Recovery measures of underfunded pension funds: contribution increase, no indexation, or pension cut?*

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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: contribution increase, no indexation, and pension cut. The estimation results suggest, firstly, 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. Secondly, the results suggest that Dutch pension funds consider contribution increase first, no indexation second, and pension cuts only as a last resort.

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1 Introduction

Pension funds around the world were 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 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) defined benefit plans, the average funding ratio of all over six hundred pension funds under supervision dropped from a comfortable 1.44 in 2007 to 0.95 in 2008 (Figure 1). The funding ratio dropped below 1.05 for almost half the pension funds, which is the regulatory required minimum funding ratio. On average, their funding ratio dropped to 0.91 in 2008.

[insert Figure 1]

The policy responses to the crisis have been quite diverse across OECD and non-OECD countries (e.g., Antolín and Stewart, 2009). In the Netherlands, the earlier solvency crisis of 2001–2004 already urged 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 defined benefit 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. 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.

Most of these predictions have materialised since the crisis. Contributions were increased, indexation restricted or even skipped. 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 five 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 the Netherlands, point out that the youngest generations prefer indexation policy, while the older generations prefer contribution policy to recover from underfunding. The reasoning 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.

Since the introduction of the FTK in 2007, Dutch regulation demands that a pension fund running a funding deficit submits a short-term recovery plan stating how it expects to bring the funding ratio back above the minimum required level within a period of three years. A defined benefit pension fund has several options in order to improve the funding ratio at such short notice.

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. During the previous solvency crisis of 2001–2004, when pension funding ratios dropped strongly 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. Writing off existing pension rights is considered the last resort and supervision is aimed at avoiding this in all but very exceptional circumstances (Beetsma and Bucciol, 2011).

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 (by e.g. 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. This paper adds to the literature by addressing all three recovery measures (contribution increase, no indexation, pension cut) together and empirically analysing the determinants of the choice between them.[2]

For the present analysis, data from recovery plans and recovery progress reports of 213 Dutch pension funds for the years 2011, 2012 and 2013 are used. First, a multinomial logit model is estimated that distinguishes the three short-term recovery measures (contribution increase, no indexation, and pension cuts) and relates their use by the pension funds to the funds' characteristics. The results suggest that the probability of a pension cut increases when the funding ratio is lower, there is less 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 any preference hierarchies among the three recovery measures are apparent from the actual choices made by the pension funds. This is tested using ordered probit analysis. In

[2] 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 and for this reason the present research does not consider it.

particular, I estimate separate ordered probit models for each possible hierarchy and then test which one of these orderings suits best 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.

In the Netherlands, recovery plans exist since 2008. But also in other countries with defined benefit pension systems such as the UK, 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 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. The results of this paper are therefore also relevant for countries with pension systems with defined benefit characteristics, such as Switserland, the UK, the US and Canada.

The set-up of this paper is as follows. After a sketch of the Dutch regulatory system in Section 2, the data is described (Section 3), followed by a description of the explanatory variables that are used in the discrete choice models throughout the paper (Section 4). The estimation results for the multinomial logit model, explaining recovery measure choices, are discussed in Section 5, while Section 6 presents the analysis of the ordered probit estimates. Section 7 concludes.

2 Regulation of Dutch pension funds

The Netherlands has an extensive pension system with nearly universal coverage and assets over 100 percent of GDP. It was an early adopter of risk-based supervision methods.[3] The Dutch central bank (De Nederlandsche Bank, hereafter: DNB), as supervisor of the financial position of the pension funds, assesses whether the pension funds are financially healthy and whether they can be expected to fulfil their obligations in the future. Since the introduction of the FTK in 2007, all pension assets and liabilities must be valued at market value. Dutch pension funds must keep a buffer of own funds, known as regulatory own funds, sufficient to keep the probability of a situation in which the pension fund's assets undershoot the pension liabilities within a period of one year below 2.5%. The required amount of regulatory own funds depends on the pension

[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).

fund's risk profile. Own funds are expressed as a ratio of pension liabilities and this ratio is called the funding ratio.

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 lower limit, a pension fund has a so-called *funding deficit*. Pension funds with a funding deficit have to draw up a *short-term recovery plan*. This plan contains specific recovery measures enabling the fund to comply once again with the minimum required funding ratio within a term of not more than three years. In view of the exceptional circumstances in 2008, the term for the short-term recovery plan has been extended from three to five years. If the recovery does not take place within that period, then cuts in accrued pension rights must be considered.

The funds that ran into a funding deficit in 2008 also had to submit a *long-term recovery plan*, which they did for the first time in 2009.[4] This plan must enable the funds to bring the funding ratio above the *regulatory required funding ratio* within 15 years. Each pension fund's level of the regulatory required funding ratio is set in accordance with the supervisor depending on the pension fund's risk profile.

Figure 2 shows, for the sake of illustration of recovery plans, the actual aggregate development of the 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 as well as long-term recovery plans during the *entire* five year recovery period 2009-2013.[5] 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 submitted in 2008, 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.

[insert Figure 2]

4 If a pension fund's funding ratio falls below the regulatory 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 also submit a long-term recovery plan. Pension funds that have neither funding nor reserve deficits, still had to submit a long-term recovery plan every three years, in the interest of the so-called *continuity analysis*.

5 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 regulatory required funding ratio or higher, have not been included into this figure.

In retrospect, Figure 2 shows that the sub-sample of funds actually 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 straight line 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 back to 0.96 in 2011, to finally reach the level of 1.06 in 2013.

