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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Abstract

This paper studies the saving response of households to shocks in the capital position of their pension fund. Using survey panel data matched to supervisory data of Dutch occupational pension funds for a period that involved three major economic crises, we provide evidence of an increase in savings driven by a worsening of the financial position of pension funds. The identification strategy exploits cross-sectional and time variations in the funding ratios of pension funds. These variations are exogenous shocks to the pension wealth of pension fund members as these result from asset price adjustments and asset allocations over which members have no direct control. We show significant saving responses to general changes in the funding ratios, as well as to direct shocks to pension funds such as in the event of a funding deficit or a stop to conditional indexation. The change in savings is especially seen among workers who participate in pension funds with historically lower returns.

JEL codes: Household saving, occupational pensions, funding ratios
Key words: D14, G51, H55

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1. Introduction

This paper investigates whether shocks to the capital position of occupational pension funds affect household saving behavior. Our empirical analysis focuses on the Netherlands, where the total value of assets invested in the pension fund sector is the highest in the world as a share of the country's GDP (about 200% of GDP).

This topic gained momentum with the COVID-19 pandemic, during which the total asset value in the Dutch pension fund sector fell by almost 120 billion euros in a single quarter, causing the mean statutory funding ratio of the entire sector to fall by nearly ten percentage points, even to values below 90 percent[1]. A funding ratio below 100 percent indicates that the actual or expected value of assets is lower than the value of current or future liabilities, corresponding to the value of all pension contributions of pension plan members, typically workers employed in a certain industry or company. Concerns about the financial position of pension funds were also common among households, as evidenced by the responses to a questionnaire designed by the Dutch National Bank (*De Nederlandsche Bank*, DNB) on people's expectations about the likely consequences of the pandemic. More than one-fourth of respondents to the survey reported that a pension curtailment would be either likely or very likely. This led us to inquire whether savings decisions of individuals respond to concerns about the financial position of pension funds, and thus to personal pension wealth.

A negative effect of pension cuts on savings was already noted both as to public pensions (Tyros, 2018; Mastrobuoni, 2009) and occupational pensions (Lindeboom and Montizaan, 2020). Also, changes to indexation have been found to relate to household savings (Van Schie, 2017), while the development of assets could affect savings directly, for instance when it comes to home equity (Caloia and Mastrogiacomo, 2022), or indirectly, through pension wealth effects (Lachowska and Myck, 2018; van Santen et al., 2013). These studies have separately looked at factors that determine household savings. This paper investigates whether the deterioration in the capital position of pension funds, either signaled by a drop in funding ratio or by recovery actions (indexation, pension cuts, etc.), affects the saving behavior of pension plans members. Price corrections in capital markets impact the value of assets invested by pension funds, making them steadily less sufficient to cover the value of the corresponding liabilities, determined by the pension contributions of current and past workers. Therefore, shocks to the capital position of pension funds represent, *de facto*, shocks to the expected pension wealth of members of those plans, and that in turn might affect their financial decisions (consumption, saving, etc.).

To answer this question, we link household survey data to pension fund supervisory data for a period covering three major economic crises and a change in the supervisory framework of

[1] See https://www.dnb.nl/en/actueel/statistical-news-releases/statistical-newsreleases-2020/dutch-pension-funds-financial-position-deteriorated/

pension funds. More specifically, we use the DNB's Household Survey on the income, wealth, and financial behavior of Dutch households, where respondents are asked to identify their pension fund, even if they are currently no longer active participants. Via the reported name, we link detailed supervisory data containing information on their capital position and asset allocation. The resulting data consists of a panel dataset covering household members, and a total of 108 pension funds, for a period of twelve years (2008-2020) that are characterized by three major economic crises (the global financial crisis, the sovereign debt crisis, and the COVID-19 crisis) that involved strong asset price corrections, a structural unfavorable change in monetary policy as well as in overall macroeconomic environment (low interest rates), and the introduction of a supervisory framework with stricter regulatory requirements.

The literature on wealth effects has emphasized the importance of distinguishing between endogenous and exogenous wealth changes, i.e. changes in wealth that results from changes in asset allocations and changes in asset prices, respectively. Examples include financial wealth (Paiella and Pistaferri, 2007) and housing wealth (Caloia and Mastrogiacomo, 2022). For pension wealth, most of the literature has focused on the so-called displacement effect (Attanasio and Brugiavini, 2003; Attanasio and Rohwedder, 2003; Alessie et al., 2013; Li et al., 2016; Hurd et al., 2012; Borsch-Supan et al., 2008; and Bottazzi et al., 2011), i.e. on the substitutability between private (voluntary) and public (mandatory) pension wealth, given by the decline in non-pension savings associated with each euro amount of mandatory pension wealth contributions. The focus of this literature is therefore on pension contributions, which is the endogenous component of pension wealth accumulation. This paper, however, focuses on changes in the capital position of pension funds, which mostly results from changes in asset prices in financial markets. Changes in the capital position of pension funds can be interpreted as exogenous pension wealth shocks, i.e. changes (actual or expected) in the level of pension wealth that are independent from the value of one's contribution. These changes are often discussed by Dutch media, and participants are also regularly informed of them (Elling and Lentz 2019). Various studies have pointed out how relevant communication strategies can be implemented (Knoef et al., 2020) and how they can positively affect decision-making (Debets et al., 2020; Gerrard et al., 2019). Our identification strategy exploits the substantial cross-sectional and time variation in the changes in the funding ratios of pension plans, to elicit the saving response of individuals. This is the same approach as in Salamanca et al. (2020). Alternatively, one could use the funding ratio as an instrument for pension wealth, as in Van Santen (2019).

