PEF, **17** (4): 437–468, October, 2018. © Cambridge University Press 2016
doi:10.1017/S1474747216000287 First published online 19 December 2016

*Recovery measures of underfunded pension funds: higher contributions, no indexation or pension cuts?**

LEO DE HAAN

Economics and Research Division, De Nederlandsche Bank, Amsterdam, The Netherlands
(*e-mail:* l.de.haan@dnb.nl)

Abstract

Using recovery plan data of 213 underfunded Dutch pension funds for the years 2011, 2012 and 2013, discrete choice models are estimated describing pension funds' choices between three recovery measures: higher contributions, no indexation and pension cuts. The estimation results suggest, first, that pension cuts are more likely when the funding ratio is very low, there is little time left for recovery, the pension fund is not a corporate pension fund, and its participants are still relatively young. Second, the results suggest that Dutch pension funds consider contribution increase first, no indexation second and pension cuts only as a last resort.

JEL CODES: G23, G28, G32

Keywords: Pension funds, funding ratio, regulation, recovery plans.

1 Introduction

Pension funds around the world have been affected on an unparalleled scale by the recent financial crisis. In 2008, global pension assets declined by more than 20% (e.g., Pino and Yermo, 2010). While financial markets partly recovered during 2009, funding ratios (defined as the ratio of assets to liabilities) of defined benefit (DB) pension plans, making out 60% of total pension assets in the OECD, remained very low. In the Netherlands, where about 90% of pension assets are (pure or mixed) DB plans, the average funding ratio of all over 600 pension funds under supervision dropped from a comfortable 1.44 in 2007 to 0.95 in 2008 (Figure 1).[1] The funding

* The author would like to thank two anonymous referees and the editor (David Love), Jacob Bikker, Laurence Booth, Dirk Broeders, Jakob de Haan, Paul Hilbers, Jeroen Hinloopen, Steven Jonk, Agnes Joseph, Sebastiaan Pool, Maarten van Rooij, participants of the 2015 World Finance Conference (Buenos Aires) and the Netspar Pension Day (Utrecht, 2015), and seminar participants at DNB for useful comments on earlier versions. Patrick Colijn, Henk van Kerkhoff and Enrico Vroombout provided valuable data assistance. The views expressed are the author's and do not necessarily reflect official positions of DNB.

[1] Since 2007, the funding ratio of Dutch pension funds is defined as the ratio of the market value of assets to the market value of pension liabilities. The market value of pension liabilities is the present value of

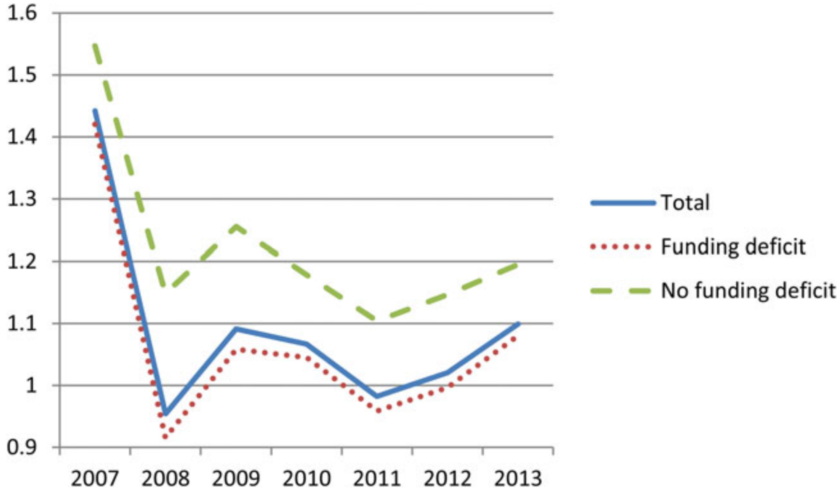

Figure 1. (Colour online) Aggregate funding ratio of Dutch pension funds. Total = unbalanced panel of 620 funds. Funding deficit = 293 funds with funding deficit in 2008. The funding ratio is defined as the ratio of assets to liabilities, both in market values.

ratio dropped below 1.05, i.e., the regulatory required minimum funding ratio, for almost half of the Dutch pension funds.[2] On average, their funding ratio dropped to 0.91 in 2008.

The data used for the analysis in this paper reveal that funding ratios can drop sharply when conditions deteriorate as much as during the global financial crisis of 2008. Pension fund recovery plan data, submitted in 2008, offer a unique opportunity to study the recovery measures taken by underfunded pension funds. Using data from recovery plans and recovery progress reports of 213 Dutch pension funds for the years 2011, 2012 and 2013, I examine the choice between three recovery measures, i.e., contribution increase, no indexation, or pension cuts.

First, I estimate a multinomial logit model that distinguishes the three short-term recovery measures (contribution increase, no indexation and pension cuts) and relates pension funds' choices to their characteristics. The results suggest that the probability of a pension cut increases when the funding ratio is lower, there is little time left until the regulatory deadline of the recovery period, the pension fund is an industry-wide rather than a corporate pension fund, and the age composition of the pension fund's participants is still relatively young.

Second, I examine whether there are any preference hierarchies among the three recovery measures apparent from the actual choices made by the pension funds. This is tested using ordered probit analysis. In particular, separate ordered probit

future pension benefits, using the term structure of the risk-free market interest rate (i.e., the swap rate) as discount factor. As indexation for inflation by Dutch pension funds is conditional, an inflation-indexed bond rate is not used as the discount factor.

[2] The 1.05 limit is set by the Dutch regulator, to ensure that the pension fund will take precautionary measures against underfunding in time.

models for each possible hierarchy are estimated and then it is tested, which one of these orderings best suits the data. According to the results of this analysis, Dutch pension funds consider contribution increase first, no indexation second and pension cuts only as a last resort.

This paper adds to the empirical literature analysing supervisory data of Dutch pension funds, by addressing the three recovery measures (contribution increase, no indexation, pension cut) together instead of in isolation, analysing what drives the choice between them and determining whether there is a preference hierarchy among them. For this, pension recovery plan data are used which is a novel data source.

The setup of this paper is as follows. After a sketch of the Dutch regulatory system in Section 2 and a review of the related literature in Section 3, Section 4 gives a theoretical motivation of the determinants of pension funds' choices of recovery measures. This is followed by a discussion of the data (Section 5), after which Section 6 presents the estimation results for the multinomial logit model explaining recovery measure choices. Section 7 offers the results of the ordered probit models indicating the preference hierarchy among recovery measures. Section 8 concludes.

2 Regulation of Dutch pension funds

The Netherlands has an extensive pension system with nearly universal coverage and assets over 100% of GDP. It was an early adopter of risk-based supervision methods.[3] The Dutch central bank (De Nederlandsche Bank, hereafter: DNB), the supervisor of pension funds, assesses whether the pension funds are financially healthy and whether they can be expected to fulfil their obligations in the future.

In the Netherlands, the earlier solvency crisis of 2001–2004 already forced Dutch pension funds to reconsider their final-pay plans with de facto unconditional indexation; most Dutch pension funds switched to a career average-wage plan with solvency-contingent indexation (Ponds and Van Riel, 2009). This explicit emphasis on the conditionality of indexation introduced an element of flexibility to the Dutch pension system that made it more resilient to crises (Blome *et al.*, 2007). The typical Dutch pension contract since then comprises a career-average earnings DB pension in which only nominal benefits are guaranteed, but with the intention to provide wage or price indexation. Provisioning is not required for conditional pension rights, although contributions have to be consistent with the indexation ambition.

In 2007, the introduction of the Financial Assessment Framework (in Dutch: Financieel Toetsings Kader; hereafter FTK) forced a complete switch to market valuation of Dutch pension funds in accounting and regulation. Since the introduction of the FTK in 2007, all assets and liabilities of pension funds must be valued at market value. Dutch pension funds must hold sufficient assets to keep the probability that their assets undershoot their liabilities within a period of 1 year below 2.5%. Pension funds must therefore hold a buffer of assets over and above the value of the liabilities. The ratio of the value of assets to liabilities is called the funding

[3] For a description of the pension system in the Netherlands, see e.g. Hinz and Van Dam (2008), Federation of the Dutch Pension Funds (2010) and Broeders and Pröpper (2010).

ratio. Each pension fund's *required funding ratio* is set by the supervisor and depends on the pension fund's risk profile.

The *minimum* required funding ratio is the lower limit set by the regulator for a pension fund's funding ratio. For the period under investigation, the minimum required funding ratio is approximately 1.05. If the funding ratio falls below this level, a pension fund has a so-called *funding deficit*. Pension funds with a funding deficit have to propose a *short-term recovery plan*. This plan contains specific recovery measures enabling the fund to comply with the minimum required funding ratio within 3 years. In view of the exceptional circumstances in 2008, the allowed period for the short-term recovery plan has been extended from 3 to 5 years (i.e., 2009–2013). If the recovery is insufficient within that period, cuts in accrued pension rights must be considered.

If a pension fund's funding ratio falls below the required funding ratio, but remains above the minimum of 1.05, it has a so-called *reserve deficit*. In that case, a pension fund must submit a *long-term recovery plan*. This plan must enable the funds to bring the funding ratio above the required funding ratio within 15 years.[4]

A DB pension fund has several options in order to improve the funding ratio.

1. It can raise contributions for employees, which will also raise contributions from the employer as in most cases the employer pays a fixed percentage above employees' contributions. If the fund is a corporate pension fund, i.e., it is for the employees of a single company or corporation, the firm may give a voluntary donation.[5] During the previous solvency crisis of 2001–2004, when pension funding ratios dropped as well, the supervisor urged pension funds to take measures, which resulted in an increase of pension contributions to sustainable levels (Bucciol and Beetsma, 2010). Therefore, the scope for further contribution increases for most pension funds was quite limited in 2008.
2. The pension fund can decide to not fully index pension rights to (price or wage) inflation, or index not at all. Since the change from final pay pension plans to career average wage pension plans in the aftermath of the dotcom crisis, pension funds replaced de facto unconditional indexation with contingent indexation based on the funding position of the pension fund (Ponds and Van Riel, 2009).
3. The pension fund can cut pension rights. The Dutch pension law considers writing off existing pension rights as the last resort and supervision is aimed at avoiding this in all but very exceptional circumstances (Beetsma and Bucciol, 2011).

There are also measures taken by the government with respect to the pay-as-you-go *public* old-age pension scheme, which is the first pillar of the Dutch pension system. For example, the government has decided to raise the public pension age, which was 65 years until 2014, step by step to 66 years in 2018 and 67 years in 2021. It is to be expected that pension funds, constituting the second pillar of the Dutch pension

[4] Pension funds that have neither funding nor reserve deficits, still have to submit a long-term recovery plan every 3 years, as part of the so-called *continuity analysis*.
[5] There are no legal obligations for the sponsor to do this, like in the USA, in case of underfunding.