The aggregate level of the regulatory required funding ratio of the sub-sample was 1.21 for the years 2010-2013.[6] Figure 2 shows that the long-term plans submitted in 2009, 2010 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 regulatory 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 regulatory required funding ratio. When the funding ratio is below the lower limit of 1.05, no indexation is given at all. In between the lower and upper boundary, partial indexation is granted proportionally to the funding ratio.

3 Recovery measures

Three recovery measures are considered: (1) contribution increase, (2) no indexation, and (3) pension cut. These measure are defined as follows.

1) *Contribution increase* is an increase of the contribution rate (total contributions as a ratio of the total pension base) by more than 1 percentage point. 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.[7] A robustness test will be presented in which a different measure for contribution increase is used.

[6] Data for earlier years are not available.

[7] 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 the funding ratio (Stroop, 2008). However, this does not reveal whether the contribution rate has been increased.

2) *No indexation* as an event where a pension fund reports that indexation had a zero contribution to the funding rate in the past year. 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. [8]

3) *Pension cut* is an event where a pension fund reports that a pension cut had a positive contribution to the funding rate in the past year.[9]

All pension funds that submitted a short-term recovery plan at any time during 2008-2013 are considered for the sample. 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 not all three recovery measure dummy variables have non-missing values (0 or 1) 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 each year of the five-year short-term recovery period, the proportions of pension funds by recovery measure. It shows both the proportions of pension funds that took a *single* recovery measure (i.e., either contribution increase, no indexation, or pension cut) and the proportions of pension 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 the most frequently observed. Pensions are rarely cut and when they are, mostly not until the last year of the five-year recovery period (2013) and then often in combination with no indexation.

[insert Figure 3]

Multivariate discrete choice models are estimated in the empirical part of the paper (sections 5 and 6), 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

[8] Partial indexation is not considered in this paper. According to DNB (2013), in the five 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.

[9] 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).

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 all combinations from the sample. The third is to code hybrid choices 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.[10] 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 dummy variable is coded 1 if there is a solitary contribution increase, 2 if there is a solitary no indexation decision, and 3 if there is either a solitary pension cut or any combination of measures including a pension cut. The coding of the third choice implies that a pension cut is assumed to be a particularly strong measure (following solution 1)[11] and ensures that 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.

[10] In De Haan and Hinloopen (2003) the loss was 22%.
[11] 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.

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.

4 Empirical model

The recovery measure dummy 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 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 5.

Let the base outcome be i = 1,[12] then the multinomial logit model defines the probability (Pr) that observation j is equal to 1, 2 or 3 as:

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

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.

The explanatory variables **x** that are used in the discrete choice models throughout the paper are introduced and discussed below.[13]

- *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 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

[12] The choice of the base outcome is a necessary parameterization of the underlying model, without any consequences for the predicted probabilities.
[13] For definitions and sources of the explanatory variables, see Appendix B.

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 alarming when time is running out.

- *Size*, defined as the logarithm of total assets. The size of the pension funds varies considerably, as far as the number of members is concerned as well as the accrued capital. 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 euro. Size is therefore added as a control variable. There are no priors as to the effect of size on the use of recovery measures.

- *Equity holdings*, defined as the proportion of equity in the investment portfolio. The 2008 crisis manifested itself by a crash on the equity market. It is to be expected that pension funds that hold much equity respond differently from pension funds that do not.

- *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 a rule, retirees are not represented in the boards of Dutch pension funds, at least not during the sample period.[14]

- *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.

[14] Since 1 July 2013, representation of retirees in Dutch pension fund boards has been laid down by law. Until then, boards have been represented on a 50/50 base by employers and employees only. In some corporate pension funds, retirees' representation already was possible before 2013.

- *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. 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.

- *Pension fund type*. 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 fund for independent professionals such as medical specialists and dentists (3) industry-wide pension funds, i.e. for a whole sector, such as the civil service, construction industry, hotel and catering industry or the retail sector. A dummy 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. Pension type may affect the way recovery measures are taken. For example, only corporate pension funds have a sponsoring firm that may decide to make a donation when financial needs are high. For all six hundred pension funds under supervision the distribution over the three types is: 82%, 2%, and 16%, respectively.

- *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 dummy variable 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.

- *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. If this ratio is high, the age composition of the fund's participants is still relatively 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. This is another measure of maturity. Hence, the priors are similar to those for *Maturity* and opposite to those for *New commitments.*

- *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.[15]

- *Ambition*, measured by the final goal for the funding rate according to the long-term recovery plan, submitted by the pension fund at the beginning of the current year. If the ambition is high, it is to be expected that the pension fund is more prepared to take necessary measures.

- *Regulatory required funding ratio*, according to the short-term recovery progress report, submitted at the beginning of the current year. If the regulatory required funding ratio is high, it is to be expected that the pension fund is more prepared to take measures.

In order to avoid constructed correlations between explanatory variables and recorded recovery measures, the above mentioned explanatory variables are lagged one year, if relevant.[16]

The sample is restricted due to the availability, lagging and first-differencing of the explanatory variables. As a result, the sample period effectively runs from 2011 till 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 impact the composition of the sample.

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.

[15] 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.
[16] Lagging is considered to be irrelevant for *Time left*, *Pension type*, *Expected investment return*, *Ambition* and *Regulatory required funding ratio*.