The results provide evidence of the saving response by pension plan members to shocks to the financial position of their occupational pension funds. In particular, a general decrease in the funding ratio of pension plans is associated with higher voluntary active savings of pension fund members, who are seen to also increase their active savings in the event of a funding deficit of their pension fund and/or when associated recovery measures (e.g. changes in premiums or indexation) are taken. The increase in private savings is driven by lower expected compulsory

pension wealth (displacement effect). And it seems to be mostly concentrated among members of pension funds with below-median rates of return.

The remainder of the paper is as follows. Section 2 presents institutional details about the Dutch pension system. Sections 3 and 4 present the data and the descriptive evidence. Section 5 presents the results of the empirical analysis. Section 6 contains our conclusions.

2. Institutional Setting

2.1 Dutch pension system

In 2019, the Dutch pension system scored among the best in the world[2]. As in many European countries, its structure consists of three pillars. The first one - called AOW (*Algemene Ouderdomswet*) - is a state old-age pension based on a pay-as-you-go (PAYG) scheme and financed by contributions through taxes on income. This pillar is aimed at preventing poverty among the elderly by providing a flat pension benefit to all residents aged 65 and above[3]; it is linked to the statutory minimum wage and depends on the length of legal stay in the Netherlands.

The second pillar, consisting of occupational pensions managed by pension funds, supplements the flat public benefit for workers who earn more than the minimum wage (Bovenberg and Nijman, 2019). Occupational pension schemes are typically associated with a single employer (although there are various large to very large industry pension funds), with board members who are appointed by or on behalf of employers, employees, and pensioners (De Grip, Lindeboom and Montizaan, 2011; Chen and Beetsma, 2015). They are organized as defined benefit (DB) plans, where the benefit is determined according to the number of years worked and a reference wage (either final pay or an average of previous earnings). However, since the residual risk of any shortfall of pension funds lies with participants themselves, this system can also be considered as hybrid, having characteristics of both DB and defined contribution (DC) plans. Indeed, while the accrued pension rights are typically specified as in a common DB plan, they are also partially DC since the yearly indexation is linked to the financial position of the pension funds, and therefore to investment returns (Ponds and Van Riel, 2009; Bikker et al., 2012). Participation is mandatory for almost all employees (coverage is more than 90% of the work force) but typically excludes self-employed workers.

The third pillar consists of voluntary personal pension provisions such as complementary pensions and other pension arrangements, annuities, and life insurance policies. It is worth noting that these voluntary savings enjoy almost the same tax benefits (EET) as occupational pension savings, as well as the same drawbacks (illiquidity for instance). As in many other countries, the third pillar is the least popular (Alessie and Mastrogiacomo, 2011) as only few workers voluntarily top up their mandatory pension wealth with voluntary pension schemes.

2.2 Supervisory framework

[2] According to the Melbourne Mercer Global Pension Index 2019, an index built upon adequacy, sustainability, and integrity scores, the Dutch pension system is ranked at the top, together with Denmark (https://info.mercer.com/rs/521-DEV-513/images/MMGPI%202019%20Full%20Report.pdf).

[3] The retirement age was gradually raised from 65 to 67 during the years 2014-2021. As from 2022 it is linked to the average life expectancy (Chen and Beetsma 2015).

The Dutch supervisory (or assessment) framework (*Financieel Toetsingskader* or FTK in Dutch) for the pension fund sector was introduced in 2007. Under the FTK, the financial position of a pension funds is determined by the funding ratio (*dekkingsgraad*), the ratio between its assets and liabilities[4]. If the funding ratio of a pension fund drops below the minimum required level, this means that total assets are not sufficient to cover total expected future liabilities, i.e. the pension benefits of the members of the pension plan). In such case, the pension funds is obliged to submit a recovery plan to the DNB, which acts as supervisory agency. This constitutes a concrete plan to restore its capital position to a level above the minimally required funding ratio.

In 2015, the supervisory framework was replaced by the new financial assessment framework (nFTK). Also, the supervisory framework for insurance companies (Solvency II) was redeveloped, and that for banks was reshaped under the Basel agreements. In the old supervisory framework for pension plans, liabilities were discounted using adjusted market rates, but in the new framework this has been replaced by the ultimate forward rate. This is relevant to our analysis since the period that we investigate exhibited lower trending interest rates, which contributed to reduce the funding ratio. Investment returns as well as funding ratios have strongly related to interest hedging strategies of pension funds in such an unfavorable interest rate environment. The revised framework was introduced with the goal, among others, of avoiding widespread curtailments by pension funds, as well as excessively long recovery periods. Under nFTK, the recovery period has been shortened to ten years, and pension funds are obliged to apply pension curtailments if the funding ratio remains below the minimum required funding ratio (104.3% at the time) for five consecutive years.

