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**Annual Versus Lifetime
Income Redistribution by Social Security**

Jan H.M. Nelissen

WORC PAPER 95.05.008/2

Paper written in the context of the WORC Research Unit
'Work & Social Security' (P2-03)

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Annual Versus Lifetime Income Redistribution by Social Security

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Keywords: income redistribution, microsimulation, social security

Summary

In this article we compare the redistributive impact of the Dutch social security on an annual basis with the lifetime redistributive impact. The analysis confirms the theoretical notion that the lifetime impact is smaller than the annual incidence studies suggest. This especially holds for the old-age pensions and social assistance and to a lesser extent the disability state pension. We also find that the younger the cohort is the larger the difference is. However, the employee insurances do not necessarily imply a smaller redistributive impact on a lifetime basis. The results are of course affected by the discount rate used and the assumptions with respect to economic growth. The discount rate generally appears to be negatively correlated with the redistributive impact, whereas the effect from growth is less straightforward.

1. Introduction.

It is generally assumed that the redistributive impact of social security schemes on a lifetime basis is smaller than annual incidence studies suggest [see e.g. Layard (1977) and Reynolds and Smolensky (1977)]. It is also clear that the incidence will differ among generations. However, because of lack of (longitudinal) data, no empirical studies in this field are available. So, it is unknown whether the position empirically holds, and how large the differences between generations are. An additional problem is that it is not always possible to trace back the various benefit payments from official statistics. For example, the Income Statistics in the Netherlands are derived from data from the Inland Revenue and the latter are based on individual tax

declarations. However, the tax form is not always univocal and, moreover, not all (generally low income earning) taxpayers are obliged to fill in a tax form. Consequently, we find an underrepresentation in the Income Statistics of low income recipients, and benefit recipients, in particular. In 1990, the public old-age and widow pension benefits in the Income Statistics amount to only 66 % of total benefits by government. Disability benefits are only reported for 46 %, social assistance for 62 %, sickness benefits for only 14 % (!), unemployment benefits for 56 %, child allowances for 48 % and occupational pensions for 84 %.¹

The alternative is to use survey data. However, useable surveys, like the Dutch Socio-Economic Panel only report net benefits, which makes it quite difficult to compare them with national aggregates. Muffels, et. al (1990: 189-190) show that the panel is more representative than the Income Statistics, but still there is underrepresentation of unemployment benefits (83 % has been reported), disability benefits (92 %) and public old-age pensions (90 %). On the other hand, social assistance benefits have been overrepresented (116 %).

We have chosen a third alternative, to wit dynamic microsimulation. Here, the microsimulation technique is used to reconstruct the social security contributions and receipts in the Netherlands from 1947 on and to simulate future contributions and receipts. It has also been used to simulate or reconstruct the social security benefits and contributions in the year 1991. We compare the redistributive impact of the social security system for that particular year with the lifetime incidence for the birth generations 1930 and 1950. This is the subject of section 5. In the first instance we discuss the lifetime income concept in section 2. Thereafter we give a brief description of the Dutch social security system (section 3). Then we go into the microsimulation approach and discuss the microsimulation model used (section 4).

2. Annual or lifetime income.

To gain insight into the relative positions of persons or groups of persons, it does not suffice to look at the order in a specific year. The income level and its composition in a certain year depends too much on chance. The transitory income has a large impact on income over a

¹ Derived from tables from the Netherlands Central Bureau of Statistics and Department of Social Affairs (1993).

limited period. According to Friedman (1957), 15 to 30 % of the variance in household incomes in urban areas can be explained by transitory income elements. Since the 1950s, this percentage has probably even risen. The income flow over a longer period is subjected to this albeit to a lesser extent. In addition to past experiences, future expectations are also important. In particular, if one analyses social security schemes, because '... the social services typically involve payments by workers to support nonworkers such as children, pensioners, the sick or the unemployed. Since individuals do not remain in these dependent categories throughout their lives, current beneficiaries will, at other times, be supporting people who are similar to themselves but at a different stage of their life-cycle or of their fortunes...' [Layard (1977: 46)]. Here, we find another argument against the use of a limited period in our analysis: the impact of the social security system on the income distribution of each individual also depends on the stage of the life-cycle the individual is in at that particular moment. Income differences between persons at one moment in time can be compensated for in another period. Both Deleeck (1974) and Pestieau (1990) give an example of a society in which each income increases with age and by the same proportion. Imagine a society where the initial income, the age at which the initial income is earned and the age of dying do not differ; all the young people in this society would be relatively poor, and all the old people relatively rich. The income distribution, as measured at any time, would be unequal. However, the income distribution on a lifetime basis would be completely equal. Each individual would receive the same income during his or her life. See also Fullerton and Rogers (1994: 10-11).

Lillard (1977: 42) gives analogous reasons: '... among recent entrants into the labour force low earnings may reflect high levels of investment in training which will be compensated by high earnings at later stages of the life cycle...'. The situation is reversed for those who cannot invest optimally in this area. Income differences can be caused by differences in earning capacity. A cross-section analysis does not allow us to distinguish between these sources of income differences.

