Analysis

Retirement savings adequacy in the Netherlands
Towards a more comprehensive picture of retirement income of the Dutch population

Retirement savings adequacy in the Netherlands: towards a more comprehensive view on retirement income of the Dutch population

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1. Summary

A key objective of the pension system is to ensure that people can maintain a reasonable standard of living in retirement. We describe this as retirement savings adequacy. The Dutch pension system is known internationally for its high level of adequacy: in 2023, the Netherlands received the highest score in the Mercer Pension Index, both in relation to other countries and over time. Since the inception of this index, the Netherlands' score has risen from 76/100 to 85/100 (Mercer Pension Index, 2023).

Although the expected pension income is adequate for many households, there are significant differences, for example between socio-economic groups. Not all households are able to maintain their standard of living after retirement. Some workers have little or no occupational or voluntary pension incomes. On the other hand, there are households that have a relatively high level of savings for retirement and therefore have less to spend prior to retirement. An Interdepartmental Policy Study (IBO) was therefore undertaken to examine whether pension accrual is 'balanced', to assess impact of an 'unbalanced' pension accrual, and to propose policy options. This DNB Analysis presents the results of the calculations made for this IBO.

Median households in the Netherlands are able to replace 60% of their previous income with a state pension (AOW) and supplementary pensions after retirement, and 64% if their savings account and stocks and securities are included. The figure is 78% if other assets, including net housing wealth, are also included. We analyse pension adequacy based on the most recent data for all Dutch households. To do so, we have adopted the method used by Knoef et al. (2016), taking households' private wealth into account in addition to pension income from the first three pillars – state pensions, occupational pensions and voluntary pension products. For the median household, we find that pension income from the first three pillars amounts to around €33,000 gross per year, which means that around 60% of income can be replaced in retirement. If we include total private wealth, expected retirement income rises to €50,000 gross per year, representing a replacement rate of 78%.

The expected pension income equals at least the state pension for the majority of households. Anyone who has lived or worked in the Netherlands will receive this old-age provision as a basic pension from the central government when they reach the state pension age. Around one in ten households has an expected gross retirement income from the first three pillars below the full state pension. These households have accrued incomplete state pension benefits as a result of living abroad and have insufficient pension income from the second and third pillars to compensate for this. However, this does not necessarily mean that these households will face poverty upon retirement. They can claim a supplementary income provision for the elderly (AIO).

There are large differences in the degree to which households can maintain their living standards in retirement. Besides avoiding poverty, maintenance of living standards is an alternative way to examine retirement savings adequacy.: in the IBO, 70% to 80% of previous income is considered as an adequate retirement income for most households to maintain their living standards. About 34% of Dutch households have an expected retirement income of less than 70% of previous income, and 50% have a retirement income of more

than 80% of previous income. The optimal retirement income varies from household to household, because household expenditures likewise vary.

Households with income from self-employment in particular may find it difficult to maintain their living standards in retirement. Their expected pension income from the first three pillars is only 46% of previous income, compared to 59% for employees. The self-employed do usually have greater wealth, however, for example in home equity or a business. If this wealth is depleted, the retirement income is similar for the median employee and the median self-employed worker.

This study is based on a number of key assumptions. Results may differ under alternative assumptions. For example, the return on capital may differ from the level assumed here. Furthermore, actual retirement income per household may turn out higher or lower, for example as a result of job loss or promotion, a change in household composition, inheritance or relocation. This study does not take changes resulting from the new pension legislation (Wtp) into account. Moreover, we only calculate gross retirement incomes. Income taxes are lower after retirement. Section 4 of the IBO shows the gross-net trajectory for a number of sample households. Finally, for policy recommendations we refer to Section 5 of the IBO.

2. Introduction

Previous research by Knoef et al. (2016, 2017) shows that around 30% of households have an expected retirement income of less than 70% of their previous income. Unlike OECD (2023) and the Mercer Pension Index, where adequacy is calculated for fictitious persons[1], Knoef et al. (2016, 2017) use detailed microdata to evaluate actual retirement savings adequacy. This shows for the first time which income components households have at their disposal to finance their retirement. Alongside accrued state pension rights, this study includes occupational pensions and voluntary pension products, as well as private wealth (savings accounts, shares and securities, business assets, home equity etc.). Based on administrative data for a representative sample of Dutch households for 2008, Knoef et al. (2016) conclude that the median household can replace around 83% of its pre-retirement income after retirement, representing a gross replacement rate of 83%. On the basis of a rule of thumb that an adequate pension provides a replacement rate of at least 70%, they conclude that 31% of households have inadequate retirement income.[2]

Another group of Dutch households saves more than the 70% rule of thumb. Knoef et al. (2016, 2017) also find that a large proportion of households have a replacement rate well above 70%, especially if home equity is included. Households may therefore 'oversave' in the Dutch pension system. Ciurila et al. (2020) find that most Dutch households save more than the optimum level according to the life-cycle model and that most of these savings are illiquid, such as home equity. This limits the flexibility of the pension system and is an area for potential improvement according to Mercer. Been et al. (2023) show that substantial welfare gains could be achieved if home equity could be used more flexibly over the life cycle. The question is therefore not only to what extent our pension system can ensure that households are adequately provided for in retirement, but also whether they have sufficient resources at the right times in their lives.

This analysis builds on previous studies by using recent and improved data, providing a clearer and more up-to-date picture of retirement savings adequacy. Since the above-mentioned study, a number of follow-up studies have been conducted, such as Knoef et al. (2017), which focuses on differences in retirement income before and after the financial crisis (pension accrual in 2012 versus 2008), and Zwinkels et al. (2017), which focuses on the retirement savings adequacy of the self-employed in 2012. Various macroeconomic developments have occurred since then, such as a decrease in real pension rights in the second pillar. The state pension age has also been gradually raised. In addition, there has been an improvement in administrative data over that time. We therefore build on Knoef et al. (2016) in terms of methodology, but this analysis includes a number of new elements:
- Up-to-date data for the entire Dutch population (2022 instead of 2012).
- Population data are now available, instead of a representative sample, providing an even more comprehensive picture and allowing a clearer focus on specific subgroups, such as certain types of

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1 OECD (2023) examines workers in the Netherlands with a constant income from 22 to 70 at three different income levels: 50% of the mean income, the mean income and 200% of the mean income. OECD finds gross replacement rates of 87.3%, 74.7% and 68.4% for the three income levels respectively, and net replacement rates of 94.6%, 93.2% and 87.5%.

2 The majority of pension funds aim for a replacement rate of 70% of the last average earned wage. This aim is based on the assumption that employees contribute 1.75% of their wage for 40 years. The rule of thumb of 70% is used in other countries as well, see chapter 3.

workers (self-employed, directors/majority shareholders) and household characteristics (gender, background).

- New data on wealth accumulated in bank savings mortgages (previously unavailable).
- A clearer picture of wealth in voluntary pension products due to the availability of more contribution years.

This analysis is intended as a contribution to the policy debate on adequacy. The results provide input for the Interdepartmental Policy Study (IBO) on pensions. The IBO also includes policy options to facilitate political decision-making.

3. What is an adequate level of retirement savings?

A natural starting point for retirement savings adequacy is the life-cycle model (Banks et al., 1998). The simplest version of the life-cycle model, based on strict assumptions such as rational household behaviour, a perfect capital market and perfect forward-looking agents, implies that households maximise their utility over their lifetime by opting for a level of consumption that maintains their marginal utility of consumption at a constant level at all stages of life. The total lifetime utility is maximised when the utility of the most recent euro spent remains unchanged over time. This implies in general that households maximise their well-being by borrowing at the start of their life, saving during their working life and dissaving in retirement. This pattern is maintained in more extensive versions of the life-cycle model with less strict assumptions.

The life-cycle model provides three tools to analyse pension adequacy; first, the standard of living should remain more or less unchanged after retirement. A significant drop in consumption could indicate insufficient retirement income to maintain pre-retirement living standards. Recently, Been & Goudswaard (2023) examined the effect of retirement on consumption changes in the Netherlands. They find no evidence of a decrease in consumption after retiring for the average Dutch household..

