Redistributive effects of first- and second-pillar pensions

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A synthetic lifecycle analysis for the Netherlands

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Abstract

We analyze the redistributive effects of the Dutch pension system, using synthetic lifecycles based on administrative data. The Dutch pension system mainly consists of a pay-as-you-go pillar and a capital-funded pillar, which have their particular redistributive effects on incomes over the lifecycle. We consider the funding (taxes and contributions) and pension benefits in both pillars for 1.4 million individual lifecycles. Results show that the first pillar (pay-as-you-go) is much more redistributive than the second pillar (capital-funded). This redistribution is from high to low incomes, and occurs mainly through the income-dependent taxes and contributions levied to finance the first pillar. The redistributive effect of the second pillar is relatively mild, from rich to middle incomes, due to a limited tax advantage (when considered over entire lifecycles). Policy simulations show that income redistribution from rich to poor (as measured over entire lifecycles) would be further enhanced if first-pillar contributions become more income-dependent, or if a part of the second pillar is shifted towards the first pillar. The introduction of a notional defined contribution (NDC) scheme (partly) replacing the second pillar would however decrease income redistribution, because persons in the highest income decile would benefit most from this type of pension. Income redistribution is not a goal per se of these policies, but it is important to also take these effects into account when adjusting or designing pension systems.

Introduction[1]

It is not without reason that all developed countries have a pension system. Principal goals of pension systems are preventing poverty at old age and smoothing consumption over the life cycle. Clearly, the policy goal of preventing poverty at old-age involves income redistribution towards the lowest income groups. In addition, the financing of pension systems through taxes and pension contributions also leads to – an often overlooked – important income redistribution. This means that the way that pensions are financed impacts on income inequality. In the Netherlands, it has been shown that the financing of first-pillar pensions leads to considerable income redistribution towards the lowest income deciles (Caminada et al., 2019; Muns and Van Vuuren, 2021).

It is important to consider first- and second-pillar pensions simultaneously, because their redistributive effects may cancel out to some extent. First-pillar pensions – financed on a pay-as-you-go basis – tend to redistribute towards low income groups and women, since the pension benefits of these groups exceed their pension contributions. Low income groups typically pay fewer contributions over their life-cycle. Their lower life expectancy, i.e., shorter expected retirement duration, only partly compensates this contribution effect. Redistribution towards women is related to their higher life expectancy. Taking into account contributions and pension benefits given different mortality rates, the first pillar in the Netherlands indeed importantly redistributes towards lower income groups and women (Muns and Van Vuuren, 2021). In other countries pay-as-you-go schemes also redistribute from higher to lower income groups (Caminada et al., 2019; Piirits & Võrk, 2019). Second-pillar pensions, financed on a capital-funding basis, tend to redistribute towards high income groups and females (Ivaškaitė-Tamošiūnė & Thiemann, 2021). These groups on average outlive their poorer counterparts and males, respectively.[2] Notably, when annuitizing second pillar capital, actuarial fairness is limited to age groups. It does not apply to income groups or gender. Moreover, pension contribution are tax deductible at a higher tax rate than applicable to the corresponding future pension benefit. This so-called reversal rule is particularly beneficial for those facing high marginal tax rates during their working life, thus high income groups.

This paper investigates the redistributive effects of the Dutch pension system and the impact of different policy alternatives on income redistribution. In doing this we consider pension benefits as well as the taxes and pension contributions to finance the pension system. Three policy changes are studied:

1. *contribution-to-tax-shift*: finance first-pillar pensions only from regular income taxes (instead of partly from earmarked income taxes),
2. *second-pillar-to-first-pillar-shift*: increase first pillar benefits (and contributions) while decreasing the second pillar contribution by a corresponding amount,
3. *second-pillar-to-NDC-shift*: introduce an extension on top of the first pillar while decreasing the second pillar contribution by a corresponding amount.

In the Netherlands, the second pillar (mandatory occupational pensions) is large by international standards. Accumulated savings range up to over 200 percent of GDP.[3] We consider the first and second pillar; the third pillar is not included as it concerns only six percent of all Dutch pensions (Bruil et al. 2015).

Essential in our analysis is the lifecycle perspective, because cross-sectional analyses of pension systems typically overestimate redistributive effects. To see this, high pension contributions during an individual's career are likely to result in high pension benefits at a later age. This is obviously the case in the second pillar, but there could also be an important correlation within the first pillar. For instance, a relatively healthy person may pay relatively many taxes – related to the more favorable labor market position of healthy persons – and on the other hand receive many pension benefits as a result of a higher life expectancy. Failing to take this correlation into account may lead to an overestimation of the redistributive effect of the pension system. Second, the dispersion is often larger for the observed cross-sectional income distribution than for the income distribution considered over the entire lifecycle (Aaberge & Mogstad 2015; Bowlus & Robin 2012). The reason is that some extreme observations in a certain year are often 'smoothed out' over a longer period of time. An individual appearing to have a high income in a certain year may actually have fewer resources during her entire career, hence pay less taxes, and also receive fewer pension benefits. Also in this example, the cross-sectional analysis will likely overstate the redistributive effect of the pension system. The latter effect can be reinforced by individual behavior, as high-income individuals are more inclined to retire early (Montizaan, 2017) and receive a lower income on a cross-sectional basis during their early retirement.

Further biases in cross-sectional analyses may arise as a result of path and duration dependence and failing to account for cohort effects. As a result of path and duration dependence, individuals may 'stick' to a certain status for a longer period of time (Kiefer, 1988). For instance, long-term unemployed workers may find it difficult to return to the labor market. As a result, their expected contributions to the pension system on a lifetime basis may be lower than indicated in a cross-section. Failing to account for cohort effects also introduced a bias, because a part of the observed 'redistribution' is related to between-cohort inequality and not so much a result of the pension system. For instance, each cohort is confronted with different economic prospects due to, e.g., business cycle fluctuations, feminization of the labor force, changes in the educational system, and technological innovation. A lifecycle model can largely eliminate such between-cohort differences.

Lifecycle models have previously been used to study income redistribution without suffering from the bias present in cross-sectional studies (De Koning et al., 2006; Ter Rele, 2007; Bovenberg et al., 2008; Van Vuuren and Muns, 2021; Waaijers and Lever, 2013; Wouterse et al., 2022). In comparison to these earlier studies, we use more recent administrative data on jobs and earnings of the entire Dutch population. In addition, we construct individual lifecycles more accurately by making use of a richer set of matching variables. So-called synthetic lifecycles are used, because integral lifecycle data do not exist, and because an individual might otherwise anticipate multiple institutional changes during the life course. A few years of observed data of similar individuals in different phases of their lives are combined to construct synthetic lifecycles. Ideally an

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[3]   Figure for the year 2021. See: https://www.oecd.org/daf/fin/private-pensions/Pension-Funds-in-Figures-2021.pdf

observation period is chosen where institutions are (nearly) unchanged. A part of a life path of one individual with a certain income, age, gender, education and origin is extended by a part of the life path of another individual with very similar characteristics. This approach is known as the 'nearest neighbor resampling principle' and has been previously adopted in Bovenberg et al. (2008), Muns and Van Vuuren (2021), Van Vuuren and Muns (2021), Wong et al. (2017), and Wouterse et al. (2022).

Our paper is among the first to use the lifecycle approach to compare the redistributive effects of the pension system. We consider the combined distributional effects of the first and second pillar, which is important because they may have some opposite effects. Muns and Van Vuuren (2021) have shown that the first pillar strongly redistributes towards lower income groups. According to calculations made by Bonenkamp and Ter Rele (2013), the Dutch pension system (first and second pillar) redistributes from high to lower educated and from males to females. The vast majority of redistributive effects results from the first pillar. The authors come to their conclusion by predicting lifecycles for eight archetypical individuals (male/female and four educational groups) born in 1995, Compared to this study, we are able to produce more precise estimates by making use of administrative data.

Our results indicate that the Dutch pension system importantly redistributes from high income groups to low income groups. On a life cycle basis, individuals in the highest income decile on average contribute more than 800 thousand euro to the pension system, whereas in the lowest two income deciles, individuals receive 160 thousand euro. This effect is largely explained by the redistributive effect of the first pillar. Redistributive effects from the first pillar mainly occur from contributions (as opposed to benefits); through the earmarked first pillar contributions and income-dependent taxes used to finance first pillar benefits.

The second pillar is far less redistributive. The direct link between contributions and pension entitlements limits redistribution opportunities. Second pillar contributions, capital holdings, and capital returns are exempted from income taxes, while future pension benefits are generally taxed at a lower tax rate than during working life (EET). As a consequence, the tax benefit from the second pillar is mainly enjoyed by higher income groups. Since we assume a balanced budget, this advantage is financed by taxes. As taxes are primarily financed by the highest income groups, this largely cancels the advantage of the tax exemption.