Another point is that some forms of public expenditure - like education and employment programmes - bear the character of an investment, through which the complete gain is only partly measured. Generally, one can say that income differences on an annual basis are partly the consequence of differences in human capital investments [see Mincer (1974)]. A fourth objection against the use of annual incomes is that the integral public income policy is not

exclusively focused on annual incomes. A practical rather than a methodological objection is that non-positive incomes are not considered. Focusing on the redistributive impact of social security schemes, another important - maybe even the most important - argument is that a '... pure social insurance system will significantly affect the pattern in which income is received over an individual's lifetime, but will have no impact on income distribution across individuals ... it does not represent an increase in the well-being of some individuals at the expense of others but merely a change in the timing of income receipt across individual lifetimes...' [Burkhauser and Warlick (1981: 403)]. Of course, the social security system does not merely consist of pure social insurances, but insurance elements are present in at least a part of almost all schemes (not including the pure welfare programmes, like some social assistance schemes). Some additional arguments stem from Aaron (1977) and Cohen and Friedman (1972). Persons from high income classes generally start working at a later age and have a higher life expectancy than persons from low income classes. Consequently, the former pay contributions during a shorter period, but receive certain types of benefits (*e.g.* old-age pensions) during a longer period. Certain contributions are tax-deductable, which favours high incomes. This is strengthened by the progressive nature of the tax system. As a consequence, annual income groups differ from lifetime income groups, for the same individual [see Fullerton and Rogers (1994: 13)].

Although the aforementioned arguments favour the use of the lifetime approach, its application is quite limited. This is the result of both practical and methodological problems. The most important practical problem is the lack of sufficient data. Only in the United States do we find longitudinal income data, covering a sufficiently large sample over a long period². Usually, a cross-section approach is used to solve this problem. However, this approach gives a distorted picture of lifetime income [see *e.g.* Nelissen (1987: 60 and 63) for the Netherlands]. It does not take the career effect, technological developments, changes in the demand-supply proportions of types of labour, and so on into account.

The two main methodological objections raised against using the lifetime income concept are the uncertainty, with respect to future income flows, and the valuation of the elements of the income flow in the course of time [see Ritzen (1979: 94-98)]. The first problem is unavoidable

² The Longitudinal Employer-Employee Data, which covers 1 % of all wage earners since 1957 and the Michigan Panel Study of Income Dynamics which is held from 1968 on [see Atkinson, *et al.* (1988: 622-623)].

when we use the lifetime income approach for persons still living. Uncertainty about their future incomes will continue to exist, irrespective of the methods and models used. There are always factors which cannot be predicted. The other problem, the valuation of the income flows - ideally measured by the consumption streams - with respect to each other in the course of time, is that not everyone has the same risk aversion. In practice, we cannot use different utility functions to suit each individual. The problem escalates when we are talking about a perfect capital market, because this implies that persons with consumption streams having the same present value at a given discount rate can have different utility and different present value for their discounted incomes. Layard (1977) shows that a low discount rate justifies the resulting issue best. Another possibility is to get an idea of the problem by using several alternative discount rates.

Other objections against using lifetime income are [see Von Weiszäcker (1978), especially the discussion of the paper]:

- Transfers between different times in the life-cycle incur costs, both in a material and an immaterial sense;
- People are generally unable to value events up to the end of their lives, which argues for a high discount rate;
- The expectation of a high income in the future does not remove the current poverty.

It is clear that both the annual and lifetime income concepts contain inadequacies. We consider here the lifetime approach as a supplement to annual analysis, as "... a way of assessing the long-run distributional effects (... that) can play a valuable role in policymaking, as long as it is viewed as a supplement to, and not a replacement for, annual incidence calculations" [Fullerton and Rogers (1994: 28 and 29)].

3. The Dutch social security system.

The current definition of social security (in its broad sense) in the Netherlands, considers social security as the totality of legal measures which are aimed at guaranteeing continuity in the spending opportunities of individuals. On the basis of this definition, one can divide social security into four components: (1) Social insurances; (2) Occupational pensions; (3) Social

assistance and (4) Direct payments by the employer. Social insurances are all legal arrangements which are primarily aimed at *income redistribution* between persons or social groups whereby the right to a benefit is based on the insurance concept. Voluntary insurances, for which participation depends on legalised entry requirements, are also considered as being social insurances. In the Netherlands, the social insurances are characterised by a dualistic system, namely a combination of a flat-rated (but not means-tested) minimum system covering the whole population (called *general insurances*) and a wage-related system for employees (called *employee insurances*). In both cases contributions depend on the income and have to be paid up to a ceiling. The first one starts from the solidarity principle, whereas the latter has the equivalence or insurance principle as its starting-point. Both are financed by the pay-as-you-go system. These two types of social insurances cover about 40 and 30 %, respectively, of the total social security expenditures in the Netherlands. The general insurances include the old-age state pension (AOW), the widow state pension (AWW), the disability state pension (AAW), the family allowances (AKW) and the state provision for health costs (AWBZ). The net pensions for a family, a one-parent family and a single person amount to 100, 90 and 70 %, respectively, of the net minimum wage (about Dfl. 23,070 or \$ 12,800 in 1994). The employee insurances are the sickness benefit (ZW), the disability benefit (WAO), the unemployment benefit (WW) and (up to a certain income limit) the health-care costs provision for employees (ZFW). Here, the gross benefit for the ZW, WAO and WW amounts to 70 % of the last earned income, up to a maximum of Dfl. 74,360 or \$ 41,300 in 1994.

Occupational pensions include all arrangements, which primarily are aimed at the *redistribution of the income of persons over time*. They are based on a labour relation. These 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. In contrast, the old-age state pension (AOW) has not been based on labour relations and is financed by the pay-as-you-go system. Contributions for the occupational pensions generally depend on one's income. The benefits are mostly related to the last-earned wage income and are supplementary to the old-age state pension. The occupational pensions cover about 12 % of total social security expenditures. Social assistance schemes include all arrangements in the field of social security, where the (means-tested) benefits are *financed directly by the state*. No specific premiums are levied: these provisions are financed by public funds. The General Social Assistance Act (ABW) forms the most important social assistance

scheme. Its maximum benefits equal those for the general insurances. The social assistance schemes also cover about 12 % of total social security expenditures. Direct payments by the employer refer to payments to (former) employees on the basis of a *labour relation*. It mainly concerns benefits towards (former) public servants. The benefits are wage-related, with the exception of the child allowances. No contributions have been levied. The benefits are also financed via public funding and form about 5 % of the social security expenditures. Because of the small amounts involved, we will not discuss this component.