Second, the life-cycle model implies that households deplete wealth in retirement for consumption. If they do not do so in practice, this could indicate that retirement income is higher than necessary. Van Ooijen et al. (2015) and Suari-Andreu et al. (2019) show that Dutch households do not deplete their private wealth and even sometimes accrue wealth in retirement. Home equity is the main source of wealth. On the basis of this study, it could therefore be argued that retirement income is relatively adequate for the average Dutch household if home equity can be liquidated (e.g. by means of a sale, reverse mortgage or shared equity mortgage; see Bounen et al. 2023). Inheritance motives may also explain why people accrue more than they need to maintain their living standards and why they dissave less in retirement (i.e. Dynan et al., 2002).

Third, the life-cycle model implies that income will decrease somewhat after retirement. The replacement rate does not have to be 100% (Boskin & Shoven, 1987), for example because work-related expenditure is no longer necessary or because households have more time to carry out household tasks for which they previously hired outside labour (Been & Goudswaard, 2023). In addition, households tend to have lower housing costs after retirement, and no longer need to support children. An insufficient replacement rate, however, may imply that there is relatively little income to maintain living standards. Haveman et al (2007) show that a gross replacement rate of 70% is usually used as a rule of thumb in the literature.[3] In practice, not all households need the same replacement rate. Low-income households, for example, may fall into poverty despite having a gross replacement rate of 70%. There are various indications that replacement rates should be higher for low-income groups and lower for higher-income groups. For people with high incomes, post-retirement spending needs will decrease more than for people with low incomes (Kools and Knoef, 2016). In the United Kingdom, the target replacement rate depends on income (Pension Commission, 2004). In addition, the optimal replacement rate depends on personal preferences (De Bresser & Knoef, 2016).

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3 See also Bernheim et al (2001) for a quantitative underpinning of this rule of thumb.

Another way to look at retirement savings adequacy is to apply an absolute minimum for poverty prevention. Internationally, a relative measure of poverty is used (Kuitto et al., 2021), such as income below 60% or 70% of median income. In the European Union, the poverty line is taken to be 60% of standardised income. The OECD generally uses a threshold of 70%. In the Netherlands, it is common to use an absolute measure. In its estimates of pensioner poverty, the Netherlands Bureau for Economic Policy Analysis uses a measure equivalent to a fully accrued state pension[4]. The Social Minimum Commission (2023) recommends a measure of net income based on the minimum expenditure a household should be able to make to avoid getting into difficulty. In this study we therefore not only consider replacement rates but also consider retirement income in absolute euros.

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4 https://www.cpb.nl/sites/default/files/omnidownload/CPB-Publicatie-Ramingsmethodiek-armoederaming.pdf

4. Data and method

We use Statistics Netherlands' improved microdata. Our methodology is based on that of Knoef et al. (2016), unless stated otherwise. The databases have improved since then. A key difference is that population data are now available instead of a sample. Previously, around 70% of pension funds supplied data on pension rights, while pension rights for the remainder of the population were estimated by Statistics Netherlands. More recent data are also now available (up to 2022, instead of 2008). The recent data also include wealth accumulated in savings mortgages (previously unavailable). We also take into account self-administered pensions of directors/ majority shareholders as far as possible. These data have not previously been examined.

Our database contains 4.3 million Dutch households. We examine all households with a Dutch address and a main earner aged 35 years or over. We exclude households with a main earner below the age of 35, because their income changes significantly and future retirement income is difficult to predict. We add the incomes of a potential partner to the income of the main earner of the household to obtain the household income.[5] Expected retirement incomes are shown at household level, as partners in a household usually make joint decisions on major expenses and savings (Social Minimum Commission, 2023). In addition, wealth is only recorded at household level. Previous research shows that households make decisions on pension savings at household level (Johannisson, 2008). Furthermore, partners are often entitled to all or part of their partner's pension capital. The retirement incomes of two-person households are standardised for comparability with one-person households. For this we use the Statistics Netherlands equivalence factor of 1.40, since research by Statistics Netherlands shows that a two-person household needs 40% more income to attain the same well-being as a single-person household.[6]

4.1 Method

We use the same method as Knoef et al. (2016) to calculate the expected gross retirement income per household. We do so by examining the four pillars of the Dutch pension system. The first pillar consists of the state pension and provides a basic pension regardless of income during a person's working life. The second pillar comprises occupational pension accrued through an employer. The third pillar consists of voluntary pension savings products, such as annuity insurances. All other forms of saving, such as shares or home equity, are included in the fourth pillar. The method is explained below for each pillar.

First pillar: we observe the accrued state pension rights at individual level in Statistics Netherlands data up to the end of 2022. Accrued rights are based on the number of years a person has lived in the

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5 The survey data in Knoef et al. (2016) consist of total household income, including, for example, the income of any children living at home. In the present study we only include the income of the main earner of the household and a potential partner and hence exclude children living at home and other household members. If partners are under the age of 25, we disregard them and assume that the household consists of a single person. This is in line with Knoef et al. (2016).
6 See Statistics Netherlands (2004) for a methodological description and https://longreads.cbs.nl/materiele-welvaart-in-nederand-2022/bijlagen for the latest equivalence factors.

Netherlands in the fifty years before reaching the state pension age. We assume that all persons resident in the Netherlands in 2022 will accrue full state pension rights in the remaining years up to the state pension age. The level of the state pension differs for singles(€16,427 gross per year in 2022) and couples (€11,174 gross per year per person). We assume that people who are single in 2022 will remain so and that couples will stay together.

Second pillar: we use the attainable pension income per person per year as stated in the uniform pension statement. This is calculated by pension providers on the basis of the current pension system using a prescribed calculation methodology.[7] They assume that a person will continue to work in the same job up to the state pension age. We receive data on the expected annual pension income from the state pension age as calculated by pension providers and anonymised in Statistics Netherlands microdata. If individuals have different pension schemes, we add up the gross amounts. Some people who have retired early do not appear in the Pension Register. In that case we use data from the latest available year prior to retirement, in 2022 values.

Third pillar: we use the contributions paid since 2011 from the Statistics Netherlands microdata (obtained through income tax returns). These are contributions for private insurance related to pensions. We add up the annual contributions for the period 2011-2022. We assume that people who have previously made contributions will continue to make the past year's average contribution annually over the remaining years up to the state pension age. We also assume a real return of 2% per year, equivalent to the return in the fourth pillar. We explain this assumption in more detail in Section 4.2. We convert the third-pillar pot into a gross benefit per year from the state pension age, taking into account life expectancy based on gender and year of birth. The expected state pension age also depends on the date of birth.

Fourth pillar: we use two definitions of wealth based on Statistics Netherlands microdata, **namely financial and total private wealth.** We make that distinction because financial wealth is easier to use as retirement income than illiquid wealth such as housing wealth. Financial wealth comprises bank and savings deposits and shares and securities, i.e. types of capital that can be paid out relatively easily. In addition to financial wealth, total wealth consists of other types of capital, such as home equity or business capital (see Table 1). Wealth is spread over the expected remaining years of life for a single person or both partners. If one of the partners has reached the state pension age and the other has not, the annual withdrawal from household wealth is half of the amount that would have been withdrawn if both partners had reached the state pension age. We assume that the younger partner stops working as soon as he or she reaches the age at which the older partner starts receiving the state pension. See Annex A for details of this method.

Table 1. Composition of financial and total private wealth: average amounts per household in 2022

FINANCIAL WEALTH	TOTAL PRIVATE WEALTH

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7 This is the middle amount in the navigation metaphor used in the uniform calculation methodology. The calculations take account of the fact that workers do not accrue any second-pillar pension on amounts up to the level of the state pension benefit. See https://pensioenmodellen.nl for more information on the calculation methodology.