[insert Table 1]

5 What determines the choice of recovery measure?

Model (1) is estimated using maximum likelihood estimation, allowing for possible correlation between observations belonging to the same pension fund. Table 2 presents the estimation results for a multinomial logit model relating the recovery measures taken by pension funds to the explanatory variables introduced above.[17] 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, thereby taking into account any interactions with other model variables, which is especially relevant for the interaction variables. The marginal effects given for the dummy variables (i.e., *Time left* = 1, 2; *Pension type* = Corporate; *Contribution coverage* > 1 = 1) are relative to the marginal effects of the omitted values for these dummy variables (i.e., *Time left* = 0; *Pension type* = Professionals, Industry-wide; *Contribution coverage* > 1 = 0, respectively).

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%.[18]

[17] The data are only available for underfunded pension funds that have to submit a short-term recovery plan (which is the principal data source; see Appendix B). This does not necessarily cause a problem of selection bias (that should require a Heckman type of correction). The response variable represents policy measures (such as no indexation and pension cut) that are specific to underfunded pension funds which have submitted short-term recovery plans, and are thus less relevant to pension funds which are not in a state of underfunding and therefore not required to submit a short-term recovery plan.

[18] 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.

[insert Table 2]

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 is more powerful 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 in the pension-cut equation suggest that the probability of a pension cut increases when the funding ratio is lower, there is less 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 (i.e., large *New commitments*).

Marginal effects give changes in probabilities. Alternatively, Figure 4 shows the model's predicted probability *levels*, or 'relative frequencies', for a pension cut, plotted against the distribution of the funding ratio. 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 suggest that a pension cut is even more likely under such circumstances when there is no time left (time left = 0 years) until the recovery period's deadline.[19] Panel B suggests that a pension cut is more frequently applied under such circumstances by industry-wide pension than by corporate pension funds. This may be the case as the latter may be able to avoid pension cuts on occasion when 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 ratio is less than 1. The difference with funds whose contribution coverage ratios is greater that 1 is not statistically significant, however.

[insert Figure 4]

The finding that a relatively young pension fund is more likely to cut pensions than to increase contributions is consistent with the prior formulated in Section 4. Pension cuts hurt inactive participants relatively more than active participants while contribution increases involve active participants only. This finding is also shown in Figure 5, which plots the predicted relative

[19] 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).

frequencies for the three recovery measures against *New commitments*. This figure suggests that, although the impact of the pension fund´s age composition on the choice between contribution increase and pension cut is statistically significant, the economic impact is rather small.

[insert Figure 5]

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 3). For the pension funds these figures are 92% and 91%, respectively. Hence, the model seems to be about as good as the pension funds themselves in predicting decisions regarding indexation and pension cuts. The pension funds are more optimistic than the model with regard to no indexation and slightly less optimistic than the model with regard to pension cuts.

[insert Table 3]

6 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.

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. 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 **x** plus a disturbance term *u*:

$$y_j^* = \mathbf{x}_j\boldsymbol{\beta} + u_j \tag{2}$$

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

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

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 trespassed, 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:

$$\begin{aligned} \Pr(\text{recovery measure}_j = i) &= \Pr(\mu_{i-1} < -\mathbf{x}_j\boldsymbol{\beta} + u \leq \mu_i) \\ &= \Phi(\mu_i - \mathbf{x}_j\boldsymbol{\beta}) - \Phi(\mu_{i-1} - \mathbf{x}_j\boldsymbol{\beta}) \end{aligned} \tag{4}$$

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 fits best the data. In principle, this yields 3! = 6 different ordered probit estimates and ½ x 6 x 5 = 15 bilateral likelihood 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.[20] Accordingly, there are only 3 ordered probit estimates to be considered and ½ x 3 x 2 = 3 bilateral likelihood comparisons to be

[20] 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}.

made to determine which hierarchy fits the data best. In Table 4, the outcomes of these 3 pairwise LR-tests are reported. The LR-tests are computed as -2[ln(likelihood$_{col}$) - ln(likelihood$_{row}$)]. Significance values at the 5% and 1% level are 3.84 and 6.63, respectively. For both significance levels, the resulting rankings of the 3 hierarchies, h1, h2, and h3, are included in Table 5.

[insert Table 4 and 5]

The results of the ordered probit analysis show that pension funds appear to have an ordered preference for recovery measures. If not, all hierarchies would not differ from each other in a statistical sense. Funds have one unique most preferred hierarchy: 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. *h*1).

The estimation results of the ordered probit regression that yields the most preferred hierarchy (*h*1) are given in Table 6. 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.[21]

[insert Table 6]

Two types of robustness tests are presented in Appendix A. First, instead of the total contribution rate, employees´ contributions per active participant are used to determine whether contributions have been raised (Appendix A1). The results of the probit analysis using this alternative dummy for contribution increase indicates 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 combinations of contribution increase and no indexation in the sample and code these (Appendix A2). The coding is done in one of two alternative ways. The first is to code such combination as if it were a single decision of no indexation. The second is to code it as if it were a contribution increase. In both cases, the same hierarchy between the recovery measures is found: (1) contribution increase, (2) no indexation,

[21] 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.

and (3) pension cut. However, if a significance level of 1% is used, the second alternative coding suggests that there is no statistically significant hierarchy between contribution increase and no indexation.

7 Conclusion

The data used for the analysis in this paper reveals that funding ratios can drop unexpectedly sharply when conditions deteriorate as much as during the global financial crises of 2008. 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, the choice between three recovery measures is examined: contribution increase, no indexation, or pension cuts.