4. The microsimulation model NEDYMAS

The applied model, called NEDYMAS - which stands for *NE*therlands *DY*namical *MI*cro-*AN*alytical *SI*mulation model [see Nelissen (1991, 1993 and 1994)] - is a dynamic cross-sectional model. Dynamic microsimulation stems initially from the ideas of Orcutt [see Orcutt et al (1976) and (1986)]. An overview of the ins and outs of the microsimulation approach, especially with respect to social policy, can be found in Citro and Hanushek (1991). The dynamic approach implies that demographic processes are explicitly simulated, which means that the size of the micro database changes during the simulation period. The sample passes through time year by year. For each person contained in the micro database we examine which personal characteristics change, and to what extent, each year. The principle of microsimulation is simple. To illustrate this, we will use the modelling of mortality. The decision, whether an individual will or will not undergo a potential transition, is simulated with the aid of the Monte Carlo method. In view of this, the conditional probability of an individual undergoing that event has to be given. For example, in 1968 the probability for a 77-year-old divorced woman of dying is 6.75 %. We then draw at random a number from the uniform [0,1] distribution. If this number is smaller than or equal to 0.0675 (the probability of dying), the woman is expected to die. If the number is larger than 0.0675, the woman will remain alive. If she dies, we then check to see if she had dependent children (who have become orphans). So, decisions (or events) at the level of an individual can have implications for other individuals. Microsimulation creates a synthetic database which reflects the (developments in the) demographic and economic structure of the population. A stylised example is given in Figure 1.

[INSERT FIGURE 1 ABOUT HERE]

At the heart of microsimulation modelling is its state representation of the components of the system of interest. To execute this representation, first draw a list of attributes for each individual in the sample. Next, after the adaptation of a micro-representation, specify an initial population. Using a real sample of individuals and households along with their attributes would have been preferable, however, such a sample is not available. A first useable sample can be derived from the 1947 Census data [see Nelissen (1991 and 1994)]. So, the model simulates all events from 1947. Each year the characteristics of the individuals (and thus the households) are updated, if necessary. The modules which are used in the current version of NEDYMAS are given in Table 1.

[INSERT TABLE 1 ABOUT HERE]

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. With the exception of the occupational pensions - which have been considered as social security income - the simulation model is not able to simulate capital income, because it does not contain a module for private consumption. As savings cannot be determined, as a consequence neither can wealth or income from wealth the analysis is therefore limited to the redistributive impact of the social security system with respect to lifetime *labour* income. Because the model does not contain a module for capital income, taxes are imposed solely on wages and social security income. So, only a part of all tax transfers are considered and the model is not able to take full account of the redistributive impact via public funding of the schemes under consideration. Therefore, we do not take account of general revenue financing. This implies that about 10% of the contributions have been ignored. But this holds both for the annual and lifetime approach.

The various transition rates are based on observations, if available, and differ between years. However, especially for the period 1947-1965, additional assumptions had to be made. The future demographic transition rates are based on the forecasts of the Netherlands Central Bureau of Statistics. The transition probabilities, with respect to the education submodules, are held constant at the 1988-level from 1988 on, whereas the future developments in the field of labour participation and unemployment are based on forecasts of the Department of Social Affairs

(1984). It will be assumed here that national income grows annually by 2%, which is in accordance with the long-term economic projections by the Dutch Central Planning Agency [see Central Planning Agency (1992)]. Further, it should be noted, that from 1991 onwards, the social security contributions are determined endogeneously on the basis of the simulated benefits and income. A comparison of simulated data with real data can be found in Nelissen (1991 and 1993).

The purpose of this study implies that we want to gain more insight into welfare distribution. Thus, the model will have to take into account the consumption possibilities of households and to consider welfare differences between various types of households. To make the welfare positions of different types of households comparable, equivalent income must be used. Economists disagree on this issue and on which equivalence scale should be used. Research in the field of lifetime redistribution inclines towards the application of equivalence scales. With respect to the choice of the equivalence scales, it holds that other scales (e.g. empirical-objective methods) do not result in other conclusions. Of course, the exact figures differ, but the direction of the results does not. See, for a discussion, Coulter, Cowell and Jenkins (1992). We use the results of Diederer (1983), who applies an empirical-subjective approach. The equivalence scale is applied to each income component and the sum of all the equivalent income components is imputed each year to each individual in the household unit. This implies that the income measure takes full account of the variance in household circumstances by attributing the standard of living of the household to each individual residing in that household. For a further discussion, see Harding (1993: 51-55). Lifetime income (or benefit or contribution) is measured by the sum of the (discounted) annual equivalent income (or benefit or contribution) amounts. This can be considered as a type of (discounted) lifetime utility, where the utility function has been defined as:

$$U(Y) = Y / \text{equivalence scale}$$

We refer to this as equivalent (lifetime) income instead of lifetime utility. In interpreting the results one should bear this in mind. The income components have been adjusted for the household composition (via the equivalence scale) and the resulting amounts have been adjusted for changes in the wage index and discounted to 1990, using a discount rate of 4 %. Moreover, persons who were involved in migration have been excluded in our calculations for the lifetime

income. The calculations are based on ten runs with a different set of random numbers, all starting with a micro database of 10,000 persons in the year 1947. The simulation runs to the year 2060. Thus, the birth generations 1930 up to 1950 can be followed completely with respect to their socio-economic life history. The average number of persons per run involved in the simulation amounts to 923 for cohort 1930 and 2297 for cohort 1950. Because ten runs have been used, this implies e.g. for cohort 1930 that the calculations are based on about 9230 individual life histories. The redistributive impact has been measured via comparison with the before-tax income, because no data exist to simulate a world in which government is absent. Further, it is assumed that the burden of benefits (contributions) is fully incident upon the person who receives (pays) the benefit (contribution). This follows standard practice in major incidence studies [see Reynolds and Smolensky (1977) and Central Statistical Office (1990)].