Policy simulations show that the income redistribution from rich to poor (as measured over the entire lifecycles) would be further enhanced if first-pillar contributions become more income-dependent, or if a part of the second pillar is shifted towards the first pillar. More income-dependent contributions to the first pillar can be achieved by abolishing earmarked first pillar contributions. As a result, the first pillar is then completely tax financed. A policy where first pillar contributions are increased by ten percent also increases redistribution, but less than in the first policy option. The second policy option increases redistribution, because mainly higher income groups pay for the increased first pillar contributions. Our third policy option – replacing part of the second pillar by an NDC scheme – reduces the redistributive effect of the pension system. The NDC-option has the smallest effect on redistribution through the pension system, since the redistribution of an NDC scheme is similar to the second pillar. Note that our policy simulations focus on long-run effects, and that the transitional effects would require an additional analysis.

Institutional setting

In the Netherlands the pension system consists of three pillars. The first pillar is the old-age state pension scheme, the second pillar is a quasi-mandatory capital-funded employment-related pension scheme. The third pillar is a voluntary capital-funded individual pension scheme.

First pillar

The first pillar is the state old-age pension (AOW). It provides pensioners a basic income. An individual is eligible for the AOW once the individual has reached the state pension age. The state pension age is 67 years in 2024, after which it will be indexed to the remaining life expectancy of the Dutch population. An individual accrues 2 percent of a full state pension for each insured year. Insured years are those years where an individual is at most 50 years before the state age and mainly resides in the Netherlands. A full net state pension equals about 50 or 70 percent of the net minimum wage. Couples each receive 50 percent of the minimum wage (993 euro gross per month in the second half of 2023), while pensioners living alone receive 70 percent (1,458 euro gross per month).

AOW benefits are financed on a pay-as-you-go basis by earmarked AOW contributions and income taxes. Earmarked AOW contributions are levied as 17.9 percent of taxable income, but only for those younger than the state pension age. A floor and a cap apply to the annual amount of earmarked AOW contributions. In 2023 the minimum amount is 558 euros and the maximum amount is 5,588 euros. The total amount of AOW contributions is insufficient to cover the government's expenses for the AOW benefits (Muns and van Vuuren, 2021). This gap currently amounts to about one half of AOW benefits, and is funded from general tax resources.[4]

The AOW redistributes from higher to lower income groups (Bonenkamp and Ter Rele, 2013; Muns and Van Vuuren, 2021). Every resident (former and current) receives the same amount of first-pillar benefits for each insured AOW year regardless of an individuals' income or labor history. However, high income earners contribute more, since both types of AOW contributions are income-related. Muns and Van Vuuren (2021a) estimate a positive net benefit from this first pillar for the bottom two third in the lifetime income distribution, while the net benefit is negative for the top one third.

Second pillar

The second pillar is an occupational pension accrued by the vast majority of employees in the Netherlands during their working lives. Employees and employers pay a second pillar pension contribution to the pension fund. In most cases, employees start to receive a second pillar pension at the state pension age, but individuals can also opt for an early take-up or a postponement, mostly at an actuarially fair rate.

Second pillar pension systems can be divided in defined benefit and defined contribution pensions. Defined benefit pensions explicitly aim to attain a particular replacement rate at retirement date, but with a more variable contribution rate. Pension

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[4]   https://www.rijksfinancien.nl/memorie-van-toelichting/2023/OWB/XV/onderdeel/1452039

contributions are added as annuities to an employee's existing pension accruals. Participants share investment risk, interest rate risk and longevity risk. Pension entitlements in a defined benefit scheme are almost always based on average pay and usually feature conditional indexation (price inflation or the wage increase in the sector). Defined benefits schemes are very common in compulsory industry-wide pension funds. In recent years defined benefit schemes are under financial pressure due to longer life expectancy, aging of the population, and lower expected returns on financial markets due to lower nominal interest rates. As a result, many pension funds, including the largest, have been unable to index pensions since the financial crisis in 2008/2009 until the increase in nominal interest rates since 2022.

The financial pressure of defined benefits schemes entailed a shift towards defined contribution schemes. Defined contribution schemes can be characterized by a more stable contribution rate, but a more uncertain replacement rate at retirement. Participants only share longevity risk in the most individualized version of such pension schemes.[5] The pension benefit is determined at retirement by annuitizing pension capital. As a consequence, the benefit is explicitly linked to the pension contributions paid and the investment returns on these contributions.

In the second pillar, an individuals' pension contribution is determined by the pension base. The pension base equals the annual gross wage less a floor. The floor ('franchise') proxies for the state pension (AOW). Pension accruals are absent over this amount as the employee is expected to receive a state pension when reaching the state pension age. In addition, the pension base is capped at 128,810 euro for a full time worker (2023). For part-time workers, the cap and floor are proportionally lower. This ensures that combining two parttime jobs adds up to the cap and floor of a fulltime worker.

Pension contribution rates vary over time, particularly in defined benefit schemes. Pension funds set the contribution rate with the aim of achieving some pension replacement rate (formally expressed as the second pillar pension benefit as a share of the average pension base during the life cycle), after consulting (representatives of) affiliated employees and employers. Most pension funds operate for all employers in a sector, but some pension funds operate only for a single (large) firm.

Second pillar pensions are tax favored. First, pension contributions are exempted from taxes, while pension benefits are taxed. This is beneficial since (i) individuals' marginal tax rate tends to be higher during working life than during pension period, and (ii) current income tax rates ('box 1 taxes') are lower after the state pension age since no earmarked AOW contribution is due. Second, accumulated pension savings in the second (and third) pillar are untaxed, while a rate of 32 percent (2023) applies to the estimated income on (non-pension) financial savings ('box 3 taxes').

The second pillar redistributes from lower to higher income groups (Bonenkamp & Ter Rele, 2013). First, the tax advantages are beneficial for higher income groups. Second, higher income groups have a higher life expectancy than lower income groups.

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[5]   In the intermediate 'collective defined contribution' schemes participants share additional risks.

Tax system

Dutch income taxes are split into three different categories (known as boxes). Each box applies to a different kind of income with a distinct tax scheme. The three boxes are income from work and home ownership (box 1), so-called substantial interests in a limited company (box 2) and income from savings and investments (box 3).

The box 1 tax is on a progressive basis with two tax brackets. For individuals who reached the state pension age, there are three brackets. The bottom tax bracket of this group reflects the exemption for earmarked first pillar contributions.[6]

The income tax system also contains various tax credits, each with different tax brackets. The general tax credit, labour tax credit and elderly tax credit are the most important tax credits.

First of all, there is the general tax credit. This is a tax credit that everyone in the Netherlands receives. The amount depends on an individual's annual income level. Personal income up to 22,600 euros is entitled to the maximum general tax credit of 3,070 euros (2023). Each additional euro of income implies a 6.095 cent lower general tax credit. Individuals with an income higher than 73,031 euro, do not receive any general tax credit. Individuals who have reached the pension age receive about half of the general tax credit of their younger counterparts.

Labor tax credit is a labor related tax credit. It only applies to individuals who have income as employee or as a self-employed. The entitled amount of labour tax credit depends on the individuals yearly income from work. The labour tax credit has both an income-dependent buildup and a reduction. The maximum tax credit is 5,020 euros (2023). It phases out for incomes between 37,691 euros and 115 thousand euro per year. Incomes above 115 thousand euro receive no labour tax credit.

The elderly tax credit is a tax credit for individuals who have reached the state pension age. Elderly with income below 40.889 euro per year are entitled to a tax credit of 1,835 euros in 2023. Every euro additional income, leads to a decrease of the elderly tax credit with 0.15 euro. Elderly do not receive this tax credit if income is above 53.122 euros.

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[6]   More details on the tax system can be found at https://www.belastingdienst.nl/wps/wcm/connect/bldcontenten/belastingdienst/business/payroll_taxes/you_are_not_established_in_the_netherlands_are_you_required_to_withhold_payroll_taxes/when_you_are_going_to_withhold_payroll_taxes/calculating_payroll_taxes/rates/.

The lifecycle model

Data

We use a rich administrative dataset from Statistics Netherlands (CBS) which contains detailed information on personal characteristics (gender, age, migration background, marital status, number of children in household), employment status, and personal income. These data are collected by the Dutch Tax and Customs Administration. The data distinguishes between different sources of income: wages (employees), profits (self-employed and company owners), and social security. Further, the data contains information on taxes paid and household type.

Our data covers the period 2011 to 2019. During this period, our variables of interest were not affected by any major policy changes, which is a good starting point for the construction of synthetic lifecycle profiles.

Modeling assumptions

Our dataset is a panel containing observed values of the variables of interest $Y_{j,a}$ for individuals j = 1, …, J with age a staring from 18 onwards. From this dataset we create synthetic lifecycles to study the redistribution effects of the Dutch pension system. Synthetic lifecycles are constructed by matching similar individuals in 2011 and 2019.