Bank and savings deposits	49,945	49,945
Securities	18,493	18,493
Housing wealth		306,973
Other real estate		26,775
Business capital		16,253
Substantial interest		72,963
Other wealth		7,548
- Mortgage		- 129,110
- Student debt		- 2,129
- Other debts		- 21,453
Total	68,438	346,527

Source: own calculations based on CBS microdata

For director/major shareholders, we use data on self-administered pensions from 2021 corporation tax returns. Since 1 July 2017, it has no longer been possible to accrue self-administered pension rights, but previously accrued pension rights may remain on the balance sheet, or could be converted into a retirement obligation with less strict conditions. We link the pension capital in the company to individuals by assuming that the current director/majority shareholder is entitled to these pension rights. This is not always the case, for example because the director/majority shareholder may have changed over time. We can allocate around three-quarters of the amount to individuals.

4.2 Assumptions

The results in this analysis depend on a number of assumptions. For example, we assume that everyone will retire at the state pension (AOW) age. The other main assumptions are explained below. The parameters are determined as in Knoef et al. (2016), but their level varies. Annex B then shows the effect of alternative assumptions on the results.

In the baseline scenario, we assume a real return of 2% per year on net capital in the third and fourth pillars.[8] This percentage has been determined in consultation with experts. In our assumptions, the return on all asset types is the same: if we were to assume different returns without taking into account the risks, everyone could be expected to switch ultimately to the best-performing asset type. At the same time, this percentage is lower than that on shares, because a portion will always remain on the bank or savings account. Since the assumption about the real return is always somewhat arbitrary, we calculate it on the basis of alternative assumptions in sensitivity scenarios. With an alternative return of 1% (3%), the median retirement income is around €4,000 lower (higher), i.e. 9% (see Annex B).

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8 This is roughly equal to the expectation with an investment mix of 50% variable-yield securities under the following assumptions:
- Risk premium on variable-yield securities = 4%
- Inflation = interest rate = 2%
- Expected nominal return: 50% * (2% + 4%) + 50% * 2% = 4%
- Expected real return 4% - 2% = 2%

Future wealth in the fourth pillar is based on wealth in 2022 plus the return. This is because it is difficult to predict how much households will save in the future, and whether they will receive an inheritance, for example. We therefore assume that there is no capital growth and that debts are not repaid. The same applies to mortgage debt. Our methodology minimises arbitrage in the choice of wealth components. To that end, it is also appropriate that we make no assumptions concerning future developments in wealth and debt. Annex B shows the expected retirement income with 70% repayment of the mortgage in one of the scenario analyses. In that case, the median retirement income including private wealth would amount to approximately €58,000.

We also assume that home equity can be fully depleted, for example by selling the house or taking out a reverse mortgage. We use two different definitions to calculate wealth (see Section 4.1). For the definition of total private wealth, we assume that wealth can be fully used as retirement income, but in reality few households sell their homes or take out a reverse mortgage. This calculation can therefore be seen as an upper limit on income in retirement. Annex B shows how sensitive our results are to this assumption and we assume a scenario in which homeowners benefit from lower housing costs, but do not deplete net housing wealth. In that case, the median income is around €5,000 lower than under the assumption of home equity being depleted, but still €7,000 higher than if only financial wealth is taken into account. The variant with lower housing costs is the baseline scenario in Knoef et al. (2016).

We assume that there is no income growth. Previous research showed that this assumption has almost no impact on the expected median replacement rates (OECD, 2014). If we simulate income growth and hence pension rights,, both the numerator and the denominator increase. Workers usually have income growth at the start of their career, but also a decrease in income at the end of the life cycle. This decrease is mainly explained by lower labour participation and early retirement.

We estimate gross expected pension incomes without any allowances. Knoef et al. (2016) calculate both gross and net retirement incomes and replacement rates. There was insufficient time to do this during this study. Income tax is lower after retirement than during working life. Households with incomplete state pension accrual can receive top-up social welfare benefits. In Section 5.4.4 we examine this state pension gap to gain an idea of which groups may be able to claim top-up social welfare benefits. Care and rent allowances are also disregarded in this analysis.

Finally, this analysis does not examine the effect of the new pension system on expected pension incomes. Our calculations are based on data from 2022 and the regulations in force at the time. The new pension legislation has consequences for expected retirement incomes and replacement rates, but these have been disregarded in this study. It is not yet clear precisely how the new legislation will affect the results. This will depend, for example, on compensation for the abolition of the uniform and standardised way of accruing a pension and the extent to which buffers are paid out. The transition from nominal "promises" to expected pension will change the nature of the pension. Furthermore, the total pension pot will not change as a result of the change of system and we will also be dealing with the same financial markets in the new system. Estimating

replacement rates under the new pension legislation is also complex due to the many variables that have an impact, such as economic conditions, investment results and pension funds' policy choices. The new act will make pensions more dynamic and sensitive to economic fluctuations, which may have both positive and negative effects on replacement rates.

5. Results

5.1 Retirement income

This section provides an overview of the various pension components. Table 2 presents both the average income from the different pillars and the median (p50), the first quartile (p25) and the third quartile (p75). Half of Dutch households have an income between p25 and p75. The median is less sensitive to outliers than the mean. The results in Table 2 also show that gross retirement income is skewed to the right: the mean is usually much higher than the median. The interpretation of the results in this analysis will therefore be largely concentrated around median results.

If private wealth is included, the median household has expected gross retirement income of almost €50,000 per year. The combined pension income from the first and second pillars is over €33,000 per year for the median household. For half of Dutch households, it is between €22,000 and €47,000 per year. The median retirement income increases to €34,000 and €37,000 per year if we also include the third pillar and financial wealth. If total wealth is also added, the median household has a retirement income of almost €50,000 per year. A quarter of the population receives more than €72,000, but a quarter also receives less than €28,000 per year.
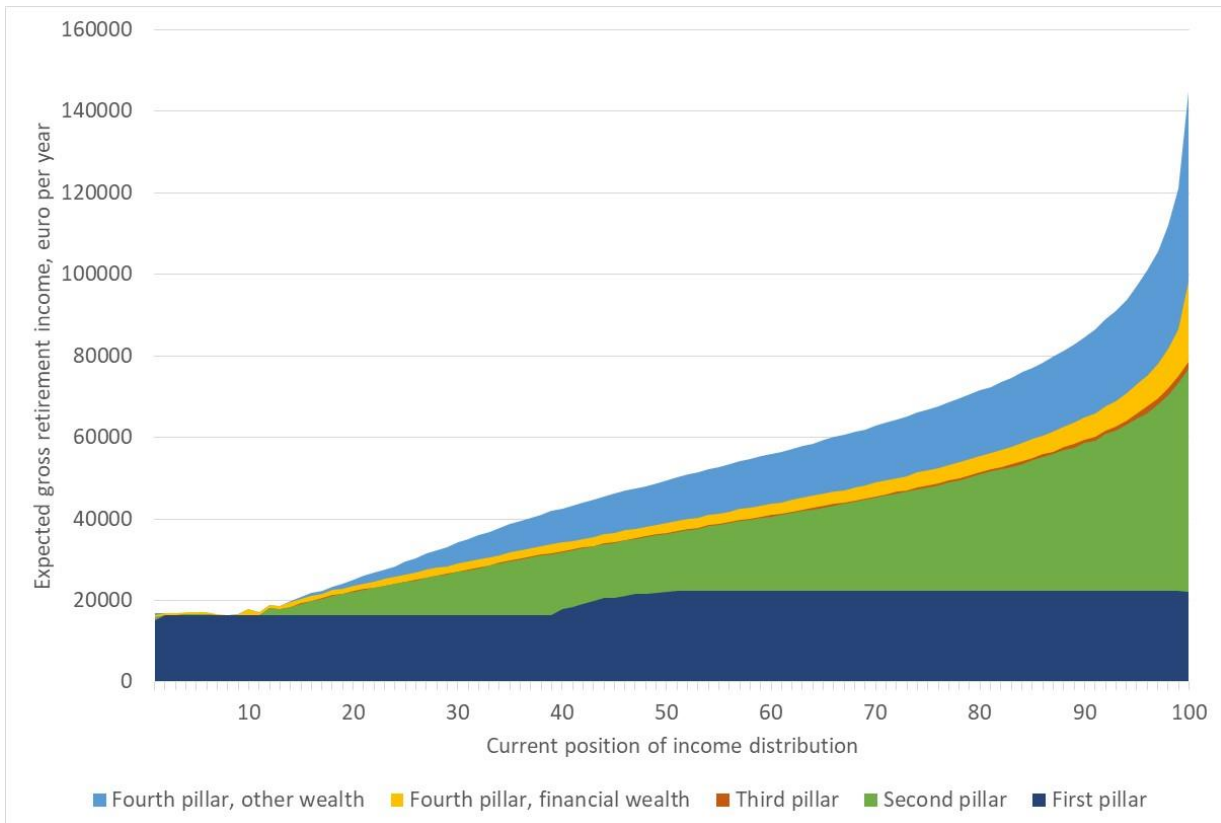
Table 2. *Expected retirement income in euro*

