The logo of De Nederlandsche Bank, featuring the bank's name in white text on a dark blue rectangular background.

DeNederlandscheBank

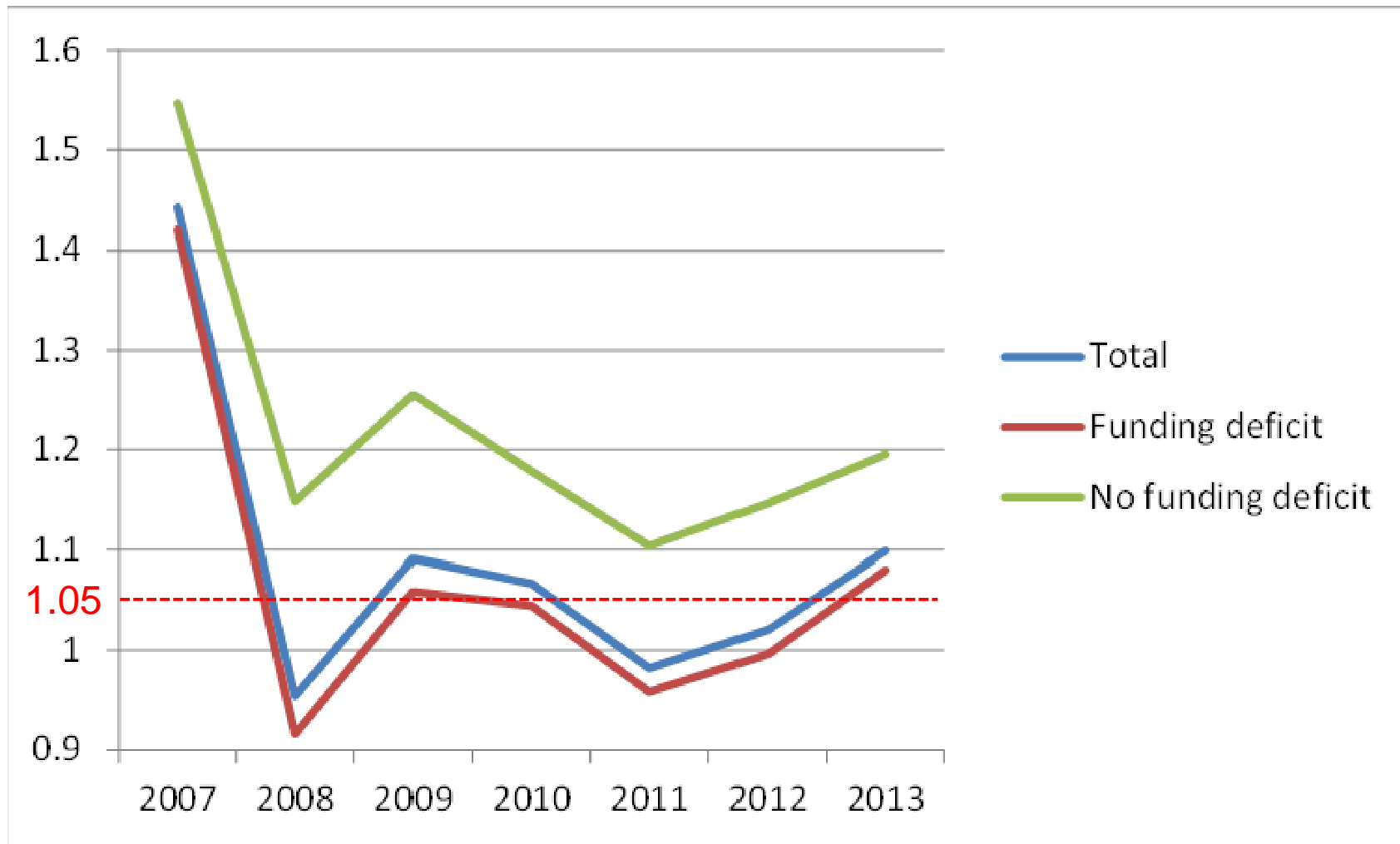
EUROSYSTEEM

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

Leo de Haan

NETSPAR Pension day  
Utrecht, October 1, 2015

# Funding ratio Dutch pension funds



Total unbalanced panel of 620 funds, of which 293 with funding deficit in 2008.