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 less 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, 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 suits best 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 to the treatment of hybrid recovery measures, i.e. whether to include combinations of contribution increase and no indexation in the sample or not.

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 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 regulatory

required funding ratios, to make funding requirements for indexation more stringent, and to stabilize premium levels. More specifically, the new rules will imply, among other things:

- The increase of the regulatory required funding ratio by five percentage points on average,
- the introduction of a 'policy funding ratio', equal to the moving average of the actual funding ratio over 12 months, hence spreading the effects of solvency shocks over a longer period,
- the usage of a 10-year rolling average of the ultimate forward rate as the discount rate,
- the prohibition of any indexation if the funding ratio is lower than 1.10,
- the granting of full indexation only if the funding ratio is at least 1.28,
- the stabilisation of premium levels based on a 10-year moving average of interest rates.

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Appendix A. Robustness checks

A1. Alternative definition of contribution increase

In the main text the total contribution rate is used to calculate contribution increase. As a robustness check, I calculate employees' contributions by dividing total employees' contributions in a particular year by the number of active fund participants in that year. Then I code the response variable with value 1 if employees' contributions per active participant increases 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 dummy variable for contribution increase indicates the same hierarchy between the recovery measures as in Table 5: (1) contribution increase, (2) no indexation, and (3) pension cut (Table A1).

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

Hierarchy	Premium increase	No index-ation	Pension cut	Log Like-lihood	Rank at 1%	Rank at 5%	Pseudo-R2
*h*1	1	2	3	-123.84	1	1	0.495
*h*2	2	3	1	-151.96	2	2	0.380
*h*3	3	1	2	-188.99	3	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 likelihood ratio test results, for both 1% and 5% significance levels.

A2. Alternative coding

I define two alternative recovery measure dummy 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 second alternative codes these combinations 1, the value of a solitary decision to increase contributions.

The results of the probit analysis using the both alternative codings indicate the same hierarchy between the recovery measures: (1) contribution increase, (2) no indexation, and (3) pension cut (Table A2). However, the second alternative coding suggests that there is no statistical significant hierarchy between contribution increase and no indexation if a significance level of 1% is used. The relatively low values of the pseudo-R^2 for the probit models using this second alternative coding suggest that it is not a good one.

Table A2. Hierarchies and their ranking according to their likelihood. Combined fund-year observations of contribution increase and no indexation is coded 2

Hierarchy	Premium increase	No index-ation	Pension cut	Log Like-lihood	Rank at 1%	Rank at 5%	Pseudo-R2
h 1	1	2	3	-151.89	1	1	0.462
h 2	2	3	1	-172.31	2	2	0.390
h 3	3	1	2	-220.28	3	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 likelihood ratio test results, for both 1% and 5% significance levels.

Table A3. Hierarchies and their ranking according to their likelihood. Combined fund-year observations of contribution increase and no indexation is coded 1

Hierarchy	Premium increase	No index-ation	Pension cut	Log Like-lihood	Rank at 1%	Rank at 5%	Pseudo-R2
h 1	1	2	3	-417.67	1	1	0.198
h 2	2	3	1	-419.78	1	2	0.194
h 3	3	1	2	-499.86	2	3	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 likelihood ratio test results, for both 1% and 5% significance levels.

Appendix B.

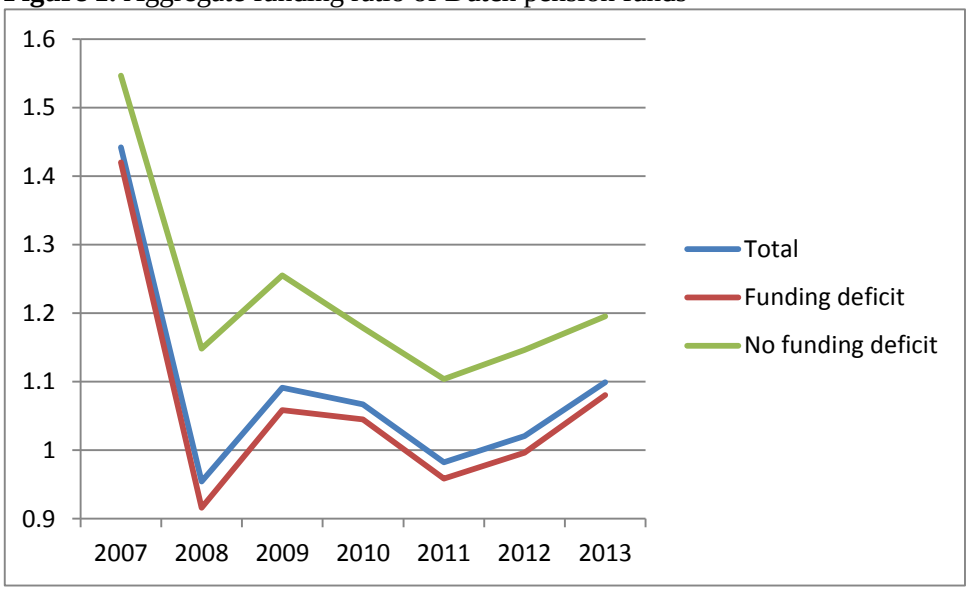
Definitions and sources of explanatory variables

