activity is determined. First, it is decided (using the probabilities derived from the *Labour Force Survey 1977*) whether (s)he is disabled or not. If so, the pointer 'disabled' becomes true, the state becomes 'disabled, others' (state 11) and the percentage of disablement is assigned by lot. If the person is not disabled, his or her labour supply is determined, using the labour supply function. If this labour supply is zero or negative, (s)he becomes a househusband or housewife (state 13). If it is positive, the person gets the state 'unemployed others' (state 4). It is assumed that people start looking for a job three months before they immigrate. This determines the year and month of unemployment. Next, we follow the procedure as described for school leavers, on the basis that a job cannot start before the date of immigration.

Labour income

The distribution of lifetime earnings is generally derived from panel data or a pooling of cohort and cross-sectional data, covering only a relatively very small part of the period where a person earns money. In the most favourable cases, the period under investigation spans about ten years, so that the age–earnings profile does not relate to the complete lifetime earnings of any one individual.[42] The researcher usually starts from the widely accepted assumption that at a particular age earnings are distributed lognormally; the development of the mean of the logarithms of earnings to age has been assumed to follow a quadratic function in the variable age, whereas the variance is assumed to follow a linear function in the variable age (see for example Fase [35]).[43] Sometimes other variables are added.[44] The

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[41] See NCBS [103].

[42] See eg Creedy and Hart [27] and Fase [35].
[43] This immediately follows from the assumption that log income at age t equals log income at age $t-1$ plus a systematic term and an additive random shock.
[44] For example, Creedy and Hart [27] use dummies for the different birth cohorts.

functions are estimated and the distribution of lifetime earnings is determined in this way. In a similar way, it is possible to describe the distribution of earnings in a particular year.

In addition to the fact that the functions for different cohorts are based on a (too) limited period, this procedure has another important drawback. It is hardly possible to derive the distribution of earnings for the future or for the past, because the parameters of the aforementioned quadratic and linear functions for the mean μ_t and variance σ_t^2 differ between generations and years. This is, of course, the result of the fact that these functions are not based on theoretical arguments, but only on empirical insight.[45] Therefore it is hardly possible to derive the distribution of lifetime earnings. Fase [37] claims that his model can be used for this purpose. However, in practice he can only provide us with the geometric mean. His method also only holds for homogeneous educational or occupational categories, so that the method cannot be applied to the total population of a country, which severely limits its application. The foundation of this kind of stochastic models is weakened by the result of the Thatcher [145] and Taubman [144] tests. Sahota's conclusion in his 1978 survey on personal income distribution theories is clear: 'The old stochastic theory of distribution is apparently in disrepute' (Sahota [132], p 9).

The course of lifetime earnings can be explained in two ways. We can either work in a completely descriptive manner, or we can select an appropriate function on the basis of income formation theories. The first approach has the disadvantage that the user does not know what determines the course of the income curve, so that the forecast of the future becomes very speculative. However, if we want to know the real line of the age–earnings profile, of, for example, the birth generation of 1950, knowledge of the future is of vital importance. On the other hand, the method has the advantage that (part of) the course of the profile can be determined in a very simple way using only relatively few data. This does not hold for the second method, in which microdata are preferred. Unfortunately, these data are not available for a sufficiently long period for most countries,[46] so this method is not an obvious choice. In the light of the available data for the Netherlands, we opt for a pragmatic approach in which we estimate μ_t and σ_t^2 using macrodata and extending the model used by eg Creedy and Hart [27]. We drop the assumption that

log income in the current year equals log income in the foregoing year plus a systematic term and an additive random shock. So, the limitation to homogeneous categories does not hold.

Following a description of the data, we then discuss the model. Next, we estimate mean male full-time income and variance by age. Lastly, we show how we use these results to simulate the age–income profile for individuals.

The data. Since 1962, the Netherlands Central Bureau of Statistics (NCBS) has published (aggregated) earnings data for individuals. Before 1962 the household was the income unit, so that for married people individual income, and thus mean (aggregated) income, was not available. We use the *kerninkomen*, which gives the sum of the income components which are characteristic of each socioeconomic category. As a consequence, the same income elements are included in the *kerninkomen* of self-employed persons, civil servants, employees, and managers of private and limited liability companies and corporations. *Kerninkomen* can be considered as primary income excluding income from capital. This will be our income concept. This means that we use the income from labour of the self-employed, employees, and managers of private and limited liability companies and corporations.[47] From the NCBS we have received data for different age groups for both males and females for the years 1967, 1970, 1975, 1983 and 1985. Available data for other years are not used because these data are not completely comparable. Some changes in definitions have also taken place in the data used.[48] From these pooled cross-sectional data, we can derive 46 observations for the mean income and the variance: six age groups in 1967 and ten age groups in the other years: see Figure 3. Because we are using pooled cross-sectional data, individuals aged about 17.5 years in 1970, for example, who earned on average about 4800 guilders then, are not the same people as those in 1975 aged 22.5 years who earned on average about 18 300 guilders in that year. No doubt, many of these people were the same, but because some people had left the labour force, and others of the same age had entered the labour force between these two years, these data do not exactly measure the earnings of the cohort born around 1939–40 in this example. In interpreting our results, we must realize that they only hold for those people who are in the labour force at the time under investigation. The mean labour income by age is given in Figure 3.

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[45] Human capital theory also gives a inverted U-shaped profile for μ_t. The statistical model for μ_t can also be interpreted in this way: see Fase [36].

[46] The USA and the UK are probably the only exceptions: see Atkinson *et al* [4,5].

[47] Some benefits for the unemployed are included and cannot be isolated. However, their impact during the period under investigation was limited.
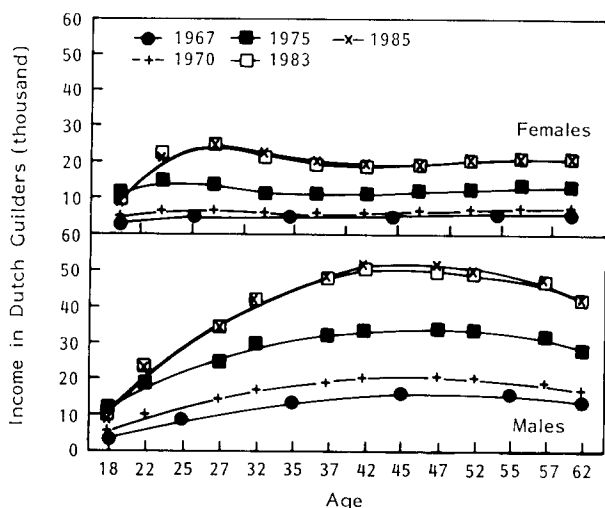
[48] See NCBS [106–112, 114–116].

Figure 3. The age–income profile for the Netherlands: 1967, 1970, 1975, 1983 and 1985.

The variance is based on grouped data. The number of income brackets varies between 13 and 32. This means that the true inequality is underestimated, while the inequality within brackets is ignored. The degree of underestimation depends on the number of income brackets. Empirical studies show that the underestimation is limited to a few per cent when ten or more income brackets are used (eg Gastwirth [44], and more specifically for the Netherlands, Odink and Van Imhoff [123]).

The model. Our point of departure is the statistical model, adapted from Aitchison and Brown [1] and Fase [35], which describes the distribution of individual income by age. Individual income has been considered as a random variable related to age. The individual is assumed to start his career at age s, at which (s)he receives an annual income equal to $\underline{y}_s$. This variable $\underline{y}_s$ is assumed to follow a two-parameter lognormal distribution and age is considered to be a discrete variable. This implies:

$$P(y_s < \bar{y}_s) = \Lambda(y_s; \mu_s, \sigma_s^2) \tag{3}$$

with

$$\Lambda(y_s; \mu_s, \sigma_s^2) = \int_0^{y_s} (y . \sigma_s . \sqrt{2\pi})^{-1} *$$
$$\exp[-\tfrac{1}{2}((\log y - \mu_s)/\sigma_s)^2] \, dy$$

If we also assume that the distribution of proportional changes in income with increasing age is a normal one, which is a realistic assumption, then income follows a lognormal distribution for all ages (see Hart [49]).

Thus

$$P(y_t \leqslant \bar{y}_t | t) = \Lambda(y_t; \mu_t, \sigma_t^2) \tag{4}$$

with

$$\Lambda(y_t; \mu_t, \sigma_t^2) = \int_0^{y_t} (y . \sigma_t . \sqrt{2\pi})^{-1} *$$
$$\exp[-\tfrac{1}{2}((\log y - \mu_t)/\sigma_t)^2] \, dy$$

Using $\underline{x}_t = \log \underline{y}_t$ Equation (4) can be transformed into the normal distribution, so that for all ages:

$$F(x|t) = N(x_t; \mu_t, \sigma_t^2) \tag{5}$$

This model has been extensively tested by Creedy [25]. As mentioned before, the usual procedure is to determine the distribution of the complete age–income profile by introducing a quadratic function in the variable age for μ_t and a linear one for σ_t^2 (eg Fase [35] and Creedy [26]), whereby in some cases dummy variables for different cohorts are also used (eg Creedy and Hart [27]). Although this approach gives a rather good description for the age–earnings profile within a year, or for (part of) a generation, the problem is that the parameters of the quadratic and linear functions are not, of course, constant over time and differ between generations. So this method can hardly be used to describe the future profile, unless we are able to predict and explain the parameters. But in that case we would prefer to look for a better model. We will follow this method by introducing theoretically interpretable variables.

The foregoing only implies that labour income at every age follows a lognormal distribution. No assumptions have been made concerning the distribution of labour income over a range of years.[49] While μ_t, being the mean of the logarithm of the income at age t, cannot be calculated from the data, we will estimate the logarithm of the mean income (called $\log \alpha_t$). For the same reason we will estimate the variance of the income (β_t^2) instead of the variance of the logarithm of the income (σ_t^2). Then, μ_t and σ_t^2 can be determined via $\mu_t = \log \alpha_t - \tfrac{1}{2}*\sigma_t^2$ and $\beta_t^2 = \alpha_t^2 * [(\exp(\sigma_t^2)) - 1]$.[50]

The estimation of α and β. A general model for $\log \alpha$ is:

$$\log \alpha_t = X_t' . \beta + Z_t' . \tau + \varepsilon_t \tag{6}$$

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[49] Generally, this last distribution is not the normal one and probably it will be leptokurtic; see Hill [67].
[50] See Aitchison and Brown ([1], p 8).

where

$X_t = (X_{t1}, \ldots, X_{tm})'$ a vector of m explanatory variables, which represent individual attributes which are fixed over time (eg sex, formal education)

$Z_t = (Z_{t1}, \ldots, Z_{tk})'$ a vector of k explanatory variables, which represent individual attributes, which vary over time (such as family status and job related characteristics)

$\beta = (\beta_1, \ldots, \beta_m)'$ a vector of parameters

$\tau = (\tau_1, \ldots, \tau_k)'$ a vector of parameters

$\underline{\varepsilon}_t$ = error term, representing unobserved characteristics

Now two problems arise. The first one is what explanatory variables have to be included in Equation (6). A review of theories can be found in Sahota [132]. An all-embracing general theory, however, is not available. Theories of primary income formation can be divided into four categories (see eg Hagenaars and Wunderink-Van Veen [47]):

(i) Theories based on free choices, in which consumers try to maximize their utility. This implies among others the following explanatory variables: education, age, household composition and type of job.

(ii) Theories in which characteristics of the parents explain the income profile: inheritance of genetic characteristics and social environment.

(iii) Theories based on chance mechanisms.

(iv) Theories based on imperfect markets, for example segregated labour markets.

Some theories combine these four types. These theories are termed by Sahota 'more complete theories'. They seem to be the most appropriate for our purpose. Our second problem now becomes apparent: we must limit ourselves to macrodata and this means that we have to use explanatory variables which are aggregate approximations of elements that are at work at the micro level. Besides, data are not available for all the variables that should be included.

We limit ourselves to the following variables:

(i) The development in the logarithm of the income per head of the working population, NI.

(ii) Age minus 15 years, $AGE15$, and its square, $AGE152$.

(iii) The unemployment rate for each age group as a proportion of the average unemployment rate by age, UN.

(iv) The proportion of people with primary or secondary education by cohort, EDL.

Because the development in mean income depends on the growth in national income, and on the size of the

Table 3. GLS estimation results for $\log \alpha$.

Variable	Coefficient	t-value
Intercept	-0.122	-0.27
NI	0.908	27.01
UN	-0.011	-0.34
$AGE15$	0.069	15.27
$AGE152$	$-0.104E-2$	-12.70
EDL	-0.168	-1.63

$R^2_{adj} = 0.990$ $\qquad \sigma_\varepsilon = 0.050$

Mean $\log \alpha = 10.24$ $\qquad$ Observations $= 41$

earning population, given by the proportion of the working population in the total population, the inclusion of the variable NI is self evident. This variable is, like the dependent variable, measured in constant 1980 prices. We expect, of course, a positive effect of NI on mean income by age. According to human capital theory, one would prefer an inverted U-shaped profile in the variable age. The variables $AGE15$ and $AGE152$ are therefore inserted. UN is inserted because relatively high unemployment, indicative of a larger gap between labour supply and labour demand, could put pressure on labour income. Lastly, we have the variable EDL. It is assumed that a higher level of education means a larger marginal productivity and thus a higher income per worker. Studies of the effect of education on earnings confirm this picture; human capital theory also leads to this conclusion.[51] We therefore assume that a reduction in the proportion of persons with only a primary education has a positive effect on mean income.

Because individual female income profiles are heavily affected by strong fluctuations in labour supply, while changes in male income profiles are rather limited, we limit ourselves to the explanation of male mean income and its dispersion. For this we use full-time income for males of 20 years and older. The estimation results can be found in Table 3.

The goodness of fit as measured by the adjusted R^2 is very high. All variables have the expected sign. The coefficients of the age variables imply that income increases up to the age of about 48 years. Thereafter it declines. If the logarithm of the national income, corrected for the proportion of the working population in the total population, increases by 1 percentage point, then the logarithm of the mean income rises by 0.908 in each age group. The relative unemployment rate is not significant. An increase in the variable EDL by 1 percentage point results in a decline in the logarithm of mean income of 0.168.

In a similar way a regression equation for the

[51] For a review, see eg Freeman [40].

Table 4. GLS estimation results for β/α.

Variable	Coefficient	*t*-value
Intercept	2.070	2.85
NI	−0.255	−4.63
UN	0.210	3.18
*AGE*15	0.043	5.21
*AGE*152	−0.057E−2	−3.55
EDL	0.387	1.57

$R^2_{adj} = 0.899$ $\sigma_\varepsilon = 0.077$

Mean $\beta/\alpha = 0.702$ Observations = 41

logarithm coefficient of variation β_t/α_t has been estimated. Here, the same explanatory variables are inserted. It is assumed that income inequality decreases if the level of education increases. The variable *EDL* has been used to measure this impact on income inequality. The sign should be positive: a decrease in the proportion of less educated people reduces inequality. For the variable *NI* we assume an analogous mechanism: an increase in *NI* decreases income inequality. To cover the impact of changes in the distribution of productivity as age increases (for example as a consequence of a larger inequality in health) the variables *AGE*15 and *AGE*152 are also incorporated. The effect of differences in unemployment rates between age groups is measured by the variable *UN*. We expect a positive sign: the larger the unemployment, the larger the income inequality. The regression result is given in Table 4.