[4] Liabilities are determined by the pension contributions of the members. Assets are determined by the investments of the pension fund, typically long-term assets as such equities and bonds, but also more alternative assets such as direct and indirect real estate holdings or shares of hedge and investment funds.

3. Data and Descriptive Statistics

3.1 – Data

The data used in the empirical analysis consist of two sources. The first source is the DNB Household Survey (DHS). The DHS is a representative annual survey held in Dutch. It contains detailed information about the income and wealth of respondents and also several detailed questionnaires about the psychological aspects of financial behavior. The second source consists of DNB supervisory data. Since the introduction of the new financial assessment framework as part of the Pensions Act, Dutch pension funds are required to report detailed information about their asset allocation and capital position. In principle, this information can be made public, which is done by means of the yearly financial reports of pension funds. The benefit of using the data collected by DNB is their completeness and comparability. The two data sources are linked via the following questions in the DHS:

1. "*Do / did you participate in a pension fund / insurer through your current / past employer?*"
2. "*In which of the following pension funds / insurers do / did you participate through your current / last employment?*"

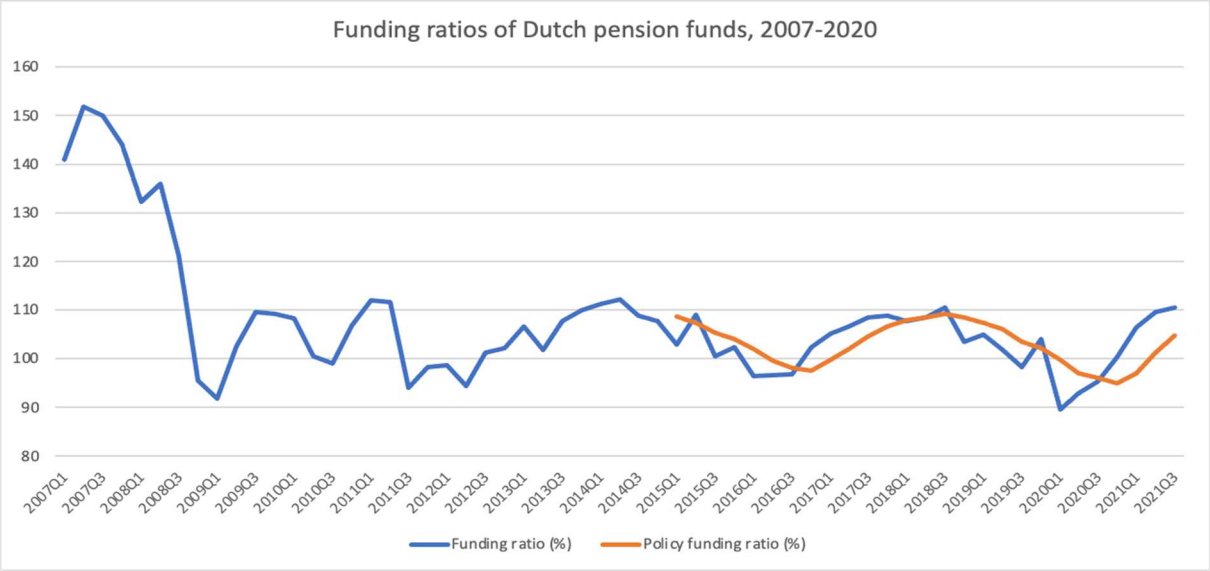
By asking respondents which pension fund they are or were a member of, the DHS allows us to link survey data of each individual respondent with their occupational pension fund via the reported name of the fund. In that way it is possible to obtain comprehensive information on both the financial situation of household members (e.g. their income and wealth, savings and investments) and on the financial situation of the pension fund (e.g. asset values and allocations). For the period between 2008 and 2020 we were able to retrieve more than 60 pension fund names and individual affiliations for 2,113 people (about 12,687 observations over time).

3.2 – Descriptive evidence on pension funds performances

Figure 1 shows the development of the mean funding ratio in the occupational pension funds sector over the period 2007-2020, as it emerges from the supervisory data. The figure shows the deterioration in the financial position of Dutch pension funds over this period: the global financial crisis (GFC) led to an unprecedented wipe-out in asset values, and the mean funding ratios fell from values near 140% to below 100%, a drop never seen before. Then, despite a recovery of asset values after the GFC, funding ratios never recovered to pre-crisis values, due to the prolonged zero interest rate environment that characterized the monetary policy response to the GFC. Low interest rates are detrimental for investors such as pension funds, as they need to *search for yields* to guarantee pre-crisis levels of returns. Higher risk profiles of investments by pension funds are associated with larger asset price corrections during crises, such as the subsequent sovereign debt crisis and the COVID-19 crisis, as these were marked by strong corrections of sovereign bond and

equity values. Following these episodes, the funding ratio of the pension fund sector did not come to exceed 110 percent, and in fact reached dropped to values below 100 percent three more times, most recently during the COVID-19 pandemic. This means that pension funds could no longer use adjusted market rates (historically about 4%). The obligation to use the lower UFR, linked to current rates, has thus contributed to keep funding ratios low.