[INSERT TABLE 2 ABOUT HERE]

The extent to which the model covers the various schemes in 1991 has been shown in Table 2. There we also present the coverage by the other alternatives (Income Statistics or panel data). See also Section 1. Bearing in mind that the figures for NEDYMAS have been based on a simulation that starts in 1947, we find that the coverage by NEDYMAS is much more extensive than that by the Income Statistics or the Socio-Economic Panel. Our approach also serves the possibility to discriminate between the disability state pension (AAW) and the disability insurance for employees (WAO), which is not possible with the two other approaches. The old-age state pension (AOW) is underestimated by 4 %, whereas the widow state pension (AWW) is overestimated by 7 % by NEDYMAS. This is the consequence of an underrepresentation of the aged abroad who receive an AOW benefit, whereas the simulated number of widowed persons is too high [see Nelissen (1991)]. The Socio-Economic Panel results in an underestimation of 10 % for both schemes together, whereas the Income Statistics show a deficit of 34 %. For the latter the problem is, that a large number of aged persons do not receive a tax form. This group may have no deductions or only a small number of deductions, which consequently means that they have not been registered by the income tax authorities. This also plays a role with respect to the occupational pensions, which are even more seriously underestimated by the Income Statistics (-16 %). NEDYMAS results in a small underestimation (-3 %), which is in agreement with the AOW results. The Socio-Economic Panel does not publish the coverage figure for the occupational pensions. Family allowances (AKW) are treated

quite well by NEDYMAS. Its deviation is almost nill. The Income Statistics report on the AKW is poor. Only 48 % of the benefits is reported. The disability state pension (AAW) is somewhat underrepresented in NEDYMAS (-5 %), whereas the disability insurance (WAO) is overestimated by 2 %. The Income Statistics are not representative at all, whereas the Socio-economic Panel shows a small underrepresentation. NEDYMAS covers the sickness insurance (ZW) and unemployment insurance (WW) quite well. Its deviation is less than 1 %. For the other sources, the ZW is a huge problem, because the sickness benefit is generally offset against the wage. As a consequence, it is very difficult for an employee to see the difference and this explains the poor representation in the Income Statistics and the Socio-Economic Panel. The latter does not even report on this issue. The WW also results in problems for the other two methods. Lastly, the social assistance (ABW). NEDYMAS overestimates the benefits somewhat (+5 %). The Socio-Economic panel overestimates its benefits even more (+16 %), whereas it is again underrepresented in the Income Statistics. These figures show that from the point of view of coverage of the social security schemes, the microsimulation approach has to be preferred for our comparison of the lifetime and annual redistributive impact of the social security system.

5. Results.

To determine the redistributive effects of the social security system, we look at the following: (1) the average lifetime wages and the average benefits from and contributions to the social security schemes by decile; (2) the net effect of the contributions and benefits on the income distribution, as measured by the Theil coefficient; (3) the Lorenz curves.

We look first into which income groups pay the contributions and which income groups receive the benefits. To that end, we look at the contributions and benefits by decile. The deciles are based on before-tax income. Table 3 shows the distribution of the contributions by decile. It concerns contributions by both employees and employers.

[INSERT TABLE 3 ABOUT HERE]

The table shows that the percentual proportion is larger, the higher the income is. The difference between the highest and lowest decile is larger for the annual figures. This particularly holds for the employees' insurances. This is because, on an annual basis the lowest deciles are mainly populated by non-employees, like the aged, the unemployed and students. On the other hand, almost everyone is eventually involved with wage income and consequently with the payment of contributions to the employees' insurances on a lifetime basis. In particular, due to the fact that we deal with equivalent income streams.

[INSERT TABLE 4 ABOUT HERE]

Whereas the differences between the annual approach and the lifetime approach are limited, with respect to the contributions, the benefits, on the contrary, show a large difference; see Table 4. On a lifetime basis, the benefits are rather gradually divided. The deciles 2, 3 and 4 proportionally receive most. However, as said, the difference is small. Decile 10 receives 8 % if we look at the sum of general insurances, employees' insurances and social assistance (the lowest panel of Table 4), whereas decile 2 and 3 receive 12 % (cohort 1930) or 13 % (cohort 1950). On an annual basis, the benefits are far more concentrated. Now decile 2 receives 19 % of total benefits and decile 22 %. On the other hand, decile 8 and 9 receive only 5 % and decile 10 as little as 4 %.