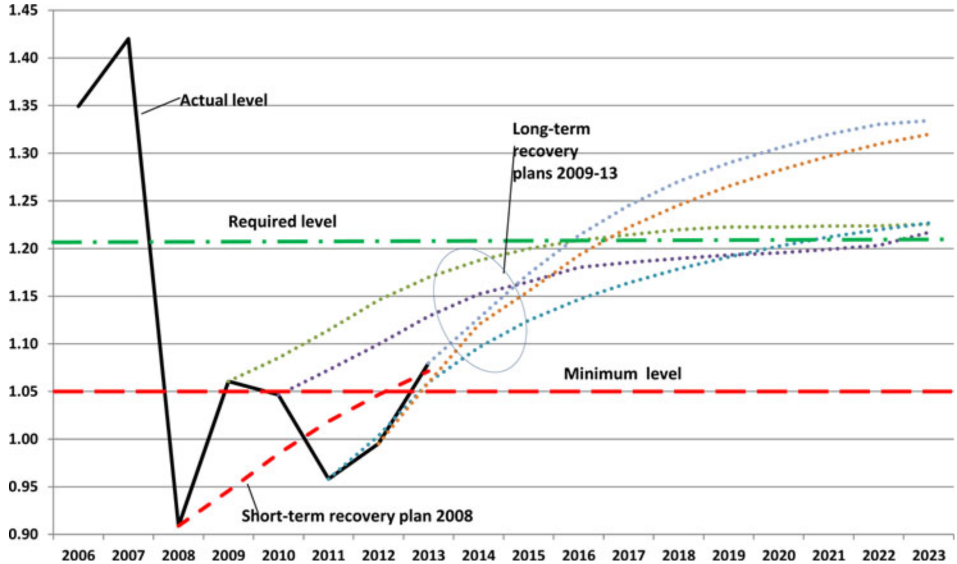

Figure 2. (Colour online) Aggregate funding ratio of selected pension funds in recovery. Explanatory note. 98 Selected Dutch pension funds with a funding shortfall in 2008 and complete or nearly complete recovery plan and progress report data for the entire recovery period 2009–2013. Minimum required funding ratio is set to 1.05. Required funding ratio represents the sub-sample average 1.21 for the available years 2010–2013.

system, will raise the pension age accordingly. This is beyond the scope of the present study that focuses on the recovery period until 2013.

Figure 2 shows, for the sake of illustration, the aggregate funding ratio for a sub-sample of 98 Dutch pension funds that ran into a funding deficit in 2008, and submitted both a short-term recovery plan in 2008 and recovery progress reports during the *entire* 5-year recovery period 2009–2013.[6] For this sub-sample, the aggregate funding ratio shows a sharp drop, from 1.42 in 2007 to 0.91 in 2008, which is mostly the result of the stock market crash. According to the short-term recovery plans, the pension funds aimed at bringing back their aggregate funding ratio to a level of 1.06 in 2013, slightly above the regulatory minimum of 1.05.

Figure 2 shows that the funds managed to bring their funding ratio back to 1.08 in 2013, three basis points above the lower limit of 1.05. However, the road to recovery was bumpy, unlike the originally planned continuous improvement from 0.91 in 2008 to 1.06 in 2013. The funding ratio first recovered strongly to 1.06 in 2009, but subsequently fell sharply to 0.96 in 2011, to finally reach the level of 1.06 in 2013.

The aggregate level of the required funding ratio of the sub-sample was 1.21 for the years 2010–2013.[7] Figure 2 shows that the long-term plans submitted in 2009, 2010

[6] Specifically, pension funds that either temporarily or definitely stopped submitting short-term recovery reports because their funding status reached a level of 1.05 or higher, or that either temporarily or definitely stopped submitting long-term recovery reports because their funding ratio reached the level of the required funding ratio or higher, have not been included in this figure.

[7] Data for earlier years are not available.

and 2011 aimed at a level slightly above 1.21 to be reached in 2023 and those of 2012 and 2013 at levels between 1.30 and 1.35.

The required funding ratio is an important benchmark, as the scope for full indexation of nominal pension rights to inflation depends on it. Pension funds are mostly using so-called policy ladders to determine the scope for indexation. Full indexation is granted when the funding ratio is equal to or higher than the required funding ratio. When the funding ratio is below the lower limit of 1.05, no indexation is given at all. Between the lower and upper boundary, partial indexation is granted proportionally to the funding ratio.

3 Previous literature

There are two strands of literature dealing with recovery of (Dutch) pension funds.

The first strand consists of simulation studies. Van Rooij *et al.* (2008), using a simulation model, show that market valuation for a typical Dutch pension fund (offering a guaranteed average pay nominal pension with conditional indexation) increases contribution volatility significantly if market valuation is used for both unconditional and conditional rights. Bikker and Vlaar (2007) present simulations showing that fully guaranteed indexation is virtually unaffordable, because the real discount rate is generally both very low and highly volatile. Van Ewijk (2009) shows by means of simulations that no indexation is a relatively effective way to achieve recovery of funding ratios up to the minimum within the short-term recovery period of 5 years, but that this measure especially hurts the baby boom generations. Bucciol and Beetsma (2010), using an Over Lapping Generations model describing a small open economy with a two-pillar pension system like that of the Netherlands, point out that the youngest generations prefer indexation policy, while the older generations prefer higher contributions to recover from underfunding. The reason is that indexation cuts spread the burden of adjustment over all working and retired generations, with the older generations contributing relatively more because of their larger accumulated nominal pension claims, while contribution increases only directly affect workers. Workers who are further from retirement can expect to contribute more to the recovery from underfunding than workers who are close to retirement. Their stochastic simulations show that pension buffers are highly volatile and underfunding occurs frequently, mostly arising from uncertainty about the yield curve. Chen *et al.* (2014), using an overlapping generations model with a pay-as-you go pension pillar, a funded pension pillar and a government, show that contribution and indexation policy are substitutes, i.e., stronger responses of contributions to funding ratio imbalances require less indexation and vice versa.

The second strand of literature analyses supervisory data of Dutch pension funds. Davis and De Haan (2012) present empirical evidence for about 200 Dutch defined benefit pension funds in 1996–2005, showing that the willingness or ability of the sponsoring firm to give a voluntary donation to the pension fund depends, among other things, on the financial position of that firm itself. Broeders *et al.* (2014) empirically analyse indexation by 166 Dutch pension funds from 2007 to 2010 and show that the key drivers of conditional indexation are the funding ratio, inflation and the real wage growth. Bikker *et al.* (2014), using balance sheet data of Dutch pension funds during 1993–2005 and the fact that in the pre-FTK period the discount rate was still fixed, deduce that there is a link between the funding ratio on the one hand and the expansion (e.g. by indexation) or limitation (e.g., by setting pension premiums over actuarially fair levels) of pension rights on the other.

To the best of my knowledge, determinants of the decision to increase the contribution rate or cut pension rights have not yet been examined using real data on actual decisions of pension funds. Thus, this paper adds to the second strand of literature by addressing all three recovery measures (contribution increase, no indexation, pension cut) together and empirically analysing the determinants of the choice between them.[8] For this, pension recovery plan data are used which is a novel data source.

In the Netherlands, recovery plans exist since 2008. But also in the UK, DB pension funds have to submit recovery plans when their funding ratios fall below regulatory required minimum levels. In the UK, recovery plans exist since 2005, when the Pensions Act 2004 came into force on 30 December 2005. The UK pension funds regulator regularly publishes analyses of these recovery plans (e.g., The Pension Regulator, 2007), but to the best of my knowledge, these data have not yet been used for econometric research. Investigating pension recovery plans therefore is another contribution of this paper.

4 Determinants of pension funds' choice

This section discusses the determinants of pension funds' choice between the three recovery measures: contribution increase, no indexation and pension cut. In some cases it seems possible to make plausible theoretical predictions under which circumstances a specific recovery measure will more likely be chosen. In other cases, however, it seems only possible to indicate which factors may increase the pension funds' preparedness to take any recovery measures at all, or at best to take 'more drastic' measures. For those cases, the data will have to tell which recovery measures are considered to be more drastic.

4.1 Maturity of the pension fund

The age composition of the pension fund participants could play a role because young and old employees and retirees have different interests (e.g., Bucciol and Beetsma, 2010). A high proportion of retirees imply that relatively more participants will be in favour of higher contributions rather than no indexation or pension cuts, because the latter hurt inactive participants relatively more than active participants who still have time to save, while contribution increases involve active participants only. As will be discussed below, Dutch pension boards have a 50%–50% representation of employees and employers, and only since 2013 retirees are represented in the board

[8] Theoretically, there is a fourth recovery measure that underfunded pension fund may take, i.e., choosing a less risky investment mix. In practice, this option has rarely been used because it means lower future investment returns and therefore does not really help raising future funding ratios. For this reason, the present research does not consider it.

as well. Hence, it is possible that the effect of retirees on pension policy is at best indirect, for example through moral suasion.

4.2 Regulation

In principle, if a pension fund is in a state of underfunding (i.e., the funding ratio is below the 1.05 minimum), the pension fund board's freedom of choice among these recovery measures is limited. Regulatory rules dictate that, in a state of underfunding, contributions should add to a rise of the funding ratio, conditional indexation be skipped, and benefit cuts be used only as a last resort.

The recovery period is 5 years, so there is some scope for timing of the recovery measures. It is to be expected that if time is running out, the pension fund is more prepared to take more drastic recovery measures such as a pension cut because a low funding ratio becomes more problematic when time is running out.

The progress of the recovery plan is annually evaluated by the supervisor, so if the pension fund's recovery is behind schedule, it is to be expected that the fund is more prepared to take recovery measures.

The underfunded pension fund is monitored closely and has to give a projection for its funding ratio each year. The outcome for the funding ratio may deviate from this expected level. If the outcome is disappointing in a particular year, it is to be expected that the fund is more prepared to take recovery measures in the following year.

For an underfunded pension fund, it is most urgent to increase the funding ratio above the minimum level of 1.05 within the 5-year recovery period. However, to be able to fully index pension rights in the future, a further increase up to the required funding ratio after this period is necessary. Therefore, if the pension fund has a higher required funding ratio, it is to be expected that the pension fund is more prepared to take measures.

In the longer term, pension funds may aim for higher than the required funding ratios because they wish to be more certain to be able to index pension rights without interruption in the future. If its ambition is higher, it is to be expected that the pension fund is more prepared to take necessary measures.

4.3 Portfolio allocation, investment risk and return

As the 2008 crisis led to a crash on the global equity market, it is to be expected that pension funds that held much equity at the time suffered greater losses than funds that held more bonds. Those funds may therefore be more prepared to take measures.

Part of the recovery of the funding ratio may be accomplished by a recovery of the financial markets after the crash, resulting in higher investment returns. If the expected return on investments is high, the pension fund probably will be more reluctant to take drastic recovery measures.

4.4 Contribution coverage

Regulatory rules in principle dictate that, in a state of underfunding, contributions should add to a rise of the funding ratio, i.e., the contribution coverage, defined as the ratio of actual contributions to actuarially required contributions, should be greater than one. However, the Dutch government granted pension funds some ‘breathing space’ with respect to the need to raise contributions in 2011–2013, in order to avoid a too negative impact on the real economy. This may to some extent have diminished the frequency with which underfunded pension funds in the sample chose contribution increase for recovery. Nevertheless, it is to be expected that a lower contribution coverage ratio increases the probability of a contribution increase and vice versa.