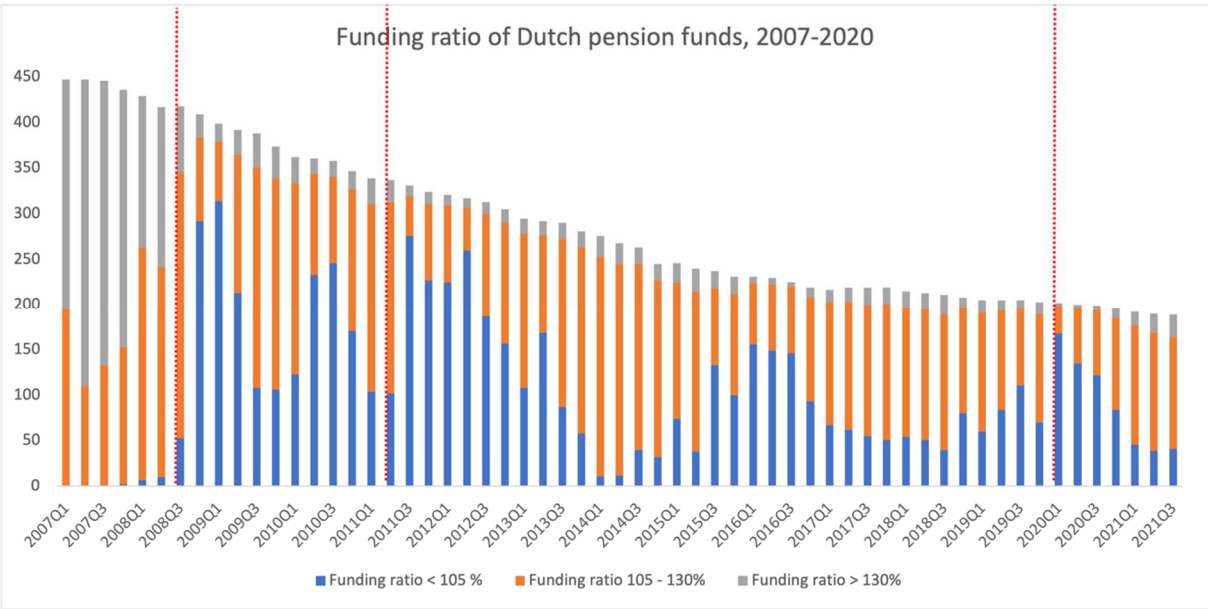
Figure 1: Funding ratios of pension funds



Explanatory note: The figure shows the development of average funding ratios over the sample period. The funding ratio (in blue) is the ratio of the current value of assets versus the current value of liabilities. The "policy funding ratio" (in orange) is defined as the 12-month moving average of the actual funding ratio.
Source: FTK supervisory data

Figure 2 shows the breakdown of the number of pension funds by the level of their funding ratio. Before the global financial crisis, no pension fund had a funding ratio below 105%. This means that the asset position of all pension funds was high enough to cover their liabilities. Less than a year later, about 80% of pension funds had funding ratios below 105 percent. Despite the temporary improvement after the crisis, the vulnerability of Dutch pension funds continued, as evidenced by the high number of pension funds with low funding ratios (below 105%) in years that were more favorable for the Dutch economy, such as those between the end of the sovereign debt crisis and the COVID-19 pandemic (2014-2019).

Figure 2: Distribution of funding ratio of pension funds, in buckets



Explanatory note: The figure shows the breakdown of pension funds by level of funding ratio. The dotted (red) lines represent the start of the global financial crisis, the sovereign debt crisis and the COVID-19 crisis, respectively.
Source: FTK supervisory data

What drives changes in the capital position of pension funds? The funding ratio of pension funds is highly sensitive to changes in financial condition, most notably to changes in the level of interest rates or equity prices. This is evidenced by the asset allocation of pension funds, as this is mostly characterized by fixed income securities, such as government or corporate bonds, and by equity instruments, such as shares and mutual funds. For the rest, pension funds hold more alternative assets, most notably real estate, via both direct and indirect (real estate funds, mortgage funds or REITs) holdings. What is also evident from the data is that pension funds vary greatly in size (as measured by either assets or number of members). As expected, the largest pension funds have more diversified asset holdings and lower administration and transaction costs. This lowers the overall risk of larger pension funds at any level of the target return, thus improving the overall risk-versus-return profile of the investment allocation.

In summary, this section provides descriptive evidence of the deterioration in the capital position of pension funds over the past twelve years. This was partly due to the lower growth in pension contributions (as some wage employment was lost, partly due to the financial crisis and partly because of a shift to self-employment), but also price corrections in financial markets and changes in monetary policy in the euro area contributed to this. The number and percentage of underfunded pension funds varied considerably over time, and in some cases shocks to pension funds translated into shocks to their members, for instance via pension curtailments or stops to indexations and increases. The next two sections investigate whether shocks to pension funds affect the saving behavior of pension plan members.