Looking at the redistributive impact of the social security system, one major problem in comparing annual and lifetime income redistribution is that situations can occur in which people do not have an income, or have a negative income. This holds in particular for the annual redistributive impact where a large part of the population does not have primary income. Null incomes do not form a problem, when using the Theil coefficient [see Theil (1967) and Odink (1985: 47-48)]. The Theil coefficient has been defined as:

$$T = \sum_i (X_i/Y) \cdot \ln(X_i/N/Y)$$

where N equals the number of income recipients, Y the sum of all incomes and X_i the income of the i-th person ($i=1, \dots, N$). It now holds that:

$$\lim_{X_i \rightarrow 0} (X_i/Y) \cdot \ln(X_i \cdot N/Y) = 0$$

This implies that nill incomes carry the weight zero in the summation. But, it does not imply that the group of nill incomes can be neglected. The difference between incorporation and omission equals:

$$\sum_i (X_i/Y) \cdot \ln(X_i \cdot N/Y) - \sum_i (X_i/Y) \cdot \ln((N - N_0) \cdot X_i/Y) = \ln(N/(N - N_0)) \equiv N_0/N$$

in which N_0 equals the number of nill incomes. This implies that the resulting error as a consequence of the omission of nill incomes amounts to:

$$\ln \frac{N}{N - N_0}$$

Another recognized problem in comparing income distributions, i.e. the presence of negative incomes, does not occur in our application, because we do not take capital income into account.

The redistributive effect of a scheme has been measured via a comparison with the before-tax income. For example, the impact of the AOW benefit for 1991 in Table 5, being -29.0 %, equals the procentual difference between the Theil coefficient for the before-tax income and the Theil coefficient for the before-tax income minus the AOW benefits. The former amounts to 0.3021 and the latter to 0.4255. So, we get $(0.3021 - 0.4255) / 0.4255 = -29.0 \%$. Thus, inclusion of the AOW benefits will decrease the Theil coefficient by 29.0 %.

[INSERT TABLE 5 ABOUT HERE]

The redistributive impact for the social security *benefits* is shown for both the annual figures (1991) and the cohort figures (1930 and 1950) in the upper panel of Table 5. We find that the old-age state pension (AOW) has a very large effect on annual basis (-29.0 %), whereas the effect on lifetime basis is both smaller and decreasing (- 15.1 % for cohort 1930 and -5.2 %

for cohort 1950). Here, we see most clearly the veiling effect of an annual approach. The annual effect is large because the AOW benefit is paid to about 15 % of the total population. About one third of this group does not have other income sources, whereas also about one third has an additional income that is at least half the benefit. On lifetime basis, the AOW is less important. Then, it only forms about 12 % for cohort 1930 and 6 % for cohort 1950, respectively, of (equivalent discounted) lifetime income. Consequently, the redistributive impact decreases. The widow state pension (AWW) only has a limited effect, both on annual and lifetime basis. This is, among other things, due to its limited size. It is the smallest scheme involved. The annual redistributive impact is also larger than the lifetime effect. But, the (proportional) difference is smaller than that for the AOW. One explanation for this could be that widowed men can also claim an AWW benefit and these men generally have additional income. The latter would also explain the differences between the two cohorts, as this possibility to claim only exists since 1988. The disability state pension (AAW) has a considerable effect in the year 1991 (-9.8 %). The same holds with regard to the oldest cohort (-7.8%). Cohort 1950 shows a bit smaller redistributive effect. Family allowances (AKW) have a large redistributive impact on an annual basis in comparison with the lifetime impact. This scheme, like the AOW, is an example of a scheme in which redistributive impact is determined by the group of persons that can claim a benefit. In both schemes, the claimants are in a particular phase of the life-cycle. The AKW covers, in particular, people between 25 and 45 years of age. Because (almost) everyone goes through these age brackets, the lifetime effect is undoubtedly smaller.³ These general insurances together, show of course the same picture: a large annual redistribution (-40.0 %) and a smaller and decreasing lifetime redistributive impact (-26.7 and -14.0 %, respectively).

The difference between the annual and lifetime redistributive impact of the sickness benefits (ZW) has been limited. The lifetime approach is even a bit more redistributive. The slight difference is due to the circumstance that the ZW benefits are rather evenly distributed over the life-cycle. The unemployment insurance (WW) also has a limited effect. The benefits from the disability insurance (WAO) have in 1991 an impact which is in between the lifetime impact for the cohort 1930 and the cohort 1950. The lifetime impact for cohort 1950 is somewhat smaller. A possible explanation for this is that cohort 1930 receives more frequently a WAO benefit.

³ This of course does not necessarily hold if we look at subgroups; for example, if we differentiate by number of children ever born in the household [see Nelissen (1994)].

Also the lowering of the replacement ratio from 80 to 70 % in 1985 is disadvantageous for the younger cohort. These employee insurances together result in a lowering of the Theil coefficient by 8.5 % in 1991, whereas the cohorts show a decrease of 8.8 and 6.8 %. So, the annual figures do not largely differ from the cohort figures. As a consequence, the benefits from the general and employee insurances together show the same picture as the general insurances: the annual impact is large and considerably above the lifetime impact and the lifetime impact is lower for the youngest generation.

Social assistance (ABW) has a large redistributive effect. The annual figure (-16.8 %) is almost twice the impact for the cohort 1930 (-10.6 %) and three times the impact for the cohort 1950 (-5.7 %). The occupational pensions show a rather extraordinary picture. On an annual basis, they seem to decrease income inequality, whereas on a lifetime basis they enlarge income inequality. In the annual approach, the benefit goes towards persons without labour income and with only a basic pension (the AOW). So, the effect should be an income equalizing effect. But, looking at the lifetime income, we find that persons with a high (labour) lifetime income, also have large occupational pension benefits. So, the effect is actually the opposite one. The difference between the two cohorts can be explained by the nature of the largest part of the occupational pensions in the Netherlands. Most of them are based on the final-pay principle and for the older cohort this will result in proportional high back-service gains. This is in particular advantageous for high-income earners.