	Definition	Source is DNB[a]
Funding ratio $_{t-1}$	Assets $_{t-1}$/Pension Liabilities $_{t-1}$	Table 8.8
Size $_{t-1}$	Log of Total Assets $_{t-1}$	Table 8.1
Equity holdings $_{t-1}$	Equity holdings $_{t-1}$/Total Assets $_{t-1}$	Table 8.1
Maturity $_{t-1}$	Inactive Participants $_{t-1}$/Total Participants $_{t-1}$	Table 8.6
Time left	2011 = 2, 2012 = 1, 2013 = 0	
Deviation from plan $_{t-1}$	Funding Ratio $_{t-1}$ - Planned Funding Ratio $_{t-1}$	Table 8.8 and K501
Deviation from expectation $_{t-1}$	Funding Ratio $_{t-1}$ – Expected Funding Ratio $_{t-1}$	Table 8.8 and K501
Pension type	Corporate pension fund = 1, Pension fund for independent professionals = 2, Industry-wide pension fund = 3	
Contribution coverage $_{t-1}$	Contributions $_{t-1}$/Actuarially Required Contributions $_{t-1}$	K501
New commitments $_{t-1}$	Actuarially Required Contributions $_{t-1}$/Pension Liabilities $_{t-1}$	K501
Benefits $_{t-1}$	Benefits $_{t-1}$/Pension Liabilities $_{t-1}$	K501
Expected investment return $_{t}$	Expected rate of return on investment portfolio for current year	K501
Ambition $_{t}$	Final Goal Funding Ratio	K502
Regulatory required funding ratio $_{t}$	Regulatory Own Funds $_{t}$ /Pension Liabilities $_{t}$	K501

[a] 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´).

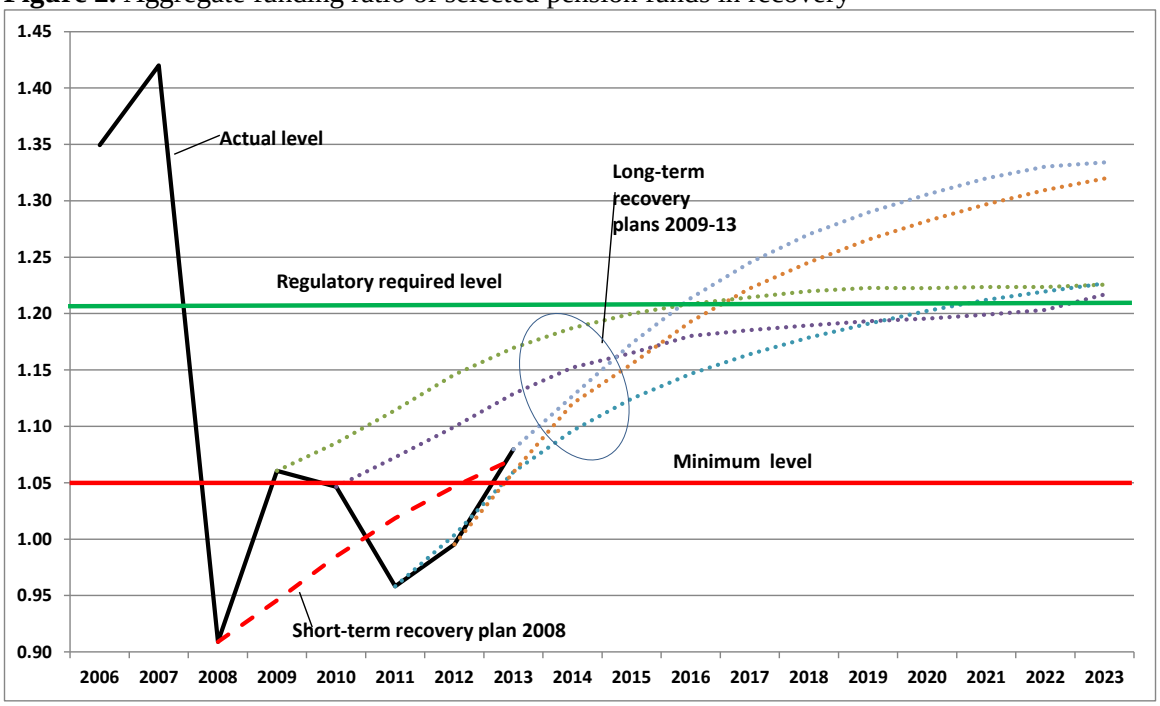
Figures

Figure 1. Aggregate funding ratio of Dutch pension funds



Total = unbalanced panel of 620 funds. Funding deficit = 293 funds with funding deficit in 2008.

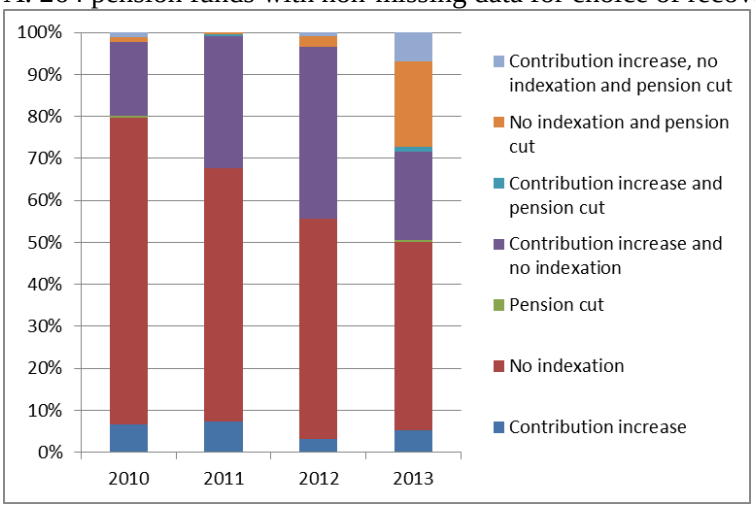
Figure 2. Aggregate funding ratio of selected pension funds in recovery