Expected retirement income	mean	p25	p50	p75
First + Second pillar	36,547	22,348	33,404	46,870
First + Second + Third pillar	36,980	22,457	33,922	47,427
First + Second + Third pillar + financial wealth	41,249	24,338	37,027	51,997
First + Second + Third pillar + total private wealth	58,459	27,875	49,808	71,862

Total retirement income ranges from €18,000 gross per year for the 10% lowest-income earners to €85,000 per year for the 10% highest-income earners. Figure 1 shows the level of retirement income across the current gross household income distribution. For low-income earners (lowest 10%), the total retirement income does not exceed €18,000 per year.

For low-income households, the state pension is a relatively important source of retirement income, whereas for higher-income earners the second pillar is a relatively important component (Figure 1). The state pension (first pillar) provides a basic income during retirement. The amount of the state pension benefit depends on the household situation: single or cohabiting. Households with a median income or higher tend to be cohabitants, and therefore have a higher expected income from state pension.
The third pillar is fairly negligible for both low- and high-income earners, and therefore barely visible in the figure. By contrast, financial wealth is relatively more important for higher-income earners. This is particularly true of retirement income from total private wealth.

Figure 1: Total expected gross retirement income per year from the different pillars according to the pre-retirement household income distribution (median per income percentile).

Current position of income distribution: the horizontal axis shows the income position in 2022. The 50th income percentile is the median household. The vertical axis shows this household's expected retirement income. The colours indicate the composition of expected retirement income.

5.2 Replacement rates

Replacement rates indicate the extent to which consumption patterns can continue after retirement.
The previous section gave an idea of the amount of retirement income in euro and which components are important. To illustrate the adequacy of these retirement incomes, this section analyses the replacement rates, i.e. the (gross) pension income (at household level) divided by current gross household income (adjusted for household composition). The current gross household income is equal to the expected final household income before retirement.

For the median household, the state pension and second pillar pension replace around 59% of income in retirement. Table 3 shows the replacement rates of the different pillars, separately and cumulative. We show the median replacement rate and p25 and p75 to gain an idea of the dispersion. For the median household, we find that the state pension replaces around 31%of income. For half of Dutch households, the figure is between

22% and 47%. The second pillar replaces around 24% of the average household's income, with half of households between 10% and 34%. The first and second pillars combined therefore enable an average household to replace almost 60% of its income.

This replacement rate for the first and second pillars is lower than the 71% and 70% calculated by Knoef et al. (2016 and 2017) using data from 2008 and 2012. There are a number of reasons for this. The previous study assumed that second-pillar pensions would be indexed by 50% in the future. In practice, there was hardly any indexation between 2008 and 2022, so the replacement rate in the second pillar is significantly lower. Furthermore, the composition of the Dutch population has changed, with increases in the percentages of self-employed workers and households with a migration background. In 2022, 18% of households had a non-Western migration background, compared to just 8% in 2008. They have significantly lower expected retirement income than households without a migration background (see Section 5.4.4 for more details). Finally, we now use different data, so the results cannot be compared like for like with those based on 2008. We now use population data instead of a sample (see Section 4 for more details).

Adding third-pillar income and financial wealth has little effect on the replacement rate. The replacement rate increases by 0.4 percentage points due to the addition of the third pillar and by 4.3 percentage points due to the addition of financial wealth to around 64% for the median household. By contrast, total wealth significantly increases the replacement rate by 15 percentage points to almost 79% for the median household. This is due in particular to home equity. Adding all these components together, half of Dutch households have a replacement rate between 62% and 99%. A quarter of households are below 62% and a quarter above 99%.

Table 3. Replacement rates of retirement income (in fractions).

Replacement rate	p25	p50	p75
First pillar	0.216	0.307	0.473
Second pillar	0.099	0.239	0.340
Third pillar	0.000	0.000	0.000
Fourth pillar, financial	0.008	0.024	0.058
Fourth pillar, private wealth	0.022	0.155	0.317
First + Second pillar	0.464	0.591	0.729
First + Second + Third pillar	0.470	0.595	0.732
First + Second + Third + Fourth pillar, financial wealth	0.510	0.638	0.787
First + Second + Third + Fourth pillar, private wealth	0.624	0.788	0.987

In the case of lower-income earners, we find that the first two pillars replace most if not all of the income. Since replacement rates also depend greatly on the denominator, the pre-retirement income, it is interesting to note how the replacement rate differs across the income distribution. Figure 2 shows gross replacement rates across the household income distribution. Lower-income earners obtain almost all their retirement income from the first two pillars. They have little replacement income from other pension components.

Across the income distribution, we see that the first two pillars replace a steadily decreasing percentage of income, so there is a negative slope. This slope is roughly the same when we include the other pension components. Adding financial and other wealth mainly results in higher replacement rates for households from the 15th income percentile.

Figure 2. Replacement rates of retirement income over the household income distribution (median fractions per income decile).
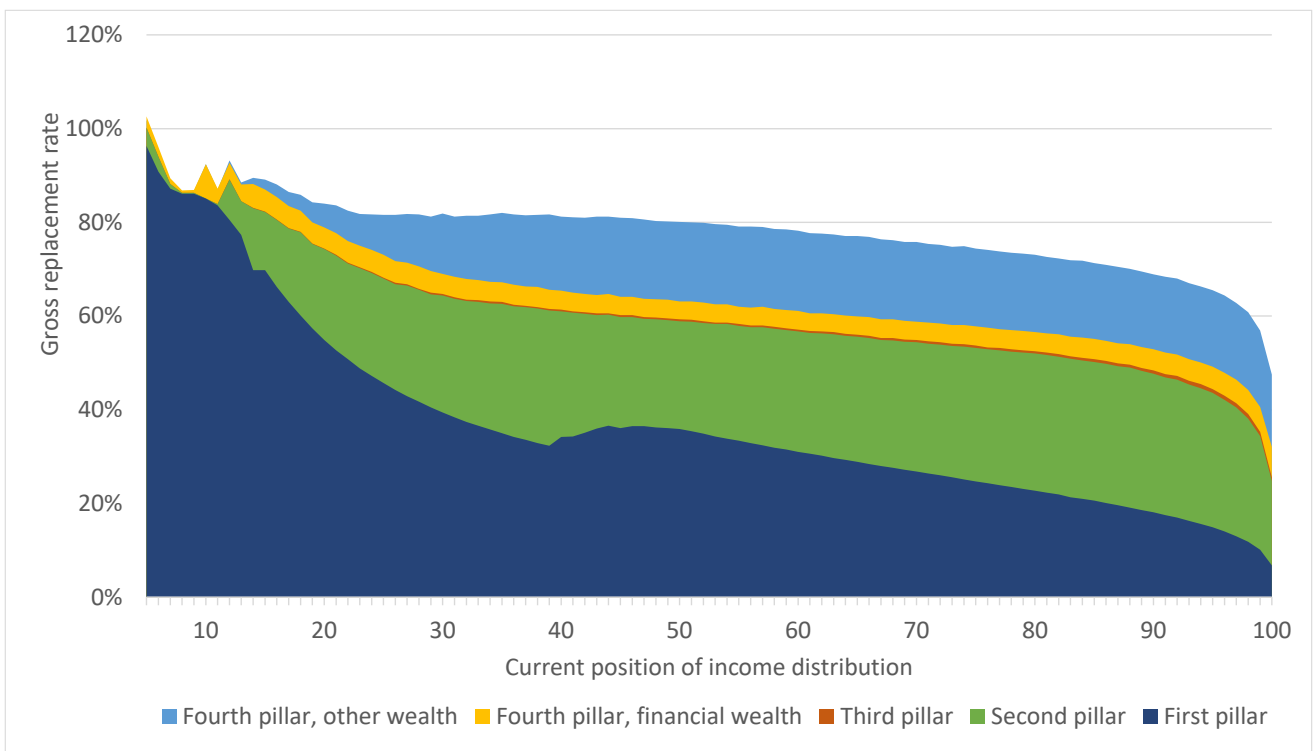
Current position of income distribution: the horizontal axis shows the income position in 2022. The 50th income percentile is the median household. The vertical axis shows this household's expected retirement income. The colours indicate how the expected retirement income was accrued. This figure excludes the replacement rate for the first four percentiles of the income distribution, as this distorts the picture due to outliers.