The impact of the *contributions* for the various schemes is given in the lower panel of Table 5. Because of the existence of a maximum contribution amount (ceiling), the contributions for the social insurances have a regressive nature. The contributions for the general insurances increase income inequality. This increase is larger on an annual basis. On a lifetime basis the income inequality enlarging effect generally is somewhat smaller for the younger cohort. The latter implies that the increase of the contribution rates has been more than compensated by the size of the discount rate. We find one exception: the AAW. This can be explained by the decrease of the general revenue financing in this scheme and the large increase in the contribution rate. Therefore, the younger generation paid considerably more than the older one. From 1989, the financing of the family allowances (AKW) does not take place via a contribution rate but is financed by state via the taxes. We therefore do not report a figure for the year 1991.

The employee insurances show a somewhat different picture. With exception of the health cost insurance (ZFW), the annual effect is smaller than the lifetime effect. Probably this is caused by the circumstance that on an annual basis only employees pay this type of contributions, whereas on a lifetime basis almost everyone has been confronted with payments for employee insurances. This also explains the exception for the ZFW. ZFW contributions also have to be paid by recipients of social assistance benefits and part of the retired persons. The unemployment insurance (WW) shows hardly differences between the annual and cohort figures. They enlarge income inequality to a small degree. The disability insurance (WAO) shows a different picture. The contributions within a year hardly affect income inequality (and even diminish income inequality), whereas the lifetime contributions enlarge income inequality somewhat. The regressive nature of the contributions has been lowered by the existence of an exemption. The employee insurance contributions together have an income inequality enlarging effect. The annual effect is smaller than the lifetime effect. The difference in lifetime impact between the two types of insurances, given the amounts involved is strikingly small. This small difference between the general and employee insurances can be explained by the level of the ceiling. The existence of a ceiling results in an increase of income inequality and the lower the ceiling, the larger the increase is. Looking at the general and employee insurances together, we find a very limited difference between the annual and lifetime redistributive impact. The contributions for the occupational pensions show a completely different picture. They lower income inequality, which is due to the existence of a contribution exemption and often no ceiling. Then, the effect is income equalizing. The difference between the annual and lifetime approach has been limited, but is somewhat larger for cohort 1930.

[INSERT TABLE 6 ABOUT HERE]

The result for both benefits and contributions (the net benefit) is shown in Table 6. Table 6 also reports the effect of the discount rate. We first discuss the results for the 4 % discount rate. The net benefit from the old-age state pension (AOW) results in a large redistribution on an annual basis (-25.1 %). For cohort 1930, the effect is still large (although considerably smaller) whereas it almost disappears for cohort 1950. The point being that the intra-personal transfers increase, whereas the intergenerational transfers decline; see Nelissen (1995). The widow state pension (AWW) also has a proportionally large annual effect in comparison with the lifetime impact for cohort 1950. The absolute values, however, are small. The disability state pension

(AAW) shows a different picture. Its annual effect in 1991 about equals the lifetime effect for cohort 1930. But, the effect for cohort 1950 is considerably smaller. For the family allowances (AKW) we do not actually have a net annual effect. For, from 1991 no contributions have been levied for the AKW. This also explains the larger income equalizing effect for the younger cohort. The general insurances together are on an annual basis much more redistributive as on a lifetime basis: -31.7 % in 1991 against -17.8 % for cohort 1930 and -5.3 % for cohort 1950.

The net redistributive effect for the sickness insurance (ZW) hardly differs between the annual and lifetime approach, although its effect is somewhat smaller for cohort 1930. The unemployment insurance (WW) the disability insurance (WAO) show a small difference between the annual impact for 1991 and the effect for cohort 1930. Cohort 1950 shows a smaller redistributive impact. All employee insurances together have for cohort 193 a more redistributive impact than on an annual basis. For cohort 1950, we find, however, a smaller impact for the lifetime approach. But the difference in the impact is relatively small in comparison with the general insurances. The occupational pensions have quite a large redistributive impact on an annual basis, but for the cohorts we only find a smaller effect. For cohort 1930 the occupational pensions even enlarge income inequality.

If we look at the results for other discount rates (the last four columns of Table 6) we find for the general insurances (with the exception of the AWW for cohort 1950) that a lower discount rate generally results in a larger redistributive impact on cohort basis, whereas a higher one results in the opposite. The explanation for this is rather straightforward: benefits are generally received at higher ages, whereas for contributions it is the opposite. This means that benefits (contributions) are valued lower (higher) when the discount rate increases and vice versa. This also explains why the WAO follows the same pattern, whereas the pattern is reversed (ZW) or unclear (WW and ZFW) for the other employee insurances. Here, benefits and contributions take place during working life. WAO benefits are generally received at on average higher ages. General and employee insurances together show an income inequality decreasing effect if the discount rate decreases, whereas the reverse effect holds in case of an increase of the discount rate.

The effect of a changing discount rate is not sharp for the social assistance benefits (ABW). Both a higher and lower discount rate result in an income inequality decreasing effect for cohort

1930, whereas cohort 1950 shows an income inequality increasing effect. For the occupational pensions we find the reverse effect. Looking at the effect for all social security schemes together on the Theil coefficient (indicated by the row called 'Before-tax income') we find that a higher discount rate results in a smaller redistributive impact of the social security system, whereas the opposite holds for a lower discount rate.