Our synthetic lifecycles are constructed using nearest neighbor matching (NNM). NNM is a non-parametric method matching each individual from a donor group (for instance 45 years old single men in 2019) to a similar individual from the receptor group (45 years old single men in 2011). A distance metric determines the distance between two individuals, based on one or more some covariates (such as deflated personal income). NNM has been applied previously in similar contexts, see e.g. Wong et al. (2017) and Wouterse et al. (2022). The method has also been applied in other disciplines (e.g. Farmer and Sidorowich 1987; Hsieh 1991).

Using the NNM algorithm we construct N individual lifecycles. Each simulated lifecycle i consists of a time series $Z_i = \{Z_{i,0}, Z_{i,1}, …. Z_{i,\bar{a}}\}$, where each $Z_{i,a}$ is a vector containing income and other variables of interest (e.g., gender, household type etc.) at age a. Age a = 0 denotes the starting age (in our case 18 years), while age $a = \bar{a}$ is the oldest observed age of any individual (in our case $\bar{a}$ = 87 at 105 years). Each $Z_{i,a}$ of individual i is empty after death or emigration and before immigration, if applicable to this individual.

The algorithm is as follows. Our starting point is the collection of lifecycle paths of all individuals who are 40 years old between 2011 and 2019. The lifecycle path $Z_i = \{Z_i^{(2012)}, Z_i^{(2013)}, …, Z_i^{(2019)}\}$ ends in 2019 at some age $a_{i,2019}$. To extend this lifecycle path to age $a_{i,2019}$ + 1 we consider all individuals with age $a_{i,2019}$ in 2011. We select a specific individual using k-nearest neighbor matching. More specifically, the distance from individual i to each neighbor j (with matching characteristics in 2011) is determined by the difference between some other characteristics of individual i and j. One neighbor is randomly drawn out of the k-nearest neighbors. The life cycle path of this neighbor from 2012 to 2019 extends our lifecycle with eight additional age years. We can repeat this procedure using all individuals in the data with age $a_{i,2019}$ + 8 in 2011, matching

again on the same characteristics. This procedure is repeated until an individual is matched to another individual who dies (or migrates to another country) between 2012 and 2019.

We require that individuals match exactly on gender, household type, position in the household, migration background, type of labor contract (if employee), and main source of income (also for partner, if applicable). Migration background is matched until an individual is 40 years old. At higher ages it is more difficult to find individuals with a migration background.[7] The main source of income and type of contract are matched until an individual is 65 years old.

The variables income, partner income (if applicable), parttime factor, household's liquid assets, and number of children in the household do not have to match exactly. Instead, these variables determine our distance measure after normalizing with the standard deviations of the corresponding variables. Using NNM, we then identify for each individual the $k = 20$ neighbors whose characteristics are most similar to the considered individual. Following among others Rajagopalan and Lall (1999) and Wong et al. (2017), we randomly select one neighbor from the twenty nearest neighbors. Randomly picking one nearest neighbors preserves heterogeneity and avoids duplications of lifecycles. To see this, if we were to use $k = 1$, the NNM would tend to match individuals to a relatively small group of individuals from the receptor group. The constructed lifecycles would then be too similar at high ages. This problem is largely resolved by the random selection from the twenty nearest neighbors.

Similar to Lever and Waaijers (2013), we only include lifecycles that end after the state pension age. This implies that we exclude 392,526 paths where the lifecycle ends before the state pension age. These lifecycle paths are less relevant for our analysis. Lifecycles can end before the state pension age because of several reasons: premature death, emigration, and absence of any matching individual. The last two reasons would bias our results. In case of emigration, we do observe pension contributions in both pension pillars, but not the pension benefits they receive while living abroad. In contrast to Lever and Waaiers, we maintain lifecycles that start after 18, since we still observe all pension contributions and benefits. In the end we obtain 1.39 million different lifecycles.

Characterization of lifecycle paths

Table 1 contains some descriptive statistics of our 1.39 million lifecycles from which 52 percent is female and 48 percent is male. On average individuals die at 84.5 years old. Although women have a higher life expectancy, lifetime labor income is 43 percent lower for women than for men. This is for an important part related to the high prevalence of part-time work among women in the Netherlands.

The lifecycles are grouped into income deciles based on average annual gross personal income from age 25 to (including) 65. In the lowest income decile, 75 percent is female and 25 percent is male. Within this bottom income decile, life expectancy for

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[7] In addition, it is questionable to what extent the remaining lifecycle of pensioners with a migration background differs from pensioners without migration background, with the other characteristics the same. For instance, after the pension age language deficiencies and labor market discrimination play at most a minor role.

women (84.6 years) is substantially higher than for men (79.8 years). In this decile yearly labor income (for ages 25–65) is lower for men.

Within each income decile women have a higher life expectancy then men, although this gender difference decreases when income increases. In the second decile the difference in life expectancy is 4.8 years, while it is only 2.4 years in the highest income decile.

Persons in the lowest income group on average earn three thousand euros a year during their working life (between 25-65 years old), and persons in the highest income group on average earn around 110 thousand euros a year. Individuals in the fifth decile earn around three times as much as those in the lowest income decile. Individuals in the highest income group earn around three times as much as those in the fifth decile. Labor income is higher than personal income, since labor income also contains the employee and employer contribution to social insurance premiums. These components are not included in the personal income.

Table 1   Descriptives of the constructed lifecycles

	Gender	Life expectancy	Yearly labor income (25-65)*	Yearly personal income (25-65) *	N
Total		84.7	43	40	1.387.045
Women		86.1	32	30	715,325
Men		83.3	56	51	671,720
Income decile 1	F	84.6	3	10	104,509
	M	79.8	3	16	34,194
Income decile 2	F	85.5	12	15	108,627
	M	80.7	12	20	30,076
Income decile 3	F	86.0	21	21	102,610
	M	81.4	21	24	36,093
Income decile 4	F	86.3	28	26	92,107
	M	81.9	28	29	46,596
Income decile 5	F	86.5	35	31	79,599
	M	82.4	35	33	59,104
Income decile 6	F	86.7	42	37	65,301
	M	83.0	42	38	73,402
Income decile 7	F	86.9	50	43	54,133
	M	83.4	50	44	84,570
Income decile 8	F	87.0	59	50	45,328
	M	84.0	59	51	93,375
Income decile 9	F	87.3	72	61	35,666
	M	84.5	73	62	103,037
Income decile 10	F	87.5	107	91	27,443
	M	85.1	114	98	111,259

Note: Income deciles are based on average labor income between the age of 25 and 65. Labor income includes social insurance contributions such as employee and employer contributions. Labor income in a certain year is zero for individuals without labor income.

Modelling the Dutch pension system

In this section we explain how we translate pension institutions into our lifecycle model. In addition to the modeling of the current pension institutions, we explain how we model new features in our policy simulations, most notably the NDC scheme.

To construct a population from our lifecycles, we assume that each year a new cohort of the same 1.4 million lifecycles is born (with identical future realizations on income profile, mortality event, etc.). For each pension pillar, we impose that the yearly government budget is balanced. Any deficit or surplus is covered by a balanced budget tax proportional to (non-earmarked) box 1 taxes.

First pillar

The first pillar ('AOW') is modelled by three components: benefits, earmarked contributions, and (non-earmarked) taxes. Earmarked first-pillar contributions are computed using an individual's income (until the state pension age) and the tax rules in 2020. The minimum and maximum contribution limits also come from 2020. Starting the state pension age, each individual is assigned the standard first pillar benefit (conditional on partner status). We use the benefit amounts of 2020 to determine the level of the first pillar benefits. In our lifecycle paths first pillar benefits are constant over time, since first pillar benefits are indexed with a wage index and all amounts in our life cycles are deflated with a wage index.

The statutory pension age in our lifecycle paths is 68, which corresponds to the current pension target age ('pensioenrichtleeftijd'). This target age functions as an anchor for pension funds to determine the average expected pension age for the current working population.

Since the first pillar is a PAYGO system, we assume a yearly zero net balance at the macro level. That is, the yearly aggregate first pillar benefit equals the aggregate contributions (earmarked and non-earmarked).

Measured over the lifecycle, the net benefit from the first pillar is for individual i

$$\text{net first pillar benefit}_i$$
$$= \text{first pillar benefit}_i - \text{earmarked first pillar contribution}_i$$
$$- \text{ balanced budget tax}_i$$

Note that this involves a summations over all ages of individual i. To balance each year's government budget, a uniform share of an individual's income tax (net of earmarked taxes) is imposed:[8]

$$\text{balanced budget tax}_i = \tau_{\text{1st pillar}} \times \text{nonearmarked tax box 1}_i$$

The balanced budget tax is determined by balancing the yearly government budget. Since each year a new cohort of the same lifecycles is born, it follows that

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[8]   In policy discussions, this balanced budget tax is referred as the taxed part ('gefiscaliseerd deel') of the first pillar, although earmarked first pillar contributions are earmarked taxes.

$$\sum_i \text{net first pillar benefit}_i = 0,$$

This gives for the share $\tau_{\text{1st pillar}}$

$$\tau_{\text{1st pillar}} = \frac{1}{\sum_j \text{nonearmarked tax box 1}_j} \sum_k \text{net nontax benefit}_k$$

Using our synthetic lifecycles and parameters, we find $\tau_{\text{1st pillar}}$ = 45.1 percent.