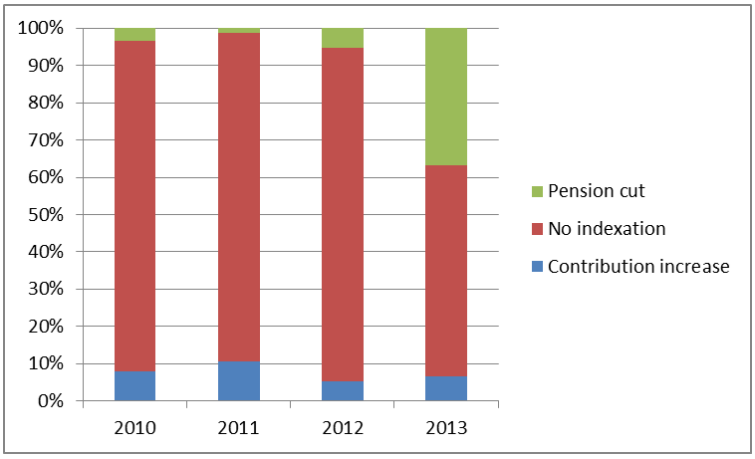
Explanatory note. 98 Selected Dutch pension funds with a funding shortfall in 2008 and complete or nearly complete recovery plan and progress report data for the entire recovery period 2009-2013.
Minimum required funding ratio is set to 1.05.
Regulatory required funding ratio represents the sub-sample average 1.21 for the available years 2010-2013.