[INSERT TABLE 7 ABOUT HERE]

The effect of economic growth can be found in Table 7. Here, we confront our findings hitherto with the redistributive impact (as measured by the Theil coefficient) of the schemes under consideration when economic growth amounts to 1 % and 3 %, respectively. Until now, we have assumed an economic growth of 2 %. The results are based on a discount rate of 4 %. For the general insurances together we find a higher redistributive impact if economic growth increases and vice versa. But, the effect is not clear with respect of the individual schemes, with the exception of the AOW. For the latter, it holds that the benefits increase proportionally to other income sources if the growth rate increases.

Contrary to this, employee insurances do not show an unambiguous picture. The redistributive impact increases as the economic growth rate increases by 1 %, but also when the rate declines by 1 %. The effect of economic growth on the redistributive impact of occupational pensions is again different. Both the 1 % and 3 % economic growth-scenario result in a larger redistributive impact for cohort 1930 and a smaller one for cohort 1950. Looking at all schemes together ('Before-tax income') we also do not find a clear picture. The use of Gini coefficients results in an analogous picture.⁴

Finally, we show the Lorenz curves for the year 1991 and the cohorts 1930 and 1950. Both the gross wages and before-tax income have been shown. For the latter, also the concentration curve has been given. These curves clearly show the considerable effect of the social security system on an annual basis in comparison with the lifetime impact. In 1991, almost 25 % of the individuals would not have had any income at all if there had not been a social security system

⁴ These Gini coefficients have not been reported here, but are available upon request. The same holds with respect of the impact of different discount rates.

in existence. On a lifetime basis, this is 0 %: nobody is completely dependent on social security benefits during their entire lifetime.⁵

[INSERT FIGURE 2 ABOUT HERE]

The concerning Gini and Concentration indices have been given in Table 8. They refer to a growth rate of 2 % and a 4 % discount rate.

[INSERT TABLE 8 ABOUT HERE]

6. Evaluation

Evaluation of the redistributive impact of the social security system is generally limited to its annual incidence. For the most part it is assumed that the redistributive impact on a lifetime basis is smaller than annual incidence studies find [see e.g. Layard (1977) and Reynolds and Smolensky (1977)]. It is also clear that the incidence will differ among generations. However, because of lack of (longitudinal) data, no empirical studies in this field are available. Here, this problem has been solved for the Netherlands by using microsimulation. The applied model, called NEDYMAS - which stands for *NEtherlands DYnamic Micro-Analytic Simulation* model [see Nelissen (1991, 1993 and 1994)] - is a dynamic cross-sectional model. The resulting income components have been adjusted for the household composition (via the equivalence scale) and the resulting amounts have been adjusted for changes in the wage index and discounted to 1990, using a discount rate of 4 %.

The microsimulation approach appears to result in a coverage that is much more extensive than that by the Income Statistics or panel studies. To determine the redistributive effects of the social security system, we look at the following: (1) the average lifetime wages and the average benefits from and contributions to the social security schemes by decile; (2) the effect of the contributions and benefits on the income distribution as measured by the Theil coefficient; (3) the Lorenz curves. All three measures confirm that the redistributive impact on a lifetime basis

⁵ Note, that both the annual and lifetime figures are based on equivalent income.

is considerably smaller in comparison with annual data. In particular, the old-age state pension (AOW) has a considerably higher impact on an annual basis than on a lifetime basis. This is also partly true for the occupational pensions. But all other social security schemes also show a higher redistributive impact for the annual approach. The differences appear to be larger for the general insurances (which have flat-rated benefits and wage-related contributions) than for the employee insurances (where both benefit and contributions are wage-related). Social assistance also has a large impact on a lifetime basis and its impact declines over cohorts just as this holds for the other schemes.

If we take the results for other discount rates (the last four columns of Table 6) we find that a lower discount rate results for all schemes together in a larger redistributive impact on cohort basis, whereas a higher one results in the opposite. The explanation for this is rather straightforward: benefits are generally received at higher ages, whereas for contributions it is the opposite. This also explains the deviating results for the employee insurances. The effect is not clear for the social assistance benefits and the occupational pensions.

Economic growth also effects the results. The impact differs among the various schemes and there is no clear picture.

Summarizing, we can conclude that our analysis confirms the theoretical notion that the lifetime redistributive impact of the social security system is smaller than the annual incidence suggests. In particular for the old-age pensions and social assistance and to a lesser extent for the disability state pension. We also find that the younger the cohort is the larger the difference is. However, our analysis also shows that this does not necessarily hold for the employee insurances, where the distribution of benefits and contributions differs less by age than for the aforementioned schemes holds. Here, horizontal redistribution aspects play a larger role.

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Figure 1 An example of microsimulation¹

1986 (sample data)						1987 (aged data)					
	ID	Age	Sex	Job	Income		ID	Age	Sex	Job	
Household 1						Household 1					
P1	1	47	M	Yes	38000	P1	1	48	M	Yes	
P2	2	44	F	No	0	P2	2	45	F	No	0
P3	3	20	M	Yes	23000	P3	4	16	M	No	0
P4	4	15	M	No	0						
Household 2						Household 2					
P1	5	79	F	No	14000	P1	3	21	M	Yes	
					25000	P2	8	19	F	No	0
Household 3						Household 3					
P1	6	37	M	Yes	32000	P1	6	38	M	Yes	
P2	7	38	F	No	0	P2	7	39	F	Yes	
P3	8	18	F	No	0						
Household 4						Household 4					

¹ Pi = ith person in the household

ID = identification number

Source: Hellwig (1988).

Figure 2. Lorenz curves for the year 1991 and the cohorts 1930 and 1950.