NDC scheme

We assume that in a NDC-scheme all workers (employees and self-employed) accrue NDC entitlements. The NDC contribution is a percentage of annual gross labor income[9] between a lower threshold and a cap. The lower threshold equals 14.167 euro. The cap on the NDC contribution is 110.111 euros. These limits are based on the 2020 amounts for the (standard) lower and upper cap in the second (and third) pillar. [10]

The accrued NDC entitlement is proportional to the corresponding NDC contribution. Similar to the current first pillar, NDC entitlements are indexed with the wage bill. At retirement, NDC entitlements are converted to an NDC benefit based on the remaining life expectancy of an average person and expected future indexation.

The NDC scheme has four distinct tax effects. First, NDC contributions are tax exempted, similar to second pillar contributions. To see this, consider the situation without NDC contributions: individuals would then earn additional labor income which would be regularly taxed (box 1). Thus, an individual's box 1 tax advantage is the difference between taxes paid when NDC contributions are tax exempted, compared to the counterfactual case where NDC contributions are taxed. Measured over the lifecycle,

$$\text{box 1 tax advantage}_i = \text{taxes paid}_i - \text{counterfactual taxes paid}_i.$$

Second, accumulated NDC entitlements are tax exempted from income on savings (box 3). For an individual with age *a*, the tax exemption is identical to the base case with a higher second pillar contribution in place of the NDC contribution:[11]

$$\text{box 3 tax advantage}_i = \text{box 3 tax advantage acc}_i + \text{box 3 tax advantage dec}_i,$$

where

$$\text{box 3 tax advantage acc}_i = \text{box 3 tax rate} \times \sum_{a<68} \left(\sum_{t=0}^{a} \text{NDC contribution}_{i,t} \right).$$

$$\text{box 3 tax advantage dec}_i = \text{box 3 tax rate} \times \sum_{a\geq68} \text{value NDC entitlement}_{i,a}.$$

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[9]   The amount includes the employee's contribution, but excludes the employer's contribution to the pension contributions.
[10] Wet op de loonbelasting 1964, art. 18a, lid 3, and art. 18 ga. https://wetten.over-heid.nl/BWBR0002471/2023-07-01
[11] We assume that substituting one euro pension contribution in the NDC scheme for the second pillar does not change an individual's liquid savings (box 3). In addition, the rate of return on liquid savings is assumed to be equal to the discount rate.

Third and similar to other sources of pension income, NDC benefits are subject to income taxation. This final component is actually a loss for the individual. Therefore, an individual's box 1 tax disadvantage equals the difference between the taxes paid when NDC benefits are taxed, compared to the counterfactual case where NDC benefits are tax exempted. For the lifecycle of individual i,

$$\text{box 1 tax disadvantage}_i = \text{taxes paid}_i - \text{counterfactual taxes paid}_i.$$

On aggregate, it turns out that the three tax components are a tax subsidy received by individuals. This means that the box 1 tax disadvantage is typically smaller than the tax advantages in box 1 and box 2. To balance each year's government budget, the tax subsidy is financed proportional to (non-earmarked) income taxes (in box 1), which is our final component of the tax effect:

$$\text{balance budget tax}_i = \tau_{\text{NDC}} \times \text{nonearmarked tax box 1}_i$$

Similar to the first pillar discussed above, the parameters τ_{NDC} is a mark-up on nonearmarked box 1 taxation. It follows that

$$\tau_{\text{NDC}} = \frac{1}{\sum_j \text{nonearmarked tax box 1}_j} \sum_k (\text{box 1 tax advantage}_k + \text{box 3 tax advantage}_k - \text{box 1 tax disadvantage}_k).$$

Using our synthetic lifecycles and parameters, we find $\tau_{\text{NDC}} = 8.3$ percent.

The net benefit of the NDC-scheme over the lifecycle is for each individual i calculated as follows:

$$\text{net NDC benefit}_i = \text{net nontax benefit}_i + \text{net tax benefit}_i$$

where

$$\text{net nontax benefit}_i = \text{NDC benefit}_i - \text{NDC contribution}_i$$

and

$$\text{net tax benefit}_i = \text{box 1 tax advantage}_i + \text{box 3 tax advantage}_i - \text{box 1 tax disadvantage}_i - \text{balance budget tax}_i.$$

In each year the aggregate NDC benefit is equal to the aggregate NDC contribution, thus on aggregate the net nontax benefit is zero for the NDC scheme:

$$\sum_i \text{net nontax benefit}_i = 0$$

Similarly, the tax to balance the budget ensures that the aggregate net NDC tax benefit is also equal to zero:

$$\sum_i \text{net tax benefit}_i = 0$$

Hence, the aggregate net benefit from the NDC scheme is also zero:

$$\sum_i \text{net NDC benefit}_i = 0$$

Second pillar

We reconstruct the second pillar pension contributions and pension benefits in order to achieve consistent lifecycle patterns. Thus we ensure a mechanical link between past contributions and future pension benefits, which would be otherwise missing in our synthetic lifecycles. In addition, the observed information on second pillar contributions is incomplete.

The assumed second-pillar contribution enables us to construct second-pillar pension benefits. As a side benefit, we can neglect the indexation of second pillar pension benefits in our data period 2011-2019. The indexation pattern in this period is unlikely to be representative of the future, since indexation was completely absent for most pensioners.

Our second pillar pension system is a stylized defined contribution system with a fixed contribution rate. Unless stated otherwise, this rate is set at 25 percent. Thus, 25 percent of an individual's pension base (annual wage cost[12] between a lower threshold and a cap) is contributed to this pension scheme. The lower threshold equals 14.167 euro, while the cap equals 110.111 euros, which is the same as in our NDC scheme. We assume that all employees contribute to their pension scheme and all self-employed individuals who paid pension contributions in that respective year.

Second pillar pension contributions are invested in financial assets. By assumption, the return on these assets matches the discount rate. The pension benefit of an individual is an annuity depending on accumulated pension savings and remaining life expectancy. During retirement, pension savings are still invested in financial assets to earn the discount rate.

The second pillar has similar tax effects as the NDC scheme. Again, the aggregate tax effect is a tax subsidy received by individuals at the expense of the government. In line with the NDC tax benefit, we assume that this subsidy is financed proportional to (non-earmarked) income taxes (box 1).

The net benefit of the second pillar is obtained in a similar way as for the NDC scheme:

$$\text{net 2nd pillar benefit}_i = \text{net nontax benefit}_i + \text{net tax benefit}_i$$

where

$$\text{net nontax benefit}_i = \text{2nd pillar pension benefit}_i - \text{2nd pillar contribution}_i$$

and

$$\text{net tax benefit}_i = \text{box 1 tax advantage}_i + \text{box 3 tax advantage}_i - \text{box 1 tax disadvantage}_i - \text{balance budget tax}_i$$

The methodology is the same as in the NDC case. On a macro level discounted benefits are equal to contributions. Again, the aggregate net tax benefit is equal to zero by imposing a tax markup ($\tau_{\text{2nd pillar}}$) on (non-earmarked) box 1 taxes. Here, we find $\tau_{\text{2nd pillar}} = 60.1$ percent

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[12] The amount includes the employee's contribution, but excludes the employer's contribution in the pension contributions.

Tax system

The tax system in our model is based on institutions in the Netherlands in 2020. Box 1 income is taxed at a progressive rate with two tax brackets: Income[13] till 68,508 euros is taxed at a 37.35% rate, and income above 68,508 euros is taxed at a 49.5% rate. Box 2 is absent in our model. Concerning box 3, the government assumes a predetermined fictional return to determine taxable income from savings and investments. We adopt a four percent return, i.e., the rate the government assumed until 2017.[14] This fictional return on savings and investments is taxed at a 30% rate.

The tax system in our model also contains three tax credits; the general tax credit, the labor tax credit and the elderly tax credit. For those eligible, the tax credit depends on the income level.

To determine an individual's tax burden, we subtract earmarked contributions for the first pillar and other earmarked contributions[15]. Earmarked taxes, although considered part of income taxes, are designated for specific purposes. Earmarked first pillar contributions and taxes on (gross) first pillar benefits are assumed to be only utilized for financing first pillar benefits. The other taxes on pension benefits (from second pillar and NDC scheme) are used to finance tax advantage of both schemes. The remaining amount of box 1 income taxes, obtained after deducting the earmarked contributions and taxes on pension benefits, is utilized to balance the government budget by distributing the financial burden of the pension system among individuals. First the remaining taxes are used to bridge the deficit in the first pillar, then, in the case of a NDC-scheme, the remaining taxes are used to the NDC-scheme balance budget tax. At last, the taxes are used to finance the second pillar balance budget tax. It is important to note that with each allocation, the taxes are deducted from the aggregate tax pool.