Again, the variables have the expected sign, and are all – with exception of *EDL* – significant. A 1% decrease in the proportion of persons with less education results in a decrease in income inequality, as measured by β/α, of 0.387%. A rise in the logarithm of the national income, corrected for the proportion of the working population in the total population (*NI*), reduces income inequality. If relative unemployment is large in an age group, the resulting income inequality will be relatively somewhat larger. The coefficients of the variables *AGE*15 and *AGE*152 show that income inequality increases as age increases. Maximum inequality is reached at the age of about 63.

We have now implicitly derived the age–income profile for the period 1967–81 (the estimation period for both equations). For the past, the observations for the different variables were used. For the future, we make the following assumptions. National income will grow by 2% a year. Employment rises by 0.5% per year up to 2020. The unemployment rate is derived from Departementale Werkgroep Ministerie van SZW [28], but adapted for unemployment figures in 1990. The other variables are obtained from the NEDYMAS results. We will use these results to simulate the income of individuals.

The individual age–income profile. The distribution of the age–income profile, determined above, is a distribution at the macro level. For every year we can indicate what the mean income is and what its variance will be for each age.

If we now know in which quantile of the distribution an individual is, we are able to say what his or her income will be. Let v_q be the *q*th quantile of the normal distribution, with mean zero and variance one. For τ_q, being the *q*th quantile of the lognormal distribution with mean μ and variance σ^2 (parameters which are determined above), the following holds:

$$\tau_q = \exp(\mu + v_q \cdot \sigma) \tag{7}$$

The implication for our model NEDYMAS is that, if we know for each age in which quantile an individual is, we also know his or her lifetime income profile. An individual leaving school is assigned a percentile by lot. The percentile drawn depends on sex and level of education. The probabilities are based on Corpeleijn [23], which contains the mean full-time labour income and its variance for persons, aged 23 and 24 years old, by age and level of education for the years 1979 and 1985. Using these data, we simulated the distribution by percentiles for different levels of education for both men and women. A procedure is used to maintain consistency if the distribution of persons leaving school changes by level of education. With the help of this distribution and the level of education the percentile is assigned by lot in the year in which the person leaves the educational process.

Income mobility has been modelled using Alessie *et al* [2]. These authors used (micro-)data from the first four waves of the Socio Economic Panel, collected by the Netherlands Central Bureau of Statistics (NCBS), held in April 1984, October 1984, April 1985 and October 1985. In this panel only after-tax wages are discussed. These after-tax wages were transformed into taxable income. Alessie *et al* then estimate the taxable income of people who have a paid job. Although this income concept differs from ours (it is primary income; for the differences, see Nelissen [122], Table 1.3, and footnote 11 in Chapter 1), we will use their results because these are the only available microdata.[52] While Alessie *et al* do not correct for part-time labour force participation, and our model is based on full-time annual income, we only use their results for heads of households. From this group, the larger part works full time. Alessie *et al* adapt the following model:

$$Y_{it} = X'_{it} \cdot \beta + \phi_i + \varepsilon_{it} \tag{8}$$

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[52] The Socio Economic Panel data are not available for this study in view of its costs. If they were available we could have transformed the after-tax wages into before-tax wages.

in which Y_{it} is the logarithm of individual i's income in year t; X'_{it} is a vector of explanatory variables, β is a vector of parameters, ϕ_i is a normally distributed error term with mean zero and variance σ_ϕ^2 and ε_{it} is a normally distributed error term with mean zero and variance σ_ε^2. The error terms ϕ_i and ε_{it} are independent. This specification implies a stochastic part composed of an individual effect (ϕ_i) and a time-independent effect (ε_{it}). The first part stands for differences between persons, such as differences in natural ability and in labour ethos, which are not incorporated in the systematic part of Equation (8), $X'_{it}.\beta$ and which do not differ over time. The second part stands for other elements which are not incorporated in the systematic part. These factors are allowed to vary over individuals as well as over time. The first of the stochastic specification can be considered to be implicitly incorporated in our assignment of the percentile an individual belongs to after leaving school. Alessie *et al* [2] use the following explanatory variables: the natural logarithm of age, its square, dummy variables for level of education and dummy variables for type of education. This results for σ_ε^2 in an estimated value of 0.11. We use this value to determine income mobility in our model. The starting point is the percentile the individual is assigned. Each year, the income belonging to this percentile is determined using the results for the mean income and its variance for the individual's birth cohort (using Tables 3 and 4). This income is adjusted for the development of ε_{it}, according to:

$$Y_{it} = \exp(\mu_{it} + v_{it}.\sigma_{it} + \varepsilon_{it} - \varepsilon_{i,t-1}) \tag{9}$$

in which Y_{it} is the income of individual i in year t, μ_{it} is the mean of log income of i's birth cohort in year t, v_{it} is i's percentile assigned for year t, σ_{it} is the variance of log income of i's birth cohort in year t and ε_{it} is drawn from the normal distribution with mean zero and variance 0.11. When each person has passed through the labour income submodule, each person's percentile is again determined.

Given the percentile in which the individual is classified, his or her age, the calculated *NI*, *UN* and *EDL*, and the random draws from the normal distribution, his or her full-time labour income for the current year is determined. Multiplying this full-time labour income by the participation rate and the number of months worked in the current year divided by 12 gives earned labour income.

Taxes

Because we have limited ourselves to labour income, only income taxes have to be considered.[53] In the

Dutch income tax system, the taxes to be paid are determined by the tax group in which one is classified and the tax rate (which differs among tax groups up to 1973). Because NEDYMAS starts its calculations in 1947, the model contains the different variants of the Dutch income tax system from that year on.

Between 1947 and 1972 the Dutch income tax system consisted of three tax groups. Tax group III applied to persons who were entitled to family allowances. The tax rate within this group also depended on the number of children for whom family allowances were received. Tax group II applied to married persons who could not claim family allowances, to divorced and widowed persons, who were 65 years or older or had been married for at least five years, and to never married persons who had reached the age of 65 years. All other persons came within tax group I. Each of these tax groups had a different personal tax allowance. From 1955, disabled (but younger than 65 years old) and aged people received an extra income tax deduction. Married women were not taxable. Their income was added to the husband's and tax was levied on this combined income.

Separate tax tables existed for all tax groups. The tax to be paid was fixed in these tables for different income groups. The number of different income groups was very large. For example, tax group I contained 1507 income groups in 1972! For practical reasons, we have approximated this tax system by a derived graded system of income brackets for tax assessment, one for tax group I and another for the other tax groups. It appears that the marginal income tax rates hardly differ between tax groups II and III, and within group III, if we take account of the personal tax allowances. So we could limit ourselves to a number of income groups that range from 16 income groups for tax groups II and III in 1947 to 34 income groups for tax group I in 1948, 1949 and 1950.

In 1973 the Dutch labour income tax system was revised. Under this revision four tax groups are distinguished, which determine the personal tax allowance. One tax rate system is applied to taxable income, independent of the tax group. The number of income groups is limited: eight in 1973 and 1974 and nine from 1975 on. Up to and including 1982 the aged were allowed an extra income deduction. The deduction differed between married and non-married persons. Also up to and including 1982, disabled persons were allowed an extra deduction, if they were younger than 65 years old and disabled at least 45%.[54] Since 1973 self-employed people have received an extra deduction if their income is below a certain level. Up

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[53] All data used in this submodule are derived from NCBS [97].

[54] In 1981 two groups were distinguished: those with a degree of disability of more than 80% and those whose disability was less.

to 1978 there was a tax deduction for children. The deduction depended on the number of children and on whether or not family allowances were claimed under the Family Allowance Act for Wage-Earners.

For the years 1973 up to and including 1989, the classification into tax groups was determined by sex, age, marital status, presence of children, partner's income and labour participation. During these years, the precise classification changed a number of times. The last adaption (in 1985) resulted in the following tax group classification:

I all persons not belonging to tax groups (II), (III) or (IV);

II (a) single persons, aged 27 years or older, who cannot claim family allowances;

    (b) non-married, non-cohabiting persons, aged 27 years or older, with children up to 27 years old belonging to the household, for whom no claims on family allowances exist;

III (a) married persons, whose partner has no income;

    (b) cohabiting, non-married persons, aged 27 years or older, whose partner has no income and is 18 years or older;

IV (a) non-cohabiting, non-married persons, who can claim family allowances for children belonging to their household;

    (b) single non-married persons, who can claim family allowances.

In 1990 the proposals of the so-called Oort Committee became operative. These proposals have resulted in a relatively radical change in the tax system and in the way in which premiums for the general social insurances are levied. Labour income taxes and the premiums for AOW, AWW, AAW and AWBZ are combined in one levy.[55] This also implies a transfer of the AAW and AWBZ premiums from employers to employees. Employees are compensated for this transfer by an extra allowance on the labour income. The maximum premium income equals the first income tax group from now on. The nine income tax groups are replaced by only three groups, and the premiums for general insurances are no longer deductible. Now six tax groups are used:

I Married or cohabiting persons who transfer their tax allowance to their partner. The tax allowance for the person in this group becomes zero.

II (a) Married or cohabiting persons in a household in which both partners earn an income above the tax allowance (Dfl4568 in 1990);

(b) single persons, who are not classified in group (VI);

(c) persons, who are head of a one-parent family, but who are not classified in groups (IV), (V) or (VI).

The tax allowance amounts to Dfl4568 in 1990.

III Married and cohabiting persons who receive the tax allowance of their partner. Their tax allowance now is Dfl9112 in 1990.

IV Non-married, non-cohabiting people who run a household with at least one child younger than 27 years old and no children over 26 years old. The tax allowance amounts to Dfl8222 in 1990;

V Non-married, non-cohabiting people who have a paid job and who run a household with at least one child younger than 12 years old. The tax allowance amounts to Dfl8222 plus 6% of the labour income (up to a maximum of Dfl3654) in 1990.

VI Single persons, aged 27 to 65 years old, with an income below Dfl35000 (in 1990). The tax allowance amounts to Dfl5695 (in 1990).

In contrast to the past (when a partial transfer was possible), the complete tax allowance is now transferred to the partner. All extra allowances for working people have been abolished.

The tax group classifications, the tax rates (for the period 1947–72 in an approximate manner) and the allowances have been built in NEDYMAS. When a person has passed the social security module (see below), his or her tax group is determined for the current year.[56] Taxes can only be determined at this point, because a person's taxable income was not known until now. With reference to the other tax-deductible items (like extraordinary charges, deduction of costs above the so-called 4% acquisition costs rule, commuting costs above the minimum deduction, various specific costs and gains for self-employed persons) we only consider the 4% acquisition costs rule and a fixed amount for commuting costs.[57] An

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[55] See Ministerie van Sociale Zaken en Werkgelegenheid ([92], pp 46–47) and Directoraat-Generaal der Belastingen [30]. The AKW premium was terminated in 1988. It is now paid by the state. Persons older than 64 do not pay AOW and AWW premiums.

[56] With the exclusion of married women up to 1973. Their income has been added to their husbands' income.

[57] Generally speaking, working people can always claim a reduction for costs which are necessary for the acquisition of an income on their taxable income. The reduction is 4% of the gross wage after deduction of the private pension premium and the deduction for civil servants at minimum. But the minimum deductible amount is limited downwards and upwards (Dfl200 and Dfl800 respectively in 1988). This regular 4% deduction is called the 4% acquisition costs rule. If real acquisition costs are larger than these 4% or Dfl800 (in 1988) the real costs can be claimed. In this way, most employees have been treated correctly. From NCBS ([116], p 144) it is known that 94% of the employees applied the 4% rule and consequently 6% claim more than 4%. Dfl200 was the figure for commuting costs in 1988.

Table 5. Derivation of the taxable income for an employee in 1986 (Dfl).

a.	Gross wage	40 000
b.	Private pension premium (5.1% of the gross wage after deduction of the franchise of 25 640)	732
c.	Income on which the employee insurances are levied (a)−(b)	39 268
d.	Premium ZFW, employers' part (4.8% of (c))	1 885
e.	Premium WW (1.75% of (c))	687
f.	Premium ZW (1% of (c))	393
g.	Premium WAO (15.05% of (c) after deduction of the franchise of 23 751)	2 335
h.	Deductions − commuting costs	200
	− 4% acquisition costs rule (upper limit)	800
i.	Income on which the general insurances are levied ((c)+(d)−(e)−(f)−(g)−(h))	36 738
j.	Premiums AOW and AWW (12.7% of (i))	4 666
h.	Taxable income (i)−(j)	32 072

example of the determination of an employee's taxable income is shown in Table 5.[58]

Until 1990 this taxable income is reduced by claims on disablement allowances, allowances for the aged, tax deduction for children, the allowance for one-parent families, the allowance for working people, the extra allowance for working people and the allowance for self-employed persons. If the resulting amount is less than the tax group allowance, no tax is levied and since 1984 the difference between both amounts is transferred to the partner, if present. If this amount is larger than the tax group allowance, this amount is reduced by the tax group allowance, and the tax rates are applied to this. From 1990 on the taxable income equals the income on which the general insurances are levied (in both cases item (i) in Table 5 minus the tax allowances).

The social security module

After the determination of labour income, the social security module begins. The current definition of social security in its broad sense in the Netherlands, considers social security as the totality of legal measures which aim to guarantee continuity in a person's spending opportunities.[59] On the basis of this definition, we can divide social security into four components:

(i) social insurances;
(ii) pension insurances;
(iii) other social provisions; and
(iv) social benefits, directly paid by the employer.

Social insurances are all legal arrangements which primarily aim to redistribute income between persons or social groups; the right to a benefit is based on the insurance concept. Voluntary insurances, for which participation depends on legalized entry require-

ments, are also considered social insurances. Pension insurances include all arrangements which aim to redistribute the income of persons over time. They are based on a labour relation. Pension insurances are financed by a capital reserve system. So, a relationship is created between the insured person and the pension fund. The insured person has a personal claim on the pension fund, so to speak. Other social provisions include all arrangements in the field of social security, where the benefits are financed directly by the state. No specific premiums are levied: these provisions are financed by public funds. Social benefits paid directly by the employer, refer to payments to (former) employees on the basis of a labour relation.

The Dutch social security system was built up especially in the years after the Second World War. Its development can be called ambiguous. No choice has been made between the two types of social security systems which are generally distinguished, the Atlantic needs-based minimum approach and the Continental wage-related approach.[60] Two types of social insurance can therefore be seen in the Netherlands: general insurances and employee insurances. Both types of insurance are based on the pay-as-you-go system. The general insurances are Atlantic oriented, flat rate benefits, covering all residents. Premiums have to be paid by all residents, they are proportional to income and have to be paid up to a fixed maximum income. The solidarity principle is the starting point, not the insurance principle. The following schemes in the Netherlands are current general insurances: AOW, AWW, AKW, AWBZ and AAW. Employee insurances only apply to employees in the private sector. The insurance or equivalence principle is the point of departure. These insurances are compulsory for these employees. The employee insurances are genuine insurances: on the one hand, premiums are a fixed proportion of the income (which can be seen as the insured risk), whereas on the other hand, benefits are

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[58] The example is taken from Bolhuis ([13, p 133]).
[59] See Ministerie van Sociale Zaken en Werkgelegenheid [88].
[60] See Veldkamp [147] and Muffels *et al* ([93], pp 2–3).