Lorenz curve 1991
annual data

Lorenz curve 1930
lifetime data

Lorenz curve 1950
lifetime data

• Before tax × Gross wages * Conc. curve bef. tax

Table 1. An overview of the modules in NEDYMAS

Programme module	Conditional upon
A. Demographic module	
Immigration	year of birth, age, marital status, year of previous emigration if applicable, prob. of immigration without family, prob. of re-migration like immigration
Emigration	
Old people's home	year of birth, age, sex, marital status
Death	year of birth, age, sex, marital status
Marriage	year of birth, age, sex, marital status, level of education
Divorce	year of birth, age, sex, marital status, age difference between partners, number of children
Child custody	year, sex
Dehabitation ⁶	like marriage
Cohabitation selection	like divorce
Fertility	year of birth, age, sex, marital status, living together or not, parity
Splitting-off children	year of birth, age, sex, nuptiality rate, prob. of cohabitation, participation in high education
B. Labour and income module (first part)	
Education	year, sex, availability certificates
Scholarship	year, age, type of education, parents' income
Income percentile	year, level of education, sex
Labour supply	year, age, household composition, wage rate, non-labour income
Transitions from school	year, age, sex, labour supply
Transitions from disablement	year, age, sex, labour supply
Transitions from military service	year, age, labour supply
Transitions from being employed	year, age, sex, type of employment, level of education
Transitions from being unemployed	year, age, sex, marital status, level of education, labour supply, duration of unemployment
Transitions from the state houseman / housewife	year, age, sex, labour supply
Retirement	age
Labour income	year, age, hours of work, unemployment rate, growth national income, labour force, level of education
C. Social security module	
Private pension contrs.	contribution rate, wage income, exemption
Pension contrs. for civil servants	contribution rate, wage income, exemption
Deduction civil servants	contribution rate of various schemes, income
Old-age state pension benefits	year, age, sex, marital status
Widowers state pension benefits	year, age, sex, marital status, presence of minor children, age at widowhood
Widow, widower and orphan pensions for civil servants	year, former income, term of service
Family allowances	year, sex, marital status, number of children, age of the children
Disability state pension benefits	year, former income, degree of disability
Sickness insurance benefits	year, income, marital status, minimum wage
Disability insurance benefits	year, income, marital status, minimum wage, degree of disability

⁶ In this paper we use the term "cohabitation" only for people living together without being married. If they decide to dissolve their consensual union, we speak of "dehabitation".

Disablement pensions civil servants	year, former income, term of service, degree of disability
Old-age pensions for civil servants	year, former income, term of service
Unemployment benefits civil serv.	year, former income, term of service
Unemployment insurance benefits	year, former income, sex, marital status, minimum wage, # weeks worked during last and during last 5 years, age of children
Unemployment provision benefits	year, age, sex, marital status, minimum wage, numbers of days worked in the last year, duration of employment
Supplementary benefits	kind of benefit(s), marital status, partner's income
Provision older and partly disabled employees	age at 1st day of unemployment, # weeks worked during last 5 years, degree of disability, marital status, partner's income
Social assistance benefits	year, age, marital status, wealth, income, partner's income, labour supply
Sickness insurance contributions	contribution rate, income
Health insurance contributions	contribution rate, income, number of children, partner's income
Disability insurance contributions	contribution rate, income, exemption
Unemployment insurance contr.	contribution rate, income
Old-age state pension contributions	idem
Widowers state pension contrs.	contribution rate, income, age, sex, marital status
Disability state pension contrs.	contribution rate, income
Family allowance contributions	idem
Exceptional medical expenses contributions	contribution rate, income, number of children, partner's income
Contrs. civil servants pension fund	contribution rate, income, exemption, age

B. Labour and income module (second part)

Taxes	year, age, sex, marital status, income, presence of children, type of employment, degree of disability
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Table 2. Deviation between total expenditures for social security schemes and the amounts covered by three alternatives (total expenditures in billions of guilders; deviations in %).

	Expenditures 1991	Scheme	Income Statistics	Socio- Economic Panel*	NEDYMAS
Year			1990	1986	1991
Old-age state pension	31.1	AOW	-34 %	-10%	- 4 %
Widow state pension	4.5	AWW			+ 7 %
Family allowances	6.3	AKW	-52 %		- 0 %
Disability state pension	14.1	AAW	-54 %	- 8 %	- 5 %
Disability insurance	8.1	WAO			+ 2 %
Sickness insurance	11.6	ZW	-86 %		+ 0 %
Unemployment insurance	5.4	WW	-44 %	-17 %	- 0 %
Occupational pensions	24.4		-16 %		- 3 %
Social assistance	10.9	ABW	-38 %	+ 16 %	+ 5 %

* The Socio-Economic Panel only asks net income. As a consequence, it is not possible to give the (gross) amounts involved. Therefore, we give the deviation in number of benefit recipients.

Source: Department of Social Affairs (1993), Muffels, et. al (1990) and Nelissen (1993).

Table 3. Contributions by decile for the year 1991 and the cohorts 1930 and 1950 (deciles are based on before-tax income).

Decile	1	2	3	4	5	6	7	8	9	10
General Insurances										
1930	4	6	8	9	10	11	11	12	14	15
1950	3	7	9	9	10	11	12	12	13	14
1991	2	3	5	7	10	12	13	15	16	18
Employees' insurances										
1930	2	6	7	9	10	12	13	13	13	14
1950	2	7	9	10	11	11	12	12	12	13
1991	0	0	0	5	10	13	16	17	19	21
Gen. + Empl. Insurances										
1930	3	6	7	9	10	11	12	13	14	15
1950	2	7	9	10	10	11	12	12	13	14
1991	1	2	3	6	10	12	14	15	17	19

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