Limitations of the model

Two important limitations apply. First, we consider net benefits for lifecycles at the personal level. The net benefit of a partner is absent in this analysis, although a partner's net benefit does affect the net benefit (and disposable income) at the household level. This is particularly relevant for households consisting of (at least) two persons from subgroups with opposite effects, e.g., a male and female, and the lowest and highest income group.

Second, our lifecycles represent a steady state, which means that our redistributive effects reflect a long-run effect. Important transition effects for different cohorts can particularly be expected when changing the proportions of PAYGO and capital funding, such as in our second and third policy option. Without question, when considering a change in the pension system policymakers must always include transition effects in their analysis.

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[13]   Box 1 income is in our model defined as income from work or social security, plus income from homeownership, minus the employee's and employer's contribution to the pension scheme.

[14]   In 2020 a return of 4.07 percent was assumed by the government for assets between 70 thousand and 1 million euros. Currently, the assumed return is more complex as it depends on an individual's asset mix.

[15]   The other earmarked contributions are insurance contribution to finance a basic survivors' pension benefit and the long-term care act.

Current redistribution

In this section we discuss results for the current Dutch pension system. The first pillar (AOW) is a PAYGO state pension financed through earmarked contributions and taxes. The second pillar is capital funded pension financed by contributions from employees and employers. In this section analyze the net benefit that different groups receive from the pension system. Differences in received net benefit imply a redistribution between groups. Then we analyze the effects of both pillars.

Figure 1 shows the average net benefit (gross subsidy minus taxes) received from the first and second pillar in the Dutch pension system. On average women benefit from the pension system (150 thousand euros), and men face a net loss. Note that the average net benefit of women is not exactly equal to the average net loss of men, since the number of female lifecycles exceeds the number of male lifecycles.

Because of their higher life expectancy, women enjoy a larger first pillar subsidy than men. On average a woman receives around 260 thousand euros in gross first pillar subsidies during her life. For men this number is 200 thousand. Men pay 60 thousand more earmarked contributions for the first pillar and a larger amount of taxes to ensure that the government balances the budget. The latter can be explained by the higher average income of males.

The tax benefit in the second pillar is closely related to labor income. For instance, men benefit on average 180 thousand euros from the second pillar tax advantage, this is 70 thousand euro more than for females. On the other hand, men also pay a 130 thousand more to balance the government's budget. As a result, men face a net loss from the second pillar, while women receive a small net benefit. The magnitude of the net effects of the second pillar is small compared to the size of the contributions and the subsidies.

The Dutch pension system also redistributes between income deciles (Figure 1). Over their lifetime, the highest decile face a significant negative net benefit of more than 790 thousand euro. The 8th and 9th decile experience a much smaller net loss. The bottom half income groups derive the greatest net benefit from the pension system; between 150 and 190 thousand.

The lowest income groups predominantly benefit from the first pillar, while the middle class benefits more from the second pillar. The gross subsidy in the first pillar is the state old age pension. Unsurprisingly, this subsidy is very similar for all income groups. An average individual receives 230 thousand from the state old age pension. The lowest income groups receive the lowest amount, because they tend to pass away earlier, see Table 1. The highest income group consists of a relatively large proportion of men (80 percent, Table 1). The resulting adverse gender effect on life expectancy slightly dominates the advantegous income effect on higher life expectancy. As a result, first pillar benefits by income group are very similar.

Figure 1   Net profit of the pension system in the base case
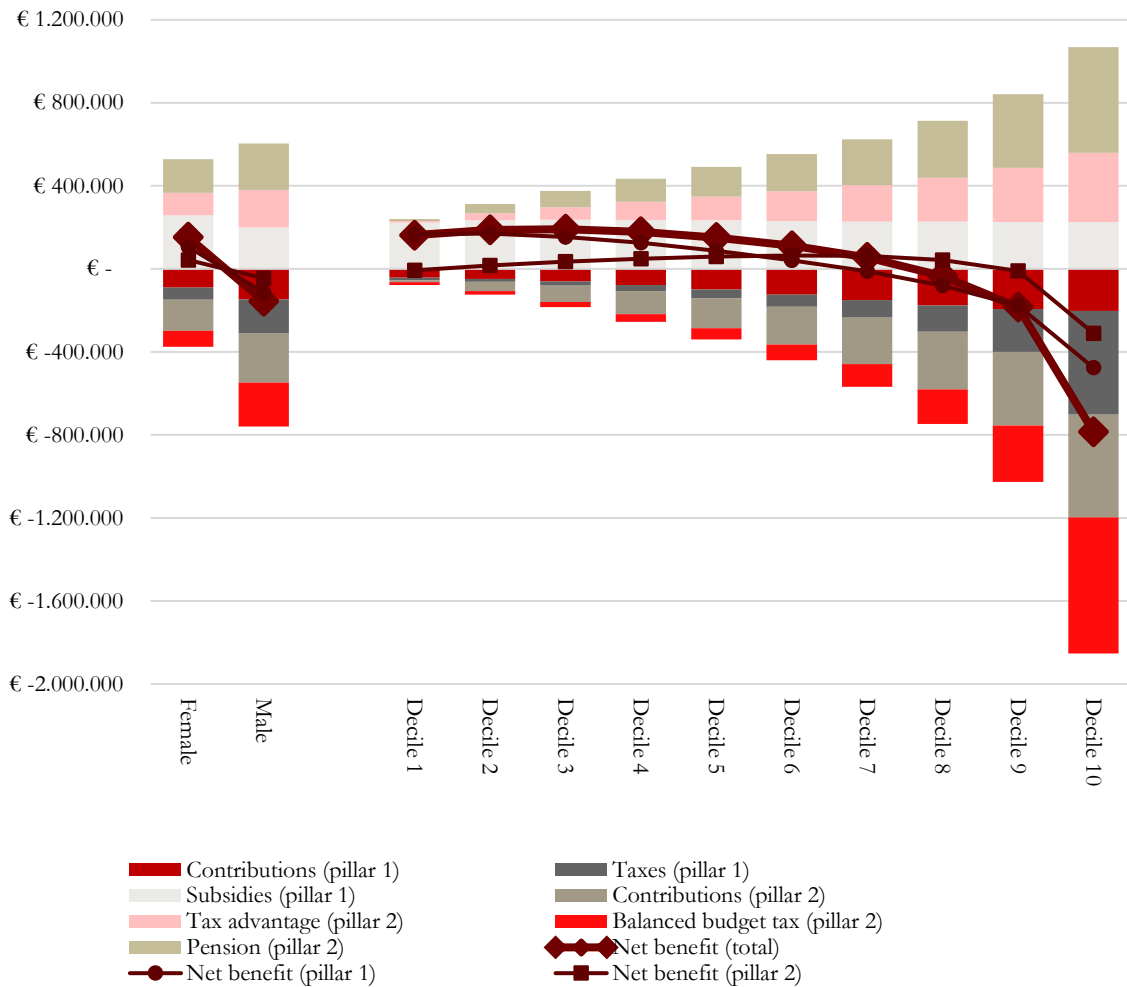
Note: The net benefit from the Dutch pension system is defined as subsidies minus contri-
          bution and taxes. First pillar contributions are the earmarked first pillar contributions.
          First pillar taxes are the taxes needed to finance the first pillar with balanced budget.
          First pillar subsidies are gross first pillar pension benefits individuals start to receive
          after having reached the state pension age. Second pillar contributions are the em-
          ployment related pension contributions. The second pillar tax advantage consists of
          the tax exemption of pension contributions (box 1) plus of accumulated capital (box
          3) minus the tax on the pension. The balanced budget tax are the taxes that are
          needed to finance the tax advantage. Second pillar pension represent the gross sec-
          ond pillar pension benefits. Income deciles are based on average labour income be-
          tween the age of 25 and 65.

In the second pillar, the pension depends much stronger on the income group. For the
bottom income group the second pillar pension is on average 9 thousand euro, while
the highest income group receives 500 thousand euro. For the lowest income groups,
the second pillar is much less relevant than for higher income groups, because of the
franchise which is mostly equal to the first-pillar pension. As a result, zero or very few
pension contributions are paid by those with an income around the minimum wage (or
lower). Higher income groups enjoy a larger pension since they pay most contributions
in the second pillar (which are all tax deductible). Over their lifetime, the highest

income group pays about 65 times more contributions than the lowest income group, i.e., 500 thousand euro compared to 9 thousand euro. This difference is much larger than in the first pillar, since first pillar contributions are capped at an annual gross income of 34,712 euro (2020). In contrast, second pillar contributions are only capped at 110,111 euro for a fulltime worker, and a lower threshold euro at 14, 167 euro applies.