Table 6. The size distribution of the Dutch social security system (total benefits in million Dutch guilders)

Type	1950	1960	1970	1980	1987
Social insurances	53	63	72	75	68
General insurances	11	23	34	43	40
Employee insurances	42	39	38	31	28
Supplementary pensions	26	20	14	12	15
Social provisions	11	9	8	12	13
Direct payments	11	9	7	5	4
Total as a % of *NI*	11	14	21	32	34
Total benefits	1.9	5.6	24.4	101.8	132.3

Sources: Ministerie van Sociale Zaken en Werkgelegenheid ([89], pp 95–101, [91], pp 136–140) and NCBS [99].

related to the (former) income.[61] Both are limited by a fixed maximum income. At the moment, the following employee insurances are in operation: ZW, WAO, NWW and ZFW.

Social provisions in the Netherlands are mainly intended to support those who cannot provide for themselves. The following schemes can be considered as other social provisions: IOAW, TW, ABW and KKZ. In the Netherlands a number of state arrangements exist for civil servants and employees in public firms. They are comparable to the employee insurances. Besides their duration, these arrangements differ in particular in the way the premiums are paid: they are paid by the state in its capacity as employer and employees are exempt from paying. The most important schemes are: WRO, DSO, IZA, KTO.

A large number of pension provisions are available for both civil servants and private employees. The largest pension fund is the ABP.

Table 6 gives information on the size of the Dutch social security system. This table is based on the broad definition of the Department of Social Affairs. From this table, the important role of the social security system in the income redistribution process is immediately clear. At the moment about one-third of the Dutch net national income is redistributed in the form of social security benefits. If we also take account of fund raising, the percentage even exceeds 40% of national income. The main element is social insurances. These constitute about two-thirds of total benefits. Both social provisions and supplementary pensions account for about 15%, whereas direct payments by the employer constitute no more than a few per cent of the total social security benefits.

As we said before, the starting point for our analysis is the current definition of social security in its broad sense. However, information on some schemes is

lacking. We deal with the following social security arrangements in our analysis:

(i) in the field of unemployment provisions: WW (1952–86)/NWW (1987–)/WWV (1965–86)/ WRO (1947–);[62]

(ii) in the field of long-term disability: AAW (1976–) WAO (1967–)/IP-ABP (1947–);

(iii) in the field of sickness and short-term disability: ZW (1947–)/DSO (1947–);

(iv) in the field of old age, widows and orphans: AOW (1957–)/AWW (1959–)/OP-ABP (1947–)/ WP-ABP (1947–)/WP-PS (1947–);[63]

(v) in the field of family allowances: KW (1947–62)/ KWR (1947–62)/KWL (1963–79)/KKZ (1963–79)/AKW (1963–)/KTO (1947–79);

(vi) in the field of health costs: ZFB (1947–66)/ZFW (1967–)/AWBZ (1968–);[64]

(vii) other provisions: ABW (1965–)/IOAW (1987–)/ TW (1987–);[65]

(viii) other social security premiums: IW (1981–).

The extent to which the various social security schemes are treated in this paper can be derived from Table 7.

In terms of total benefits, we cover 60.6% in 1950, 77.2% in 1960 and 85–90% from 1970 onwards. The benefit side has not been covered 100% as a consequence of the lack of data in the field of supplementary pensions. Less than half the supplementary pensions are treated because we are not able to simulate all private pension benefits. The multiplicity of kinds of private pensions and the absence of a module for intrajob mobility in our microsimulation model makes it impossible for us to simulate these pensions in a realistic way at the moment. Therefore only pensions under the ABP are included.

From 1970 onwards, social insurance benefits have almost completely been included in the model. Up to

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[61] However, these insurances cannot be seen as actuarial insurances, because premiums are not differentiated by the real risk of becoming unemployed or the real risk of becoming disabled. ZFW benefits are not related to income. This act regulates the provision of medical and surgical treatment or its compensation.

[62] The period considered is given in parentheses.
[63] WP-PS only premium payments.
[64] Only premium payments.
[65] For the greater part, see the description below.

Table 7. Coverage of the various social security schemes (%).

Type	1950	1960	1970	1980	1987
Benefit side					
Social insurances	66.1	90.0	97.5	99.1	97.7
Supplementary pensions	34.3	33.1	38.8	40.4	41.5
Social provisions	82.7	70.8	66.8	68.7	78.1
Direct payments	74.9	94.3	97.5	95.6	97.4
Total	60.6	77.2	86.9	88.6	86.8
Financing side					
Social insurances	56.3	82.1	90.5	91.6	96.4
Supplementary pensions	100	100	100	100	100
Total	71.7	86.5	92.1	92.8	97.0

Sources: Ministerie van Sociale Zaken en Werkgelegenheid ([89], pp 95–101; [91], pp 136–140).

1967, the former Accident Insurance Act and the Disablement Act (in combination with the Temporary Act for Disabled Pension Receivers) existed, but they are not included in our model. These schemes accounted for a substantial proportion eg 16% in 1950 and 9% in 1960. The Temporary Act Old Age Pensions, which was operative until the introduction of the AOW in 1957, has not been included in NEDYMAS. This law accounted for 16% in 1950. The remaining discrepancy between total benefits and benefits included in the model may be attributed back to the Voluntary Advanced Retirement scheme and insurance against the risk of unemployment due to weather conditions. Both are only a few per cent maximum.

The other social provisions are covered for 70–80%. Not included are arrangements for social work provision (WSW), arrangements for artists (BKR), special pensions for groups of war victims, and home care. The WSW formed 11% of the other social provisions in 1987 (the minimum), and 23% in 1970 (the maximum). Home care ranged from 2 to 9%, special pensions from 4 to 9% and the BKR was about 1% at most.

Social benefits directly paid by the employer are almost completely covered. The only elements which are not included are the Voluntary Advanced Retirement for Civil Servants (about 2% in 1987) and the Breadwinner and Income Compensation for Soldiers (25% in 1950 to less than 1% in 1987).

On the financing side, we can limit ourselves to social insurances and supplementary pensions. The other social provisions and benefits paid directly by the employer – ie the state – are both financed by public funds. The percentages equal the percentages for these schemes at the benefits side, augmented by the premiums for the compulsory ZFW, the AWBZ and private pensions. The Accident Insurance Act and the Disablement Act (in combination with the

Temporary Act for Disablement Pension Receivers) are not included. This explains the somewhat lower percentages in 1950 and 1960. From about 1965 onwards the financing side is covered for more than 90% and even for 97% in 1987.

The treatment of social security schemes has been shown in Figure 4. First the premiums for private and civil servant pensions and the deduction for civil servants are determined. This also gives us the gross wage. If this has been executed for all workers and we are in the year 1992 or later, via the net–net and gross–gross coupling, the level of the different benefits, the maximum premium income for the general insurances and the maximum premium income for the employee insurances are calculated (see below). For the years 1991 and earlier, these amounts are known from NCBS [99].[66] Next, the claims for the General Old Age Pensions Act, the General Widows and Orphans Pensions Act, the widows' and orphans' pensions of the Civil Servants Pensions Fund, family allowances, the General Disablement Benefits Act, the Sickness Benefit Act, the Disablement Insurance Act, the disablement pensions of the Civil Servants Pensions Fund, the old age pensions of the Civil Servants Pensions Fund, the unemployment benefits of the Civil Servants Pensions Fund, the Unemployment Insurance Act, the Unemployment Provisions Act and the New Unemployment Insurance Act are determined.

If this is done for all persons, we can calculate the claims that also depend on the income of other household members: the Provision for Older and Partly Disabled Unemployed Employees, the Supplementary Benefits Act and the General Social Assistance Act. If we are in the year 1988 or later, we then have to calculate the premium percentages. Last, we can determine the premium payments for the Health Insurance Fund Act, the Sickness Benefit Act,

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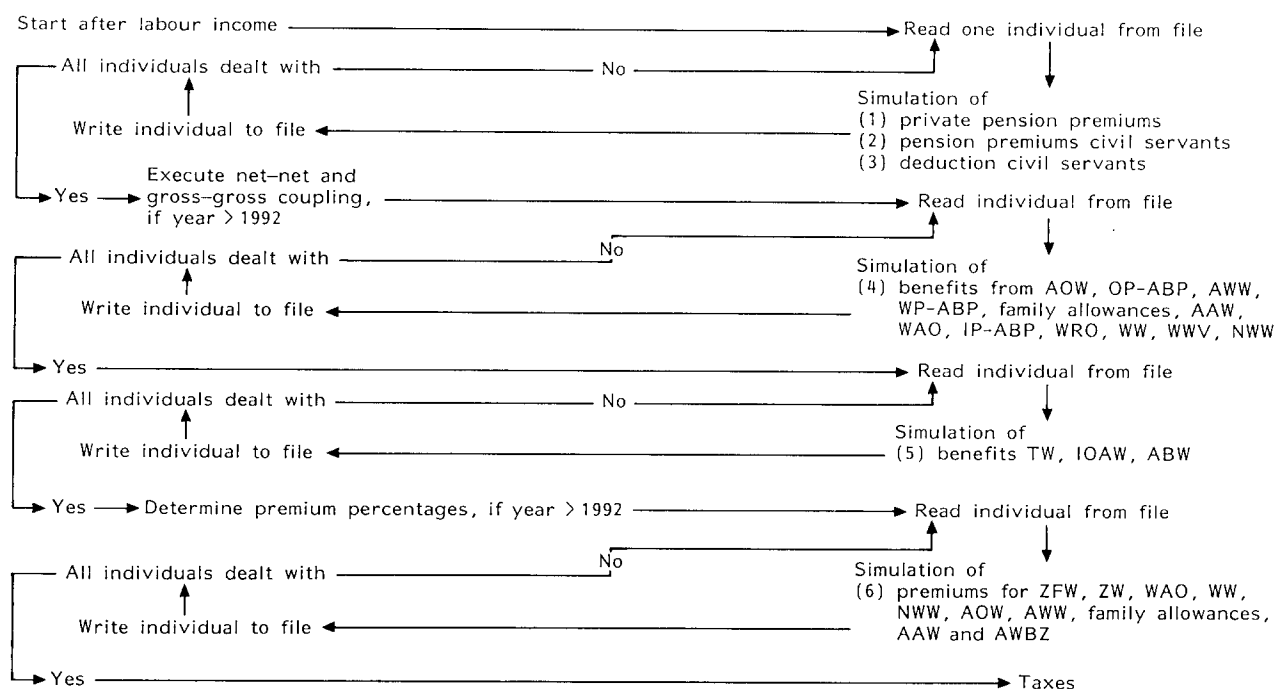[66] Like all other data, unless mentioned otherwise.

Figure 4. An overview of the social security module.

the Disablement Insurance Act, the Unemployment Insurance Act, the New Unemployment Insurance Act, the General Old Age Pensions Act, the General Widows and Orphans Pensions Act, family allowances, the General Disablement Benefits Act and the General Exceptional Medical Expenses Act. At this point, all calculations for the social security module are executed and we go back to the labour market and income formation module to calculate taxes.

The social security benefits

The General Old Age Pensions Act (AOW). The AOW came into force on 1 January 1957.[67] The law provides for a compulsory insurance against the financial consequences of old age on reaching the age of 65 years. All residents in the Netherlands aged 15 to 65 years are insured.[68] An AOW benefit can be claimed if a person is 65 years or older and has been insured. Until 1 April 1985, married women could not claim a benefit. Their benefit was linked to that of their

husbands. The husband's claim started on the first day of the month in which he became 65 years old. Exceptions existed for some specific groups. Since 1 April 1985, both married women and men are independently entitled to an AOW benefit.

Initially the AOW benefit was a relatively small amount. It was raised to a social minimum on 1 January 1965, so that a fixed minimum standard of living was guaranteed. In the early 1970s further structural increments took place and holiday allowances were added to the benefit. From 1976 the (net) AOW benefit for a married couple equalled the net minimum wage. A non-married individual now receives a benefit which amounts to 70% of the benefit which a couple receives.

Since 1 January 1987 new cases of non-married cohabiting people have been treated in the same way way as married persons.[69] A married person receives 50% of the total benefit for married couples when he or she reaches the age of 65. On this same date, a special AOW benefit for one-parent families, receiving family allowances, was introduced. The benefit amounts to 90% of the (100%) benefit for married couples. Between 1 January 1987 and 1 April 1988, an extra allowance – which is independent of the income of the younger partner – is paid if one of the partners receives an AOW benefit, and the other partner has not yet

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[67] The description is derived from NCBS [99] and Elseviers ([33], p 117–123).

[68] Non-residents who are governed by Dutch tax laws while they are employed in the Netherlands, are also insured for the AOW. However, residents who are insured for a foreign old age pension, because they are employed abroad, are not insured for the AOW. Persons who are no longer insured, have the possibility of continuing the AOW insurance – which is only possible in combination with a voluntary AWW insurance – by voluntary premium payments.

[69] Relatives in the first degree (for example a parent and a child) are treated as non-cohabiting persons.

reached the age of 65 years. Since 1 April 1988, a pension of 70% of the net minimum wage is paid to a person eligible for the AOW, if his or her partner is younger than 65. The amount of the extra allowance depends on the partner's income if this partner is 59 or younger. The extra allowance is made up to a maximum of 100% of the AOW benefit for married couples. This income dependency does not hold if one partner was eligible for the AOW benefit before 1 April 1988.

The AOW benefit is based on an insurance duration of 50 years (between the ages of 15 and 65). A number of temporary provisions are at work. For example, people who were already 65 or older on 1 January 1957 (when the AOW was introduced) received a benefit based on an insurance duration of 50 years. For persons who were already 15 but not yet 65 on this date, an analogous provision holds. If a person has no income in any year, but does meet the other requirements, he or she is also insured. Some temporary provisions for immigrants and emigrants also apply. If a person has not been insured for a year or has not paid the AOW premium due to carelessness, the AOW benefit is reduced. The reduction amounts to 1% for married people (and people treated in the same way) and 2% for non-married persons.

In the case of death, the AOW benefit is paid up to and including two months after the month of death for married persons, and up to and including the month of death in the case of a non-married person.

The General Widows and Orphans Pensions Act (AWW). The AWW came into force on 1 October 1959.[70] It is a compulsory general insurance against the financial consequences of death of the insured husband (the widows' pension) or both wife and husband (the orphans' pension). Recently, the Centrale Raad van Beroep (Court of Appeal) decided that men can – under the same conditions as women – also claim an AWW benefit when their (insured) wife dies. As a consequence, widowers can claim an AWW benefit from 1 January 1988. The following therefore applies to men as well as women.

The group of insured persons is exactly the same as for the AOW. Analogous temporary provisions are at work and a voluntary insurance is also possible here (but only in combination with a voluntary insurance for the AOW). In addition, some specific groups of widows and orphans living abroad can claim an AWW benefit.