4.5 Other factors

Other factors that may affect the choice of recovery measures include the size and the type of the fund and its board composition. The *size* of Dutch pension funds varies considerably. The largest fund in the Netherlands has more than 1 million active members and an invested capital in excess of 150 billion euro. On the other hand, there are also funds with less than 100 members and an invested capital of just a few million euros. There are no priors as to the effect of size on the choice of recovery measures.

In the Netherlands, there are three different *types* of pension funds: (1) corporate pension funds, i.e., for a single company or a corporation, (2) pension funds for independent professionals such as medical specialists and dentists and (3) industry-wide pension funds; i.e., for a whole sector or industry, such as the civil service, construction industry, hotel and catering industry or the retail sector. For all 600 pension funds under supervision the distribution over the three types is: 82%, 2% and 16%, respectively. Pension type may affect the choice of recovery measures. For example, only corporate pension funds have a sponsoring firm that may decide to make a voluntary donation when financial needs are high.

The choice among recovery measures has to be made by the pension fund’s board. In principle, the fund’s board of trustees has an equal number of employer and employee representatives, who are required to act independently and only in the fund’s interest. With the 50%–50% representation of employers and employees in all pension funds, the *board composition* between these two interest groups should play no role. The board composition between employees and retirees could in principle play a role. However, it is only since 1 July 2013 that representation of retirees in Dutch pension fund boards has been laid down by law.[9] Hence, the board composition with respect to retirees in the sample period (2011–2013) should play hardly any role. Still, the composition of the board in terms of demographics may play a role. Veltrop *et al.* (2015) and Bikker *et al.* (2012) show that Dutch pension board demographics impact board performance and asset allocation, respectively. Unfortunately, there are no data on board demographics available for our sample.

5 Data

This section statistically defines the recovery measures, discusses the sample selection, and introduces the potential explanatory variables.

[9] Though in a few corporate pension funds, retirees’ representation already was possible before 2013. There are no data on board representation by retirees for the sample of pension funds.

5.1 Recovery measures

Three recovery measures are considered: (1) contribution increase, (2) no indexation and (3) pension cut. Dummy variables for each of these recovery measures are defined as follows.

(1) The dummy variable *Contribution increase* is 1 if the increase of the contribution rate (total contributions as a ratio of the total wage sum of active pension fund participants) is more than 1 percentage point (and 0 if not). This threshold ensures that substantial contribution increases are detected. As the contribution rate is only available in the recovery progress reports for some pension funds from 2009 onwards, this variable runs from 2010 onwards.[10] A robustness test will be presented (Appendix A) in which a different measure for contribution increase is used.
(2) The dummy variable *No indexation* is 1 when a pension fund reports that indexation had a zero contribution to the funding rate in the past year (and 0 if not). No indexation is an extreme form of partial indexation. Nevertheless, it is often used as recovery measure by the underfunded pension funds in the sample, as will be shown below.[11]
(3) The dummy variable *Pension cut* is 1 when a pension fund reports that a pension cut had a positive contribution to the funding rate in the past year (and 0 if not).[12]

All pension funds that submitted a short-term recovery plan at any time during 2008–2013 are considered for the sample. The data are longitudinal, i.e., recovery plan data are available for each fund for a number of years. Nine pension funds with erroneous figures for the funding ratio in the original short-term recovery plan are deleted from the sample. Further, fund-year observations for which one or more of the three recovery measure dummy variables are missing are deleted. Often, there is a missing value for the contribution increase dummy variable. This results in a dataset for 264 pension funds.

Panel (A) of Figure 3 shows, for the years 2010–2013 for which data on contribution increase were available, the proportions of pension funds by recovery measure. It shows the proportion of pension funds that took a *single* recovery measure (i.e., either contribution increase, no indexation or pension cut) and the proportion of pension

[10] The recovery progress report also reports how contributions as such are a source of funding ratio changes (Smid, 2010). The formula is $(C/C_{req} - f_{t-1}).C_{req}/(C_{t-1} + C_{req})$, where C = contributions, C_{req} = actuarially required contributions, and f is the funding ratio (Stroop, 2008). However, this does not reveal whether the contribution rate has been increased.

[11] Partial indexation is not considered in this paper. According to DNB (2013), in the 5-year recovery period, most pension funds only partially kept pace with price inflation. Only a limited number of funds were able to provide full indexation. DNB (2013) notes, however, that the inflation rate need not be consistent with a fund's ambition, given that the basis for indexation (wage inflation, price inflation, or a combination of those two) is different for each fund and may vary over time. For an analysis of partial indexation of 166 Dutch pension funds from 2007 to 2010 using another dataset; see Broeders *et al.* (2014), who show that the key drivers of indexation are the funding ratio, inflation and the real wage growth and that pension funds are using real rather than nominal policy ladders for indexation.

[12] Pension cuts are another source of increase of the funding ratio (Smid, 2010). The magnitude of the contribution of a pension cut to the funding ratio is $f_{t-1}.cut(1 + cut)$, where f_{t-1} is the funding ratio at the end of the previous year and cut is the percentage cut in pension rights (Stroop, 2008).

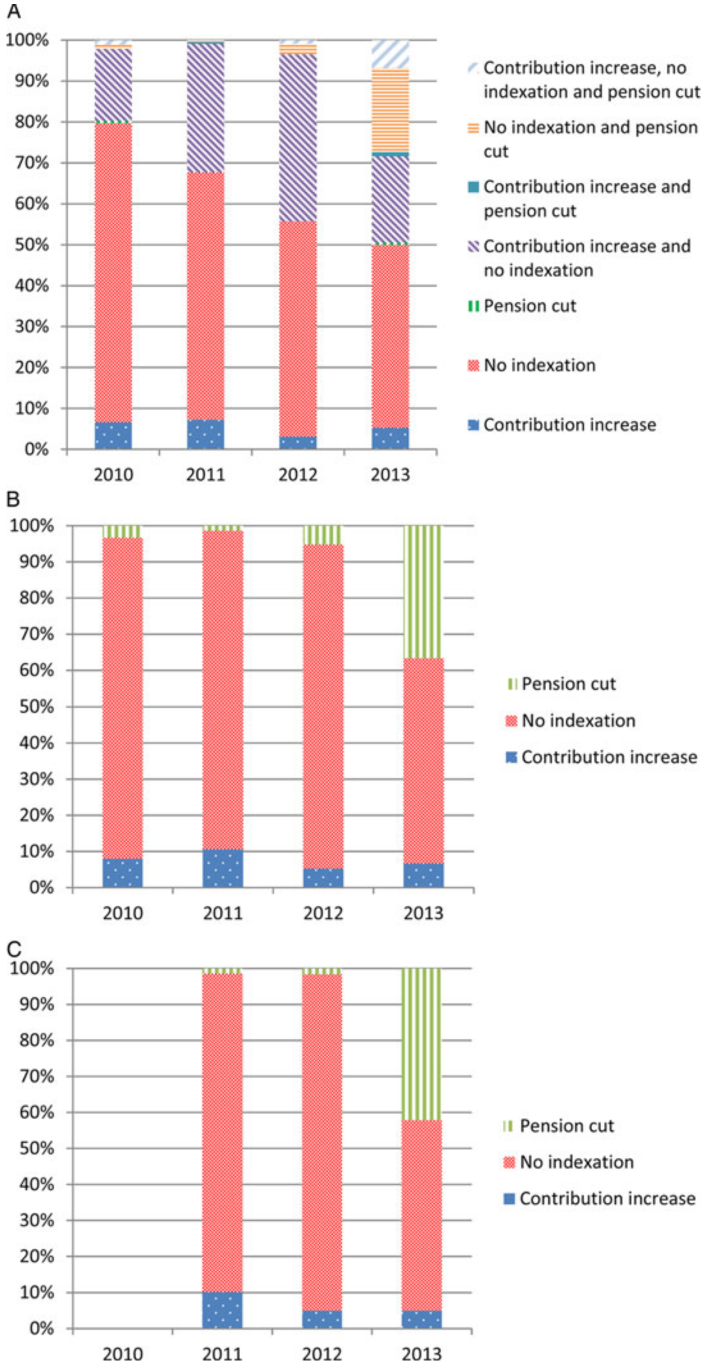

Figure 3. (Colour online) Percentage of underfunded pension funds, by choice of recovery measure. (A) 264 pension funds with non-missing data for choice of recovery measure. (B) Of which 246 pension funds, after dropping combinations of contribution increase and no indexation. (C) Of which 213 Pension funds for which all explanatory variables are available.

funds that *combined* two or all three measures. Of the single-measure observations, the bulk involves no indexation, followed by contribution increase. Of the combined recovery policies, the combination of contribution increase and no indexation is observed most frequently. Pensions are rarely cut and when they are, mostly not until the last year of the 5-year recovery period (2013) and then often in combination with no indexation.

5.2 Sample selection

Multivariate discrete choice models are estimated in the empirical part of the paper (Sections 6 and 7), in order to find: (1) the determinants of the choice of recovery measure and (2) to test for a preference hierarchy for the recovery measures. Multivariate discrete choice models require a response variable (the dependent variable) that has one unique code (such as 1, 2, 3), in this case for each possible recovery measure. The question arises what to do with combinations. If there are three mutually non-exclusive options A, B and C, as in the present study, the question is how to code the four possible combinations, AB, BC, AC and ABC. For example, in the empirical literature on non-financial firms' financing choices where multivariate discrete choice models are used (e.g., De Haan and Hinloopen, 2003), three solutions for this coding problem are discussed. The first solution is to decide on the relative dominance of the choices; for example, C dominates B and B dominates A, so that combination AB can be coded as B and any combinations including C (AC, BC, ABC) as C. The second solution is to remove combinations (AB, AC, BC, ABC) from the sample. The third is to code them separately.

The first solution has as advantage that there is no loss of observations but as disadvantage that the assumed hierarchy between the choices and hence the coding of the combinations is arbitrary. The second solution does not require arbitrary choices but has as disadvantage a loss of observations, in this case amounting to 37% of the original sample.[13] The third solution has as advantage that there is no loss of observations, but as disadvantage that the interpretation of the results for the hybrid choice(s) is complicated and that the cells of some hybrid choices will contain too few observations.

The coding chosen for the present study is a mix of the first and second solution. The recovery measure variable is a categorical variable that is coded 1 if there is a solitary contribution increase (i.e., the contribution increase dummy variable is equal to 1, but the no-indexation dummy variable and the pension cut dummy variable are not equal to 1); 2 if there is a solitary no indexation decision (i.e., the no-indexation dummy variable is equal to 1, but the contribution increase dummy variable and the pension cut dummy variable are not equal to 1); and 3 if there is either a solitary pension cut or any combination of measures including a pension cut (i.e., the pension cut variable is equal to 1). The coding of the third choice implies that a pension cut is assumed to be a particularly strong measure (following solution 1)[14] and ensures that

[13] In De Haan and Hinloopen (2003), the loss was 22%.