5.3 Adequacy

In this section we analyse the adequacy of retirement income. In other words, we examine the extent to which retirement income can prevent poverty in retirement (Section 5.3.1) and the extent to which retirement income enables households to maintain their living standards (Section 5.3.2). In the previous sections, we focused particularly on retirement income in euro and the replacement rate. Taken separately, these results provide an incomplete picture of actual retirement savings adequacy. After all, a low replacement rate may mean that households have high retirement incomes in absolute terms but low retirement incomes compared to their

current income. *Vice versa*, a high replacement ratio does not necessarily mean that households have ample pensions; the state pension soon completely replaces a welfare income.

5.3.1 Is the retirement income sufficient to prevent poverty?

There are different approaches to defining a poverty line. The Interdepartmental Policy Study sets a lower limit equivalent to the full state pension. The gross amount of a full state pension benefit including allowances is approximately equal to the net amount used by the Social Minimum Commission. The state pension that is used as the poverty line in this study is €16,427 per year.

Around 10% of households have retirement income from the first three pillars that is lower than the full state pension. This amounts to more than 400,000 Dutch households out of a total of 4.3 million. In practice, more households may get into difficulty, for example because they do not always claim the allowances and/or local authority benefits to which they are entitled, or because unavoidable expenses differ between households. This percentage is substantially higher for households with a migration background, whether Western or non-Western: 38% and 34% respectively. That is mainly due to incomplete state pension accrual. In Section 5.4.4 we discuss the pension accrual of households with a migration background in greater depth.

5.3.2 Is retirement income adequate to maintain living standards?

There is no uniform definition of 'adequate' retirement income to maintain living standards. This also depends on households' current income and consumption patterns (Been & Goudswaard, 2023). Since a 70% gross replacement rate is a widely accepted adequacy standard in the literature, this is also the threshold we use in our calculations. We only look at the replacement rate for households with expected retirement income above the level of full state pension. Of course, these definitions only provide broad guidance as to the adequacy of retirement income for the maintenance of living standards, and the optimal replacement rate depends on individual circumstances and preferences.

To assess the adequacy of retirement income from the first three pillars, we use the following categories:[9]
- Replacement rate of less than 70%
- Replacement rate between 70% and 80%
- Replacement rate of more than 80%

Based on just the first three pillars, around three-quarters of households have a replacement rate of less than 70%. In Table 4, we show the expected replacement rate for households with expected incomes above the state pension level. Table 4 shows that 73% of households have a replacement rate below 70% from

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9 These categories were established jointly with the IBO Pensions working group.

the first three pillars. The aforementioned 10% of households with a pension income from the first three pillars lower than a full state pension benefit are thus not included in the table.

If we take financial wealth into account, including home equity, the percentage of households with a replacement rate below 70% falls to 63%. This is 34% under the assumption that all assets are used for retirement income. These results imply that depleting home equity increases households' ability to maintain their living standards in retirement. For households with an expected replacement rate above 80%, we see the opposite picture: only around 15% of households have a replacement rate of more than 80% based on retirement income from the first three pillars. This figure rises to 24% if we include financial wealth, but it grows substantially to 50% if other wealth is also included. Home equity plays an important role in retirement savings. The latter is also confirmed by Been et al. (2023).

Table 4. Pension adequacy: expected gross replacement rate

	Less than 70%	70% to 80%	More than 80%
First + Second + Third pillar	72.7%	11.0%	16.2%
First + Second + Third + Fourth pillar, financial wealth	62.4%	13.9%	23.6%
First + Second + Third + Fourth pillar, private wealth	34.2%	15.9%	49.9%

This table excludes households with expected retirement income below the social minimum.

5.4 Differences between types of workers and socio-economic groups

In this section, we provide further breakdowns by household characteristics. For example, we look at the extent to which retirement incomes and replacement rates deviate from those of the average household. We distinguish between types of workers (self-employed, employees and directors/majority shareholders) and personal characteristics (age, gender and background).

5.4.1 Breakdown by type of worker
Self-employed workers may accrue less pension because they usually have no entitlements in the second pillar. Participation in a pension scheme is compulsory for a number of professions, including dentists, medical specialists, general practitioners, painters and plasterers. These are exceptions: most self-employed workers have no such obligation. Self-employed workers may be able to save for retirement through voluntary pension components, such as the third pillar, the value of their business or their home. Zwinkels et al. (2017) and Biesenbeek et al. (2022) show that saving through these voluntary components is limited among self-employed workers. In 2022, 11% of self-employed workers accrued some pension in the third pillar. In 2023, the maximum amount that can be accrued free of tax in the third pillar was increased. Annex B shows that this increase has hardly any effect on expected retirement income, as only a small proportion of workers accrue benefits in the third pillar.

Directors/majority shareholders are responsible for their own pension accrual. In the past, they were able to build up tax-efficient pension savings in their own limited company. Since 1 July 2017, it has no longer been possible to accrue pension benefits in this way, but existing accrued benefits can be retained. In 2021, the total pension capital in limited companies amounted to around €35 billion. No research has yet been conducted into the impact of self-administered pensions on expected retirement incomes and replacement rates of directors/majority shareholders.

For employees, pension income in the first and second pillars is significantly higher than for the self-employed. This can be seen in Table 5. The difference in pension income between employees and the self-employed is attributable entirely to much higher pension income in the second pillar. The difference is marginally smaller if the third pillar is included. Households with a self-employed individual as the main earner have considerably more retirement income from private wealth, however. Nevertheless, the median total retirement income of self-employed individuals is markedly lower than that of employees: €48,000 versus €55,000. The bigger difference between p25 and p75 relative to employees shows that the dispersion of retirement income among the self-employed is relatively wide.

Households with a director/majority shareholder as the main earner have higher retirement income in all pillars than households with a self-employed individual as the main earner. By far the biggest difference is in retirement income from private wealth, however. As a result, the median total retirement income of directors/majority shareholders, at €93,000, is almost twice as high as for other self-employed individuals. The large difference between p25 and p75 shows that the retirement incomes of directors/majority shareholders are very unevenly distributed. The average retirement income is approximately equivalent to p75, which means that this group has a large number of very high pension incomes.

Table 5. Disposable retirement income in euro for employees and self-employed entrepreneurs.