The AWW has four types of benefits. First, we have the high widows' pension for widows with at least one unmarried child younger than 18 living at home. The

benefit equals the amount a married couple receives from the AOW (and thus equals the net minimum wage since 1976). The high widows' pension ends if the widow no longer meets the conditions. If she meets the conditions for the low widows' pension, then her pension is transformed into this type of pension. If this is not the case, she can claim a temporary widows' pension. Second, we have the low widows' pension. If the widow cannot claim a high widows' pension, she may have the right to this type of widows' pension. This pension holds for widows who have at least one unmarried child, but no unmarried child younger than 18 living at home; for widows who were 40 years or older or were disabled at the time of the death of their husband; and for other widows who were 35, but not yet 40 years old on the last day of the month in which their husband died and have or have had an own child who was married or had died before her husband died, assuming that the widow was already 35 years old at the time the child married or died. The benefit amounts to 70% of the AOW benefit for married couples. The low widows' pension ends when the widow no longer meets the conditions, unless she was already at least 40 years old when her disablement ended or at least 35 years old when her last child married or died. In these last two cases, her low widows' pension continues. If it ends, she can claim the temporary widows' benefit. In all other cases, the widow can claim the third type when her husband dies, the temporary widows' benefit. The duration is 19 months at the most and depends on age. The benefit is paid for six months at least. If the widow is 27 years or older, then the benefit period is increased by one month for each year she is older than 27 years at the time of being widowed, taking into account the maximum period of 19 months. The amount of the benefit is also 70% of the AOW benefit for married couples. These three types of widows' benefits are always terminated in the month the widow reaches the age of 65 years. From that moment on, she can claim an AOW benefit. If the widow remarries, the widows' benefit is terminated.

The fourth and last type of AWW benefit is the orphans' pension. It is paid to full orphans up to and including the age of 15 years old (without any limitation), to disabled full orphans aged 16 and 17 years old, to full orphans aged 16 up to 27 years old, who are studying, and to full orphans in the same age category who run the household in which at least one other child can claim an orphans' pension. The amount depends on the orphan's age.

Family allowances. The purpose of the various family allowances is to provide additional income to ensure the standard of living of children up to a certain

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[70] See NCBS [99] and Elseviers ([33], pp 107–111).

age.[71] Until January 1979 a parent received family allowances without further conditions (on the understanding that he or she was insured) for children up to the age of 16 years. Since then, the age limit has been 18 years. If a child is older, but disabled or running the houshold or a student (up to 1 October 1986) the parent receives family allowances if the child is younger than 27 years old and the child is largely supported by his or her parents. From 1963 on, a parent can receive twice or even three times a family benefit for one child under certain conditions; it is then said that the child counts for two and three children respectively. A child counts for two children if the child is younger than 16 years old, lives outside the parental home for reasons of education or sickness and is largely supported by his or her parents (that is to say for 50% or more), or if the child is 16 or 17 years old, lives alone and is largely supported by his or her parents, or if the child is aged between 18 and 27 years old, is studying (up to 1 October 1986) or running the household, and is largely supported by the parents. Up to 1 October 1986, children living outside the parental home, who were studying and aged between 18 and 27 years old, counted for three children if they were supported completely or almost completely (that is to say for 90% or more) by their parents. From 1 January 1983, unemployed school-leavers aged 21 years old or younger can claim family allowances for six months.

The following family allowances acts have been incorporated in NEDYMAS: the Family Allowances Act (KW) and the Benefit Receiving Persons Family Allowances Act (KWR), which both applied in the period 1947–62; the Wage Earners Family Allowances Act (KWL) and the Self-Employed Persons Family Allowances Act (KKZ), which were both operative in the period 1963–79; the Civil Servants Family Allowances Provision (KTO), which was at work between 1947 and 1979; and the General Family Allowances Act (AKW), which has been in force since 1963.

The AKW provides family allowances from the first child on, from January 1980. Before that date, the AKW provided only family allowances for the third child and subsequent children (since 1963), and civil servants and teachers were excluded. These last two groups obtained no family allowances at all from the AKW. As a consequence of the extension in 1980, the KWL, KKZ and KTO were abolished. From 1 January 1979 on, the family allowance for the first child, if born after that date, was halved. Since 1 January 1983, the allowance has only been halved if no other children are present in the household. From

1982 on all family allowances were adjusted for the change in the price index figure of the consumption of employee families with two children, each half year. Since 1983 the benefit structure has been specified more and more. Among other things, the child's age, for example, now also determines the benefit.

The KKZ and KWL provided some groups of family allowances for the first two children between 1 January 1963 and 1 January 1980. Self-employed persons received family allowances for their first two children if their income was below a certain level. The income level for the second child was somewhat above that for the first child. Up to 1 July 1978 the benefit equalled the KWL benefit. While the tax deduction for children continued to exist for self-employed persons, while this deduction was abolished for other persons, the KKZ benefits have been below the KWL benefits since that date. The KWL provided family allowances for the first and second children of employees and persons who were on the same footing as employees. The last category almost coincides with persons who received a benefit from the ZW, the WAO, the AWW, the WWV, the WW, the AOW or the AWW. Civil servants and teachers were covered by the KTO. Benefits and premium payments were in accordance with the KWL and AKW. The group of insured persons for the KW is about the same as for the ZW (see that subsection). However, no income limit was in force. Civil servants were again excluded. The possibility of counting one child for two or three children did not yet exist. No benefits were paid for children aged 16 years or older, who were running the household. Family allowances were provided for each employee's working day and for each day for which the employee received a benefit from a social security act, without having worked. The KWR provided family allowances to persons receiving a benefit from the Disablement Act, the AOW or the AWW. The regulation was in accordance with the KW. Benefits were, however, paid for each month instead of each working day.

The General Disablement Benefits Act (AAW). The AAW took effect on 1 October 1976.[72] It is an insurance against the financial consequences of long-term disability. All residents up to the age of 65 and some groups of non-residents are compulsorily insured for the AAW. A benefit can be received from the age of 17. To receive a benefit at that age, a person has to have been disabled for at least one year and to be insured. If an individual becomes disabled after his or her 17th birthday, he or she receives a benefit if

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[71] See NCBS [99] and Elseviers ([33], pp 102–105).

[72] See NCBS [99], Elseviers ([33], pp 40, 56–68) and Ministerie van Sociale Zaken en Werkgelegenheid [90], p 19).

insured, if the disability has already existed for at least one year and if at the moment of becoming disabled, the person earned an income from or relating to labour, which exceeded a fixed minimal amount.[73] In all cases a person has to be disabled at least 25%. Married women did not have an independent right to a benefit until 1 January 1980, under the restriction that they became disabled on or after 1 October 1975. Before that time, married women could only claim a benefit if they were breadwinners.[74]

The level of the AAW benefit is determined by the AAW basis. Up to 1980 two bases existed:

(i) high AAW basis for married men and for non-married persons who had to support at least one child, aged 17 or under;
(ii) low AAW basis (which amounts to about 70% of the high AAW-basis, and as a consequence, from 1978 on, 70% of the net minimum wage) for all other rightful claimants.

From 1980 up to and including 1986, four AAW bases existed. The general AAW basis equals 70% of the net minimum wage, with the exception of persons up to the age of 21 years, for whom in accordance with the minimum youth wages, lower amounts apply. This general AAW basis applies to everybody, unless another AAW basis has been declared. The middle AAW basis applies to married persons and to non-married persons who take care of children younger than 18, on the condition that the insured person's income, augmented by his or her partner's income (if present) amounts to at least 15% and at most 30% of the maximum AAW basis on the first day at which AAW benefit can be claimed. In this case the AAW benefit amounts to 85% of the net minimum wage. If the aforementioned sum of incomes amounts to less than 15% of the maximum AAW basis, then a person receives the maximum AAW basis, which equals the net minimum wage. Last there is an individual AAW basis. This AAW basis applies to persons who worked part-time during the year preceding the day they became disabled and whose benefit would amount to more than 80% of their income during that year. They receive 80% of this income.

From 1 January 1987 only one AAW basis has been in operation: the general AAW basis. Everyone receives 70% of the net minimum wage. If necessary,

a person can appeal to the Supplementary Benefits Act. A temporary provision applies to one-parent families. If they received a higher benefit on 31 December 1986, a supplementary benefit is paid of up to 100% of the net minimum wage. For persons up to the age of 23 years, the amounts in accordance with the minimum youth wages remain in force.

In addition to the AAW basis, the AAW benefit is determined by the degree of disablement. The AAW benefit amounts to the AAW basis times a proportion, which depends on the degree of disablement. The benefit is terminated if the degree of disability drops below 25%, or when a person reaches the age of 65 years, or dies, or – being a widow – if she can claim an AWW benefit. If a person who receives an AAW benefit dies, his or her next of kin receives a death benefit under certain conditions. The death benefit equals the AAW benefit during the remaining part of the month in which the person died plus two extra months.

The AAW also has the possibility of creating provisions which serve for maintenance, recuperation or benefit for disability, or for improvement in living conditions. People who do not receive a benefit, but are insured, can also claim this kind of provision.

The Disablement Insurance Act (WAO). The WAO became operative on 1 July 1967.[75] The law provided for the financial consequences of long-term disablement for employees up to the moment at which the AAW came into force. Since that time – 1 October 1976 – both the AAW and the WAO provide for the financial consequences of disablement. For employees who became disabled after 1 October 1976, the WAO is a supplementary benefit. All persons who are insured for the ZW and persons who receive a WWV benefit are insured. Employees above the age of 65 are not insured. This also holds for persons who participate in the Civil Servants Pensions fund.

All employees who have been disabled for 52 weeks and whose degree of disablement is at least 15% can claim a WAO benefit. The level of the benefit depends on the degree of disablement and on the daily wage. The daily wage is the wage earned on average per day in the profession practised in the year before becoming disabled. The level of the benefit is maximized by the fact that a maximum daily wage exists for the WAO. Nowadays, the benefit is at most 70% of the daily wage. From 1969 up to 1987 breadwinners with a degree of disability of more than 80% also had a

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[73] On this last condition, several exceptions exist, among others for students, unmarried persons and self-employed persons.
[74] A verdict of the Centrale Raad van Beroep has laid these limitations for married women open to criticism. The consequences are not fully clear at the moment. In any case, women who were already disabled before 1979 can claim a benefit, if they were not breadwinners.

[75] See NCBS [99], Elseviers ([33], pp 68–70) and Ministerie van Sociale Zaken en Werkgelegenheid [90], pp 20–22).

minimum benefit.[76] The benefit is index-linked with the wages.

The benefit ends if the degree of disablement drops below 15%, if the benefit recipient turns 65 years or if he or she dies. The revision of the social security system in 1987 also implied a re-examination of disabled persons aged 35 or less. Persons who become disabled after 1 January 1987 and are less than 80% disabled, are considered to be unemployed to the extent that they are not disabled.[77] This also holds for those re-examined disabled persons whose degree of disablement is readjusted downwards. A person can claim an NWW benefit if he or she worked for at least half a year before becoming disabled. For any additional claims after that period, see under the NWW. A person then has a right to a partial Continued Benefit in view of the NWW for one year maximum. Later, additional benefit from the IOAW can be claimed. The level of the partial Continued Benefit from the NWW and the AAW/WAO benefit amounts to 70% of the last earned wage income (which is index linked). It is also possible to claim an additional benefit from the TW.

Until the AAW became operative, the WAO also had provisions which served for maintenance, re-cuperation or benefit for disability or for improving living conditions. If a person who receives a WAO benefit dies, his or her next of kin receives a death benefit under certain conditions. The death benefit equals the WAO benefit during the remaining part of the month in which the person died plus two extra months.

The Sickness Benefit Act (ZW) and Sickness Payments for Civil Servants (DSO). The ZW became operative in 1930 and is the oldest provision discussed.[78] Its goal is to insure employees up to the age of 65 against the financial consequences of not being able to work as a result of disability, accident (from 1 July 1967 on) or sickness.[79] (Sickness also includes pregnancy and childbirth.) For the concept of the employee, see Elseviers ([33], p 16). As a consequence, unemployed persons who receive a WW or an NWW benefit have to claim a ZW benefit in case of sickness. Civil servants cannot claim a ZW benefit. For them, the DSO is

operative. Before 1 July 1967, a ZW benefit could only be claimed if income was below a fixed upper limit, the so-called maximum wage limit.

The benefit amounted to 80% of the daily wage up to 1 May 1985, 75% between 1 May 1985 and 1 January 1986 and 70% afterwards. From 1969 up to 1987 a minimum wage guarantee existed during the first six weeks of sickness, on the condition that the individual was married or took care of a child aged 17 or younger, and that his or her income, augmented by the partner's income, amounted to less than 93.75% of the minimum wage. From 1 January 1987, a person has to claim a benefit from the TW in this case. The benefit is limited by the maximum premium income. The benefit starts the third day after the day the sickness (or disablement or accident) took place. The maximum benefit duration is one year. After that year a person falls under the WAO or AAW or the disablement pension of the Civil Servants Pensions Fund. Before the introduction of the WAO, the Disablement Act or the Temporary Act or Disablement Pension Receivers applied.

Employers are allowed to give a supplement to the ZW benefit of up to 100% of the daily wage and to pay the first two days which are not paid by the ZW. This supplement is called the supplementary benefit.

If a person who receives a ZW benefit dies, his or her next of kin receives a death benefit from the ZW under certain conditions. The death benefit amounts to 100% of the daily wage during the remaining part of the month in which the person died, plus two extra months. The ZW considers pregnancy and childbirth benefits to be a specific element of the sickness benefit. Generally, a benefit which equals the daily wage is paid during six weeks before childbirth and six weeks after childbirth. The ZW allows for the possibility of a part-time resumption of work. The ZW benefit will then be reduced for that part. As above, civil servants have a settlement of their own: the DSO. The DSO is more or less in accordance with the ZW. However, the benefit is 100% and the first two days of sickness are also paid and its maximum duration is 1.5 years (as opposed to 1 year).

The Unemployment Insurance Act (WW). The WW, which came into force on 1 July 1952, insured employees against the financial consequences of involuntary unemployment.[80] On 1 January 1987, the WW was incorporated into the NWW. All employees up to 65 years old were insured. Before 1957 people aged 65 years and older were also insured. Civil servants were excluded. Separate settlements existed

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[76] From 1987 on, the minimum daily wage for this group is guaranteed by the Supplementary Benefits Act.

[77] Before that time, the possibility existed to increase the degree of disability if labour market circumstances were bad, the so-called *verdiscontering*.

[78] See NCBS [99] and Elseviers ([33], pp 49–56).

[79] Before 1 July 1967, the financial consequences of accidents were covered by the Accident Insurance Act and those of disablement by the Disablement Act or the Temporary Act for Disablement Pension Receivers. We will not report on these acts for lack of sufficient data.

[80] See NCBS [99] and Elseviers ([33], pp 77–91).

for this category. Until 1965 a maximum wage limit existed, which was identical to the maximum wage limit for the ZW.

The WW consisted of three parts: the unemployment insurance for persons belonging to a particular branch of industry,[81] the general unemployment insurance for employees, and the insurance against the risk of unemployment due to weather conditions.

The first insurance was for employees who belonged to a given branch of industry. During their unemployment period, they were included in the labour pool of that sector. A person was entitled to a benefit from this type of insurance if he or she had been employed by employers who were members of the trade association in question for at least 130 days during the previous 12 months. The maximum benefit period was eight weeks in a period of 12 months. Until 1 January 1985 the level of the benefit was 80% of the employee's daily wage. From that date on, the benefit amounted to 70% of the daily wage. As was the case for the WAO and ZW a maximum benefit existed which was determined by the benefit percentage and the maximum premium income. Since 1969 a minimum benefit level has existed for breadwinners.

The second insurance, the general unemployment insurance for employees, held for those employees who were not eligible for the first type of unemployment insurance (because they did not belong to the labour pool of that sector), and for those unemployed persons whose maximum period for the first type of unemployment insurance had expired, or who had already used their eight weeks during a preceding period of unemployment. Here also an employee had to be employed during at least 130 days during the previous 12 months. The maximum duration was 26 weeks a year; this figure was reduced by the period for which the first type of insurance benefit was received. The level equalled that for the first type.