[14] Pension cut definitely is the strongest measure, which is enforced by the supervisory rule that pension cuts are only allowed as a recovery measure if the other measures are sufficiently used.

observations of pension cuts are included in the sample (observations of solitary pension cuts being practically non-existent). Following solution 2, combinations of contribution increase and no indexation are deleted from the sample. In this way, arbitrary coding of the most substantial part of the combined measures is avoided. Panel (B) of Figure 3 shows the resulting composition by recovery measure for 246 pension funds. No indexation is by far the most frequently taken recovery measure among the three, followed by contribution increase, except in the last year of the recovery period when pension cuts outnumber contribution increases.

Robustness checks for the coding will be presented (Appendix A), in which combinations of contribution increase and no indexation are retained in the sample and coded in alternative ways.

5.3 Explanatory variables

Based on the theoretical framework in Section 4, potential explanatory variables are defined for use in the discrete choice models in the empirical part (Sections 6 and 7).[15] The variables, classified according to the theoretical arguments in Section 4, are the following.

5.3.1 Maturity of the pension fund

- *Maturity*, defined as the proportion of retirees in the total number of fund participants. A high proportion of retirees implies that relatively more participants will be in favour of higher contributions rather than no indexation or pension cuts, because the latter hurt inactive participants relatively more than active participants who still have time to save, while contribution increases involve active participants only. However, as explained in Section 4, retirees were not represented or underrepresented in the boards of Dutch pension funds during the sample period.
- *New commitments*, defined as the ratio of actuarially required contributions to pension liabilities at the end of the previous year. This is a measure of the weight of new commitments in comparison to total commitments (Stroop, 2008). If this ratio is high, the age composition of the fund's participants is skewed towards the young. Hence, the expected effect of this variable is opposite to that for *Maturity*.
- *Benefits*, defined as the ratio of paid out benefits to pension liabilities. If this ratio is high, the pension fund has relatively more retirees than active participants (Stroop, 2008). This is another measure of maturity which is based on cash flows instead of pension fund members. Hence, the priors are similar to those for *Maturity* and opposite to those for *New commitments.*

5.3.2 Regulation

- *Funding ratio*, defined as the ratio of assets to liabilities. The level of the funding ratio is presumably the primary explanatory variable in view of the fact that the

[15] For definitions and sources of the explanatory variables, see Appendix B.

short-term recovery plan has to be submitted because of the funding deficit in the first place. It is to be expected that the more deeply a pension fund is in a state of underfunding, the more prepared it is to take recovery measures. Moreover, as mentioned in Section 2, pension funds are often using so-called policy ladders based on the funding ratio.

- *Time left*. This variable denotes the number of years until 2013, the last year of the 5-year short-term recovery period that started in 2008. It is to be expected that if time is running out, the pension fund is more prepared to take recovery measures.
- *Funding ratio* × *Time left*. This interaction variable is included on the assumption that a low funding ratio is more problematic when time is running out.
- *Deviation from plan*, defined as the funding ratio minus its planned level according to the original short-term recovery plan. If the difference between outcome and plan is negative, i.e., the pension fund's recovery is behind schedule, it is to be expected that the fund is more prepared to take recovery measures.
- *Deviation from expectation*, defined as the difference between the funding ratio and its expected level according to the recovery progress report submitted at the beginning of the year. The difference with the previous variable, *deviation from plan*, is that the expected level may change each year, while the planned level remains constant. If the difference between outcome and expectation is negative, i.e., the recent development is disappointing, it is to be expected that the fund is more prepared to take recovery measures.
- *Required funding ratio*, according to the short-term recovery progress report, submitted at the beginning of the current year. If the required funding ratio is high, it is to be expected that the pension fund is more prepared to take measures.
- *Ambition*, measured by the final goal for the funding ratio according to the long-term recovery plan (as explained in Section 2). If the ambition is high, it is to be expected that the pension fund is more prepared to take necessary measures.

5.3.3 Portfolio allocation, investment risk and return

- *Equity holdings*, defined as the proportion of equity in the investment portfolio. This ratio is a measure of asset allocation and investment risk (e.g., Rauh, 2009; Davis and De Haan, 2012). It is possible that pension funds that hold much equity suffered greater losses in the financial crisis and therefore are more prepared to take measures.
- *Expected investment return*, i.e., the expected rate of return on the investment portfolio for the current year according to the recovery progress report submitted at the beginning of the current year. If the expected return on investments is high, the pension fund probably will be more reluctant to take drastic recovery measures.[16]

[16] It should be noted that the supervisor sets maximum values for the expected returns for the different types of assets. Hence, differences in total expected investment returns between pension funds will reflect differences in asset composition rather than differences in expectations.

5.3.4 Contribution coverage

- *Contribution coverage*, defined as the ratio of actual contributions to actuarially required contributions. Presumably, a lower coverage ratio increases the probability of a contribution increase and vice versa.
- *Contribution coverage* > 1 × *Contribution coverage*. Contribution coverage is also interacted with a dummy variable *Contribution coverage* > 1 which is 1 if the contribution coverage is greater than 1 and 0 if not, to allow for a non-linear relationship between contribution coverage and the recovery measures.

5.3.5 Other factors

- *Size*, defined as the logarithm of total assets. There are no priors as to the effect of size on the use of recovery measures.
- *Pension fund type*. A categorical variable *Pension type* is defined, which has value 1 for a corporate pension fund, 2 for a professional pension fund and 3 for an industry-wide pension fund.

Due to the availability, lagging and first-differencing of the explanatory variables (see further Section 6.1), the sample is restricted. As a result, the sample period effectively runs from 2011 to 2013. Panel (C) of Figure 3 shows the final composition of the 213 pension funds in the sample by recovery measure. It is similar to the composition of all pension funds with non-missing response variables (panel (B)). Hence, the data restrictions for the explanatory variables do not seem to affect the composition of the sample.

The bulk (77%) of the 213 pension funds in our sample chooses one and the same recovery measure in one or more of the sample years 2011–2013. They mostly (66%) choose no indexation. The rest (23%) of the funds vary their recovery measures over the years, mostly (20%) by skipping indexation in 1 year and (also) cutting pensions in another.

Table 1 gives the mean and median values of the explanatory variables for the 213 pension funds in the sample, split up according to the choice of recovery measure. From these summary statistics, some tentative inferences can be made. Pensions are cut by pension funds that have relatively low funding ratios, both in absolute terms and in comparison to planned and expected levels, have little time left and low contribution coverage ratios. Indexation is skipped by pension funds whose funding ratios deviate relatively much from last year's expectations.

6 What determines the choice of recovery measure?

In this section, the determinants of the choice of recovery measure are empirically examined. After presenting the model, the results are discussed.

6.1 Model

The recovery measure variable, defined above, can thus have outcomes $i = 1, 2, 3$. In this section, a multinomial logit model is estimated. It should be noted that, for this

Table 1. *Pension fund characteristics by choice of recovery measure*

	Contribution increase (1)	No indexation (2)	Pension cut (3)	Tests of differences in means (medians); *p*-values[a] (1) vs (2)	(1) vs (3)	(2) vs (3)
Maturity_{t-1}	0.249 (0.241)	0.215 (0.189)	0.207 (0.189)	0.252 (0.683)	0.190 (0.581)	0.715 (0.901)
$\text{New commitments}_{t-1}$	0.032 (0.027)	0.036 (0.031)	0.034 (0.030)	0.398 (0.102)	0.582 (0.068)	0.629 (0.477)
Benefits_{t-1}	0.032 (0.030)	0.030 (0.029)	0.026 (0.027)	0.386 (0.683)	0.022** (0.132)	0.077* (0.315)
$\text{Funding ratio}_{t-1}$	1.074 (1.089)	1.005 (1.008)	0.934 (0.937)	0.000*** (0.000***)	0.000*** (0.000***)	0.000*** (0.000***)
Time left	1.307 (2)	1.193 (1)	0.109 (0)	0.468 (0.191)	0.000*** (0.000***)	0.000 (0.000***)
$\text{Deviation from plan}_{t-1}$	−0.005 (−0.003)	−0.039 (−0.042)	−0.110 (−0.097)	0.016** (0.220)	0.000*** (0.000***)	0.000*** (0.000***)
$\text{Deviation from expectation}_{t-1}$	−0.062 (−0.065)	−0.073 (−0.080)	−0.009 (−0.005)	0.386 (0.083)*	0.000*** (0.001***)	0.000*** (0.000***)
Required funding ratio	1.156 (1.146)	1.139 (1.134)	1.157 (1.157)	0.042** (0.196)	0.924 (0.381)	0.002*** (0.009***)
Ambition	1.275 (1.256)	1.244 (1.233)	1.283 (1.288)	0.095 (0.220)	0.726 (0.094*)	0.003*** (0.001***)
$\text{Equity holdings}_{t-1}$	0.333 (0.321)	0.281 (0.280)	0.303 (0.292)	0.015 (0.102)	0.216 (0.304)	0.152 (0.294)
Expected investment return	0.047 (0.048)	0.048 (0.051)	0.048 (0.051)	0.834 (0.421)	0.715 (0.295)	0.822 (0.362)
$\text{Contribution coverage}_{t-1}$	1.510 (1.242)	1.369 (1.197)	1.080 (1.048)	0.351 (0.683)	0.004*** (0.048**)	0.002*** (0.000***)
Size_{t-1}	12.567 (12.785)	12.797 (12.765)	12.807 (12.788)	0.491 (1.000)	0.591 (0.939)	0.965 (0.865)
Number of observations	26	300	55	326	81	355

First three columns: mean values with median variables within parentheses.
See Appendix B for explanatory variables' definitions and sources.
[a]*p*-values are for *t*-tests of differences in means and for Pearson Chi-square tests of differences in medians, respectively. *Indicates statistical significance at 10%. **Indicates statistical significance at 5%. ***Indicates statistical significance at 1%.

https://doi.org/10.1017/S1474747216000287 Published online by Cambridge University Press

model, the values 1, 2, 3 have no meaning in the sense of any ordering; estimation results would be the same if $i = 3, 2, 1$. This is different for the ordered probit model that will be estimated in Section 7.

Let the base outcome be $i = 1$,[17] then the multinomial logit model defines the probability (Pr) that observation j is equal to 1, 2 or 3 as:

$$\Pr(\text{recovery measure}_j = i) = \begin{cases} \dfrac{1}{1+\exp(\mathbf{x}_j\boldsymbol{\beta}_2)+\exp(\mathbf{x}_j\boldsymbol{\beta}_3)}, & \text{if} \quad i = 1 \\ \dfrac{\exp(\mathbf{x}_j\boldsymbol{\beta}_2)}{1+\exp(\mathbf{x}_j\boldsymbol{\beta}_2)+\exp(\mathbf{x}_j\boldsymbol{\beta}_3)}, & \text{if} \quad i = 2 \\ \dfrac{\exp(\mathbf{x}_j\boldsymbol{\beta}_3)}{1+\exp(\mathbf{x}_j\boldsymbol{\beta}_2)+\exp(\mathbf{x}_j\boldsymbol{\beta}_3)}, & \text{if} \quad i = 3, \end{cases} \quad (1)$$

where exp(.) denotes an exponential function, $\mathbf{x}_j$ is a row vector of observed values of the explanatory variables for the jth observation and $\boldsymbol{\beta}_m$ is a coefficient vector for outcomes 1, 2 and 3.