Accrued retirement income	average	p25	p50	p75
Employees				
First pillar	19,239	16,427	21,683	22,348
First + Second pillar	42,491	29,455	40,071	52,337
First + Second + Third pillar	42,771	29,641	40,329	52,690
First + Second + Third + Fourth pillar, financial wealth	47,010	31,763	43,296	57,319
First + Second + Third + Fourth pillar, private wealth	60,897	37,136	55,192	74,781
Self-employed				
First pillar	19,375	16,427	22,101	22,348
First + Second pillar	27,166	18,746	24,407	31,730
First + Second + Third pillar	28,535	19,274	25,306	33,597
First + Second + Third + Fourth pillar, financial wealth	33,220	21,941	28,647	38,611
First + Second + Third + Fourth pillar, private wealth	57,605	28,547	47,669	70,050
Directors/majority shareholders				
First pillar	20,697	19,813	22,348	22,348
First + Second + Third pillar	31,783	23,160	28,323	37,187
First + Second + Third + Fourth pillar, financial	33,874	23,953	30,215	40,194
First + Second + Third + Fourth pillar, financial + Self-administered pension	44,346	28,178	36,491	49,165
First + Second + Third + Fourth pillar, private wealth + Self-administered pension	152,169	61,984	92,954	152,258

The replacement rates of self-employed households in the first four pillars excluding private wealth are markedly lower than those of employees (see Table 6). If private wealth is included, the median replacement rates are almost equal (76% and 77%), albeit with lower absolute retirement incomes for self-employed households. The dispersion in the replacement rates of self-employed households is markedly wider than that of employees. This dispersion is wider still in the case of directors/majority shareholders: half of all directors/majority shareholders have a replacement rate between 72% and 175% when all wealth components are included. The median director and majority shareholder has a replacement rate of around 100%. It should be noted that this high replacement rate is mainly due to income from illiquid assets. Without this component, directors/majority shareholders have significantly lower replacement rates. Hence, even more than employees and self-employed individuals, they appear to depend on private wealth to achieve a high replacement rate.

Table 6. *Replacement rates for employees and self-employed individuals.*

Replacement rate	p25	p50	p75
Employees			
First pillar	0.202	0.274	0.373
First + Second pillar	0.487	0.587	0.685
First + Second + Third pillar	0.490	0.589	0.687
First + Second + Third + Fourth pillar, financial wealth	0.526	0.630	0.738
First + Second + Third + Fourth pillar, private wealth	0.618	0.761	0.928
Self-employed individuals			
First pillar	0.221	0.331	0.507
First + Second pillar	0.312	0.442	0.628
First + Second + Third pillar	0.330	0.459	0.640
First + Second + Third + Fourth pillar, financial wealth	0.373	0.512	0.715
First + Second + Third + Fourth pillar, private wealth	0.547	0.767	1.130
Directors/majority shareholders			
First pillar	0.181	0.241	0.315
First + Second pillar	0.263	0.354	0.459
First + Second + Third pillar	0.280	0.376	0.486
First + Second + Third + Fourth pillar, financial wealth	0.334	0.441	0.576
First + Second + Third + Fourth pillar, financial + self-administered pension	0.352	0.464	0.608
First + Second + Third + Fourth pillar, total + self-administered pension	0.722	1.061	1.747

5.4.2 Breakdown by age

For median households, the differences between age groups are relatively small. This can be seen in Table 7. For households aged between 40 and 59, the median total gross retirement income (any type of wealth) is more than €50,000 per year. The 35-39 age group is somewhat lower, with retirement income of €47,000. Private wealth in particular is lower than in the other groups. However, this age group can still expect more income growth and capital accumulation than older age groups. The 60-66 age group also has a somewhat lower retirement income of €48,000. This could be because they are more likely to be single, for example, and therefore have lower expected state pension income. The expected income from private wealth is also somewhat lower among those aged 60 to 66 than in the younger age groups. A possible explanation is that some of them will work less and decumulate wealth.

Table 7. Retirement income by age groups.

Accrued retirement income	average	p25	p50	p75
Age group 35-39				
First pillar	18,851	16,427	18,930	22,348
First + Second pillar	37,502	22,276	34,423	48,699
First + Second + Third pillar	37,836	22,348	34,810	49,100
First + Second + Third + Fourth pillar, financial wealth	40,837	23,670	37,102	52,533
First + Second + Third + Fourth pillar, private wealth	53,797	25,390	47,529	69,368
Age group 40-44				
First pillar	18,867	16,427	19,915	22,348
First + Second pillar	37,883	22,449	34,736	49,269
First + Second + Third pillar	38,352	22,615	35,305	49,873
First + Second + Third + Fourth pillar, financial wealth	41,843	24,180	37,912	53,768
First + Second + Third + Fourth pillar, private wealth	58,004	26,945	50,113	72,771
Age group 45-49				
First pillar	18,813	16,427	19,916	22,348
First + Second pillar	37,511	22,566	34,400	48,419
First + Second + Third pillar	38,050	22,804	35,053	49,136
First + Second + Third + Fourth pillar, financial wealth	42,069	24,590	37,947	53,411
First + Second + Third + Fourth pillar, private wealth	59,562	28,003	50,815	73,428
Age group 50-54				
First pillar	18,872	16,427	20,079	22,348
First + Second pillar	36,677	22,705	33,778	46,694
First + Second + Third pillar	37,214	22,981	34,396	47,360
First + Second + Third + Fourth pillar, financial wealth	41,964	25,086	37,694	52,303
First + Second + Third + Fourth pillar, private wealth	61,896	29,252	51,520	73,989
Age group 55-59				
First pillar	18,794	16,427	19,509	22,348
First + Second pillar	35,985	22,483	33,136	45,651
First + Second + Third pillar	36,421	22,707	33,670	46,188
First + Second + Third + Fourth pillar, financial wealth	41,409	24,868	37,145	51,457
First + Second + Third + Fourth pillar, private wealth	60,383	29,167	50,923	72,967
Age group 60-66				
First pillar	18,481	16,427	16,427	22,348
First + Second pillar	34,352	21,192	30,989	43,450
First + Second + Third pillar	34,643	21,376	31,358	43,811

First + Second + Third + Fourth pillar, financial wealth	39,550	23,651	34,946	49,034
First + Second + Third + Fourth pillar, private wealth	56,271	28,207	47,768	68,678

5.4.3 Breakdown by gender

Women have lower expected retirement income than men. Table 8 shows that the average expected retirement income from the first three pillars is around €37,000 for men and €28,000 for women. This concerns the main earner of the household. Households with a female main earner are more likely to be single-person households (68%) than those with a male main earner (32%). For a better comparison, we have also compared single men and women. Single men have higher expected retirement income than single women, but the difference is smaller than when we compare all men and all women.

Table 8. Retirement income by gender.

Accrued retirement income	p25	p50	p75
Households with male main earner			
First pillar	16,427	22,348	22,348
First + Second pillar	24,581	36,141	48,991
First + Second + Third pillar	25,034	36,715	49,584
First + Second + Third + Fourth pillar, financial wealth	27,277	39,754	54,221
First + Second + Third + Fourth pillar, private wealth	33,198	53,340	74,556
Households with female main earner			
First pillar	16,427	16,427	21,206
First + Second pillar	18,372	27,264	41,404
First + Second + Third pillar	18,490	27,550	41,811
First + Second + Third + Fourth pillar, financial wealth	20,252	30,627	46,436
First + Second + Third + Fourth pillar, private wealth	21,217	40,313	65,213
Single men			
First pillar	15,985	16,427	16,427
First + Second pillar	16,736	23,913	35,218
First + Second + Third pillar	16,842	24,296	35,620
First + Second + Third + Fourth pillar, financial wealth	18,105	26,560	39,374
First + Second + Third + Fourth pillar, private wealth	18,602	32,795	56,197
Single women			
First pillar	16,335	16,427	16,427
First + Second pillar	16,734	22,148	32,329
First + Second + Third pillar	16,777	22,293	32,517

First + Second + Third + Fourth pillar, financial wealth	17,927	24,744	36,561
First + Second + Third + Fourth pillar, private wealth	18,056	29,255	52,342

5.4.4 Breakdown by migration background

A substantial proportion of individuals with a migration background have incomplete state pension accrual. Table 9 shows that over 86% of the individuals with a Western migration background and 66% of the individuals with a non-Western background have a state pension gap. On average, individuals with a Western migration background are likely to come to the Netherlands at a younger age, so they will accrue somewhat more state pension rights. The state pension is accrued on the basis of years of residence in the Netherlands. It is possible to 'buy' missing years retrospectively and thus supplement the state pension, but this option is relatively unknown and expensive.[10] If a person has an incomplete state pension, retirement income can be topped up to the state pension level with welfare benefits provided the claimant meets the income and wealth criteria. The percentage of individuals with an expected state pension gap in retirement is slightly lower than the percentage of individuals with a state pension gap in 2022. This is because there is still some time to close the state pension gap before the retirement date. We assume that individuals who currently live in the Netherlands will continue to do so until retirement.