Unemployment due to weather conditions was a particular type of unemployment, which differed between sectors of industry. A recipient had to have paid a premium for at least 120 days during the previous 12 months in order to receive a benefit. The benefit amounted to 110% of the hourly wage rate.

Recipients of a WW benefit were insured for the ZW. In case of sickness, the unemployment benefit was replaced by a ZW benefit. If a person who received a WW benefit died, his or her next of kin received a death benefit under certain conditions from the ZW. The death benefit equalled the WW benefit during the remaining part of the month in which the person died plus two extra months.

In March 1974 a settlement for supplementary payments to wage income was introduced. If a person accepted a job with a lower income, he or she received a supplementary payment up to this income level.

The Unemployment Provisions Act (WWV). The WWV was in force between 1965 and 1987.[82] When an employee (no longer) had a claim on the WW, he or she could be eligible for a WWV benefit. To claim a WWV benefit an employee had to be employed at least during the last six weeks before being unemployed or during 130 days in the year previous to the time of becoming unemployed. The benefit duration was two years in the first instance. If an employee reached the age of 60 years after these two years, WWV benefit was prolonged up to the retirement age of 65 years.

From 22 June 1983 onwards, young people up to the age of 23 had to have been employed for at least 130 weeks in the three years preceding their unemployment. Their benefit duration was limited to one year at most. Since 1 May 1985 benefit duration depended on age. Persons up to 23 could claim a benefit for six months at most, persons aged 23 to 30 for one year, persons aged 30 to 35 for 18 months and older people for two years. If a person had been employed for 4.5 years during the previous six years, six months were added to the period. If a person had reached the age of 60 years at the end of the benefit period, the WWV benefit was prolonged up to the age of 65 years, but the level of the benefit was limited to the net minimum wage for breadwinners and to 70% of the net minimum wage for others.

The benefit amounted to 75% of the daily wage until 1 January 1985 and 70% after this year up to the maximum premium income. From 3 November 1969 a minimum daily wage was in force for breadwinners. The settlement for supplementary payments to wage income – if an employee accepted a job with a lower income – was also applied in the WWV. Married women could only claim a benefit from 1 October 1976. Up to 24 December 1984, married women only received a benefit if they were breadwinners. If a person died, his or her next of kin received a death benefit from the ZW under certain conditions. The death benefit equalled the WWV benefit during the remaining part of the month in which the person died plus two extra months.

When the NWW became operative, the WWV was abrogated.

The New Unemployment Insurance Act (NWW). On 1 January 1987, the WW and the WWV were replaced

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[81] In Dutch, the *wachtgeldverzekering*.

[82] See NCBS [99] and Elseviers ([33], pp 91–101).

by the NWW.[83] The group of insured persons did not change. The main difference between the NWW and its predecessors is the dependence of the duration of the benefit on the number of years an employee has worked before becoming unemployed. In addition, the NWW has the possibility of voluntary insurance for, among others, development workers, employees who are employed abroad by a Dutch employer and housekeepers who are not insured compulsorily. The minimum benefit for breadwinners is abolished and replaced by the TW. The level of the benefit amounts to 70% of the daily wage and is limited by the maximum premium income.

Persons who become unemployed on or after 1 January 1987 are entitled to an NWW benefit if they were employed for at least 26 weeks in the year preceding the time of unemployment. In that case benefit can be claimed for half a year. To be eligible for a benefit over a longer period, a person has to be employed for three years in the five years preceding the time of becoming unemployed. If a person does not work in order to take care of children up to the age of 6 these years are considered as years worked; if the children are aged 6 to 12, half of these years count as years worked. Persons up to the age of 23 can only receive a benefit for longer than a half year, if they were employed for five years without interruption before they became unemployed. In that case their benefit is prolonged by three months. The extra duration of the NWW benefit for persons aged 23 and older (who have been employed for three years during the last five years) depends on their labour history. Labour history has been defined as the individual's age minus 23 years plus the number of years the individual was employed during the previous five years. If the labour history is between five and ten years, the benefit duration is prolonged by three months, and the total duration is consequently nine months. If the labour history is 10 to 15 years, the extra duration is a half year. In case of labour histories of 15 to 20 years, 20 to 25 years, 25 to 30 years, 30 to 35 years and 35 to 40 years, the extra duration amounts to one year, eighteen months, two years, two and a half years and three and a half years respectively. If the labour history is longer than 40 years, then the extra duration is four and a half years.

When the NWW benefit ends and a person meets the requirement of having been employed for three years (five years for persons up to the age of 23) during the last five years before unemployment, and a person is still unemployed, Continued Benefit under the NWW can be claimed for a year. The Continued

Benefit amounts to 70% of the minimum wage. The partner's income, if there is any does not affect the benefit. If a person is 57.5 years or older when the Continued Benefit starts, this Continued Benefit can be claimed up to the age of 65. If the continued Benefit under the NWW ends and the individual is still unemployed, he or she is normally entitled to the Governmental Group Provision for the Unemployed, the RWW. This does not hold for persons who received a Continued Benefit and were already 50 years or older when they became unemployed and for persons who did not receive a Continued Benefit, but were already 57.5 years or older when they stopped working. These two groups can claim an IOAW benefit.

Persons receiving a WW or WWV benefit on 31 December 1986 cannot claim a Continued Benefit under the NWW. However, if their WW or WWV benefit was more than 70% of their last earned wage income (for example as a consequence of the provisions for breadwinners), this higher benefit is prolonged during the NWW period.

If a person who receives an NWW benefit dies, his or her next of kin receives a death benefit from the ZW under certain conditions. The death benefit equals the NWW benefit during the remaining part of the month in which the person died plus two extra months.

The Provision for Older and Partly Disabled Unemployed Employees (IOAW). The IOAW took effect on 1 January 1987.[84] This provision is aimed at two groups of former employees. First, it is an extra provision for older long-serving unemployed employees, who have already received an NWW benefit (including Continued Benefits) for the maximum period and who were at least 50 on their first day of unemployment. If individuals are aged 57.5 years or older, they will only receive an IOAW benefit if they were employed for less than three years during the five years before they became unemployed. If they were unemployed for three years or more during these five years, they keep the Continued Benefits under the NWW until they reach the age of 65. Persons aged between 50 and 57.5 years at the time they become unemployed enter the IOAW when the Continued Benefits ends. As a temporary provision, people who were aged between 47.5 and 50 receive an IOAW benefit when their NWW expires. Second, the IOAW covers partly disabled employees who are unemployed for the non-disabled portion, irrespective of age. These people will receive an IOAW benefit when the NWW benefit (the Continued Benefits included) has ended.

Under the IOAW an individual is entitled to a(n)

[83] See Ministerie van Sociale Zaken en Werkgelegenheid ([90], pp 4–5, 8–11, 13–18).

[84] See Ministerie van Sociale Zaken en Werkgelegenheid ([90], pp 8, 10, 16, 25–26).

(additional) benefit up to the level of the social minimum. An individual only receives the benefit if the sum of his or her labour income plus the partner's labour income is below the social minimum. For the first two years 30% of own labour income and partner's labour income is exempt, but the exempt amount is limited to 15% of the social minimum. The advantage of the IOAW in comparison with the ABW – under which other long-serving employed persons fall – is that property is not taken into consideration.

The Supplementary Benefits Act (TW). The TW supplements NWW benefit, WAO benefit, AAW benefit and ZW benefit to the social minimum, but never above the last earned wage.[85] All additional income, including the partner's income, is taken into consideration, excluding property. Part of the labour income is exempt for two years, unless the person was 57.5 years or older at the time of becoming unemployed. In the latter case, the exemption has no maximum period. The exemption is 100% for incomes up to a sum of 5% of the minimum wage. Between 5 and 15% of the minimum wage, 30% of the income is exempt. If a person dies, a death benefit under the ZW is received by the heir, analogously with, for example, the NWW.

The General Social Assistance Act (ABW). The ABW, which took effect on 1 January 1965, obliges the state to provide financial support to every resident who ends up in such a situation that he or she has insufficient means to meet the necessary costs of living.[86] An ABW benefit is only received as a last resort. ABW is therefore the final safety net of the Dutch social security system.

Conditions of benefit receipt do exist. It is assumed that each individual is responsible for his or her own livelihood. Unemployed persons and school-leavers therefore have an obligation to look for an appropriate job in order to be eligible for an ABW benefit, unless medical, social or other reasons make it impossible to do so. As a consequence, a recipient has to be registered at the Regional Labour Exchange. If this is not the case, ABW benefit can be reduced or even be terminated.

The level of the ABW benefit is determined by the concept of 'necessary costs of living'. The benefit, based on this concept, is fixed for individuals or for specific groups. Recipients can be divided into three groups: National Group Regulations, assistance for

people living at home and assistance for persons not living at home.

The group-oriented treatment of benefit recipients is regulated in the National Group Regulations. At the moment, the following National Group Regulations apply:

(i) the National Group Regulation War Victims 1940–45;
(ii) the National Group Regulation Repatriates;
(iii) the National Group Regulation Amboinese;
(iv) the National Group Regulation Unemployed Persons;
(v) the National Group Regulation Self-Employed Persons;
(vi) the National Group Regulation Homeless Persons;
(vii) the National Group Regulation Deduction Old Age Provisions for Special Groups;
(viii) the National Group Regulation Elderly Self-Employed Persons.

Two pieces of legislation apply that have an additional purpose and cannot be fully considered to be National Group regulations: the Decree to Employers of Inland Navigation and the Decree to Caravan-Dwellers.

From 1 July 1974, general rules for the determination of the level of the benefit are given on the basis of the Decree National Standards Public Assistance. Before that time, no unequivocal interpretation of the concept of necessary costs of living existed and the level of the benefit differed from place to place. The decree does not hold for the National Group Regulation War Victims 1940–45, the National Group Regulation Amboinese and the National Group Regulation Homeless Persons. A specific benefit structure applies for these groups. The benefits, fixed in view of the Decree National Standards Public Assistance also hold for the assistance for persons living at home. The net minimum wage is the standard. Married and cohabiting couples receive 100% of the net minimum wage. One-parent families receive 90% and single persons above the age of 22 receive 70%. Single persons up to the age of 23 receive 70% of the minimum youth wages. If a person is 20 or younger and living in the parental home, he or she receives an adjusted (lower) benefit. Single people who share a household, and are not living in a consensual union, receive a reduction in their benefit.[87]

The Decree also regulates the extent to which the benefit is reduced by own income and property. For this, the household is the central unit, not the person who receives the benefit. The ABW has the

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[85] See Ministerie van Sociale Zaken en Werkgelegenheid ([90], p 26).
[86] See NCBS [99] and Elseviers ([33], pp 203–215).

[87] In Dutch *voordeurdelers* ([33)], pp 129–145).

option of providing costs which exceed the current cost of living. This is called Incidental Assistance.

The benefits for persons not living at home are actually a way of indirect financing of social or medical services. The benefit has three components: costs of necessary nursing and medical attendance, a premium for the health insurances and an amount for personal expenditure.

The Health Insurance Act (ZFW).[88] The ZFW is the substitute for the Decree on the Health Insurance and the Health Insurance Act for the Aged. The ZFW became operative on 1 January 1966. As a consequence, the compulsory sickness fund insurance, the voluntary sickness fund insurance and the sickness fund insurance for the aged were combined in one act. The ZFW regulates the provision of medical and surgical treatment (or its compensation). Compulsorily insured persons are insured by law. Up to 1987 the ZFW distinguished between four types of insurance: the three types discussed above and additional insurance. Voluntary insurance and insurance for the aged were abolished in 1987. About 65% of the Dutch population is covered by the ZFW.

Compulsorily insured persons for the ZW and a number of persons who are put on the same footing – like persons who receive a WAO benefit – are also compulsorily insured for the ZFW, on condition that their income is below the maximum wage threshold that obtains for the ZFW. The comparable income for people receiving a WW benefit and for disabled persons is the income on the basis of which their benefit has been determined. The compulsory insurance also holds for people receiving a WWV benefit or a benefit from the National Group Regulation Unemployed Persons. The ZFW also insures family members under certain conditions: spouses and children up to 16 (27 if disabled or – until 1987 – students) and living in the same household as the directly insured person. From 1 January 1988, unmarried cohabiting persons are treated as married couples. From 1987 on, a person remains compulsory insured if he or she reaches the age of 65, whereas before 1987 this was not the case. If a person was not been compulsorily insured and income was below the wage threshold, such a person could insure him or herself voluntarily for the ZFW up to 1987. The insurance for the aged offered aged persons the possibility of joining the ZFW if their income was below a certain income limit (which was considerably lower than the above-mentioned wage threshold), for a limited premium. Aged persons with an income between the two limits, were allowed to

enter the voluntary insurance. The additional insurance offered the possibility of insuring against risks which were not (completely) covered by the sickness fund.

The General Exceptional Medical Expenses Act (AWBZ). The AWBZ is an insurance against the financial consequences of special health costs arising from the need for long-term medical attendance, which generally are not covered by the ZFW and private health insurances.[89] The AWBZ is a general nationwide insurance. All residents are insured and no age limits are in force. Like the ZFW, the AWBZ is characterized by provisions in kind. The AWBZ came into operation in 1968. Its main purpose was to bear the heavy burden, which is often a consequence of a long illness, such as long-stay care in a nursing home or a home for mentally or physically handicapped persons. Subsequently, other types of care, with a less severe financial burden, such as aid by the Regional Institutions for Ambulant Mental Health Services,[90] were included in the AWBZ.

The AWBZ can be considered complementary to the ZFW. Generally, the costs for maintenance in hospitals, institutions and so on are reimbursed by the ZFW or private health insurance companies during the first year, after which the costs are borne by the AWBZ. The recipient has to pay a part of the costs for some facilities. These contributions have depended on income since 1 January 1983.

The Civil Servants Unemployment Benefit (WRO). A number of types of benefit exist for the civil servant who is dismissed and therefore becomes unemployed. The kind of benefit received depends on the nature and the length of the contract, the reason for the dismissal and so on. We limit ourselves to the central issues of the Decree Civil Servants Unemployment Benefits 1959 and the Civil Servants Unemployment Benefit Provision 1966.[91] Persons working under a contract for six months or less are not considered as civil servants, but as employees. They receive a WW benefit or a WWV benefit or a NWW benefit.

A civil servant with a permanent appointment can claim a benefit from the Decree Civil Servants Unemployment Benefits 1959 if he or she has been dismissed for reasons of discontinuance of the position, for reasons of reorganization, for reasons of strong objections against a transfer, for reasons of apparent impossibility of replacement after returning from fixed

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[88] See NCBS [99] and Elseviers ([33], pp 129–145).

[89] See NCBS [99] and Elseviers ([33], pp 145–153).
[90] RIAGG's in Dutch.
[91] Rijkswachtgeldbesluit 1959 and Uitkeringsregeling 1966 respectively.

types of special leave with a long duration or non-activity, or for reasons of incapacity to occupy the position (not including medical grounds).

If the civil servant only had a temporary appointment, he or she can also claim a benefit from the Decree Civil Servants Unemployment Benefits 1959, if he or she was dismissed for the reasons given above, with the exclusion of the last one. If he or she was dismissed for other reasons, the civil servant can claim a benefit from the Civil Servants Unemployment Benefit Provision 1966.