4. Empirical Analysis

4.1 – Empirical design

Our identification strategy exploits the variation and heterogeneity in the type and size of shocks that hit pension funds most notably the change in their funding ratios, and we exploit this cross-sectional and time variation to elicit the saving response of Dutch respondents in the DHS. Our identification strategy is based on the following equation pertaining to saving:

$$s_{i,p,t} = \alpha + c_p + \beta\, shock_{p,t} + \delta' \boldsymbol{X_{i,t}} + \gamma' \boldsymbol{K_i} + \theta' \boldsymbol{Z_t} + \varepsilon_{i,p,t}$$

where $s_{i,p,t}$ represents the household active saving of an individual i,[5] a member of pension fund p at time t. This information is retrieved from household survey questions that ask respondents how much money the family has put aside in the last 12 months[6]. Active saving is a measure of savings that are not attributable to capital gains[7]. The main independent variable $shock_{p,t}$ represents the shock that hits pension fund p, in time t. The types of pension fund shocks we consider are:

- the level and the change in the funding ratios of pension funds;
- a binary indicator for pension funds in underfunding (equal to one for funding ratios below minimum requirements);
- a binary indicator for follow-up actions required by the pension plan (equal to one in case of stops to conditional indexation or pension curtailments).

We control for a set of variables that potentially affect individual saving rates. In particular, $\boldsymbol{X_{i,t}}$ includes household and individual characteristics such as the household's net disposable income, a polynomial in age, marital status dummies, employment dummies, a gender dummy, a homeownership dummy, and health-related characteristics such as expected life-expectancy and self-assessed health condition. Moreover, $\boldsymbol{K_i}$ represents individual fixed cohort variables, c_p are pension-fund fixed effects, and $\boldsymbol{Z_t}$ contain macroeconomic variables that determine the level of funding ratios over the business cycle. These variables are the long-term interest rate, the inflation rate and the percentage growth rate in the employment share of the population. The long-term

[5] According to our sample selection, we consider a unique individual for each family, either the head of the household or the spouse (98% of the cases). Additionally, the selected person should have been a private sector employee at least once during the observational window.

[6] Following Caloia and Mastrogiacomo (2022), we express our dependent variable by using the inverse hyperbolic sine transformation, almost equivalent to a logarithmic transformation with the advantage of dealing with negative and extreme values (Burbridge et al., 1986).

[7] In detail, if respondents answer that their financial situation allows them to save (i.e., the variable OPZIJ indicating positive savings), we define their active savings as the answer to the question HOEVSPA (How much money did you put aside in the past 12 months?). However, as the household could also be actively dissaving (variable FINSITU, where respondents are asked whether they manage to make ends meet), we use the negative delta of financial wealth to augment the information in HOEVSPA, thereby correcting for a proxy of passive savings based on household previous financial holdings (stock, bonds, and mutual funds) and public information on the returns of these investments.

interest rates determine the base market interest rate for long-term investors such as pension funds. The inflation rate accounts for the fact that, under sound financial conditions, pension funds apply inflation indexation to the retirement incomes granted to their members. The percentage growth rate in the employment share of the population accounts for the fact that pension contributions – and thus pension funds liabilities – are not constant over the business cycle. Variables related to assets, such as changes in financial and housing wealth, are not included in the estimating equation. That is because certain dependent variables, such as active savings, may be influenced by these variables and therefore could be endogenous, as investigated by Paiella and Pistaferri (2017) and Caloia and Mastrogiacomo (2022). These two papers extend the traditional saving equation in such a way as to filter out the exogenous and unanticipated part of the change in financial and housing wealth, respectively, to elicit their effects on household savings. This paper follows a very similar approach but uses a proxy of the exogenous part of pension wealth changes, determined by shocks to the capital position of the occupational pension funds that, as discussed in Section 3, result mostly from asset price adjustments in financial markets. The full list of variables and corresponding descriptive statistics are presented in Appendix, Table A1.

4.2 – Main results

Table 1 reports the estimated effect on savings of shocks to occupational pension funds. Specifications (a) and (b) investigate how level and change in the funding ratio affect savings. Specifications (c) and (d) investigate the saving response to underfunded pension funds. A pension funds is underfunded when its funding ratio is below the minimum funding ratio set by the applicable regulation, which was equal to 104.3% (c). A pension funds with a funding deficit is required to submit a recovery plan to the supervisory authority. Here, we also investigate cases where the funding ratio is below 100% (d)[8], thus the situation where the value of total assets is totally insufficient to cover total liabilities. Eventually, specifications (e) and (f) show the saving response to shocks triggered by follow-up actions to recovery plans, such as stops to conditional indexation or direct pension curtailments.

Table 1 shows that lower funding ratios lead to higher active savings (a). Also, a negative change in the funding ratio of a pension fund leads to increase in active savings by pension fund members (b). The effect on active savings of both the level and the change of the funding ratio is statistically significant at the five percent level. This result is in line with Van Santen (2019) for the GFC period, which showed a robust relationship between both changes and levels of funding ratios and household savings. Furthermore, columns (c) and (d) of Table 1 show the saving response of members of underfunded pension funds. Results show that households increase their active savings when a pension funds becomes underfunded, but the saving response is statistically

[8] In this case, the total value of assets is less than total liabilities, given by the contributions of pension plan members.

significant only when the funding ratio drops below 100%. Eventually, columns (e) and (f) show the saving response to follow-up actions that a pension fund is required to take under the mandatory recovery plan for underfunded pension funds. Results show, as expected, a positive coefficient of the saving response to a stop in the conditional indexation of pensions or a pension curtailment, as both lead to a drop in the overall rate of return on pension contributions over the working career of plan members. However, the estimated effects are not statistically significant, most likely because of the lower estimation accuracy resulting from a lower number of observations involving follow-up actions.