Model (1) is estimated using maximum-likelihood estimation, allowing for possible correlation between observations for the same pension fund. The specification of the model, including the explanatory variables introduced in Section 5.3, is the following:

$$\begin{aligned} &\Pr\text{ob}(\text{measure}_i) \\ &= \alpha_1 \text{Maturity}_{t-1} + \alpha_2 \text{New Commitments}_{t-1} + \alpha_3 \text{Benefits}_{t-1} + \alpha_4 \text{Funding ratio}_{t-1} \\ &\quad + \alpha_5 \text{Time left} + \alpha_6 \text{Funding ratio}_{t-1} \times \text{Time left} + \alpha_7 \text{Deviation from plan}_{t-1} \\ &\quad + \alpha_8 \text{Deviation from expectation}_{t-1} + \alpha_9 \text{Required funding ratio} + \alpha_{10} \text{Ambition} \\ &\quad + \alpha_{11} \text{Equity holdings}_{t-1} + \alpha_{12} \text{Expected investment return} \\ &\quad + \alpha_{13} \text{Contribution coverage}_{t-1} + \alpha_{14} \text{Contribution coverage}_{t-1} \times \text{Coverage} > 1 \\ &\quad + \alpha_{15} \text{Coverage} > 1 + \alpha_{16} \text{Size}_{t-1} + \alpha_{17} \text{Pension type}. \end{aligned} \quad (2)$$

Explanatory variables have been lagged 1 year, if relevant.[18] Table 2 gives the correlation matrix for the (continuous) explanatory variables. Most correlations are small (below 0.4), except among the three maturity indicators (i.e. *Maturity, New contributions* and *Benefits*), which is to be expected. However, dropping one or two of these did not affect the estimation results significantly, so they were retained.[19]

[17] The choice of the base outcome is a necessary parameterization of the underlying model, without any consequences for the predicted probabilities.

[18] Lagging is considered to be irrelevant for *Time left, Pension type, Expected investment return, Ambition* and *Required funding ratio*.

[19] Two other correlation coefficients are also quite high. First, there is a positive correlation between *Funding ratio* and *Deviation from plan*. Apparently, pension funds whose funding ratios are higher, also deviate more from the recovery plan in a positive way. Second, there is a positive correlation between *Equity holdings* and *Expected investment return*. This is because the expected return on equity is higher than on other assets.

Table 2. *Correlation matrix*

	Maturity$_{t-1}$	New commitments$_{t-1}$	Benefits$_{t-1}$	Funding ratio$_{t-1}$	Deviation from plan$_{t-1}$	Deviation from expectation$_{t-1}$	Required funding ratio	Ambition	Equity holdings$_{t-1}$	Expected investment return	Contribution coverage$_{t-1}$
New commitments$_{t-1}$	−0.606										
Benefits$_{t-1}$	0.798	−0.496									
Funding ratio$_{t-1}$	−0.035	0.184	0.032								
Deviation from plan$_{t-1}$	−0.039	0.052	0.062	0.639							
Deviation from expectation$_{t-1}$	0.054	−0.081	0.041	0.168	0.153						
Required funding ratio	−0.210	0.085	−0.214	0.019	−0.022	−0.148					
Ambition	0.022	−0.089	−0.087	−0.016	−0.234	0.064	0.348				
Equity holdings$_{t-1}$	−0.067	−0.071	−0.045	0.120	0.111	−0.100	0.621	0.297			
Expected investment return	−0.059	−0.092	0.010	−0.099	−0.064	−0.059	0.232	0.364	0.313		
Contribution coverage$_{t-1}$	0.059	−0.101	0.017	0.035	0.123	0.064	0.053	0.091	0.074	0.010	
Size$_{t-1}$	0.047	−0.212	0.078	0.047	0.047	0.059	0.137	0.128	0.101	0.166	−0.132

See Appendix B for explanatory variables' definitions and sources.

Table 3. *Multinomial logit regression results with categories defined as 1 = contribution increase, 2 = no indexation, and 3 = pension cut*

	Marginal effects		
	Contribution increase	No indexation	Pension cut
Maturity_{t-1}	−0.021 (0.215)	−0.061 (0.264)	0.037 (0.141)
$\text{New commitments}_{t-1}$	−1.055 (0.843)	0.225 (0.898)	0.829** (0.334)
Benefits_{t-1}	−0.320 (1.606)	0.237 (2.330)	0.082 (1.679)
$\text{Funding ratio}_{t-1}$	0.976*** (0.308)	0.801** (0.394)	−1.777*** (0.251)
Time left = 1	0.041 (0.398)	0.318*** (0.079)	−0.360*** (0.066)
Time left = 2	0.085 (0.067)	0.260** (0.107)	−0.345*** (0.080)
$\text{Deviation from plan}_{t-1}$	−0.335 (0.301)	−0.212 (0.343)	0.548*** (0.167)
$\text{Deviation from expectation}_{t-1}$	0.365 (0.413)	−0.475 (0.449)	0.109 (0.238)
Required funding ratio	0.221 (0.316)	−0.442 (0.409)	0.221 (0.226)
Ambition	0.197 (0.203)	−0.334 (0.225)	0.136 (0.092)
$\text{Equity holdings}_{t-1}$	0.003 (0.143)	−0.136 (0.173)	0.132 (0.094)
Expected investment return	−0.560 (1.370)	3.161** (1.529)	−2.601*** (0.653)
$\text{Contribution coverage}_{t-1}$	−0.027 (0.039)	0.123** (0.059)	−0.096** (0.049)
$\text{Contribution coverage}_{t-1} > 1 = 1$	0.025 (0.040)	0.203 (0.191)	−0.229 (0.198)
Size_{t-1}	0.010 (0.011)	−0.004 (0.013)	−0.007 (0.005)
Pension fund type = Independent professionals	0.053 (0.135)	0.011 (0.131)	−0.064*** (0.016)
Pension fund type = Industry-wide	−0.081*** (0.022)	0.051 (0.034)	0.029 (0.022)
% Correct	91.3		
Log Likelihood	−89.85		
Pseudo-R^2	0.637		
Number of observations	381		
Number of pension funds	213		

See Appendix B for explanatory variables' definitions and sources.
Explanatory note: Robust standard errors adjusted for clustering are shown within parentheses. Marginal effects are evaluated at the mean values of the explanatory variables.
*Indicates statistical significance at 10%. **Indicates statistical significance at 5%. ***Indicates statistical significance at 1%.

6.2 Results

Table 3 presents the estimation results for a multinomial logit model relating the recovery measures taken by the underfunded pension funds to the explanatory variables introduced above. For ease of interpretation, the marginal effects are given, being the partial derivatives of the probabilities with respect to the explanatory variables evaluated at their respective means.

The marginal effects are given for each variable separately. Note that, by convention, the marginal effects given for the categorical variables (i.e., *Time left* = 1, 2; *Pension type* = Professionals, Industry-wide; *Contribution coverage* > 1 = 1) show the change of the probability relative to the probability for the base values for these categorical variables (i.e., *Time left* = 0; *Pension type* = Corporate; *Contribution coverage* > 1 = 0).

The advantage of marginal effects is that they are directly interpretable in terms of the implied effect of each variable on the probabilities of the recovery measures. For instance, the number of − 1.777 for the marginal effect of the funding ratio in the pension cut equation means that if the funding ratio increases by 1 percentage point in year t, the probability of a pension cut in year $t + 1$ decreases by 1.8 percentage points. In contrast, the probabilities of the decision to raise contributions and skip indexation in that case increase by 1 and 0.8 percentage points, respectively, making the marginal effects for the three equations sum up to zero. In this way, the total probability of the three recovery measures together remains 100%.[20]

The estimated pension-cut equation contains the largest number of statistically significant marginal effects, followed by the no-indexation equation. The contribution-increase equation has the smallest number of significant variables. Hence, the model seems to be more able in predicting the choice between no indexation versus pension cut than in predicting the choice of contribution increase versus either no indexation or pension cut. The statistically significant marginal effects of the funding ratio suggest that the probability of a contribution increase and no indexation is greater than the probability of a pension cut for higher levels of the funding ratio. The marginal effects of *Time left* suggest that the probability of no indexation is higher than the probability of a pension cut when there is still some time (1 or 2 years) left until the recovery period's deadline. The same holds for expected investment returns: when expected returns are higher, it is more likely that an underfunded pension fund chooses for no indexation than for a pension cut. Contribution coverage does not seem to significantly affect the probability of a contribution increase. This may reflect the fact, mentioned in Section 4, that the Dutch government granted pension funds some 'breathing space' with respect to the need to raise contributions in 2011–2013, to reduce the negative impact on the real economy of such an increase.

Marginal effects give *changes* in probabilities for each variable separately, keeping all other variables fixed, also when variables have been interacted with each other. For a clearer interpretation of the specified interactions, Figure 4 shows the model's predicted probability *levels* or 'relative frequencies' for a pension cut, plotted against the distribution of the funding ratio and interacted with *Time left, Pension fund type* and *Contribution coverage*. The thin dotted lines depict the 95% confidence intervals. All three panels of Figure 4 show that a pension cut is more likely when the funding ratio is low, especially when it is lower than around 1.00. In addition, panel (A) of Figure 4 suggests that a pension cut is even more likely when there is little time left (time left = 0 years) until the recovery period's deadline.[21] Panel (B) suggests that a pension cut is

[20] It should be noted, however, that the estimated positive marginal effects of the funding ratio for contribution increase and no indexation do not necessarily imply that higher funding ratios make contribution increase and no indexation more probable instruments as such. It may mean that an increase of the funding ratio decreases the probability of a pension cut by much more than it decreases the probabilities of a contribution increase and no indexation. In fact, when estimating a logit model for a dichotomous choice variable 'no indexation' = 1 or 0, the marginal effect of the funding ratio is negative.

[21] Time left = 1 is not shown in the figure for statistical reasons (because numerical derivatives could not be calculated due to the encounter of a flat or discontinuous region).