The duration of the benefit under the Decree Civil Servants Unemployment Benefits 1959 depends on the age and the term of service on and up to the day of dismissal. The duration is three months at minimum. Up to the age of 21, these three months are increased by 18% of the term of service. The percentage is then increased by 1.5% for each year of age above 20. If age plus term of service amounts to more than 60 years and the term of service is 10 years, at minimum, then the benefit lasts until the month in which the recipient is 65.

Until 1 January 1985, the benefit amounted to 100% of the salary on the day of dismissal for the first three months. After the first three months the benefit was reduced to 90% for nine months and thereafter to 80%. From 1985 on the percentages decreased by 10 percentage points. As a consequence of the pre-tax decline of the salaries by 3% on 1 January 1984, an extra allowance of 3% was added to the benefit for a further five years.

The Civil Servants Unemployment Benefit Provision 1966 distinguishes between long- and short-term benefits. A civil servant can claim a long-term benefit if his or her term of service has been for at least three years. If the term of service has been interrupted for one month or longer, the claim expires. A term of service which has been used for a benefit once has to start again. The duration of the benefit is for one-sixth part of the term of service for a maximum of six months. The duration of the benefit is prolonged by six months if the term of service amounts to more than 10 years and the sum of age and term of service amounts to at least 60 years. During the first two months, the level of the benefit equals 90% of the last earned salary, the following two months to 80% and for the rest of the period it is 70%. The short-term benefit under the Civil Servants Unemployment Benefit Provision 1966 has a duration of six months and amounts to 70% of the last earned salary. In both types of benefit under the Civil Servants Unemployment Benefit Provision 1966, an extra allowance of 3% is also given from 1 January 1984.

For all benefits under the Decree Civil Servants Unemployment Benefits 1959 and the Civil Servants Unemployment Benefit Provision 1966 it holds that if a person receives income from sources which have arisen after unemployment benefit is reduced for that part of the income which – together with the benefit – exceeds the former salary. The benefits are financed by public funds.

Pension provisions for civil servants. Civil servants receive additional provisions for pensions such as those for old age, disability, widowhood, widowerhood and orphanhood. All these pensions are administered by the Civil Servants Pensions Fund (ABP). Persons who became civil servants after 1965 have to earn a fixed minimum salary before they are included in the ABP. If people receive a benefit under the settlements treated under the WRO, the benefit period counts for the pension rights. In the case of early retirement, this period counts for a half, whereas in the case of disability the period counts for the proportion for which a person was disabled.

A person receives an old age pension (OP-ABP) on reaching the age of 65. The level of the old age pension is determined by the term of service, the rate and the so-called middle sum. For the calculation of the pension, 40 years of service is the maximum which is taken into consideration. The rate is the proportion by which the term of service is multiplied. Generally, the rate is 1.75%. A term of service of 40 years or more therefore generates an old age pension of 70%. The resulting percentage is multiplied by the middle sum. By and large the middle sum equals the average salary during the two last but one calendar years before retirement or discharge. The middle sum is indexed. While civil servants also receive an AOW benefit, this benefit is built in to the civil servant's pension. For each year of the term of service, 2% of the AOW benefit is built in. After a term of service of 40 years, this implies that 80% of the AOW benefit is considered to form part of the civil servant's pension and he or she receives, on top of the ABP pension, 20% of the AOW benefit.

The civil servant who is dismissed for reasons of continual sickness or incapacity can claim a disability pension under the ABP (IP-ABP). The calculation of the level of the benefit is analogous to the old age pension: the term of service times the rate times the middle sum. This amount is compared with the amount which results from multiplying the middle sum with a proportion which depends on the degree of disability. The largest of the amounts will be paid as a disability pension. In view of the salary reduction on 1 January 1984, an extra allowance has been paid since that time. For those who became disabled after 1 October 1976, the IP-ABP is a supplementary pension (to the AAW).

The widow of a civil servant, a former civil servant or a retired civil servant is entitled to a widow's pension under the ABP (WP-ABP). Her pension amounts to 5/7 of the husband's pension or the pension he could have claimed. If the husband dies before he reaches the age of 65 years, the widow's pension is calculated on the basis of the term of service her husband would have served had he reached the age of 65 years. If the widow remarries, the widow's pension continues, but now only includes the actual term of service. The divorced wife of a deceased civil servant can only claim a benefit if the divorce took place after 1 October 1971. Her pension is based on the term of service up to the day of the divorce. If the civil servant had remarried, the second wife's benefit was reduced by the amount the former wife receives.

A widower's pension (also WP-ABP) is paid if the widower's wife was a civil servant, a former civil servant or a retired civil servant, and if she was the breadwinner and the widower is disabled at least 50%. The level of the benefit is determined in the same way as for the widow's pension.

The orphan's pension is calculated analogously. It amounts to 1/7 for semi-orphans and 2/7 of the civil servant's pension for full orphans. Orphans' pensions for a widower's children can only be claimed if the widower receives a widower's pension. The total amount of the widows', widowers' and orphans' pensions is never allowed to exceed the old age pension from which it is derived. An AWW or AOW benefit is built into the widows', widowers' and orphans' pension.

The social security premiums

The social security premiums are levied as follows.

AOW and AWW. These premiums are levied on the so-called premium income for the general insurances up to 1990. From 1990 on the premium is based on taxable income. The premium is a percentage, up to the maximum premium income, which from 1990 on equals the upper limit of the first income tax group. Self-employed persons with an income below a fixed amount receive an integral or a partial reduction. This reduction is financed by the government. Until 1 April 1985, the wife's income was added to her husband's income and the AOW/AWW premium was levied on this sum (up to the maximum premium income). If the woman's income was larger than her husband's, it was possible to take the woman's income as the starting point.[92] Since then, the AOW/AWW premium has been levied on each income separately and the

maximum premium income also holds for both incomes separately.

Family allowances. All residents who have reached the age of 15 are insured under the AKW. In addition to this, some groups of non-residents are insured. Insured persons have to pay premiums up to the age of 65. For employees, the premium was paid by the employer up to 1 July 1988, and afterwards the premium was financed by public funds. Self-employed people have to pay for themselves. Deductions similar to the payment for AOW and AWW hold for this group. Women who are 45 years or older and who do not have children are exempt from premium payments on their non-labour income. The employees' premiums for the KWL were paid by their employers and for the other group the premiums were financed by public funds. The same maximum premium income as for the AKW, applied here. The KW premium was paid by the employer and amounted to a percentage of the daily wage (up to a maximum, which equals the maximum premium income for the ZFW). The KKZ, KWR and KTO benefits were financed by public funds.

AAW. Premiums had to be paid by all insured persons between 15 and 65 up to 1990. For employees, premiums were paid by the employer up to 1990. Since 1990 the AAW premium has to be paid by the employee. The employee receives a compensation for this amount from the employer. Up to 1990, the premium was a percentage of the so-called premium income for the general insurances and from 1990 on it has been levied on the taxable income. Analogous to the AOW and AWW, a maximum premium income exists, which is the same for all general insurances. For self-employed persons, the same procedure holds as for the AOW, AWW and AKW.

WAO. WAO premiums are paid by both employer and employee. Since 1981 the employee's part has been the larger. Before that year employers paid the largest part. Premiums are levied proportionally up to a maximum income, which is the same as for the ZW. A franchise has been free of payment, since 1977.[93]

ZW and DSO. The ZW premium is a percentage of the wage, up to a maximum (the maximum premium income). The premium differs between branches of industry and depends on the risk of sickness in the various branches. The employer pays the premium, but is allowed to deduct half the premium, up to 1%

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[92] Generally, this has fiscal advantages.

[93] As a consequence of the introduction of the AAW which governs the lower benefit part for employees.

at most from the employee's wage. If the employer has provided supplementary benefits, the Ministry of Social Affairs can agree to deduct more than 1%. The DSO is financed by public funds.

WW. The premium for the unemployment insurance for persons belonging to a particular branch of industry was fixed for each branch of industry by the trade association, which carried the insurance risk. Employers and employees each paid half the premium. The premium for the general unemployment insurance for employees did not differ between sectors, being a uniform rate. Both employers and employees had to pay a part of the premium. The premium for the unemployment due to weather conditions differed between branches of industry and was paid by the employer.

WWV. The WWV was financed from public funds and thus no premium levies were applicable.

NWW. Premiums have to be paid by the employer and by the employee. The premiums are a percentage of the income and are also limited by the premium income.

IOAW, TW and ABW. These benefits are financed by public funds.

ZFW. Until 1989 the ZFW premium for the compulsory insurance was a percentage of the wage income up to the ZFW premium income limit. Since 1989 the ZFW premium has been in part a fixed amount per household member (for each adult and at most two children) and the remaining part is a percentage of the wage income up to the ZFW premium income limit. Employers and employees each paid half the amount until 1989. Since then employers have paid about 1.5 times the amount paid by employees.

The other insurances had fixed premiums. Reductions were possible in the voluntary insurance, whereas the premium in insurance for the aged also depended on income.

Since 1987 aged persons can also be compulsorily insured. They pay a lower premium percentage for their AOW benefit.

AWBZ. Premiums are paid by all insured persons aged between 15 and 65. Up to 1990 premiums were paid by the employer. Since 1990 the AWBZ premium has to be paid by the employee, who receives a compensation for this amount from the employer. From 1990 on, persons older than 64 also have to pay AWBZ premiums, for which their income is adjusted. Up to 1990 the premium was a percentage of the

so-called premium income for the general insurances and since 1990 it has been levied on taxable income. Analogous to the AOW and AWW, a maximum premium income exists, which is the same for all general insurances. For self-employed persons, the same procedure holds as for the AOW, AWW and AKW.

Private pensions for employees. The Netherlands has a large variety of arrangements which offer employees the possibility of retiring at a given age.[94] In view of the large number of types of arrangements, it is not possible to include all arrangements in our model. We must therefore limit ourselves to modelling a more or less average pension premium. This is necessary because the private pension premium also determines the income on which the social security premiums are levied. We do not consider the benefits, because the model does not take account of employees' labour mobility. The necessary information on pension claims is also lacking at the macro level. The pension premium is levied as a percentage of income, up to a fixed maximum amount. A franchise has been built in to cover AOW claims.

Pension provisions for civil servants. The pension premium is paid by employer and employee. The employee pays a fixed percentage of his or her salary reduced by a franchise. The premium payment, however, has to be at least a certain percentage of salary.

The Civil Servants Deduction Act (IW). The IW became operative in 1981. The IW aims at equal treatment of civil servants and private employees for social security premiums. Civil servants do not pay premiums for the ZW, the WAO, the WW and the NWW and their benefits in this field are financed by public funds. The IW corrects the civil servants' income developments for changes in the premiums for these social security provisions in so far as they are paid by the employees. The IW is completely included in NEDYMAS.

The implementation of the social security system in NEDYMAS

The social security system is almost completely built into our model NEDYMAS. The only exceptions are listed below.

For the AOW:

(i) The exceptions for residents and non-residents, as mentioned in note 68. Residents are considered to be insured; non-residents are not insured.

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[94] See Elseviers ([33], p 116).

(ii) The provisions for immigrants are only partly taken into account.

(iii) Voluntary premium payments by emigrants are not taken into account.

(iv) The provision, in force up to 1 January 1987, that married females who were the breadwinners and whose husbands were disabled and had not yet reached the age of 65 could claim an AOW benefit when they were 65 or older, has not been modelled.

For the AWW:

(i) A number of very specific provisions for widows and orphans living abroad.

(ii) The settlements for residents and non-residents and the provisions for immigrants are treated in the same way as for the AOW.

(iii) The voluntary premium payments by emigrants are not taken into account.

For the family allowances:

(i) While the Disablement Act is not an element of NEDYMAS, it is not possible to determine family allowances for people receiving a benefit from the Disablement Act.

(ii) For children in full-time education aged 16 years and older, only grants were considered as income and this determines the extent to which these children are supported by their parents. Up to and including 1985, the level of a grant influenced claims for family allowances. Therefore, we also have to simulate grants. That has been done in a rather crude way. It is assumed that a student can receive a grant for at most six years. It is also assumed that for 60% of the students who can claim a grant, the amount of the grant is such that these students count for one child for family allowances, whereas the other 40% receive a limited amount, such that these students can claim family allowances for two children (under the condition that they are not living with their parents). The probability of receiving a scholarship is determined using NCBS [98,105], the inflow into vocational colleges and university education, parental income and the number of persons in the model population who already receive a grant.

(iii) It is also assumed that children running the household have no income, whereas disabled children only receive an AAW benefit (from 1 October 1976 on).

(iv) The group of non-residents who are insured for the AKW, are not included.

For the AAW:

(i) The model NEDYMAS does not take into account the category of non-resident persons who are insured for the AAW and the additional provisions.

(ii) The same applies to the minimum income condition for persons who become disabled after the age of 17. The impact of this is very limited in practice.

(iii) The individual AAW basis has not been included in the model.

(iv) Inflow into the AAW (and also WAO) goes via the ZW for employees and via the DSO for civil servants, whereas other people flow in via state transitions. The effect of socioeconomic characteristics on the absence from work for illness (at employees and civil servants) has been incorporated by distinguishing duration of sickness by level of education (primary school, junior (vocational) training, secondary (vocational) training, vocational colleges and university), in which a correction was made for age and sex composition. The figures are derived from Van den Brekel ([16], Table 5). These figures have not been applied for persons who become disabled via state transitions.

For the WAO:

(i) NEDYMAS contains all elements with the exception of the provisions and the re-examination of disabled persons in 1987.[95]

(ii) The effect of socioeconomic characteristics on the absence from work for illness has been incorporated by distinguishing duration of sickness by level of education in the same way as for the AAW.

For the ZW and DSO:

(i) NEDYMAS assumes that the ZW benefit is supplied by the employer up to 100% and that the employer also pays the first two days.[96]

(ii) It does not take account of the possibility of a part-time resumption of work.

(iii) No differentiation has been made in premiums between various branches of industry. The average premium percentage has been used.

(iv) The inflow into the ZW and DSO is based on the number of sicknesses by age, sex and duration in firms for which the trade association takes care of the ZW benefits.[97] These numbers are

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[95] The impact of the re-examination has been very limited.
[96] Nowadays, this holds for about 90% of all employees.
[97] Private industrial executive body for social insurance in the Netherlands: see NCBS [100].

transformed into the probability of becoming ill for i days $(i = 1, 2, \ldots, 365)$.

(v) The effect of socioeconomic characteristics on the absence from work for illness has again been incorporated by distinguishing duration of sickness by level of education: see Van den Brekel ([16], Table 5).

(vi) It is assumed that a person only receives a ZW or DSO benefit once a year.

For the WW:

(i) NEDYMAS does not distinguish between the unemployment insurance for persons belonging to a branch of industry and the general unemployment insurance for employees. The conditions for a benefit and the level of the benefit do not differ. The difference is in the premium payment. However, in NEDYMAS the branch of occupation is not modelled. We therefore use an average premium percentage for the first type of insurance.

(ii) Unemployment due to weather conditions has not been incorporated, because we do not have sufficient data.

(iii) The settlement for supplementary payments has not been incorporated.

(iv) The inflow into and the outflow out of the state unemployed is simulated by the submodule for state transitions. It is assumed that an individual loses his job once a year at most.

For the WWV:

(i) NEDYMAS contains all elements with the exception of the settlement for supplementary payments and the possibility of partial unemployment in combination with being employed for part of the time.

For the NWW:

(i) All elements have been incorporated in NEDYMAS, with the exception of the voluntary insurance and the possibility of part-time unemployment in combination with a part-time job. On the other hand, the claims for an NWW benefit for partly disabled persons are included in the model.