Table 1. Estimation results

	Dependent Variable: Active Savings (i.h.s.)					
	(a)	(b)	(c)	(d)	(e)	(f)
Funding Ratio (*level*)	-0.036**					
	(0.017)					
Delta funding ratio (i.h.s.)		-0.059**				
		(0.021)				
Underfunding 1: funding ratio below 104.3%			0.347			
			(0.245)			
Underfunding 2: funding ratio below 100%				0.630***		
				(0.169)		
Stop of indexation					-0.026	
					(0.106)	
Pension curtailments						-0.899
						(0.661)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Individual fixed cohort variables	Yes	Yes	Yes	Yes	Yes	Yes
Macro variables	Yes	Yes	Yes	Yes	Yes	Yes
Pension funds FE	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	7,798	7,680	7,798	7,798	6,702	5,083
R-squared	0.102	0.100	0.099	0.101	0.112	0.114

Explanatory note: The variables "active savings" and the "Δ of funding ratio" have been transformed by using the inverse hyperbolic sine (*i.h.s.*) transformation, as log transformation involving many zeros is cumbersome. The drop in observations in model (b) is due to the lack of two adjacent observations for a few units where the time difference could not be computed. The drop of observations in columns (e) and (f) is due to missing values in "stop indexation" and "pension curtailments". Explanatory variables are retrieved from annual DNB statistics, which are available only from 2014 onwards. Clustered standard errors (at pension funds level) are shown in parentheses, *** p<.01, ** p<.05, * p<.1
Source: DHS data and FTK supervisory data.

4.3 – Transmission channels

This section examines potential explanations. First, we investigate elicited responses about hypothetical behavior in case pensions were reduced (column a). For this, we use answers to question DNB116 in the DHS data, where respondents are asked: "*Will you adjust your behavior if pensions are reduced, for example through an adjustment on the indexation, postponement of the retirement age, or in case of a different pension system?*". Here, we distinguish the cases where the respondent replies "*Yes, I will put more money aside for my pension*" from all other possible

answers ("*No, I will see what I'll do when it happens*"; "*No, I think I can make ends meet fairly easily with the pension I will have*" or "*Otherwise*"). Contrary to our main specification, which relates a broad set of pension fund shocks (including curtailments) to actual household behavior, this specification tests whether the financial position of the pension fund affects a household's responses about its intentions. When the funding ratio declines, the capital position of the pension plan worsens, and some pension plans go in underfunding. Some members may anticipate an increase in the likelihood of a pension curtailment at that point. The decrease in funding ratio may act as a "wake-up call" for some members, and it may lead them to greater concern about the state of their pension, possibly affecting their intention in case of further worsening of the financial position of the pension fund or in case of a pension curtailment. Results in column (a) of Table 2 indicate that a change in the funding ratio of a pension plan does not affect people's responses regarding their intentions in case of a pension curtailment. This finding therefore supports the second hypothesis, according to which changes in funding ratios directly affect expectations of pension wealth.

Table 2. Transmission channels

	Dependent variables:				
	Adjust behavior if needed	**Expected replacement rate**	**Other pension arrangements**	**Expected (early) retirement age**	**Importance of retirement savings**
	(a)	(b)	(c)	(d)	(e)
Funding ratio	-0.0002	0.075***	-0.0003	0.006	0.001
	(0.001)	(0.025)	(0.001)	(0.074)	(0.001)
Control variables	Yes	Yes	Yes	Yes	Yes
Macro variables	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes
Pension funds FE	Yes	Yes	Yes	Yes	Yes
No. of obs.	6,776	6,513	7,999	6,967	8,392
R-squared	0.054	0.111	0.163	0.102	0.054

Explanatory notes: *column a)* "Adjust behavior if needed" equal to 1 if "yes, I will put more money aside for my pension", 0 otherwise; *column b)* "Expected replacement rate" refers to the expectations about the net retirement pension in percentages to the last net income received before retirement at age 65; *column c)* "Other pension arrangements" equal to 1 if "yes, through annuities, whole life policies or buying extra pension rights via employer", 0 otherwise; *column d)* "Expected (early) retirement age" refers to the expectations about the (early) retirement age; *column e)* "Importance of retirement savings" equal to 1 if "very important" (SPAARM03>=5), 0 otherwise.
Clustered standard errors (at pension funds level) are in parentheses, *** p<.01, ** p<.05, * p<.1
Source: DHS data and FTK supervisory data.

Second, we test whether shocks to funding ratios affect the expectation of pension fund members regarding their pension wealth. To do this, we use the expected replacement rate as a dependent variable in a regression specification analogous to eq. (1). Results in column (b) of Table 2 confirm that higher funding ratios directly affect people's expected replacement rates[9]. In particular, a one percent increase in the funding ratio of a pension fund associates with a

[9] From question PERCPENS: "How much do you expect your net retirement pension (including general old-age pension) to be as a percentage of the last net income you will receive before you retire after the age of 65?"

statistically significant increase in the expected replacement rate by 0.075 percent. The replacement rate is defined as the expected pension benefit, as a percentage of the final year's net income. This result is in line with Van Santen (2019) for the crisis period.