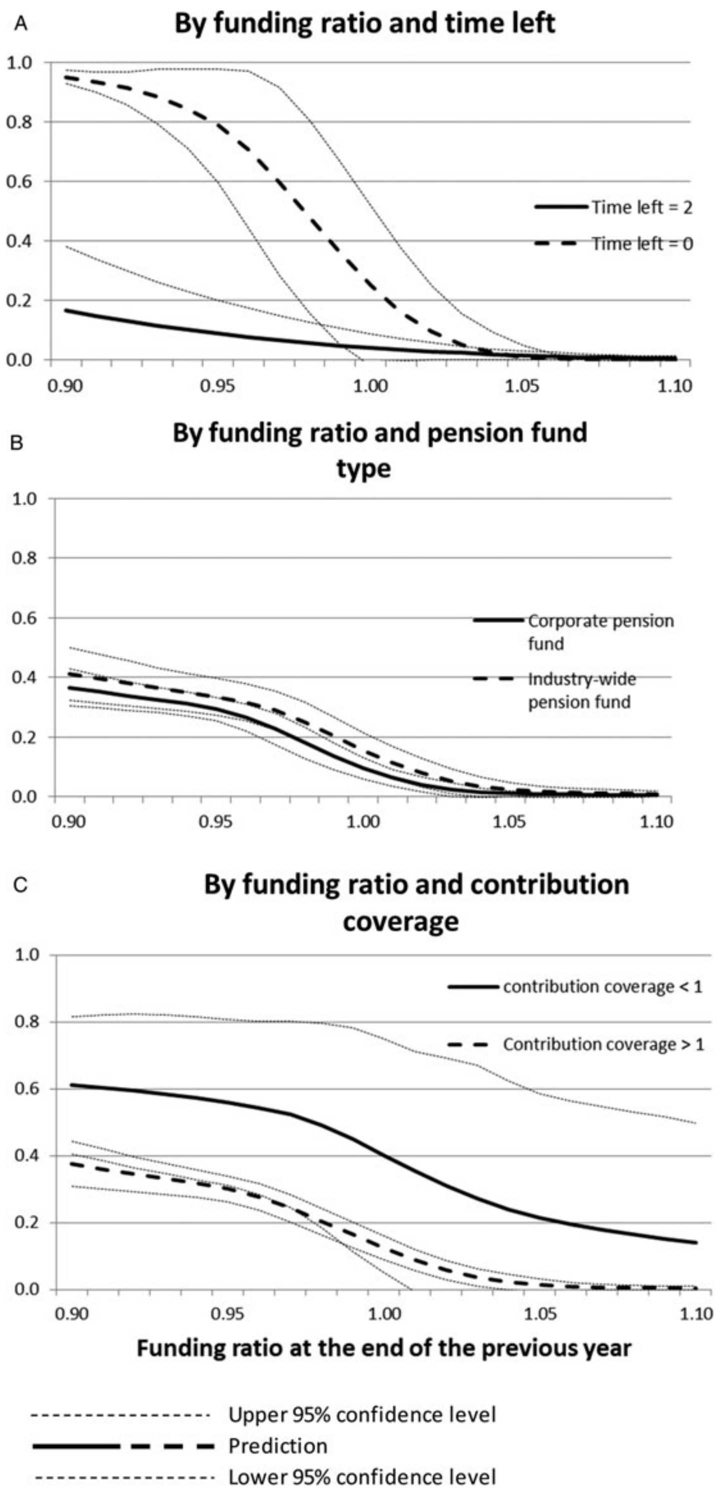

Figure 4. Predicted relative frequency of a pension cut. See Appendix B for explanatory variables' definitions and sources.

https://doi.org/10.1017/S1474747221000287 Published online by Cambridge University Press

more frequently applied under such circumstances by industry-wide than by corporate pension funds, although the difference is not statistically significant as the confidence intervals partly or wholly coincide. The difference may be due to the fact that corporate pension funds have the option to avoid pension cuts if the company is willing to make a supplementary contribution (cf. Davis and De Haan, 2012). Panel (C) suggests that a pension cut is more likely for underfunded pension funds whose contribution coverage ratios are <1. The difference with funds whose contribution coverage ratios are >1 is not statistically significant, however, as the confidence bands coincide.

Panels (A), (B) and (C) of Figure 5 plot the predicted relative frequencies for the three recovery measures against *New commitments*, respectively. Panels (A) and (C) suggest that when the age composition of the pension fund's participants is relatively young (so that *New commitments* is large), the probability of a contribution increase is lower while that of a pension cut is higher. This finding is consistent with the prior formulated in Section 4. Pension cuts hurt inactive participants more than active participants while contribution increases involve active participants only. Panel (A) also shows that, according to the estimation results, a contribution increase is more likely for a corporate pension fund than for an industry-wide pension fund.

From an econometric point of view, the estimated model is quite satisfactory, considering the percentage of correct predictions (91%) and the goodness-of-fit measure (pseudo-$R^2 = 0.64$). Alternatively, the model predictions for no indexation and pension cut can be compared with the expectations of the pension funds themselves, because they have to report to the regulator at the beginning of each year of the recovery period what effect indexation and pension cuts, if any, will have on their funding ratio at the end of the current year. It turns out that the model correctly predicts 98% of the no-indexation decisions and 89% of the pension cuts in the sample period (Table 4). For the pension funds these figures are 92% and 91%, respectively. Hence, the model's predictions and the expectations of the pension funds are very similar. The pension funds are more optimistic than the model would suggest with regard to no indexation and slightly less optimistic with regard to pension cuts.

7 Is there a hierarchy between recovery measures?

Although the multinomial logit estimate presented in Section 5 provides valuable information as to the determinants of pension funds' choice of measures to realize the recovery plan, it does not capture all information potentially present in the data. In particular, it does not test for the presence of a hierarchy of recovery measures. In this section, adopting the method used by De Haan and Hinloopen (2003) for firms' financing decisions, the presence of such a hierarchy is tested.

It is to be expected that pension cuts come last in the preference hierarchy because of the regulatory prescription that cutting pension rights should be considered only as last resort. However, the preference hierarchy between contribution increase and no indexation is an open question. It is also not inconceivable that pension funds' recovery choices are not always consistent with regulatory prescriptions. More general, from an academic viewpoint, it is interesting to see priors, regulatory or not, fulfilled by econometric evidence.

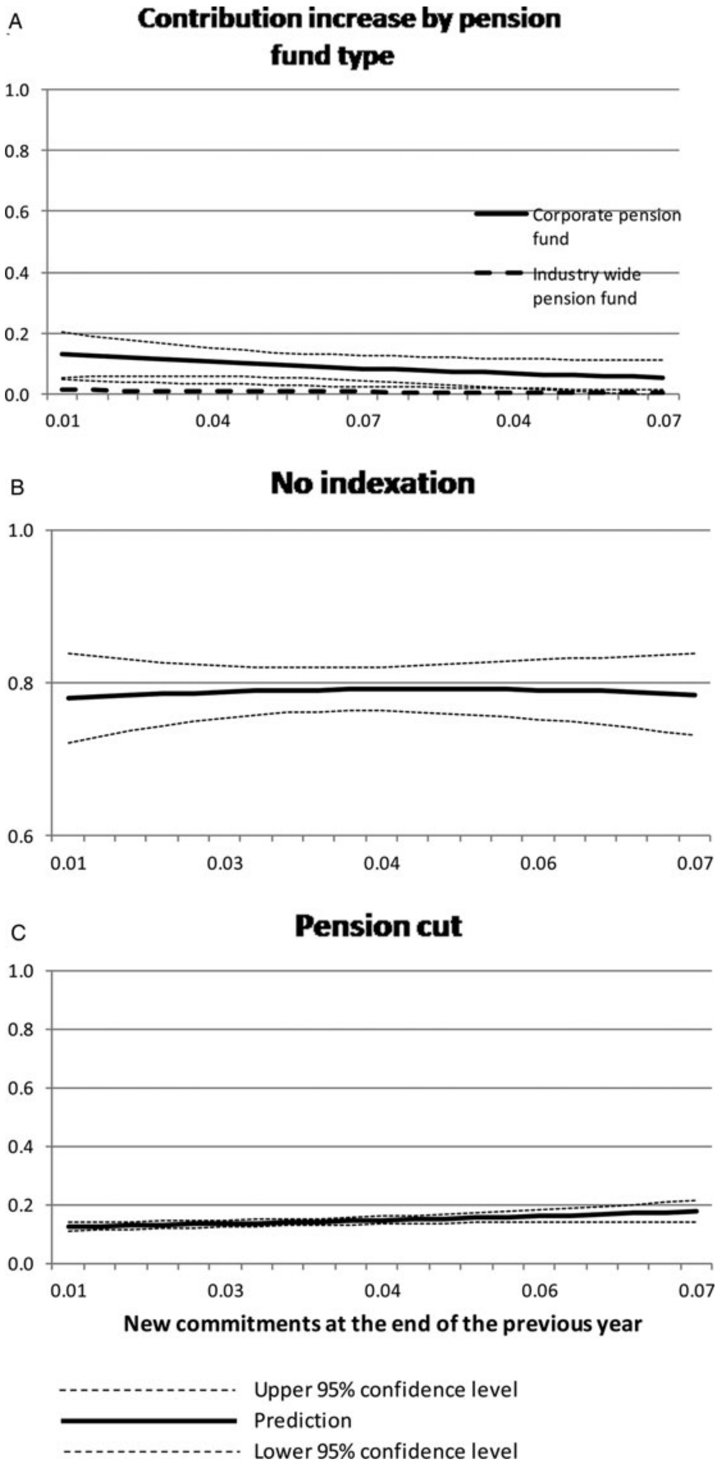

Figure 5. Predicted relative frequencies of recovery measures, by new commitments. See Appendix B for explanatory variables' definitions and sources.

Table 4. *Number and percentage of correct predictions: Model versus pension funds*

	No indexation		Pension cut	
Model predictions				
Correct	295	98%	49	89%
Incorrect	5	2%	6	11%
Total	300	100%	55	100%
Pension funds' expectations				
Correct	277	92%	50	91%
Incorrect	23	8%	5	9%
Total	300	100%	55	100%

7.1 Model

To test for a hierarchy of recovery measures, an ordered *probit* model is estimated using the same set of variables as in the multinomial logit regression (hence, the same specification as equation (2)). Unlike the multinomial logit model, the ordered probit model is especially designed for choices with a specific hierarchy. The coding of the recovery measures imposes a specific ordering for the respective choices. For example, coding the different recovery measures {contribution increase, no indexation, pension cut} with the ordinal discretes {1, 2, 3} actually imposes this hierarchy when estimating the model.

The central idea behind the probit model is that there is a latent continuous variable y^* underlying the ordinal responses {1, 2, 3} observed, which is a linear combination of some explanatory variables $\mathbf{x}$ plus a disturbance term u:

$$y_j^* = \mathbf{x}_j\boldsymbol{\beta} + u_j \tag{3}$$

y, the observed ordinal variable, takes on values 1, 2 or 3 according to the following scheme:

$$y_j = i \Leftrightarrow \mu_{i-1} < y_j^* \leq \mu_i, \quad i = 1,\ 2,\ 3, \tag{4}$$

where μ_0 is defined as $-\infty$ and μ_3 as $+\infty$.

The imposed hierarchy is modelled by two 'threshold' parameters μ_1 and μ_2. When a threshold parameter's value is exceeded, the model chooses the next choice in the hierarchy. Then, the ordered probit model defines the probability (Pr) that observation j is equal to 1, 2 or 3 as:

$$\begin{aligned}\Pr(\text{recovery measure}_j = i) &= \Pr(\mu_{i-1} < -\mathbf{x}_j\boldsymbol{\beta} + u \leq \mu_i) \\ &= \Phi(\mu_i - \mathbf{x}_j\boldsymbol{\beta}) - \Phi(\mu_{i-1} - \mathbf{x}_j\boldsymbol{\beta}),\end{aligned} \tag{5}$$

where $\Phi(.)$ is the standard normal cumulative distribution function.