(ii) Inflow into and outflow out of the state unemployed takes place in the submodule for state transitions.

For the IOAW and TW:

(i) The model does not generate own labour income for unemployed and disabled persons. The exemption has therefore not been modelled.

For the ABW:

(i) NEDYMAS does not distinguish between the different National Group Regulations.

(ii) The Incidental Assistance and the assistance for persons not living at home (insofar as it exceeds the regular benefit) are included in the latest version of NEDYMAS.

(iii) For each individual we investigated each year whether he or she had an income below the social minimum. If this is the case, then it is assumed that the person can claim an ABW benefit. The reduction for single persons living together in one household is not considered.

(iv) No reductions are made for the presence of property, since NEDYMAS does not know each individual's property.

For the ZFW and AWBZ:

(i) A description of the implementation of medical consumption has been given in Nelissen [120].

For the WRO:

(i) The WRO has been incorporated in NEDYMAS with the exception of the reduction of the benefit in the case of new additional income. The model does not generate this kind of income.

(ii) It is assumed that civil servants with a term of service which is three years or less receive a short-term benefit under the Civil Servants Unemployment Benefit Provision 1966, that those with a term of service between three to six years receive a long benefit under this Provision and that those with a term of service which exceeds six years receive a benefit under the Decree Civil Servants Unemployment Benefits 1959.

For the private pensions for employees:

(i) See above under the premium payments.

For the pension provisions for civil servants:

(i) With the exclusion of the widows' pension for divorced women, the pension provisions for civil servants have been completely incorporated to NEDYMAS.

Future premiums and benefits

Insofar as benefits are not based on (former) income, we assume that the present legal regulations do not change. The gross–gross linking determines the gross minimum wage. It is assumed that the gross minimum wage changes according to the average wage. The net minimum wage is subsequently determined by reducing the gross minimum wage by the premiums for the

Table 8. Percentage rise for administration expenses and mutual payments.

Social insurance	Rise (%)
AOW	0.88
AWW	7.24
AAW	9.72
WAO	28.26
WW	22.34
ZW	14.04

Source: Calculated from NCBS [118].

Table 9. Simulated versus realized wage income (billion Dutch guilders).

		Simulation		
	Actual	μ	σ	Index
1967	52.0	52.9	1.2	
1970	71.3	72.7	1.2	
1975	126.1	122.2	1.5	
1983	203.5	200.0	2.3	
1985	216.9	210.2	3.6	
1989		238.8	3.9	100
2000		306.2	3.0	128
2010		384.2	3.9	161
2020		481.4	3.8	202
2030		577.4	8.3	242

different general and employee insurances and the taxes. This net minimum wage is then translated into gross benefits. For example, for the AOW this means that the net amount is raised by the payable tax plus a part in the reimbursement of the costs of the health insurance.[98]

Past premium percentages are known from NCBS [99]. For the future, we have endogenized the premium percentages. The sum of the benefits is determined by the model. Dividing this sum for each of the social insurances plus a rise for administration expenses and mutual payments, by the sum of the concerning premium income, gives us the premium percentage. The rise for administration expenses and mutual payments between the several social insurances is based on the 1988 figures. These can be found in Table 8.

In this, we assumed that the maximum premium income and other income limits for the different insurances, the franchise for the WAO and the gross minimum wage change according to the average wages. This implies that we assume that the minimum wage and the benefits are indexed in the long run. It is also assumed that the state contribution does not change and that the division of the premiums between employers and employees remains unchanged. The premiums for the ZFW and AWBZ are held constant at the 1990 level.

Simulation results

In this section we will give some simulation results and compare them, if possible, with observations from official statistical sources. All simulations start in 1947. The initial population numbers only 10000 persons. The standard deviations are based on 10 repeats with different numbers for the random generator. The figures that refer to amounts (which are all in Dutch guilders) are nominal, and we assume that no inflation is present from 1992.

Table 9 gives the development in wage income for

persons aged 15 to 65. We can see that the wage income is simulated very well. The simulated wage income deviates less than 3.1% from actual wage income. Up to about 1975 the model overestimates wage income somewhat and from 1975 on we find an underestimation. One explanation for this under-reporting is that the model does not take account of the reported wage income of students who study full time and work part time. Real national wage income will double between 1989 and about 2020 given the model assumptions (see the section on wage income in particular).

The upper panel of Table 10 contains the results for the 1947–91 simulation for disabled persons. The inflow goes via the ZW for employees and the DSO for civil servants, whereas the outflow has been determined using the 1977 *Labour Force Survey* results, which also determine the inflow of other persons. The resulting outflow probabilities have been used throughout the whole simulation period. The model simulates the number of disabled employees[110] very well for the period 1947–75. The simulated number of disabled male employees is only 4% larger than the actual number, whereas the simulated number of disabled female employees is 1.2% below the actual number; and this after a simulation period of 28 years. Between 1975 and 1983 the simulation model results in a male inflow which is too large, and a female inflow which is too small. This is compensated in the other direction between 1983 and 1989, so that the simulated numbers in the latter year are again very close to the actual numbers. The deviations now amount to −4.6% and −3.7% for men and women respectively. We also see that the actual number is within the 95% confidence interval for all years during the simulation period. The number of disabled female former civil servants is always underestimated, but the deviation with respect to the actual number declines proportionally. For 1989 we see that the actual number is within the 95%

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[98] See Huijser and Van Loo ([72], pp 52–55).

Table 10. Disabled persons: simulated and actual numbers.

| | Employees | | | Civil servants | | | Others | | |
| | Actual | Simulation | | Actual | Simulation | | Actual | Simulation | |
		μ	σ		μ	σ		μ	σ
Males									
1975	272.4	283.4	16.1	–	18.9	3.6	–	42.0	8.4
1983	395.8	430.1	9.3	40.0	33.3	2.9	87.4	63.1	15.8
1989	435.4	415.3	14.7	50.9	52.8	8.9	92.0	88.5	14.6
Females									
1975	76.4	75.5	8.7	–	2.9	1.9	–	26.5	3.8
1983	142.0	112.0	10.1	14.3	8.8	2.6	31.4	41.5	4.5
1989	174.9	168.4	9.7	35.1	26.9	7.8	54.2	40.2	4.9

| | Simulation employees | | | | |
| | Males | | | Females | |
	μ	σ		μ	σ
1992	394.8	19.8		189.9	11.1
2000	378.9	18.6		230.8	11.8
2010	388.3	13.8		275.4	9.4
2020	374.1	15.7		292.6	19.2
2030	366.4	19.4		291.3	22.1

confidence interval. The male number of disabled former civil servants is close to the actual number in 1989 (+3.7%), but is also underestimated in the past.

Finally, the upper panel shows the results for the remaining category of disabled persons (such as early handicapped persons and the former self-employed). The 1989 numbers again are reasonably good in view of the limited numbers involved.

Table 10 also shows the simulated number of disabled former employees for the period 1992–2030. On the basis of the model assumptions, the number of male disabled ex-employees will decline gradually, but the decrease is very limited. On the other hand the model predicts an increase of the female number by about 50% between 1992 and 2015, whereafter the number stabilizes.

Next, we show some results with respect to the social security module. These simulation results are more or less crucial. The benefits and contributions are affected by the quality of the simulations of demography, the educational attainment, socioeconomic transitions and wage income. For the period up to 1992 we show the benefits for several schemes, whereas from 1992 we give the development in the contribution rate. This has been done, because the premium percentages are endogenized since then and consequently also determined by the simulation performance of the model with respect to the benefit side of the social security module.

We start with the results for the public pensions (AOW). These are given in Table 11. The AOW benefits are underestimated by the model, especially in the 1960s and 1970s. This is largely due to the fact that we do not take account of the benefits for

non-residents (just as for the premium payments by non-residents) and provisions for immigrants are only partly taken into account. The simulations for 1989 and 1991 are very good from this point of view. This is confirmed by the simulated AOW premium percentage for 1992 which is very nearly the same as the actual in that year (14.35%). The greying of the Dutch population will result in a large increase of the AOW premium percentage, as is confirmed by the simulations in the lower panel of Table 11. The simulated contribution rate increases from 14.33% in 1992 to 17.54% in 2010 to over 25% in 2030. These percentages are in line with other Dutch forecasts (see eg Van den Bosch *et al* [14], p 1056).

The results for the public widowers' and orphans'

Table 11. Simulated AOW benefits (billion Dutch guilders).

| | Actual | Simulation | |
		μ	σ
1967	3.62	3.10	0.16
1970	5.24	4.38	0.21
1975	11.60	9.51	0.49
1983	21.70	19.62	0.59
1989	25.43	24.09	0.72
1991	30.75	29.42	0.21

| Premium percentage | | | |
| | Actual | Simulation | |
		μ	σ
1992	14.35	14.33	0.20
2000		16.40	0.15
2010		17.54	0.19
2020		21.06	0.27
2030		25.51	0.41

Table 12. Simulated AWW benefits (billion Dutch guilders).

	Actual	Simulation μ	σ
1967	0.52	0.51	0.02
1970	0.73	0.72	0.05
1975	1.55	1.66	0.06
1983	2.62	3.01	0.03
1989	3.03	3.55	0.13
1991	4.34	4.64	0.30
Premium percentage			
	Actual	Simulation μ	σ
1992	1.15	1.27	0.09
2000		1.21	0.07
2010		1.29	0.07
2020		1.16	0.11
2030		1.13	0.13

Table 14. Simulated ZW benefits (billion Dutch guilders).

	Actual	Simulation μ	σ
1967	1.08	1.19	0.01
1970	2.13	1.96	0.09
1975	4.49	4.90	0.23
1983	6.24	6.26	0.11
1989	8.15	7.79	0.29
1991	10.90	10.90	0.09
Premium percentage			
	Actual	Simulation μ	σ
1992	4.00	4.22	0.19
2000		4.07	0.19
2010		3.90	0.21
2020		3.96	0.25
2030		3.95	0.15

a Only employers' part.

pensions scheme (AWW) are shown in Table 12. The total benefits are simulated very well in the 1950s and 1960s. However, we find an overestimation of the AWW benefits for the 1980s and to a lesser extent for the 1990s. This is due to the overestimation of widowed persons by the model since about 1975 (see Nelissen [119], Table 12). The simulated benefits also fit very well for the 1980s and 1990s if we correct for the latter overestimation in the number of widowed persons. For the future, we find a slight decrease for the AWW premium percentage from about 2010.

The simulation results for the public disability scheme (AAW) are satisfactory: see Table 13. The years 1983 and 1989 show a small overestimation of the AAW benefits, whereas we find a small underestimation in 1991 and 1992.

The overestimation of the AAW benefits in the 1980s is largely due to the lack of the minimum income condition for persons older than 17 years of age in order to claim a benefit. However, the consequences of the latter seem to be very small. The under-

estimation since 1989 is the result of the fact that the microsimulation model does not take account of the benefits aiming to create provisions for disabled persons which serve for maintenance, recuperation from or benefit for disability, or for improvement in living conditions.

Looking at the future, we see that the AAW premium percentage will still increase until about 2010, but thereafter it declines slowly.

The benefits for the sickness insurances (ZW) are very good, as Table 14 shows. The simulated ZW benefits for the year 1991 fit completely with the actual figures. Since we assume that sickness duration does not change in the future, the premium percentage hardly changes after 1992. The changes that do occur are mainly due to changes in the demographic structure of the working population.

The simulation results for the WAO are given in Table 15. Generally, the results are satisfactory.

Table 13. Simulated AAW benefits (billion Dutch guilders).

	Actual	Simulation μ	σ
1983	8.87	9.14	0.20
1989	11.04	11.46	0.52
1991	14.14	13.37	0.44
Premium percentage			
	Actual	Simulation μ	σ
1992	2.75	2.46	0.11
2000		2.66	0.07
2010		2.88	0.11
2020		2.68	0.06
2030		2.57	0.12

Table 15. Simulated WAO benefits (billion Dutch guilders).

	Actual	Simulation μ	σ
1967	0.41	0.39	0.09
1970	1.67	1.62	0.23
1975	5.42	6.57	0.35
1983	7.32	7.69	0.32
1989	6.85	7.60	0.39
1991	8.00	8.15	0.11
Premium percentage			
	Actual	Simulation μ	σ
1992	13.00	13.26	1.20
2000		13.45	0.65
2010		13.60	0.24
2020		12.77	0.36
2030		13.38	0.58

Table 16. Simulated WW benefits (billion Dutch guilders).

| | | Simulation | |
	Actual	μ	σ
1967	0.34	0.37	0.02
1970	0.28	0.60	0.06
1975	1.55	1.78	0.08
1983	3.53	3.20	0.12
1989	3.99	3.90	0.21
1991	4.43	3.96	0.23

Premium percentage

| | | Simulation | |
	Actual	μ	σ
1992	2.40	2.46	0.27
2000		2.26	0.21
2010		1.66	0.16
2020		1.24	0.17
2030		1.40	0.18

Table 17. Simulated ABP benefits (billion Dutch guilders).

| | | Simulation | |
	Actual	μ	σ
1967	1.21	0.56	0.10
1970	1.73	1.09	0.16
1975	3.98	4.14	0.56
1983	7.82	7.99	0.68
1989	10.79	10.51	0.50
1991	–	10.62	0.24

However, we find a large overestimation of the WAO benefits for the year 1975 and to a lesser degree for the year 1989, although the actual figure for the latter year is within the 95% confidence interval of the simulation. It is not known what factor(s) cause(s) the overestimation. For the future a stabilization of the premium percentage can be expected on the basis of the model assumptions.

The next insurance to be considered is the (N)WW, whose results are shown in Table 16. The results are reasonably good, with the exception of those for the year 1970. In 1970, NEDYMAS overestimates the actual WW benefits by more than 100%. An explanation as regards content is not available. Possibly, the low numbers involved in unemployment in combination with the small size of the initial simulation population (10 000 persons) play a part.

For the future the model results in a WW premium percentage that declines to about 1.4 in the long run. The decrease in the premium percentage follows from the decline in the number of unemployed persons in the model, which is based on the assumptions in Departementale Werkgroep SZW [28].

Finally we turn to comparing the simulated benefits from the Civil Servants Pensions Fund (ABP) with the actual. The figures also include the benefits for some other groups of civil servants, ie those who belong to the Railwaymen Pensions Fund (*Spoorwegpensioenfonds*) and those who can claim a benefit from the Pensions Provision for Military Men (*Voorziening in het eigen pensioen van militairen*). This is the subject of Table 17. Since our simulation starts in the year 1947, the model is not able to take account of pensions claims that were built up before that year. This implies that NEDYMAS covers the whole range of benefits at first in 1987, the year in which the first generation

(those who were 25 – the entrance age of the ABP – in 1947) which is completely covered, can claim an old age pension. From that point of view, the simulated benefits have to be below the actual up to 1987. This applies to the years 1967 and 1970, but for the year 1975 we find an overestimation of the ABP benefits, but the standard deviation is rather large. Our conclusion here is also that the model simulates the benefits very well. Because the ABP is based on capital funding, we do not give the development of the premium percentage in the future. In practice, this is influenced by political decisions.

Conclusions

In this paper several elements of the dynamic cross-sectional microsimulation model NEDYMAS are presented: the labour market module, the income formation module, the tax module and the social security module. The model has been developed in order to study long-term developments, particularly in the field of social security schemes. For that goal it is necessary to model a large number of socioeconomic characteristics at the micro level. These are shown in Appendix 1.