Higher income groups pay the largest share of contributions, which explains the following. First, higher income groups enjoy a high box 1 tax advantage of 260 thousand euro, while the lowest income group only receives 3 thousand as a box 1 tax advantage. Second, the higher income groups have a larger amount of tax exempted accumulated pension savings (and box 3 tax advantage). Third, higher contributions and savings result in a higher pension benefit, which means that the highest income group pay most taxes over their pension, 130 thousand over the life cycle. The latter amount is still lower than the box 1 and box 3 tax advantage combined. For all income groups this tax benefit in the second pillar is positive.

For each pension pillar, we impose that the government balances the budget of each pension pillar. By construction, the latter tax inherits the strong progressive effect of the box 1 tax. Unsurprisingly, the highest incomes pay most taxes to balance the budget. Notably, Figure 1 reveals that the highest income groups receive a net loss from the second pillar after taking into account the additional tax benefit to run balanced budget. It is primarily the middle classes that enjoy the largest net benefit from the second pillar. The total balance budget tax is 60 percent of the total non-earmarked tax. See Appendix A for a detailed breakdown by subgroup and pension pillar.

Policy simulations

In this section we discuss our policy simulations. First, we explain the three different policy reforms. Then we discuss the results. We show how the redistribution effect of the pension system would change, if the policy reform would become reality.

Policy reforms

In the first policy reform the earmarked first-pillar contribution – only paid by those before the pension age – is abolished. Instead, the first-pillar pension is completely financed by taxes paid by the entire population, including pensioners. The second pillar is not adjusted (see Table 2). In the current Dutch tax system, earmarked first pillar pension contributions are only levied before the state pension age. Since the earmarked contribution is part of income taxes (more specifically, part of the so-called `box 1' income tax), the income tax rate decreases when an individual reaches the pension age. Therefore, abolishing the earmarked first-pillar contributions eliminates the differences in tax regime before and after the state pension age.

Table 2   Policy simulations

	First pillar (PAYGO)			Second pillar (Funded)
	Earmarked contribution (first-pillar premium)	**General tax contribution**	**NDC earmarked contributions**	**Contribution**
Base case	P	T		F
1. Tax shift within first pillar	0	P + T		F
2. Shift from second to first pillar	P	T + 0,1 * (P + T)		F – 0,1 * (P + T)
3. Shift from second pillar to NDC	P	T	0,1 * (P + T)	F – 0,1 * (P + T)

Note: In each policy option total pension contributions are fixed at the macro level summed over all lifecycles: P + T + F. For each policy option, a uniform first pillar contribution rate applies (in terms of taxable income) and a uniform second pillar contribution rate apples (in terms of the pension base). Contributions only apply before the state pension age except for the first pillar contribution from general taxes.

The second policy option shifts contributions from the second pillar to the first pillar. As a consequence, the pension benefit in the first pillar is increased by 10 percent. This increase is completely financed by (non-earmarked) higher taxes. The second pillar contribution is proportionally reduced by the same amount to ensure that on a macro level the aggregate pension contribution (first and second pillar) remains the same as in our base case. This means that the second pillar contribution rate is lowered from 25 to 22 percent.

This second policy option resolves a number of issues in the current Dutch pension system. First, a substantial share of Dutch workers is not covered by a second pillar pension scheme. This group of 1.7 million workers (2020) is concentrated among self-employed individuals and employees not covered under a pension plan. It corresponds to

23 percent of all workers in the Netherlands (Biesenbeek et al., 2022). For most of them, second pillar coverage would entail a welfare gain as this would provide additional tax subsidies and in the absence of coverage, the consumption spending pattern may sub-optimally anticipate the low pension income (Van Ewijk et al. 2022). Second, most pension funds pension benefits increasingly depend on investment returns on financial markets. Due to ageing of the average Dutch pension fund, shocks in pension benefits can hardly be absorbed by a mark-up on contribution rates (Van Ewijk et al. 2022). Third, the downward trend in real interest rates (Commission Parameters, 2022; Rogoff, Rossi, and Schmelzing, 2023) suggest persistently lower future real returns on capital funding. Lower expected returns hampers the accrual of sufficient assets to attain a required replacement rate in the second pillar. Fourth, risk sharing with future participants is nowadays less common since (i) stricter accounting rules prevent most employers to act as a risk sponsor and (ii) the supervisory regime for pension funds has become more strict in response to sharp declines in funding ratios.[16]

Enlarging the first pension pillar solves both problems. Those not covered by a second pillar pension face an increased income after the pension age. Since the first pillar is financed on a pay-as-you-go basis, pension incomes are less dependent on financial markets but more on demographics. An enlargement of the first pillar also causes a redistribution between generations, especially in favor of the elderly at the time of the reform. In addition, a higher state pension leads to a rising tax burden to finance the state pension. The tax increase has a distortionary effect on the labor market. An implementation advantage of this option is that implementation is relatively easy and could be effective in the short term (Van Ewijk et al., 2022).

It is important to note that this policy option reduces the tax exemption from the second pillar, since second pillar pension contributions decrease. This means a smaller box-1 tax advantage in this policy option than in the base case. We assume that the box-3 tax advantage is unchanged, since the shift from second to first pillar contributions suggests that voluntary savings (which are subject to box 3 taxes) are roughly unaffected in this policy option.

Our final policy option also implements a shift from the second to the first pillar. In this third policy option, the first pillar is extended with a so-called 'Non-financial Defined Contribution pension' (NDC). In a NDC scheme, participants accrue pension entitlements proportional to contributions. That is, individuals with a higher income pay higher contributions and accrue a higher pension. In this way, an NDC scheme still gives an incentive to individuals to participate in the labor market, because future pension benefits are linked to past contributions. At retirement, the accumulated NDC entitlement is converted into a lifelong annuity, taking into account expected remaining life expectancy and future indexations.

An individual's NDC entitlement is annually increased based on nominal GDP growth or a similar index. Our NDC-scheme is a simple PAYGO-system without any investment in financial markets. Indexation of entitlements is absent in our NDC scheme, since population growth, real wage growth and interest rate uncertainty are absent in our analysis.

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[16]   https://zoek.officielebekendmakingen.nl/kst-33972-3.html

By construction, the NDC-scheme is less redistributive than the AOW scheme. In the NDC-scheme, pensions entitlements are directly linked to past contributions, which reduces the redistributive effect of the NDC-scheme. Put stronger, the NDC schemes tend to redistribute from low to high income groups by sharing differences in life expectancy.

The contribution for the NDC scheme equals 10 percent of the first pillar in the base case. Similar to the second policy option, the aggregate contribution to the second pillar is reduced by the same amount. This ensures that the total pension contribution (first and second pillar together) is on the macro level identical in the policy options we consider.

First policy option: Tax shift within first pillar

In this policy option, the first pillar benefits are completely financed by (non-earmarked) income taxes as opposed to a mix of earmarked first pillar contributions and (non-earmarked) income taxes (Table 2). As a consequence, in this policy option the share in the total first pillar contribution becomes more income dependent. Thus, this policy option magnifies the redistributive effects of the first pillar.

The redistributive effect by gender is not that large. More specifically, the net benefit of women increases by nine thousand euro over their lifecycle, while this amount is ten thousand euro for men.

Figure 2   Difference in net benefit between the base case and the first policy option. In the first policy option, earmarked first pillar contributions are abolished.
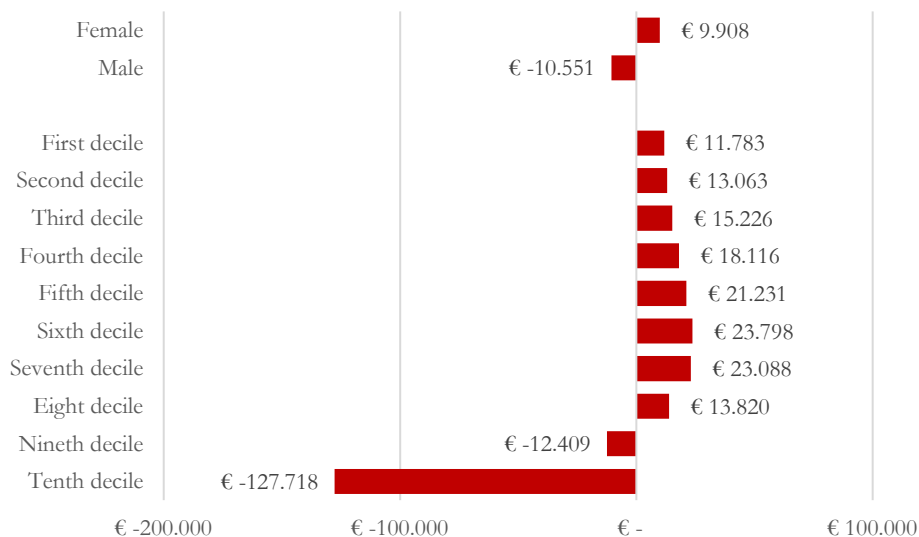
The change in redistributive effects by income decile is more pronounced. The net loss of the 10th decile further increases with 128 thousand euro compared to the base case. This reflects that the increasing amount of (non-earmarked) income taxes is not capped. The middle groups (deciles 5, 6, and 7) enjoy the largest benefit from this policy option, since their share is lower in (uncapped non-earmarked) income taxes than in (capped) earmarked first pillar contributions.