Figure 3. 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

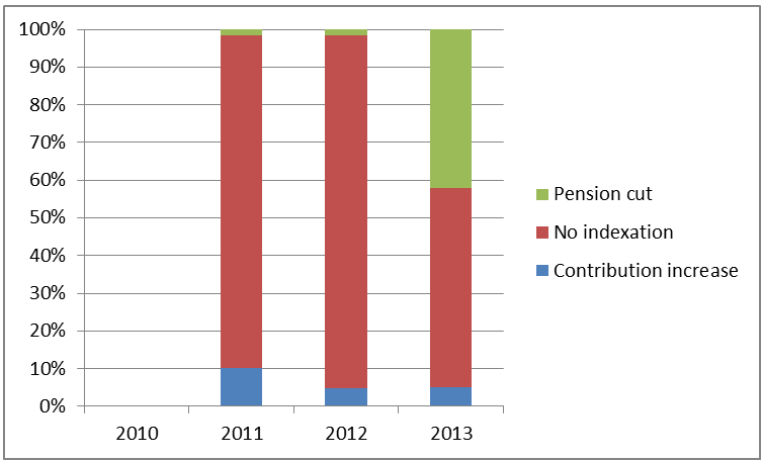


Figure 4 Predicted relative frequency of a pension cut

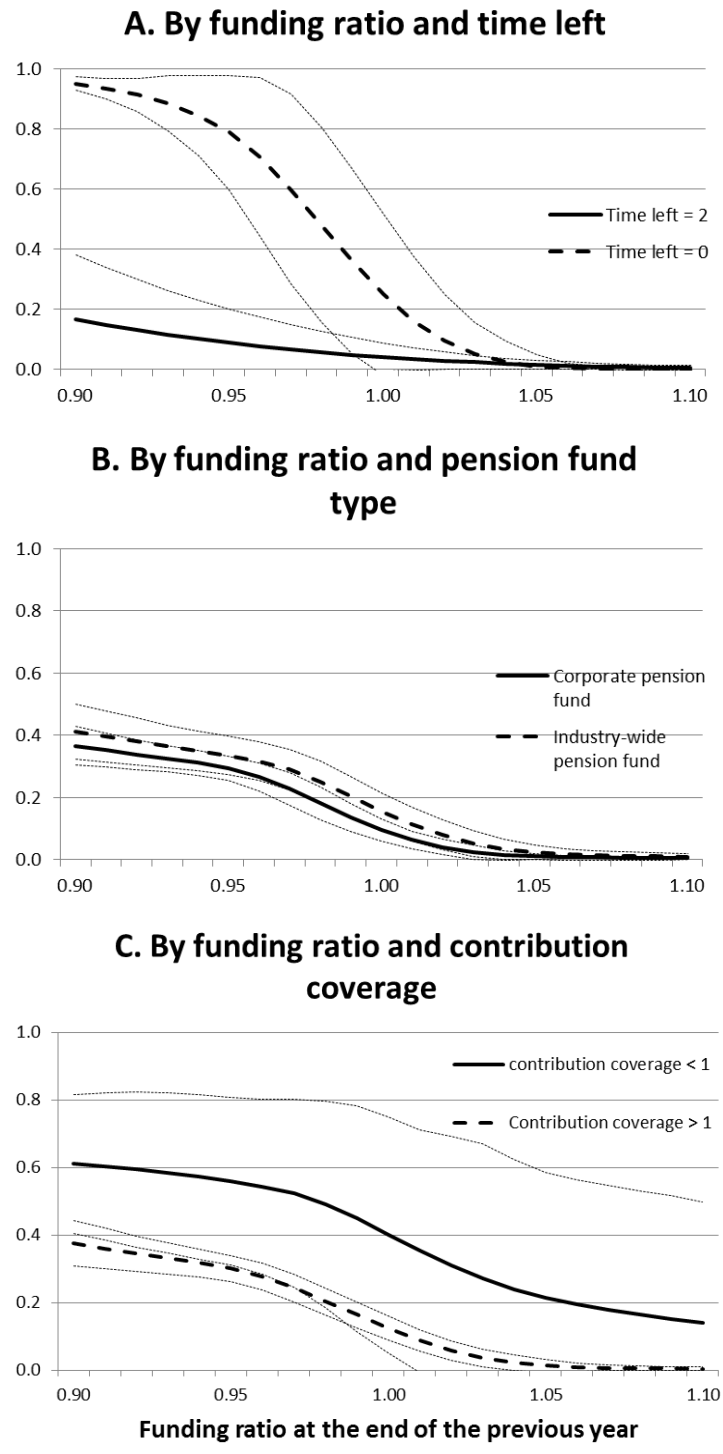
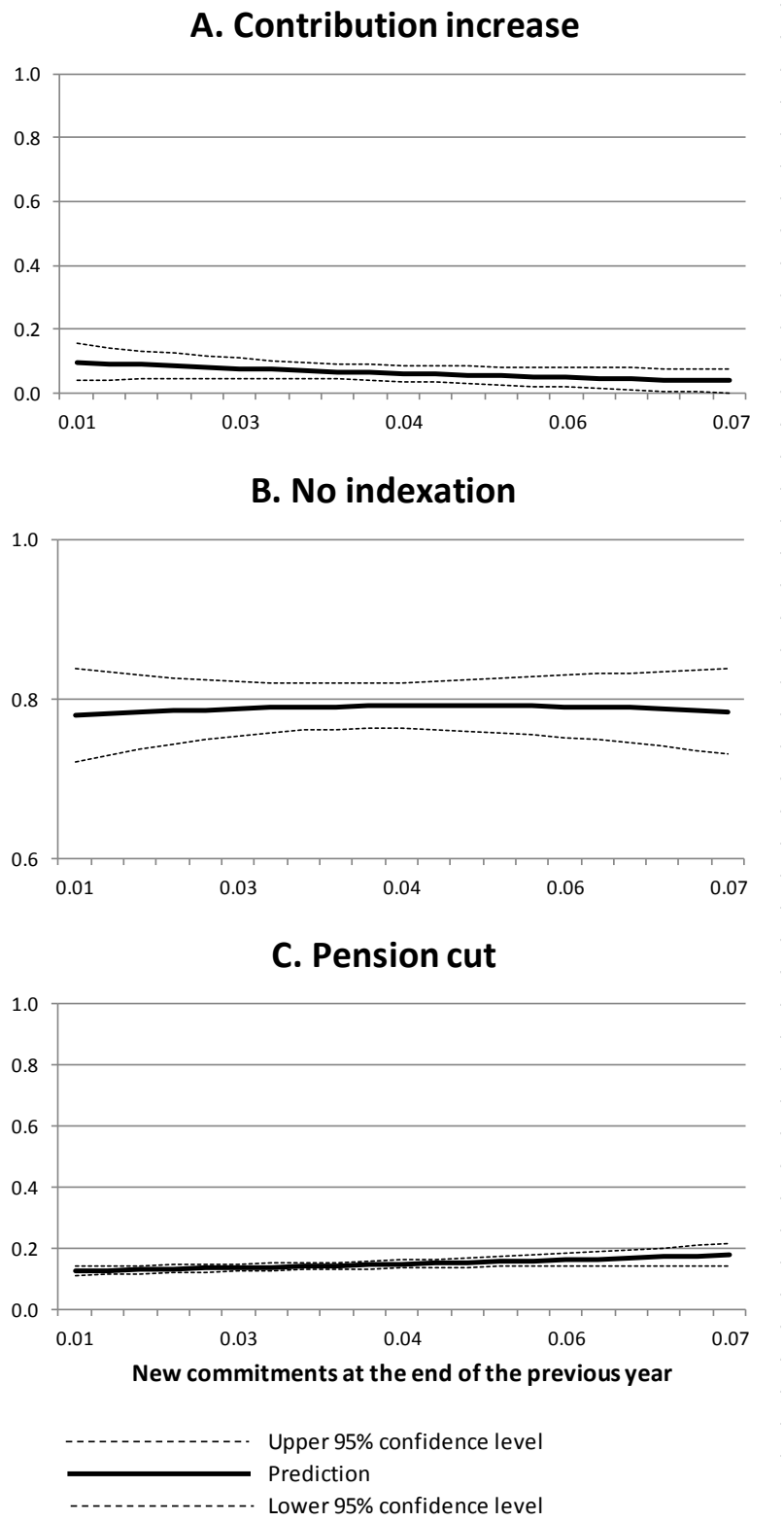


Figure 5 Predicted relative frequencies of recovery measures, by new commitments



Tables

Table 1. Pension fund characteristics by choice of recovery measure

	Contribution increase	No indexation	Pension cut	Tests of differences in means (medians); *p*-values [a]		
	(1)	(2)	(3)	(1) vs (2)	(1) vs (3)	(2) vs (3)
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***)
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)
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)
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)
Time left	1.307 (2)	1.193 (1)	0.109 (0)	0.468 (0.191)	0.000*** (0.000***)	0.000 (0.000***)
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***)
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***)
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***)
New commit-ments $_{t-1}$	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)
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)
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***)
Regulatory 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***)
Number of observations	26	300	55	326	81	355

First three columns: Mean values with median variables within parentheses.
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%.