Table 9. Incomplete state pension (<90%) by migration background.

State pension gap	Current	Pension age
Individuals without migration background	3.8%	2.9%
Individuals with Western migration background	86.3%	83.7%
Individuals with non-Western migration background	66.0%	60.9%
Total	17.0%	15.4%

Note: this is the percentage of individuals aged 35 to 66 with state pension accrual of less than 90%. The current situation relates to 2022. The percentage of individuals with a state pension gap on their retirement date is lower than the number of individuals with a state pension gap in the current situation, because it is still possible to close part of the gap.

The expected median retirement income of households with a migration background is also less than half of that of the median household without a migration background. These are households whose main earner was born outside the Netherlands (i.e. the first generation). That difference starts with substantially lower income from the first pillar (the state pension gap, see below), but the contribution from the second to the fourth pillar is also relatively low. Households with a non-Western migration background have a lower total retirement

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10 This costs €3,200 for every year that a person has not lived in the Netherlands, provided the income did not exceed the Dutch minimum wage. If the income exceeded the minimum wage, the cost is a percentage of income: See https://www.svb.nl/en/vv/cost-of-voluntary-insurance/how-much-does-voluntary-insurance-cost-if-you-live-or-work-in-the-netherlands

income than households with a Western migration background: median of €22,000 versus €27,000 (see Table 10).

Since the primary aim of the state pension is to prevent that households from falling below the poverty line in retirement, poverty is a serious risk for households with incomplete state pension accrual. In Section 4.3, we saw that 10% of the 4.3 million analysed households could expect pension income from the first three pillars to be below the state pension level. Due to the state pension gap, these percentages are substantially higher for households with a Western or non-Western migration background: 38% and 34% respectively.

A quarter of households with a migration background therefore have expected retirement income below the state pension level. That is because the total retirement income of households with a Western or a non-Western migration background in the lowest quartile is lower than the social minimum of €16,427 per year. Table 10 also shows that the dispersion of retirement income at the lower end has a longer tail for households with a Western migration background.

Households with a migration background may have pension entitlements from abroad. Unfortunately, no such information is included in this database. Other studies show that 46%, 46% and 40% of pensioners born in the United Kingdom, Germany and Belgium respectively have pension income from their country of birth (Lössbroek et al., 2024).

Table 10. *Disposable retirement income in euros by migration background.*

Accrued capital	average	p25	p50	p75
Households without a migration background				
First pillar	19,680	16,427	22,348	22,348
First + Second pillar	39,419	25,312	36,599	49,377
First + Second + Third pillar	39,940	25,787	37,167	49,968
First + Second + Third + Fourth pillar, financial wealth	44,723	28,524	40,595	54,935
First + Second + Third + Fourth pillar, private wealth	64,621	36,167	55,399	76,328
Households with a Western migration background				
First pillar	13,751	10,394	13,732	16,688
First + Second pillar	25,983	13,165	20,142	33,590
First + Second + Third pillar	26,169	13,198	20,263	33,897
First + Second + Third + Fourth pillar, financial wealth	29,793	14,129	22,062	37,286
First + Second + Third + Fourth pillar, private wealth	40,475	14,817	26,934	51,567
Households with a non-Western migration background				
First pillar	15,599	12,726	15,961	19,020
First + Second pillar	24,216	15,003	20,426	30,077

First + Second + Third pillar	24,295	15,016	20,467	30,187
First + Second + Third + Fourth pillar, financial wealth	25,921	15,481	21,402	31,968
First + Second + Third + Fourth pillar, private wealth	31,361	15,167	22,267	39,056

A person with a migration background is someone born outside the Netherlands.

Households with a Western migration background have relatively low replacement rates. Table 11
shows that the median household with a Western migration background can replace 47% of previous income from
the first three pillars, and 60% if private wealth is included. That is significantly lower than the replacement rates
from the first three pillars for households without a migration background (60%) and for households with a non-
Western migration background (62%). This is probably because households with a Western migration background
have a higher pre-retirement income than households with a non-Western migration background.

Table 11. *Replacement rates by migration background.*

Replacement rate	p25	p50	p75
Households without a migration background			
First pillar	0.214	0.297	0.436
First + Second pillar	0.473	0.594	0.721
First + Second + Third pillar	0.481	0.598	0.724
First + Second + Third + Fourth pillar, financial wealth	0.524	0.644	0.786
First + Second + Third + Fourth pillar, private wealth	0.656	0.812	1.011
Households with a Western migration background			
First pillar	0.168	0.263	0.422
First + Second pillar	0.323	0.468	0.624
First + Second + Third pillar	0.325	0.470	0.626
First + Second + Third + Fourth pillar, financial wealth	0.354	0.503	0.669
First + Second + Third + Fourth pillar, private wealth	0.411	0.596	0.817
Households with a non-Western migration background			
First pillar	0.272	0.442	0.715
First + Second pillar	0.472	0.618	0.817
First + Second + Third pillar	0.473	0.619	0.818
First + Second + Third + Fourth pillar, financial wealth	0.497	0.645	0.843
First + Second + Third + Fourth pillar, private wealth	0.538	0.706	0.905

Conclusion

This study provides detailed information on Dutch households' pension accrual and the adequacy of their retirement income. We examine the adequacy of retirement income on the basis of two pension objectives: preventing poverty and maintaining living standards. This study uses the latest data on all Dutch households.

Most households have a pension income at least equal to a state pension benefit. Around one in ten households has expected gross retirement income from the first three pillars that is lower than the full state pension.

The extent to which living standards can be maintained differs widely between households. For the median household, we find a pension income from the first three pension pillars of around €34,000 per year, which means that around 60% of income can be replaced in retirement. If we also take private wealth into account (including savings, stocks and securities, business capital and home equity), the expected retirement income rises to around €50,000, or around 78% of the final income. Retirement incomes show a wide dispersion: a quarter of households have replacement rates below 62% and a another quarter have replacement rates above 96% (based on total retirement income).

Based on income from the first three pillars plus savings, stocks and securities, 62% of households have a pension income of less than 70% of pre-retirement income. If all forms of assets are included, including home equity, 34% of households have a pension of less than 70% of pre-retirement income. By contrast, 50% of households have a replacement ratio of more than 80% according to the total assets calculation.

There are large differences between socio-economic groups. Women, for example, have significantly lower retirement incomes than men, partly because they are less likely to be the main earner in a couple. In addition, self-employed individuals generally have lower retirement incomes than employees, mainly due to lower accrual in the second pillar. The median total retirement income of self-employed individuals is €7,500 lower than that of employees. The dispersion in retirement incomes of self-employed individuals is relatively wide. The replacement rates of self-employed individuals are also lower than those of employees, except when private wealth is included. The total retirement income of directors/majority shareholders is around twice as high as that of other self-employed individuals. Migrants' median retirement income is barely half of that of a Dutch household. It may be supplemented by a pension from outside the Netherlands. There are only limited differences in expected retirement income between age groups.

Our results are based on a set of assumptions. For example, we assume that home equity (which is substantial for many households) can be used in retirement, either by selling the home or taking out a reverse mortgage. That is not always possible in practice, so total retirement income may be overestimated in practice. An alternative approach is to assume that households with net housing wealth have lower housing costs, but do not deplete housing wealth (see Annex B). We also assume that workers will not see any growth in income and wealth. In practice they usually will, however. This therefore leads to an underestimation of retirement incomes, although in practice this will have no major impact. See Section 4 for a full overview of the assumptions made.