The redistributive effect strongly depends on the balanced budget tax (see Appendix). By assumption, this tax is proportional to the progressive (non-earmarked) box 1 tax. A tax more regressive than the box 1 tax, e.g., indirect taxes would to some extent flatten the redistributive effect.

Second policy option: Shift from second to first pillar

In the second policy option the first pillar benefit is increased by 10 percent (Table 2). This increase is financed by an increase in (non-earmarked) income taxes. The second pillar contribution is reduced, such that the aggregate pension contribution is the same as in the base case. This policy option is attractive for those benefiting more from the first pillar than from the second pillar.[17]

The redistributive effects by gender are smaller than in the first policy option. In this setting, the net benefit of women increases by 7 thousand euro during an average lifecycle. Women benefit more from an enlargement of the first pillar. This implies a smaller required tax increase to finance the increase in first pilar benefits. The effect on the net benefit is slightly mitigated by the reduction of the second pillar.

In a similar vein, expanding the first pillar of the Dutch pension system has beneficial effects for individuals in the lower income deciles by their small first pillar contribution. Almost all income groups see their first pillar benefits increase by more than 20 thousand euro. These increased subsidies are financed by higher taxes, while shrinking the second pillar has a more limited impact on taxes. Again, the second pillar slightly mitigates the redistributive effect from the larger first pillar since the highest income deciles benefit from the smaller second pillar

The tax burden of this second policy option falls mostly on higher income deciles. This mainly explains the redistributive effects of this policy option. The net benefit of the lowest income group increases by approximately 20 thousand euros compared to the base case. The bottom six income groups face an increase in the net benefit, while the net benefit of the highest income groups becomes even more negative, especially for the highest income decile (35 thousand euros over their lifecycle).

These results suggests that a more substantial first pillar would provide greater support for the old-age of individuals with lower incomes, while also increasing the redistributive effects of the pension system.

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[17]   All current pensioners also face a large net benefit from an immediate 10 percent increase first pillar pensions, provided first pillar benefits are immediately increased. Our steady state analysis abstracts from transition effects.

Figure 3   Difference in net benefit between the base case and the second policy option
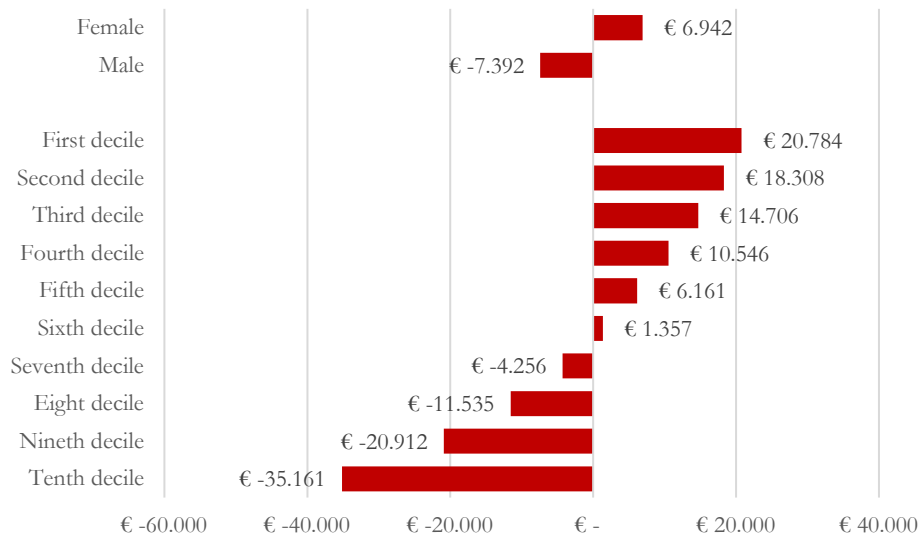
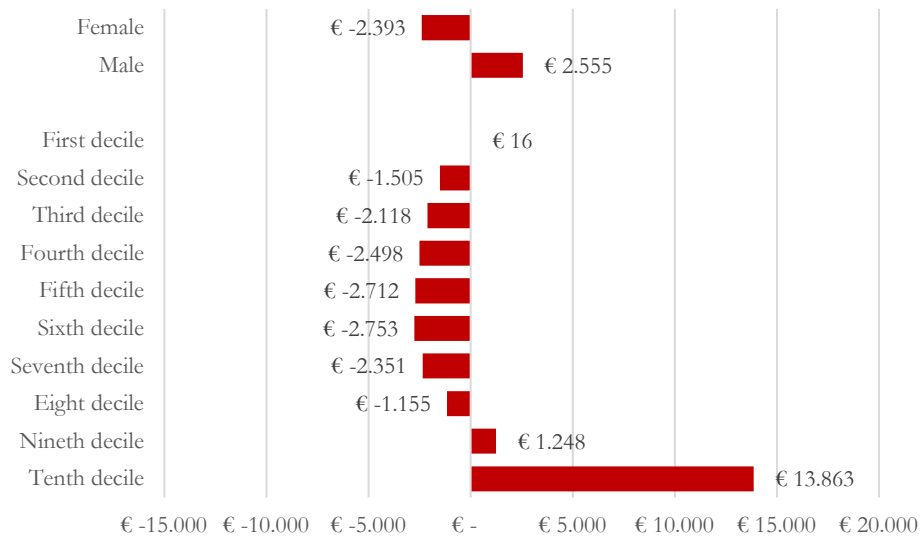Note: Income deciles are based on the average labor income between the age of 25 and 65.

Third policy option: Shift from second pillar to NDC

The third policy option introduces an NDC scheme, financed by an earmarked NDC contribution. Second pillar contributions are reduced to ensure that the aggregate amount of pension contributions is unaffected. This reduction is identical to the reduction of the second pillar in the second policy option (Table 2). Notably, all workers are entitled to the NDC scheme.

This third policy option has the smallest redistributive effects of all studied policy options. The net benefit of men increases on average by 2.5 thousand euro over the lifecycle. The net benefit of the lower income groups decreases by about 2.4 thousand euro. The highest income group see their net benefit increase by almost 14 thousand euro over the lifecycle. The sixth till nineth decile see a decrease in their net benefit by about 2 thousand euro. Although relatively small, the redistributive effects of this policy option can be explained by the fact that the NDC scheme holds for all workers (including the self-employed), while in principle the second pillar only applies for employees.

Since self-employed individuals in this policy option also pay NDC contributions, they also enjoy a tax advantage. Especially individuals in the highest income group pay less taxes than they would in the base case. Hence a higher percentage of taxes will be paid by the middle income groups to finance the first pillar and to balance the government budget. This reduces redistribution.

Figure 4   Difference in net benefit between the base case and the third policy option

Female	€ -2.393
Male	€ 2.555
First decile	€ 16
Second decile	€ -1.505
Third decile	€ -2.118
Fourth decile	€ -2.498
Fifth decile	€ -2.712
Sixth decile	€ -2.753
Seventh decile	€ -2.351
Eight decile	€ -1.155
Nineth decile	€ 1.248
Tenth decile	€ 13.863

€ -15.000 € -10.000 € -5.000   € -   € 5.000   € 10.000   € 15.000   € 20.000

Note: Income deciles are based on the average labour income between the age of 25 and
65.

Conclusion

The Dutch pension system provides households with income at old age, so as to smooth their consumption over the life cycle and avoid poverty at old age. Apart from redistributing income over the life cycle, the pension system also redistributes between individuals. This study shows the redistribution effects of the Dutch pension system on a lifetime basis. To identify these lifetime effects, we distinguish between men and women, and between ten income groups.

Our first finding is that the Dutch pension system redistributes from rich to poor and from men to women. The first pension pillar is the most redistributive of the two pension pillars. The first pillar is a pay-as-you-go system, for an important part financed by individuals with a high income. Each individual receives almost the same amount, regardless of labor history or contributions. As a result we observe a redistribution from high to lower income groups. This is in line with earlier research (Muns & Van Vuuren, 2021; Bonenkamp & Ter Rele, 2013). The first pillar also redistributes from men to women, as men generally pay more contributions and taxes during their working life and women have a higher life expectancy.

The second pillar redistributes from high to middle income deciles. This is mostly caused by a tax advantage. Since we assume a balanced budget, the tax advantage must be financed by generally higher taxes, which are mostly paid by higher income groups.

If the first pillar would be completely financed by taxes (rather than partially by contributions and partially by taxes), then the redistribution increases. In that case, the financing of the first-pillar pensions becomes more income-dependent. Men see an increase of their net loss from the first pillar, while women see an increase in their net benefit. Lower and middle income groups see their net benefit from the first pillar increase, while the higher income group faces a bigger net loss when the first pillar is completely financed by taxes.