Table 2. 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
Funding ratio$_{t-1}$	0.976***	0.801**	-1.777***
	(0.308)	(0.394)	(0.251)
Time left = 1	0.041	0.318***	-0.360***
	(0.398)	(0.079)	(0.066)
Time left = 2	0.085	0.260**	-0.345***
	(0.067)	(0.107)	(0.080)
Size $_{t-1}$	0.010	-0.004	-0.007
	(0.011)	(0.013)	(0.005)
Equity holdings $_{t-1}$	0.003	-0.136	0.132
	(0.143)	(0.173)	(0.094)
Maturity $_{t-1}$	-0.021	-0.061	0.037
	(0.215)	(0.264)	(0.141)
Deviation from plan $_{t-1}$	-0.335	-0.212	0.548***
	(0.301)	(0.343)	(0.167)
Deviation from expectation $_{t-1}$	0.365	-0.475	0.109
	(0.413)	(0.449)	(0.238)
Pension fund type = Independent professionals	0.053	0.011	-0.064***
	(0.135)	(0.131)	(0.016)
Pension fund type = Industry-wide	-0.081***	0.051	0.029
	(0.022)	(0.034)	(0.022)
Contribution coverage $_{t-1}$	-0.027	0.123**	-0.096**
	(0.039)	(0.059)	(0.049)
Contribution coverage $_{t-1}$ > 1 = 1	0.025	0.203	-0.229
	(0.040)	(0.191)	(0.198)
New commitments $_{t-1}$	-1.055	0.225	0.829**
	(0.843)	(0.898)	(0.334)
Benefits $_{t-1}$	-0.320	0.237	0.082
	(1.606)	(2.330)	(1.679)
Expected investment return	-0.560	3.161**	-2.601***
	(1.370)	(1.529)	(0.653)
Ambition	0.197	-0.334	0.136
	(0.203)	(0.225)	(0.092)
Regulatory required funding ratio	0.221	-0.442	0.221
	(0.316)	(0.409)	(0.226)
% Correct	91.3		
Log Likelihood	-89.85		
Pseudo-R^2	0.637		
Number of observations	381		
Number of pension funds	213		

Explanatory note. Robust standard errors adjusted for clustering 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 3. 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%

Table 4. Likelihood ratio test results

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

Significance values at the 5% and 1% level are 3.84 and 6.63, respectively.

Table 5. Hierarchies and their ranking according to their likelihood

Hierarchy	Premium increase	No index-ation	Pension cut	Log Like-lihood	Rank at 1%	Rank at 5%	Pseudo-R2
h 1	1	2	3	-127.86	1	1	0.484
h 2	2	3	1	-144.97	2	2	0.415
h 3	3	1	2	-193.63	3	3	0.219

Explanatory note. h1, h2 and h3 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 h1, h2 and h3. The columns 'log likelihood' and 'pseudo-R^2' present these measures of fit for the regressions for hierarchies h1, h2 and h3. 'Rank' gives the ranking of the three models in terms of data fit using the likelihood ratio test results, for both 1% and 5% significance levels.

Table 6. 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
Funding ratio$_{t-1}$	1.203***	0.505***	-1.708***
	(0.243)	(0.183)	(0.164)
Time left = 1	0.005	0.326***	-0.331***
	(0.030)	(0.061)	(0.071)
Time left = 2	0.031	0.297***	-0.328***
	(0.035)	(0.057)	(0.071)
Size $_{t-1}$	0.003	-0.001	-0.003
	(0.007)	(0.001)	(0.005)
Equity holdings $_{t-1}$	-0.120	0.017	0.102
	(0.112)	(0.023)	(0.098)
Maturity $_{t-1}$	-0.006	0.001	0.005
	(0.129)	(0.018)	(0.110)
Deviation from plan $_{t-1}$	-0.109	0.016	0.093
	(0.207)	(0.036)	(0.175)
Deviation from expectation $_{t-1}$	-0.235	0.034	0.201
	(0.335)	(0.060)	(0.283)
Pension fund type = Independent professionals	0.116	-0.069	-0.046
	(0.147)	(0.109)	(0.038)
Pension fund type = Industry-wide	-0.041**	-0.005	0.045**
	(0.018)	(0.009)	(0.023)
Contribution coverage $_{t-1}$	0.006	-0.015	0.008
	(0.031)	(0.017)	(0.042)
Contribution coverage $_{t-1}$ > 1 = 1	0.045*	0.082	-0.128
	(0.024)	(0.167)	(0.189)
New commitments $_{t-1}$	-1.146**	0.168	0.978**
	(0.499)	(0.197)	(0.433)
Benefits $_{t-1}$	-0.285	0.041	0.243
	(1.021)	(0.167)	(0.859)
Expected investment return	0.484	-0.071	-0.412
	(0.942)	(0.146)	(0.818)
Ambition	0.101	-0.014	-0.086
	(0.131)	(0.027)	(0.109)
Regulatory required funding ratio	-0.011	0.001	0.009
	(0.262)	(0.038)	(0.223)
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		

Explanatory note. Robust standard errors adjusted for clustering within parentheses. Marginal effects are evaluated at the mean values of the explanatory variables; their standard errors are identical to those of the coefficients. * indicates statistical significance at 10%. ** indicates statistical significance at 5%. *** indicates statistical significance at 1%.