Following De Haan and Hinloopen (2003), the research strategy is to estimate ordered probit models for all possible hierarchies. These can then be compared by means of a likelihood ratio test (LR), thus revealing the hierarchy that best fits the data. In principle, this yields 3! = 6 different ordered probit estimates and ½ × 6 × 5 = 15 bilateral likelihood

Table 5. *LR test results*

	h 1	*h* 2	*h* 3
h 1			
h 2	34.22		
h 3	131.55	97.34	

Significance value at the 1% level is 6.63.
Hierarchy *h*1 = (1) premium increase, (2) no indexation, (3) pension cut.
Hierarchy *h*2 = (1) premium increase, (2) pension cut, (3) no indexation.
Hierarchy *h*3 = (1) no indexation, (2) premium increase, (3) pension cut.

Table 6. *Hierarchies and their ranking according to their likelihood*

Hierarchy	Premium increase	No indexation	Pension cut	Log likelihood	Rank	Pseudo-$R2$
h 1	1	2	3	−127.86	1	0.484
h 2	1	3	2	−144.97	2	0.415
h 3	2	1	3	−193.63	3	0.219

Explanatory note: *h*1, *h*2 and *h*3 in the first column denote the three possible hierarchies. The numbers 1, 2, 3 in the 2nd through 4th column give the assumed orderings among the three considered recovery measures for hierarchies *h*1, *h*2 and *h*3. The columns 'log likelihood' and 'pseudo-R^2' present these measures of fit for the regressions for hierarchies *h*1, *h*2 and *h*3. 'Rank' gives the ranking of the three models in terms of data fit using the LR test results, for the 1% significance level.

comparisons. However, every potential ordering has a twin ordering that yields coefficient estimates of equal magnitude but with opposite sign; yet, the likelihood values are identical.[22] Accordingly, there are only three ordered probit estimates to be considered and ½ × 3 × 2 = 3 bilateral likelihood comparisons to be made to determine which hierarchy fits the data best. In Table 5, the outcomes of these three pairwise LR-tests are reported. The LR-tests are computed as $-2[\ln(\text{likelihood}_{\text{col}}) - \ln(\text{likelihood}_{\text{row}})]$. The significance value at the 5% level is 3.84. For this significance level, the ranking of the three hierarchies, *h*1, *h*2 and *h*3, are included in Table 6.

7.2 Results

The results of the ordered probit analysis show that pension funds appear to have an ordered preference for recovery measures. When deciding on taking measures to fulfil the short-term recovery plan, funds prefer contribution increase over no indexation and no indexation over pension cuts (i.e. hierarchy *h*1).

[22] This twin ordering is the unique ordering that has a perfect inverse correlation with the original ordering. For example, the ordering {1, 2, 3} has a correlation of −1 with, and only with, ordering {3, 2, 1}.

Table 7. *Random effects ordered probit regression results for the most preferred hierarchy (number 1), with categories defined as 1 = contribution increase, 2 = no indexation, 3 = pension cut*

	Marginal effects		
	Contribution increase	No indexation	Pension cut
Maturity$_{t-1}$	−0.006 (0.129)	0.001 (0.018)	0.005 (0.110)
New commitments$_{t-1}$	−1.146** (0.499)	0.168 (0.197)	0.978** (0.433)
Benefits$_{t-1}$	−0.285 (1.021)	0.041 (0.167)	0.243 (0.859)
Funding ratio$_{t-1}$	1.203*** (0.243)	0.505*** (0.183)	−1.708*** (0.164)
Time left = 1	0.005 (0.030)	0.326*** (0.061)	−0.331*** (0.071)
Time left = 2	0.031 (0.035)	0.297*** (0.057)	−0.328*** (0.071)
Deviation from plan$_{t-1}$	−0.109 (0.207)	0.016 (0.036)	0.093 (0.175)
Deviation from expectation$_{t-1}$	−0.235 (0.335)	0.034 (0.060)	0.201 (0.283)
Required funding ratio	−0.011 (0.262)	0.001 (0.038)	0.009 (0.223)
Ambition	0.101 (0.131)	−0.014 (0.027)	−0.086 (0.109)
Equity holdings$_{t-1}$	−0.120 (0.112)	0.017 (0.023)	0.102 (0.098)
Expected investment return	0.484 (0.942)	−0.071 (0.146)	−0.412 (0.818)
Contribution coverage$_{t-1}$	0.006 (0.031)	−0.015 (0.017)	0.008 (0.042)
Contribution coverage$_{t-1}$ > 1 = 1	0.045* (0.024)	0.082 (0.167)	−0.128 (0.189)
Size$_{t-1}$	0.003 (0.007)	−0.001 (0.001)	−0.003 (0.005)
Pension fund type = Independent professionals	0.116 (0.147)	−0.069 (0.109)	−0.046 (0.038)
Pension fund type = Industry-wide	−0.041** (0.018)	−0.005 (0.009)	0.045** (0.023)
Threshold value 1	−29.225*** (6.064)		
Threshold value 2	−25.186*** (5.981)		
% Correct	89.2		
Log Likelihood	−127.86		
Pseudo-R^2	0.484		
Number of observations	381		
Number of pension funds	213		

See Appendix B for explanatory variables' definitions and sources.
Explanatory note: Robust standard errors adjusted for clustering are shown within parentheses. Marginal effects are evaluated at the mean values of the explanatory variables.
*Indicates statistical significance at 10%.
**Indicates statistical significance at 5%.
***Indicates statistical significance at 1%.

Table 7 shows the estimation results of the ordered probit regression that yields the most preferred hierarchy ($h1$). The standard errors are adjusted for clustering and the model is estimated including random effects for the pension funds. The two threshold parameters are highly significant. The coefficients for the funding ratio and time left are among the most significant explanatory variables (at the 1% level) and have the same signs, hence confirming the results of the multinomial logit model.[23] The results

[23] However, there does not exist a procedure to test directly a multinomial logit model versus an ordered probit model (De Haan and Hinloopen, 2003). Their likelihood functions differ and hence their log likelihoods are not comparable.

show that pension contributions will be increased rather than pensions cut if the funding ratio is relatively high, the pension fund is not an industry-wide pension fund and the pension fund is more mature (i.e., has smaller new commitments).

Two types of robustness tests are presented in Appendix A. First, instead of the total contribution rate, the employees' contributions per active participant are used to determine whether contributions have been raised (Appendix (i)). The results of the probit analysis using this alternative for contribution increase indicate the same hierarchy between the recovery measures: (1) contribution increase, (2) no indexation and (3) pension cut.

The second type of robustness test is to retain observed combinations of contribution increase and no indexation in the sample and code these one way or another (Appendix (ii)). The coding is done in two alternative ways.

The first alternative is to code such combinations as if they were single decision to skip indexation and pool them together under the heading 'no indexation'. The preference hierarchy established in the benchmark model of the paper (Table 6) is robust to this alternative, hence, the preference hierarchy with the highest fit to the data remains: (1) contribution increase, (2) 'no indexation' and (3) pension cut.

The second alternative is to code such combinations as if they were a single decision to increase contributions and pool them together under the heading 'contribution increase'. The preference hierarchy is partly robust to this second alternative, in the sense that 'contribution increase' still comes first but that the ordering between no indexation and pension cut does not yield statistically significant differences in likelihoods for the model. Hence, the preference hierarchy based on model fit is: (1) 'contribution increase', (2 or 3) no indexation and (3 or 2) pension cut.

As explained in Section 5.2, retention of combined recovery measures has as advantage that there is no loss of observations,[24] but has as disadvantage that there is an implicit assumption regarding the hierarchy of contribution increase and no indexation. The first alternative coding implicitly assumes that it is easier to increase contributions than to skip indexation and therefore codes a combination of these measures as 'no indexation'. The second alternative coding implicitly assumes that increasing contributions is tougher than skipping indexation and hence counts combinations of these measures as 'contribution increase'. The first alternative coding hardly lowers the model fit (pseudo-R^2 is 0.462 in Table A2 against 0.484 in Table 6), while the second alternative coding more than halves the model fit (pseudo-R^2 is only 0.194 in Table A3). Hence, the second alternative coding is supported less by the data.

In conclusion, the preference hierarchy that receives strongest empirical support is: (1) contribution increase, (2) no indexation and (3) pension cut.

8 Conclusion

Pension fund recovery plan data offer a unique opportunity to study the recovery measures taken by underfunded pension funds. In this paper, the choice between three recovery measures is examined: contribution increase, no indexation or pension cuts.

[24] In fact, in this particular case, the number of observations increases from 381 to 560 and the number of pension funds from 213 to 239.

First, a multinomial logit model is estimated, relating the choice among these three recovery measures to several characteristics of the pension funds. The multinomial logit estimation results suggest that the probability of a pension cut increases when the funding ratio is lower, there is little time left until the regulatory deadline of the recovery period, the pension fund is an industry-wide rather than a corporate pension fund and the age composition of the pension fund's participants is relatively young.

Second, the data are examined for the presence of a preference hierarchy among the three recovery measures. This is tested by means of an ordered probit analysis. In particular, separate ordered probit models are estimated for each possible hierarchy and then tested which one of these orderings best suits the data. According to the results of this analysis, Dutch pension funds consider contribution increase first, no indexation second and pension cuts only as a last resort. This preferred hierarchy is robust to another definition of contribution increase and remains mostly unaffected by the treatment of hybrid recovery measures, i.e., whether to include combinations of contribution increase and no indexation in the sample or not, and how.

Despite its use as a last resort, the instrument of pension cuts had to be used by several underfunded pension funds, especially at the end of the recovery period. The concentration of pension cuts in 1 year is undesirable because of its macroeconomic impact, among other things. The policy reaction to this traumatic experience has been that the Dutch government has drafted a new version of the FTK that has recently been put in place (January 2015). The basic ideas behind the new FTK are to diminish volatility of funding ratios by using a more stable discount rate, to increase required funding ratios, to make funding requirements for indexation more stringent and to stabilize premium levels.

For the sample period under consideration, the financial markets crash of 2008 has by far been the most important reason for the severe drop of pension funding ratios. However, this does not imply that the results are not relevant for the current situation. The continuing fall of capital market interest rates has boosted market values of pension liabilities, so that many pension funds currently face deficits and have to make the same choices as analysed in the paper. In 2015, many pension funds had to submit recovery plans specifying the measures to bring funding ratios back to required levels within a period of 12 years (the new standard period of 10 years has been lengthened for the sake of the transition to the new FTK). If a pension fund has a funding ratio lower than 1.05 during five consecutive years, it has to cut pensions, but it can spread this cut over a recovery period of 12 years. This way, shocks are absorbed more gradually than before.

References

Beetsma, R. M. W. J. and Bucciol, A. (2011) Differentiating indexation in Dutch pension funds. *De Economist*, **159**: 323–360.

Bikker, J. A. and Vlaar, P. J. G. (2007) Conditional indexation in defined benefit pension plans in the Netherlands. *The Geneva Papers on Risk and Insurance*, **32**: 494–515.

Bikker, J. A., Broeders, D., Hollanders, D., and Ponds, E. (2012) Pension funds' asset allocation and participant age: a test of the life-cycle model. *Journal of Risk and Insurance*, **79**(3): 595–618.