The quality of the model has been shown by some simulations, that are run on the basis of a database constructed for the year 1947 (see Nelissen [119]). This database has been adjusted each year by the simulation model. With the exception of the unemployment figures, no corrections were applied by the resulting database. This unemployment correction is necessary because of the lack of a macromodel around the micromodel.

From the simulation results it is clear that the model is able to reconstruct the long-term socioeconomic development at the micro level satisfactorily and consequently to simulate the social security benefits very well. This in spite of the fact that behaviour equations are only applied on a limited scale. These concern the labour force participation and income dynamics. Behavioural aspects are also used (but have been limited to elements of it) in the transitions into (un)employment, sickness and disability.

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Appendix 1
Attributes used in NEDYMAS

001	identification	Sequence number of individual generated
002	sex	Male, female
003	marital status	0 = unmarried and non-cohabiting, 1 = married, 2 = divorced and non-cohabiting, 3 = widowed and non-cohabiting, 4 = ummarried and cohabiting, 5 = divorced and cohabiting, 6 = widowed and cohabiting
004	year of birth	Year of birth of the individual
005	year of death	Year in which the individual died
006	mother	Pointer to the mother
007	father	Pointer to the father
008	year of leaving parental home	Year in which the individual left parental home or both parents died
009	degree of urbanization	0 = unknown, 1 = place of residence with fewer than 50 000 inhabitants (in 1982), 2 = 50 000 up to 400 000 inhabitants, 3 = 400 000 inhabitants or more
010	level of education	See Nelissen ([122], Chapter 4, Table 4.1)
011	level of partner's education	See Nelissen ([122], Chapter 4, Table 4.1)
012	end of education	Year in which the education process is left
013	part-time education	Boolean for being in part-time (true) or full-time (false) education
014	year of emigration	Year in which the individual emigrates
015	year of immigration	Year in which the individual immigrates
016	empartner	Boolean indicating whether a married or cohabiting man emigrates with (false) or without (true) his partner
017	siblings	Number of siblings
018	children	Number of children, including partner's children born before the current marriage or cohabitation and excluding children of whom a former partner has been granted custody
019	children with former partner	Number of children of whom a former partner has been granted custody
020	year of cohabitation	Year in which the cohabitation started
021	year of marriage	Year in which the marriage was contracted
022	year of divorce	Year in which both partners divorced or dehabitated
023	year of widowhood	Year in which the partner died
025	partner	Pointer for the partner
026	former partner	Pointer for the former partner
027	old people's home	Boolean that is true if a person lives in an old people's home, otherwise false
028–047	children	Pointers to the children, with the exclusion of children of whom a former partner has been granted custody
048–067	children with former partner	Pointers to the children of whom a former partner has been granted custody, up to the age of 22 years. The last two pointers are used as pointers to the mother and father, respectively, if the mother or father has died or could claim benefits from the Civil Servants Pension Fund (ABP)

068	economic activity	1 = employee, 2 = self-employed, 3 = retired, 4 = unemployed, but not previously an employee or a civil servant, 5 = civil servant, 6 = unemployed employee, 7 = unemployed civil servant, 8 = conscript, 9 = disabled employee, 10 = disabled civil servant, 11 = disabled, not being 9 or 10, 12 = student, 13 = housewife or househusband, 14 = unemployed, before disabled employee, 15 = unemployed, before disabled civil servant, 16 = unemployed, before disabled, not being 14 or 15
069	percentile	The percentile of the income distribution to which the individual belongs
070	labour force participation	The proportion of the current labour time; 0 = participation unemployed or not available for the labour market; 1 = full time; between 0 and 1 part time
071	year of unemployment	Year in which a person became unemployed
072	month of unemployment	Month in which a person became unemployed
073	year of employment	Year in which a person entered economic activity working for the last time
074	month of employment	Month in which a person entered economic activity working for the last time
075	children	Number of children counting for the child allowance acts
076	aow years	Number of years insured for the AOW
077	aow voluntary	Boolean, which is true if a person is insured voluntarily for the AOW (emigrants only)
078	abw	Boolean, true if a person receives an ABW benefit in the current year
079	rww	Boolean, true if a person can claim an RWW benefit
080	ioaw	Boolean, true if a person can claim an IOAW benefit
081	aaw	1 = high basis, 2 = low basis
082	prinkvv	Income concept, on the basis of which the premiums for the AOW, AWW, AKW, AWBZ and AAW are determined
083	prinkwv	Income concept, on the basis of which the premiums for ZFW, ZW, WAO, WW and NWW are calculated
084	prinkwv1	Income concept, on the basis of which the premiums for ZFW are calculated, when a person is retired
085	benefit basis	The salary on the basis of which the WW, WWV, NWW and WAO benefits are determined
086	taxable income	Taxable income
087	wealth	Personal wealth
088	wealth abw	Household wealth in accordance with ABW definition
089	child allowance	The amount of child allowances received
090	benefit abw	The amount of ABW benefits received
091	labour [6]	The number of months employed this year
092	labour [5]	The number of months employed last year
093	labour [4]	The number of months employed two years ago
094	labour [3]	The number of months employed three years ago
095	labour [2]	The number of months employed four years ago
096	labour [1]	The number of months employed five years ago
097	upcs	Unemployment pay for civil servants; 0 = no rights, −1 = claim for a short benefit, +1 = claim for other type
098	upcs1	Boolean, which is true if a person can claim a upcs in the current year
099	duration upcs	Number of months a civil servant can claim unemployment pay
100	type upcs	Type of upcs; 1 = Rijkswachtgeldbesluit 1959, 2 = Uitkeringsregeling 1966, 3 = other
101	upcs amount	Amount received from unemployment pay for civil servants
102	midsum [2]	Income in the last but one year as civil servant, relevant to ABP benefits
103	midsum [1]	Income in the last year as civil servant, relevant to ABP benefits
104	term of office abp	The term of office built up for the ABP pensions
105	term of office abp 1	The term of office built up for the ABP pensions, relating to the change on 1 October 1986
106	old age abp	Amount received from ABP old age pension
107	disability abp	Amount received from ABP disablement benefit
108	widowhood abp	Amount received from ABP widowhood and orphan benefit
109	wage	Before-tax labour income
110	net wage rate	After-tax labour income per hour
111	gross income	Wage plus benefits
112	net income	After-tax income in the current year
113	scholarship	Boolean, which is true if a person receives a scholarship

114	non-wage income	The amount of non-wage income received
115	payment aow	The amount paid for AOW
116	benefit aow	The amount received from AOW
117	extra allowance aow	The amount received from the AOW as an extra allowance, if partner is younger than 65 years and has a limited income
118	payment aww	The amount paid for the AWW
119	benefit aww	The amount received from the AWW
120	payment akw1	The amount paid for child allowances (self-employed only)
121	payment akw2	The amount employer pays for child allowances (employees only)
122	payment akw3	The amount the state, as employer, implicitly pays for child allowances (civil servants only)
123	benefit akw	The amount received from child allowances
124	year of disablement	Year in which a person became disabled
125	percentage disabled	The percentage of being disabled
126	disabled	Boolean, which is true if a person is disabled
127	benefit aaw	The amount received from the AAW (lifetime)
128	benefit aaw1	The amount received from the AAW in the current year
129	payment aaw1	The amount paid for the AAW (self-employed only)
130	payment aaw2	The amount the employer pays for the AAW (employees only)
131	benefit wao	The amount received from the WAO
132	payment wao1	The amount paid for the WAO
133	payment wao2	The amount the employer pays for the WAO (employees only)
134	basis wao	The amount on which the WAO benefit is based
135	benefit dso	The amount received as sickness benefits from the state (civil servants only)
136	payment dso	The amount the state, as employer, pays for sickness insurance (civil servants only)
137	benefit zw	The amount received from the ZW
138	payment zw1	The amount paid for the ZW
139	payment zw2	The amount an employer pays for the ZW (employees only)
140	months ww	Number of months a person received a WW benefit
141	ww	Boolean, which is true if a person can claim a (N)WW benefit
142	benefit ww	The amount received from the (N)WW
143	payment ww1	The amount paid for the (N)WW
144	payment ww2	The amount the employer pays for the (N)WW (employees only)
145	wwv	The number of months of receipt of a WWV benefit
146	benefit wwv	The amount received from the WWV
147	year rww	Year in which a person starts receiving a new RWW benefit
148	month rww	Month in which a person starts receiving a new RWW benefit
149	year ioaw	Year in which a person starts receiving a new IOAW benefit
150	month ioaw	Month in which a person starts receiving a new IOAW benefit
151	benefit ioaw	The amount received from the IOAW
152	tw	Boolean, which is true if a person can claim a TW benefit
153	duration tw	The number of months in the current year, for which claim a TW benefit can be claimed
154	basis tw	The income which serves as a starting point for the TW claim
155	benefit tw	The amount received from the TW
156	nww high	Boolean, which is true for individuals who can claim a benefit, that exceeds 70% of the last salary, as a consequence of the temporary provisions at the time of introduction of the NWW
157	nww	The number of months an NWW benefit can be claimed
158	nww continued	The number of months an NWW Vervolguitkering benefit can be claimed
159	zfw	Boolean, which is true if a person is compulsorily insured for the ZFW
160	payment zfw1	The amount paid for the ZFW
161	payment zfw2	The amount the employer pays for the ZFW (employees only)
162	payment awbz1	The amount paid for the AWBZ (self-employed only)
163	payment awbz2	The amount an employer pays for the AWBZ (employees only)
164	tax	The tax amount paid in the current year
165	tax group	The tax group to which a person belongs
166	tax transfer	Income free of tax, which is not earned by the individual in question and which is added to the partner's income free of tax

167	social group	The social group a person belongs to; this group is derived from the parents' level of education
168	epsilon	The draw out of the normal distribution to generate income mobility
169	aow(t)	The aow amount received in the current year
170	lifetime wages	The sum of lifetime wages
171	lifetime taxes	The sum of lifetime taxes
172	distance	Distance (in km) to nearest general or university hospital
173	time	Total time needed for a visit to a general practitioner
174	health insurance	Health insurance class: 1 = class III; 2 = class IIB; 3 = class IIA
175	labour income logical	Yes/no labour income in current year
176	capital income logical	Yes/no capital income in current year
177	pension income logical	Yes/no pension income in current year
178	other social security income logical	Yes/no other social security income in current year
179	grant income logical	Yes/no grant income in current year
180	alimony logical	Yes/no alimony in current year
181	dgvp/iza/izr	Logical for being insured under DGVP/IZA/IZR
182	payment iza..1	The amount a civil servant pays for the DGVP/IZA/IZR
183	payment iza..2	The amount an employer pays for the DGVP/IZA/IZR (employees only)
184	private health insurance	Logical for being privately insured
185	type of zfw insurance if not compulsorily	1 = voluntarily insured under the ZFW; 2 = ZFW insurance for the insured aged; 3 = not insured under the ZFW
186	premium zfw aged	Premium payments for the ZFW insurance for the aged
187	premium zfw voluntary	Premium payments for the voluntary ZFW insurance
188	premium private health insurances	Premium payments for private health insurances
189	employers' contribution	Employers' contribution for health insurance costs for persons who do not fall under the compulsory ZFW or DGVP/IZA/IZR
190	entrance nursing home	Date at which a person entered a nursing home
191	entrance institution for the mentally disabled	Date at which a person entered an institution for the mentally disabled
192	entrance psychiatric hospital	Date at which a person entered a psychiatric hospital
193	entrance other institution	Date at which a person entered another institution
194	medical consumption *awbz*	Medical consumption reimbursed by the AWBZ
195	medical consumption *zfw*-compulsory	Medical consumption reimbursed by the compulsory ZFW
196	medical consumption *zfw*-voluntary	Medical consumption reimbursed by the voluntary ZFW
197	medical consumption *zfw*-aged	Medical consumption reimbused by the ZFW for the aged
198	medical consumption *iza/izr/dgvp*	Medical consumption reimbursed by the IZA, IZR or DGVP
199	medical consumption private insurances	Medical consumption reimbursed by private health insurances
200	rate home for the aged	Rates holding for homes for the aged (1988 prices)
201	lifetime *abw*-institution	Lifetime payments for persons living in institutions by the ABW
202	own contribution *awbz*	Own contributions for the use of AWBZ facilities
203	benefit *kwl/kbwl/kkz*	Lifetime benefits from KWL/KBWL/KKZ
204	payment *kwl/kbwl*	Lifetime payments for KWL/KWBL

Appendix 2
Dutch terminology and abbreviations (Dutch abbreviations are used throughout the article)

AAW	Algemene Arbeidsongeschiktheidswet/General Disablement Benefits Act
ABP	Algemeen Burgerlijk Pensioenfonds/Civil Servants Pensions Fund
ABW	Algemene Bijstandswet/General Social Assistance Act
AKW	Algemene Kinderbijslagwet/General Family Allowances Act
AOW	Algemene Ouderdomswet/General Old Age Pensions Act
AWBZ	Algemene Wet Bijzondere Ziektekosten/General Exceptional Medical Expenses Act
AWW	Algemene Weduwen- en Wezenwet/General Widows and Orphans Pensions Act
DGVP	Dienst Geneeskundige Verzorging Politie/Health Cost Provision for Policemen
DSO	Doorbetaling Overheidspersoneel ingeval van ziekte/Sickness Payments for Civil Servants
IOAW	Inkomensvoorziening voor Oudere en Gedeeltelijk Arbeidsongeschikte Werkloze Werknemers/Provision for Older and Partly Disabled Unemployed Employees
IP-ABP	Invaliditeitspensioen ingevolge het ABP/Disability Pension under the ABP
IW	Inhoudingswet Ambtenaren/Civil Servants Deduction Act
IZA	Instituut Ziektekostenvoorziening Ambtenaren/Health Costs Provision for Civil Servants
IZR	Interprovinciale Ziektekosten Regelingen/Health costs Provision for Provincial Officials
KKZ	Kinderbijslagwet Kleine Zelfstandigen/Self-Employed Persons Family Allowances Act
KTO	Kindertoelage Overheidspersoneel/Civil Servants Family Allowances Provision
KW	Kinderbijslagwet/Family Allowances Act
KWL	Kinderbijslagwet voor Loontrekkenden/Wage-Earners Family Allowances Act
KWR	Kinderbijslagwet voor Rentetrekkers/Benefit Receiving Persons Family Allowances Act
NWW	Nieuwe Werkloosheidswet/New Unemployment Insurance Act
OP-ABP	Ouderdomspensioen ingevolge het ABP/Old Age Pension under the ABP
TW	Toeslagenwet/Supplementary Benefits Act
WAO	Wet Arbeidsongeschiktheidsverzekering/Disablement Insurance Act
WP-ABP	Weduwen-, weduwnaars- en wezenpensioen ingevolge het ABP/Widows, Widowers and Orphans Pension under the ABP
WP-PS	Werknemerspensioenen in private sector/Private Pensions for Employees
WRO	Wachtgeldregeling Overheidspersoneel/Civil Servants Unemployment Benefit
WW	Werkloosheidswet/Unemployment Insurance Act
WWV	Wet Werkloosheidsvoorziening/Unemployment Provisions Act
ZFB	Ziekenfondsbesluit/Decree Health Insurance Fund
ZFW	Ziekenfondswet/Health Insurance Fund Act
ZW	Ziektewet/Sickness Benefit Act