If the first pillar would be increased by 10 percent and the second pillar would decrease by the same percentage, then the lowest income groups would benefit most. Their taxes do not rise significantly but their first pillar benefit does. The extra cost of the first pillar is borne by the higher income groups, especially by the highest income decile. Women also see an increase in their net benefit.

Introducing an NDC-scheme in the first pillar, as a partial substitute for second-pillar pensions, has the smallest redistribution effects. The highest income groups see their negative net benefit being reduced by the introduction of the NDC-scheme. This is related to the more general entitlements in an NDC-scheme than in the second-pillar. For instance, self-employed workers are also entitled to the NDC scheme and their share in the highest income group is relatively high.

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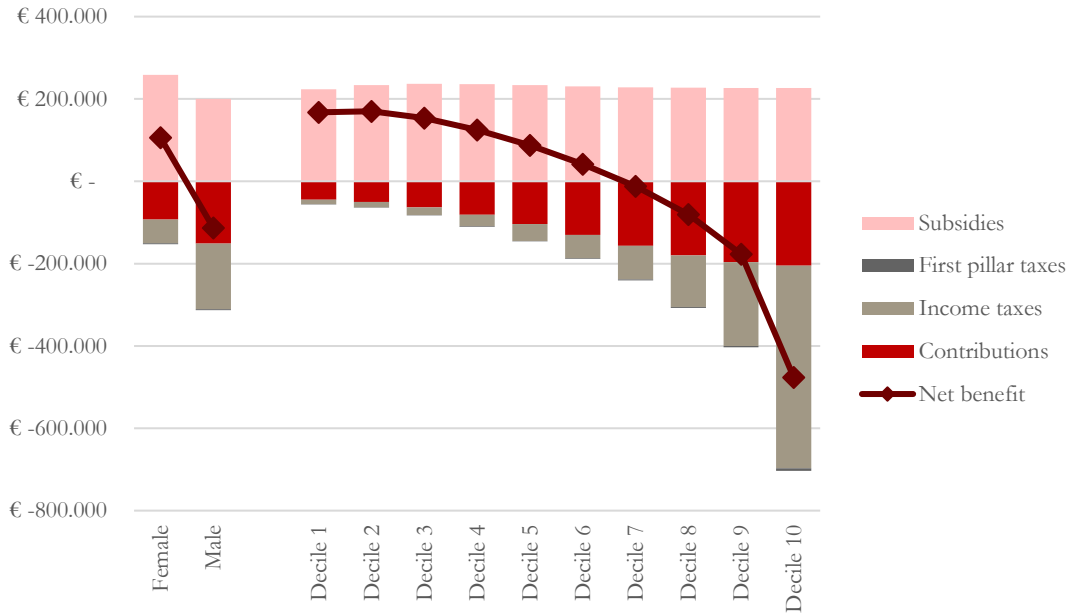
Appendix A

Figure A. 1   Redistributive effects of the first pillar in the base case
Note: The net profit from the first pillar is defined as subsidies minus contribution and taxes.
               The first pillar contributions consists of the earmarked first pillar contributions. The
               first pillar taxes consists of the taxes that are needed to finance the first pillar. The
               first pillar subsidies are the gross subsidies individuals receive after they reach the
               state pension age. Income deciles are based on average labor income between the
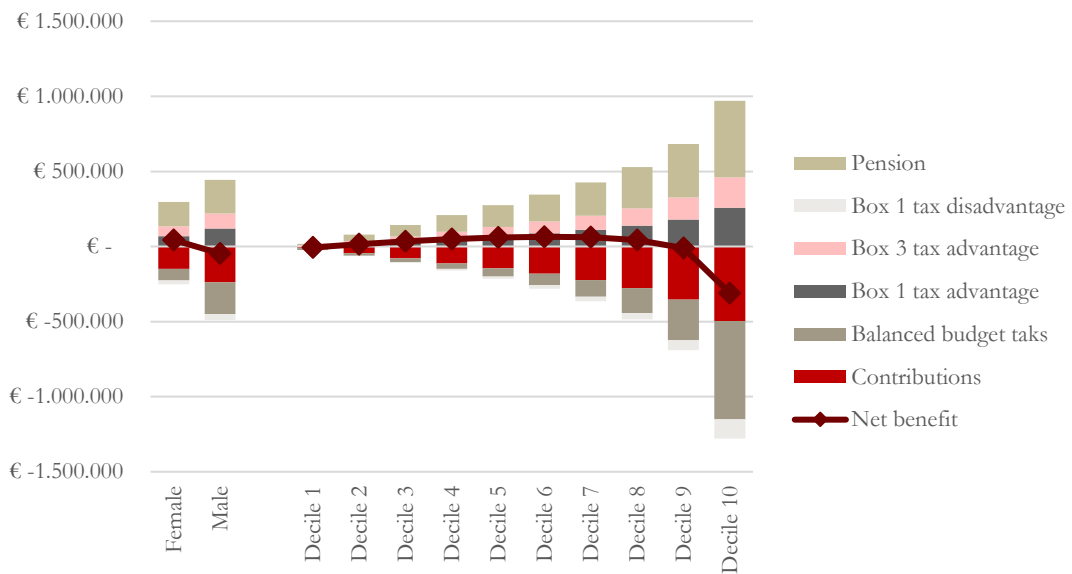   age of 25 and 65.

Figure A. 2   Redistributive effects of the second pillar in the base case
Note: The net profit from the second pillar is defined as subsidies minus contribution and
               taxes. The second pillar contributions consists of the employment related pension
               contributions. The second pillar tax advantage consists of the tax exemption of pen-
               sion contributions (box 1) plus of accumulated capital (box 3) minus the tax on the
               pension. The balanced budget tax are the taxes that are needed to finance the tax
               advantage. The second pillar subsidies are the subsidies individuals receive from
               their pensions. Income deciles are based on average labor income between the age
               of 25 and 65.

	Base	Option 1	Option 2	Option 3
Gender				
Female	€ 149.326	€ 159.234	€ 156.268	€ 146.934
Male	-€ 159.020	-€ 169.571	-€ 166.412	-€ 156.465
Income decile				
Decile 1	€ 160.462	€ 172.245	€ 181.246	€ 160.478
Decile 2	€ 186.080	€ 199.143	€ 204.388	€ 184.575
Decile 3	€ 188.063	€ 203.289	€ 202.769	€ 185.944
Decile 4	€ 174.284	€ 192.399	€ 184.829	€ 171.786
Decile 5	€ 146.225	€ 167.456	€ 152.386	€ 143.513
Decile 6	€ 106.111	€ 129.908	€ 107.468	€ 103.358
Decile 7	€ 49.735	€ 72.823	€ 45.479	€ 47.384
Decile 8	€ -37.770	€ -23.950	€ -49.305	€ -38.925
Decile 9	€ -186.524	€ -198.933	€ -207.436	€ -185.277
Decile 10	€ -786.684	€ -914.401	€ -821.845	€ -772.820
Income decile, gender				
First decile, Female	€ 185.544	€ 196.106	€ 207.822	€ 185.414
First decile, Male	€ 83.801	€ 99.318	€ 100.020	€ 84.264
Second decile, Female	€ 212.681	€ 224.794	€ 232.127	€ 210.891
Second decile, Male	€ 90.004	€ 106.495	€ 104.201	€ 89.526
Third decile, Female	€ 224.122	€ 238.421	€ 239.768	€ 221.473
Third decile, Male	€ 85.549	€ 103.411	€ 97.584	€ 84.940
Fourth decile, Female	€ 224.912	€ 242.215	€ 236.003	€ 221.426
Fourth decile, Male	€ 74.206	€ 93.927	€ 83.673	€ 73.661
Fifth decile, Female	€ 212.496	€ 233.192	€ 218.608	€ 208.250
Fifth decile, Male	€ 56.973	€ 78.925	€ 63.201	€ 56.327
Sixth decile, Female	€ 186.305	€ 209.784	€ 187.048	€ 181.552

Sixth decile, Male	€ 34.767	€ 58.848	€ 36.671	€ 33.794
Seventh decile, Female	€ 140.365	€ 163.018	€ 134.931	€ 135.612
Seventh decile, Male	-€ 8.277	€ 15.090	-€ 11.778	-€ 9.091
Eight decile, Female	€ 63.158	€ 76.974	€ 50.092	€ 59.024
Eight decile, Male	-€ 86.765	-€ 72.942	-€ 97.557	-€ 86.474
Nineth decile, Female	-€ 81.725	-€ 93.824	-€ 103.326	-€ 83.153
Nineth decile, Male	-€ 222.800	-€ 235.316	-€ 243.474	-€ 220.627
Tenth decile, Female	-€ 583.663	-€ 692.789	-€ 619.387	-€ 575.161
Tenth decile, Male	-€ 836.760	-€ 969.064	-€ 871.783	-€ 821.574

Table A.1   Net benefit over the lifecycle (€) for each policy option by gender and income decile.
Note: The net profit from the first pillar is defined as subsidies minus contribution and taxes.
                 Income deciles are based on the average labor income between the age of 25 and
                 65.