Bikker, J. A., Knaap, T., and Romp, W. E. (2014) Measuring and explaining implicit risk sharing in defined benefit pension funds. *Applied Economics*, **46**(17): 1996–2009.

Blome, S., Fachiner, K., Franzen, D., Scheuenstuhl, G., and Yermo, J. (2007) Pension fund regulation and risk management: results from an ALM optimisation exercise. In Lindeman, D. and Yermo, J. (eds), *Protecting Pensions: Policy Analysis and Examples from OECD Countries*. OECD Private Pensions Series No. 8, pp. 161–212.

Broeders, D. and Pröpper, M. (2010) Risk-based supervision of pension funds in the Netherlands. In Micocci, M., Gregoriou, G. N., and Masala, G. B. (eds), *Pension Fund Risk Management: Financial and Actuarial Modeling*. Boca Raton: Chapmann & Hall, pp. 473–508.

Broeders, D., Hilbers, P., Rijsbergen, D., and Shen, N. (2014) What drives pension indexation in turbulent times? An empirical examination of Dutch pension funds. *De Economist*, **162**: 41–70.

Bucciol, A. and Beetsma, R. M. W. J. (2010) Inter- and intra-generational consequences of pension buffer policy under demographic, financial and economic shocks. *CESifo Economic Studies*, **56**(3): 366–403.

Chen, D. H. J., Beetsma, R. M. W. J., Ponds, E. H. M., and Romp, W. E. (2014) Intergenerational risk-sharing through funded pension and public debt. *Journal of Pension Economics and Finance*, **15**(2): 127–159.

Davis, E. P. and De Haan, L. (2012) Pension fund finance and sponsoring companies. *Journal of Pension Economics and Finance*, **11**(3): 439–463.

De Haan, L. and Hinloopen, J. (2003) Preference hierarchies for internal finance, bank loans, bond, and share issues: evidence for Dutch firms. *Journal of Empirical Finance*, **10**: 661–681.

De Nederlandsche Bank (DNB) (2013) Five years in the pensions sector: curtailment and indexation in perspective. *DNBulletin* 7 March. Available online at http://www.dnb.nl/en/news/news-and-archive/dnbulletin-2013/dnb286393.jsp.

Federation of the Dutch Pension Funds (2010) *The Dutch Pension System: an Overview of the Key Aspects*. The Hague.

Hinz, R. and Van Dam, R. (2008) Risk-based supervision of pension funds in the Netherlands. In Brunner, G., Hinz, R., and Rocha, R. (eds), *Risk-based Supervision of Pension Funds: Emerging Practices and Challenges*. Washinton DC: The World Bank. pp. 51–94

Pino, A. and Yermo, J. (2010) The impact of the 2007–2009 crisis on social security and private pension funds: a threat to their financial soundness? *International Social Security Review*, **63** (2): 5–30.

Ponds, E. H. M. and Van Riel, B. (2009) Sharing risk: the Netherlands' new approach to pensions. *Journal of Pension Economics and Finance*, **8**(1): 91–105.

Rauh, J. D. (2009) Risk shifting versus risk management: investment policy in corporate pension plans. *Review of Financial Studies*, **22**(7): 2687–2734.

Smid, L. (2010) Herstelbronnen van pensioenfondsen: een analyse op basis van herstelplannen (Sources of recovery for pension funds: an analysis of recovery plans). *Tijdschrift voor Pensioenvraagstukken*, **2010/1**: 3–7.

Stroop, B. (2008) Het dekkingsgraadsjabloon nader verklaard (Explanation of the funding ratio template). *De Actuaris*, July/September, 27–29/48–51.

The Pension Regulator (2007) Recovery plans: an initial analysis. Available online at http://www.thepensionsregulator.gov.uk.

Van Ewijk, C. (2009) Credit crisis and Dutch pension funds: who bears the shock? *De Economist*, **157**(3): 337–351.

Van Rooij, M., Siegmann, A., and Vlaar, P. (2008) Market valuation, pension fund policy and contribution volatility. *De Economist*, **156**(1): 73–93.

Veltrop, D. B., Hermes, N., Postma, T. J. B. M. and De Haan, J. (2015) A tale of two factions: why and when factional demographic faultlines hurt board performance. *Corporate Governance: an International Review*, **23**(2): 145–160.

Appendix A – Robustness checks

(i) Alternative definition of contribution increase

In the main text, the total contribution rate is used to calculate the contribution increase variable. As a robustness check, employees' contributions are calculated by dividing total employees' contributions in a particular year by the number of active fund participants in that year. The contribution increase variable is 1 when employees' contributions per active participant increase by more than 3% and 0 if not. This threshold takes account of the general wage rise and avoids that measurement errors may lead to an overestimation of the incidence of contribution increases.

The results of the probit analysis using this alternative contribution increase variable indicates the same hierarchy between the recovery measures as in Table 6: (1) contribution increase, (2) no indexation and (3) pension cut (Table A1).

(ii) Alternative coding

I define two alternative recovery measure variables which differ from the one used in the main text in that combined fund-year observations of contribution increase and no indexation are retained in the sample. The first alternative attributes to these combinations the value of 2, which is also the number for a solitary decision to not grant any indexation. The results of the probit analysis using this alternative coding indicate the same hierarchy between the three recovery measures as in Table 6: (1) contribution increase, (2) no indexation and (3) pension cut (Table A2).

The second alternative coding pools the combinations of contribution increase and no-indexation together with single decisions to increase contributions, by assigning a value of 1 to these observations, which is also the value of a solitary decision to increase contributions. When using this alternative coding, the LR test results suggest that the data fit for hierarchy *h*1 is not statistically different from that of hierarchy *h*2 (Table A3). These two hierarchies differ in their ordering of no-indexation and

Table A1. *Hierarchies and their ranking according to their likelihood. Alternative definition of contribution increase*

Hierarchy	Premium increase	No indexation	Pension cut	Log likelihood	Rank	Pseudo-R^2
*h*1	1	2	3	−123.84	1	0.495
*h*2	1	3	2	−151.96	2	0.380
*h*3	2	1	3	−188.99	3	0.229

Explanatory note: *h*1, *h*2 and *h*3 in the first column denote the three possible hierarchies. The numbers 1, 2, 3 in the 2nd through 4th column give the assumed orderings among the three considered recovery measures for hierarchies *h*1, *h*2 and *h*3. The columns 'log likelihood' and 'pseudo-R^2' present these measures of fit for the regressions for hierarchies *h*1, *h*2 and *h*3. 'Rank' gives the ranking of the three models in terms of data fit using the LR test results, for the 1% significance level.

Table A2. *Hierarchies and their ranking according to their likelihood. Combined fund-year observations of contribution increase and no indexation are retained and coded 2, i.e., the value for single decisions to not grant any indexation*

Hierarchy	Premium increase	No indexation	Pension cut	Log likelihood	Rank	Pseudo-R^2
h 1	1	2	3	−151.89	1	0.462
h 2	1	3	2	−172.31	2	0.390
h 3	2	1	3	−220.28	3	0.220

Explanatory note: *h*1, *h*2 and *h*3 in the first column denote the three possible hierarchies. The numbers 1, 2, 3 in the 2nd through 4th column give the assumed orderings among the three considered recovery measures for hierarchies *h*1, *h*2 and *h*3. The columns 'log likelihood' and 'pseudo-R^2' present these measures of fit for the regressions for hierarchies *h*1, *h*2 and *h*3. 'Rank' gives the ranking of the three models in terms of data fit using the LR test results, for the 1% significance level.

Table A3. *Hierarchies and their ranking according to their likelihood. Combined fund-year observations of contribution increase and no indexation are retained and coded 1, i.e., the value of a single decision to increase contributions*

Hierarchy	Premium increase	No indexation	Pension cut	Log likelihood	Rank	Pseudo-R^2
h 1	1	2	3	−419.78	1	0.194
h 2	1	3	2	−417.67	1	0.198
h 3	2	1	3	−499.86	2	0.040

Explanatory note: *h*1, *h*2 and *h*3 in the first column denote the three possible hierarchies. The numbers 1, 2, 3 in the 2nd through 4th column give the assumed orderings among the three considered recovery measures for hierarchies *h*1, *h*2 and *h*3. The columns 'log likelihood' and 'pseudo-R^2' present these measures of fit for the regressions for hierarchies *h*1, *h*2 and *h*3. 'Rank' gives the ranking of the three models in terms of data fit using the LR test results, for the 1% significance level.

pension cut. According to *h*2, pensions are cut before indexation is passed over, while in *h*1 no indexation comes before pension cuts. Hierarchy *h*3 remains the model with the lowest data fit.

In conclusion, the preference hierarchy has been tested using two alternative ways to retain observations in which pension funds decide to increase contributions and skip indexation at the same time. The preference hierarchy established in the benchmark model of the paper (Table 6) is robust to the first alternative, and partly robust to the second alternative in the sense that contribution increase is still the first choice, but a different ordering of no indexation and pension cut no longer yields a statistically significant difference in data fit. When using the second alternative, the overall fit of the model according to pseudo-R^2 is halved for all possible hierarchies relative to the benchmark model, which indicates that this solution to retain combinations is supported less by the data.

Appendix B

Table B1. *Definitions and sources of explanatory variables (alphabetical order)*

	Definition	Source is DNB[1]
Ambition_t	Final Goal for Funding Ratio, set by Pension fund	K502
Benefits_{t-1}	Benefits_{t-1}/Market Value of Pension Liabilities_{t-1}	K501
Contribution coverage_{t-1}	$\text{Contributions}_{t-1}$/Actuarially Required $\text{Contributions}_{t-1}$	K501
Deviation from expectation_{t-1}	Funding Ratio_{t-1} – Expected Funding Ratio_{t-1}	Table 8.8 and K501
Deviation from plan_{t-1}	Funding Ratio_{t-1} – Planned Funding Ratio_{t-1}	Table 8.8 and K501
Equity holdings_{t-1}	Equity holdings_{t-1}/Total Assets_{t-1}	Table 8.1
Expected investment return_t	Expected rate of return on investment portfolio for current year	K501
Funding ratio_{t-1}	Market Value of Assets_{t-1}/Market Value of Pension Liabilities_{t-1}	Table 8.8
Maturity_{t-1}	Number of Inactive $\text{Participants}_{t-1}$/Number of All $\text{Participants}_{t-1}$	Table 8.6
New commitments_{t-1}	Actuarially Required $\text{Contributions}_{t-1}$/Pension Liabilities_{t-1}	K501
Pension fund type	Corporate pension fund = 1, Pension fund for independent professionals = 2, Industry-wide pension fund = 3	
Required funding ratio_t	1 + Required Buffer Percentage over Market Value of Pension Liabilities_t	K501
Size_{t-1}	Log of Total Assets_{t-1}	Table 8.1
Time left	2011 = 2, 2012 = 1, 2013 = 0	

[1] Table# refers to the table on the website of DNB that presents the data in aggregated form (in this paper the fund-level data behind these data is used). K501 = Short-term recovery plan and progress report ('Evaluatie Herstelplannen'). K502 = Long-term recovery plan ('Dekkingsgraadsjabloon').