Third, we test whether shocks to pension funds affect people's willingness to top up their pension through other pension arrangements, such as annuities, life-insurance policies, or via extra pension rights acquired from the employer.[10] The results of Table 2 already show that negative changes to the funding ratio lead to higher voluntary savings by pension fund members. However, some respondents may want to put money aside to supplement their pension using proper retirement saving products (instead of or in addition to voluntary savings). For instance, life insurance policies often mandate policy holders to make regular payments, and this can be seen by respondents as a useful commitment device. Results in column (c) exclude this hypothesis: a lower funding ratio does not increase the willingness to top up the pension through other pension arrangements.

Fourth, we test whether shocks to the funding ratios of pension funds affect people's expectations regarding their retirement age[11]. If people anticipate that a lower funding ratio corresponds to lower expected pension benefits, as shown in column (b) of Table 2, they might anticipate that additional years of work might be needed to maintain the same level of income during their retirement. For instance, they might decide not to use an early-retirement option. Results in column (d) also exclude this possibility, as we find no statistically significant effect on the self-reported expectations about the retirement age.

Lastly, we look at respondents' replies regarding their perceived importance of retirement savings depending on the financial position of their pension funds[12]. Results in column (e) suggest that a higher funding ratio is not associated with a higher perceived importance of savings for retirement.

[10] From questions DNB911-DNB917: "Have you made other arrangements for your pension apart from the customary pension you build up through your employer? 1) yes, through annuities; 2) yes, through whole life policies; 3) yes, through buying extra pension rights via employer; 4) yes, through extra periodical payments via employer; 5) yes, otherwise; 6) no; 7) don't know

[11] From question LFTPENS: "At what age do you expect to retire or to make use of an early retirement arrangement?"

[12] From SPAARM03: "How important is it to you to save some money to supplement your general old-age pension?"

5. Heterogeneity Analysis

This section presents the heterogeneity analysis of the results in Section 3. The aim of this analysis is to test whether the estimated effect on savings due to shocks on pension funds is more pronounced on specific categories of respondents based on certain characteristics. Three main dimensions are considered: pension fund performance, the respondent's education, and age. First, we divide the pension funds in the sample into two groups based on the median realized return over the sample period; we then estimate specification (1) in both subgroups.

Table 3. Heterogeneity Analysis

	Dependent Variable: Active Savings (i.h.s.)					
	PF performance		**By age**		**By education**	
	Above median return	Below or equal median return	Younger than 50	50 or older	Low education	High education
Delta funding ratio (*i.h.s.*)	-0.004	-0.082***	-0.071*	-0.048	-0.057	-0.057
	-0.05	-0.032	-0.039	-0.037	-0.036	-0.041
Underfunding 2:	0.648*	0.693***	0.911***	0.340*	0.686***	0.599***
Funding ratio <100%	-0.34	-0.156	-0.204	-0.187	-0.185	-0.209
Stop indexation	-0.309	0.131	-0.450*	0.269	-0.355	0.387***
	-0.297	-0.196	-0.258	-0.212	-0.221	-0.245
Demographic variables	YES	YES	YES	YES	YES	YES
Macro variables	YES	YES	YES	YES	YES	YES
Cohort FE	YES	YES	YES	YES	YES	YES
Pension funds FE	YES	YES	YES	YES	YES	YES

Explanatory note: The variables "active savings" and the "D of funding ratio" have been transformed by using the inverse hyperbolic sine transformation (*i.h.s.*). Moreover, different from the main analyses, the heterogeneity by level of education groups individuals with "vocational" and "university" education together into "high level". Clustered standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1.
Source: DHS data and FTK supervisory data.

The results in Table 3 show that significant saving responses to a pension funds shock are found mostly among members of pension funds with returns below the median value. This holds in case of a change in the funding ratio as well as when pension funds go underfunded. Respondents in pension funds with below median performance increase their savings when funding ratios drop and when pension funds go underfunded. This is consistent with the idea that a reduction in the funding ratio is more likely to lead to pension curtailments and indexation stops in pension funds with an already low funding ratio. On the contrary, pension funds with high funding ratios have more loss-absorbing capacity; thus, a shock in the financial markets does not necessarily result in a shock to the pension benefits of their members. Surprisingly, no significant coefficients appear when indexation

of pension benefits is paused. Instead, members of the best-performing pension funds respond significantly only when the funding ratio drops below 100%.

We next compare the saving responses of older and younger persons and of people with higher and lower education. Concerning the effect by level of education, two hypotheses can be made. One is that a drop in the financial position of a pension funds may be of greater concern to older workers or current pensioners, as they are closer to or already receive their pension benefit, whereas younger workers may be less concerned as they are still far from retirement. A second hypothesis is that, with a steady drop in the capital position of pension funds as documented in section 2, younger members should be more concerned about the possibility that a change in funding ratio today will translate into lower pension benefits in the future. The results in Table 2 suggest that younger respondents tend to be more sensitive to pension fund shocks than older respondents.

Concerning the effect by level of education, our hypothesis is that highly educated respondents would me more sensible to pension fund shocks, as they would be more informed about the current financial position of their pension fund and more aware of the implications for their pension of any pension fund shock. The results in Table 2 show no statistically different response between respondents with higher and lower education when it comes to changes in funding ratio and pension funds going underfunded. Instead, we find that respondents with higher education significantly increase their savings after an indexation stop, while respondents with lower education do not change their saving behavior.