Finally, it should be noted that all calculations are based on the current pension system. The changes as a result of the new pension legislation will undoubtedly affect the results, although to what extent remains unclear. The transition from nominal "promises" to expected pension will change the nature of the pension. Furthermore, the total pension pot will not change as a result of the change of system and we will also be dealing with the same financial markets in the new system. Estimating replacement rates under the new pension legislation is also complex due to the many variables that have an impact, such as economic conditions, investment results and pension funds' policy choices. The new act will make pensions more dynamic and sensitive to economic fluctuations, which may have both positive and negative effects on replacement rates.

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Annexes

Annex A. Annuitisation of private wealth

This annex describes the process of converting wealth into income streams in retirement for single persons and couples. For single persons, the annuitisation of savings is straightforward: we calculate the annuity from the statutory retirement age (FRA, the pensionable age applicable to person *f* or *m*, depending on the year of birth) associated with the present value of the capital. Formally, we annuitise wealth for single women by:

$$A = K \Big/ \sum_{n=FRA_f - a_f}^{99 - a_f} \left({}_n p_{a_f} \frac{1}{(1+r)^n} \right)$$

where *K* is the amount of capital required for annuity *A* from the *FRA* age. *a* is the age and ${}_n p_{a_f}$ is the probability that a woman of age *a* will still be alive after *n* years. The maximum age in the Statistics Netherlands mortality table is 99, so we must assume in the calculation that individuals are no older than 99. For single men we use the same comparison as that above; however, we replace ${}_n p_{a_f}$ with ${}_n q_{a_m}$, which is the probability that a man of age *a* will still be alive after *n* years. In order to annuitise the wealth of couples, we need more assumptions, since we observe wealth at household level and do not know how the members of a couple will divide their assets. We therefore assume that couples smooth their wealth over time and over each other.

Members of a couple are often of different ages, may have a different *FRA* and will not die at the same time. In the case of a man and a woman with a five-year age difference, for example, we should allow for the fact that the man will reach the *FRA* earlier than the woman, and that the woman is likely to outlive the man. We should also take economies of scale into account, as multi-person households need fewer resources per person to achieve the same level of well-being. In order to take into account both economies of scale and the age difference between members of a couple, we distinguish between the period in which only the older member of the couple has reached the *FRA* and the period in which both members have reached *FRA*. If the man is older than the woman, we calculate the annuity as follows:

$$A = K \Big/ \left(\sum_{n=max(FRA_m - a_m, 1)}^{(FRA_f - 1) - a_f} \left(\left(1 - {}_n p_{a_f}\right) {}_n q_{a_m} + 0.5 \times E \times {}_n p_{a_f} {}_n q_{a_m} \right) \frac{1}{(1+r)^n} \right.$$

$$\left. + \sum_{n=FRA_f - a_f}^{99 - a_f} \left({}_n p_{a_f}\left(1 - {}_n q_{a_m}\right) + \left(1 - {}_n p_{a_f}\right) {}_n q_{a_m} + E \times {}_n p_{a_f} {}_n q_{a_m} \right) \frac{1}{(1+r)^n} \right)$$

where a_m is the age of the man, a_f is the age of women, and *E* represents the equivalence scale (how much additional income a two-person household needs to attain the same well-being as a single-person household). We standardise the annuity on the basis of a single-person household. The first part of the comparison reflects the period in which the man has already reached *FRA* but the woman has not. If the woman is no longer alive, the man needs an annuity *A*; if the woman is still alive, we assume that the man needs 0.5 × *E* of an annuity because of economies of scale. The second part of the equation reflects the period in which both the man and the

woman have reached the *FRA*. If only the man or only the woman is still alive, the household needs an annuity *A*. If both are alive, they need *E* × A. Conversely, if the woman is older than the man, we use

$$A = K \Bigg/ \Bigg(\sum_{n=max(FRA_f - a_f, 1)}^{(FRA_m - 1) - a_m} \left(\left(1 - {}_n q_{a_m} \right) {}_n p_{a_f} + 0.5 \times E \times {}_n p_{a_f} {}_n q_{a_m} \right) \frac{1}{(1+r)^n}$$

$$+ \sum_{n=FRA_m - a_m}^{99 - a_m} \left({}_n q_{a_m} \left(1 - {}_n p_{a_f} \right) + \left(1 - {}_n q_{a_m} \right) {}_n p_{a_f} + E \times {}_n p_{a_f} {}_n q_{a_m} \right) \frac{1}{(1+r)^n} \Bigg)$$

If both men and women are of the same age, we only use the second part of the above equation, because in this situation there is no period in which one of the members has reached the *FRA* without the other also having reached the *FRA*.

Annex B. Scenario analysis

In this annex we analyse the sensitivity of our results to a number of assumptions. The median retirement income and the replacement rate for the different scenarios are presented in Table B1.

B.1 Optimistic scenario

In the baseline scenario, the real return on private wealth, including real estate, is assumed to be 2% in the future. In an optimistic scenario, we assume 3% to see the impact it has on our conclusions. The impact on the definitions including only financial wealth is relatively minor. It is dominated by the return on home equity: if the return is 3% instead of 2%, the median household has more than €4,000 per year of additional retirement income. This implies a replacement rate that is more than 6 percentage points higher. Assumptions about higher returns on private wealth therefore mainly have an impact on the proportion of households with a replacement rate of more than 80%, but much less impact on any conclusions concerning the inadequacy of retirement income.

B.2 Pessimistic scenario

In a more pessimistic scenario, we assume 1% return on private wealth to see how it affects our conclusions. Again, the impact on the definitions including only financial wealth is relatively minor. It is dominated by the return on home equity: if the return is 1% instead of 2%, the median household has over €3,000 less retirement income per year. This implies a replacement rate that is more than 3 percentage points lower.

B.3 Role of home equity

In the baseline scenario, we assume that all the net wealth in the home can be depleted.
One of the additional assumptions is that there is no further accumulation of wealth from the time at which the households are observed in the data. This also means that no further mortgage debt will be repaid. Table B1 also shows results for a scenario in which households have repaid 70% of the mortgage value at retirement age. In this case, retirement income from all wealth components is more than €8,000 per year higher and the replacement rate rises by almost 10 percentage points to 0.88. These considerable differences highlight the important role played by home equity in retirement income.

In practice, however, we note that households make relatively little use of the depletion of home equity. House sales and reverse mortgages are not very popular. Nevertheless, this assumption provides an useful ceiling for potential retirement income. Table B1 also shows a scenario in which home equity is not fully depleted, but in which homeowners only obtain an income advantage from their own home because they do not have to rent a home, in other words they have an income advantage equal to the rental value of their home. In that case, the replacement rate from all wealth components is around 5 percentage points lower than in the baseline scenario and around 12 percentage points lower than in the scenario that also includes mortgage debt repayment.

B.4 Increased tax relief in the third pillar

Finally, Table B1 shows the effect on expected retirement income due to the increase in tax relief in 2023. For this purpose, we assume that the annual contributions paid in the third pillar rise by 25% from 2023, in line with calculations by FIN/AFP. Given the relatively limited capital in Dutch third-pillar pensions, the results for the average household in this scenario scarcely differ from the baseline scenario.

Table B1. *Median retirement incomes and replacement rates under other assumptions.*

	Retirement income	Replacement rate
Baseline scenario (for comparison)		
First + Second + Third pillar	33,922	0.595
First + Second + Third + Fourth pillar, financial	37,027	0.638
First + Second + Third + Fourth pillar, private wealth	49,808	0.788
Optimistic scenario (3% return)		
First + Second + Third + Fourth pillar, financial	37,884	0.651
First + Second + Third + Fourth pillar, private wealth	53,951	0.841
Pessimistic scenario (1% return)		
First + Second + Third + Fourth pillar, financial	36,327	0.619
First + Second + Third + Fourth pillar, private wealth	46,423	0.745
Increased tax relief in the third pillar		
First + Second + Third pillar	33,964	0.595
Rental value of own home		
First + Second + Third + Fourth pillar, financial	37,027	0.638
First + Second + Third + Fourth pillar, private wealth	44,771	0.734
Repayment of mortgage on own home		
First + Second + Third + Fourth pillar, financial	37,027	0.595
First + Second + Third + Fourth pillar, private wealth	58,304	0.876