6. Conclusions

This paper investigates whether shocks to the financial position of occupational pension funds affect the saving decisions of pension fund members. Our analysis uses household survey data, merged to pension fund supervisory data, for a period that faced three major crises for the pension sector. Our identification strategy exploits the cross-sectional and time variation in the funding ratios of Dutch pension funds, that represent exogenous shocks to the pension wealth of their members, as these result from asset allocations and price adjustments over which plan members have no direct control.

The results show that a decrease in the funding ratio of a pension fund is associated with higher active savings of on the part of plan members. Members increase their active savings also in the case of a funding deficit of their pension fund, or when the indexation of pension benefits is stopped because of a recovery plan. A positive coefficient is also found for pension curtailments, but the results have non- statistical significance due to the limited number of actual curtailments in the sample (30). The increase in private savings is found to be driven by lower expectations of compulsory pension wealth (displacement effect). Significant saving responses are found among members of the worst-performing pension funds, i.e. those with a below-median rate of return. However, saving responses seem to be fairly aligned across age groups and education levels.

These results, by showing that household saving and consumption decisions respond to shocks to the financial position of pension funds, provide evidence of the direct link between financial instability in the pension sector and the real economy. Also, they highlight the importance of strict regulation and supervision in the pension sector, as a way to ensure the sustainability of pensions and to ensure the neutrality of pension schemes to the intertemporal choices of workers and pensioners.

Our results indirectly tie in with the policy discussion on the reform of the Dutch pension system. We show that shocks to pension funds have mild but statistically significant effects on economic and financial behavior of participants, which varies across different groups. The new pension system may cause shocks to the capital position of pension funds and their members, because of the translation of entitlements to wealth for certain individuals. If a translation method is chosen that allows much pension fund discretion, these shocks could be extremely heterogeneous too. It is difficult to predict the behavioral effects that may arise, even if the shocks cancel out across groups. Persons negatively affected may respond with higher savings, while those who are positively affected may not reduce their savings. This can have macroeconomic consequences on consumption, but that can be mitigated by pension funds smoothing out excessive transfers across different groups.

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Table A1. Descriptive Statistics

	Mean	St.Dev.	Obs.
Dependent variables:			
Active Savings	4,381	7,581	7,798
Transmission channels:			
Adjust behavior if needed (yes)	0.289	0.453	6,776
Expected replacement rate	73.25	11.12	6,513
Other pension arrangements (yes)	0.237	0.425	7,999
Expected (early) retirement age	53.56	27.54	6,967
Importance of retirement saving (very important)	0.762	0.426	8,392
Main explanatory variables:			
Funding ratio (%)	102.3	8.740	7,798
Underfunding: funding ratio below 104.3%	0.655	0.475	7,798
Underfunding: funding ratio below 100%	0.476	0.499	7,798
Stop indexation	0.411	0.492	6,537
Pension curtailments	0.005	0.071	5,005
Macroeconomic variables:			
Long-term interest rate	1.306	1.362	7,798
Inflation	1.392	1.024	7,798
% Growth rate in the employment	0.515	0.915	7,798
Additional controls:			
Net disposable Income	22,171	15,237	6,338
Age	49.65	11.43	7,798
Year of birth cohort 1 (1932-1947)	0.026	0.158	7,798
Year of birth cohort 2 (1947-1952)	0.138	0.345	7,798
Year of birth cohort 3 (1953-1957)	0.158	0.365	7,798
Year of birth cohort 4 (1958-1962)	0.152	0.358	7,798
Year of birth cohort 5 (1963-1967)	0.114	0.318	7,798
Year of birth cohort 6 (1968-1972)	0.117	0.290	7,798
Year of birth cohort 7 (1973-1977)	0.114	0.238	7,798
Year of birth cohort 8 (1978-1982)	0.092	0.167	7,798
Year of birth cohort 9 (1983-1987)	0.060	0.440	7,798
Year of birth cohort 10 (1988-1997) *(reference group)*	0.029	0.476	7,798
Marital status:			
Single (*reference group*)	0.262	0.440	7,798
Married or living with a partner	0.654	0.476	7,798
Divorced	0.085	0.279	7,798
Male	0.650	0.477	7,798
Level of education:			
None or low	0.551	0.497	7,798
Vocational college *(reference group)*	0.290	0.454	7,798
University education	0.159	0.365	7,798
Employment status:			
Employed	0.852	0.355	7,798
Unemployed	0.025	0.157	7,798
Retired	0.086	0.281	7,798
Self-employed & others *(reference group)*	0.037	0.188	7,798
Home-owner	0.770	0.421	7,798
Life expectation (chance to reach age 80*)	6.116	2.246	7,798
Health status: good	0.818	0.246	7,798

Explanatory notes: Descriptive statistics mainly refer to the model specification (a) of Table 1. The dependent variables referring to *transmission channels* are exceptions: they are computed based on each specification in Table 2. "Net disposable Income" represents labor income, and it is computed at the household level (statistics in Table A1 exclude values equal to zero). The variable "chance to reach age 80" is based on a scale between 0 and 10, where 0 means "no chance at all (to reach age 80)", and 10 means "absolutely certain".
Source: DHS data and FTK supervisory data.

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