# This paper

- Addresses choice of recovery measure
  - contribution increase
  - no indexation
  - pension cut
- Takes pension fund's perspective
- Uses real data from recovery plans and recovery progress reports

# Some earlier literature on Dutch pension funds

Previous empirical literature also using real data:

- Broeders, Hilbers, Rijsbergen and Shen (2013): on indexation.
- Davis and De Haan (2012): on sponsor donations

Previous literature using simulation models:

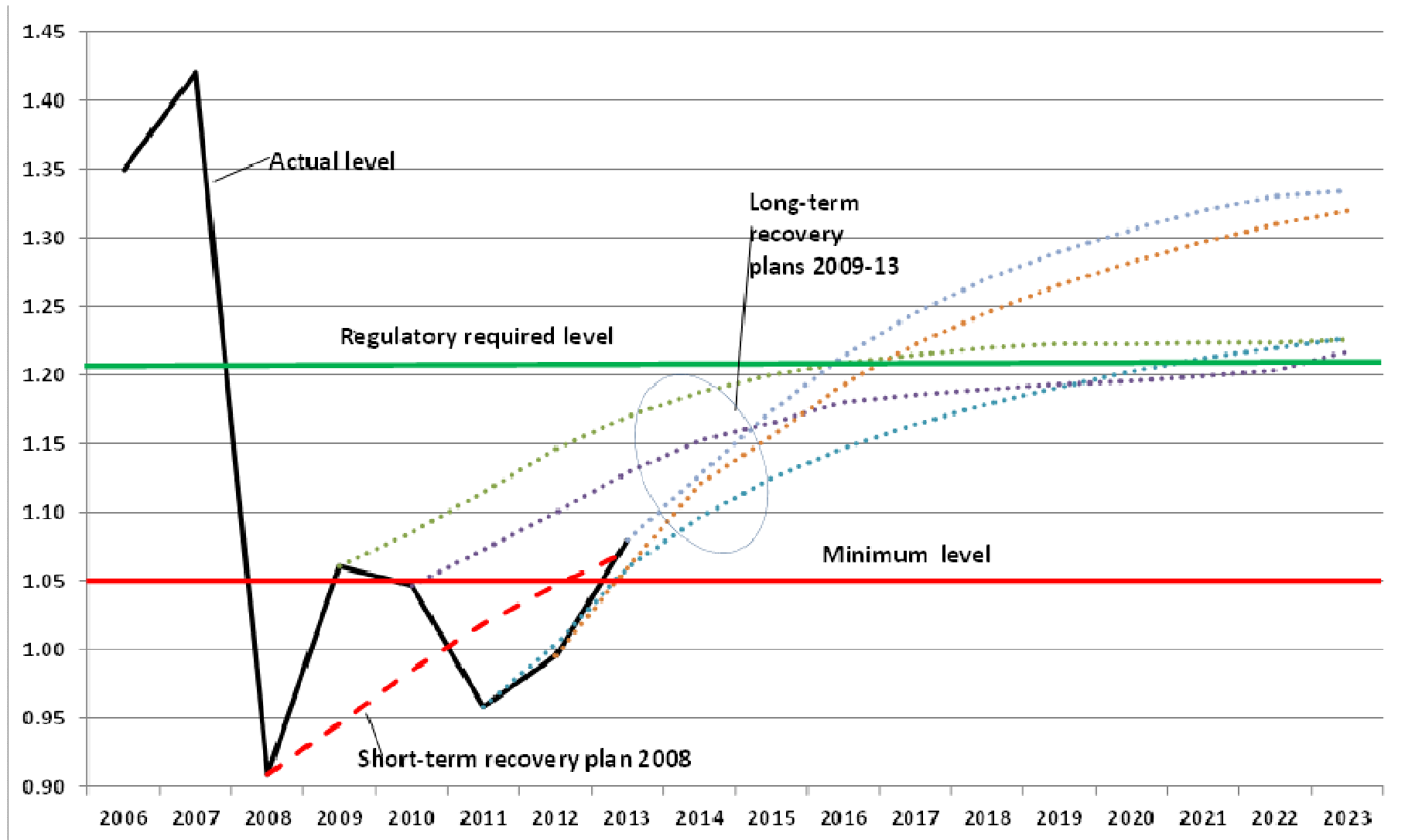
- Buccioli and Beetsma (2010), Bikker and Vlaar (2007), Van Ewijk (2009), Van Rooij, Siegmann and Vlaar (2008)

# Outline

- Data from recovery plans
- 2 research questions:
  - What determines choice of recovery measure?
  - Is there a preference hierarchy?
- Robustness checks
- Conclusion

Data from recovery plans

# Recovery plans: Funding ratio



# Discrete choice variable = 1,2,3

## 1. Contribution increase

- $\Delta$ total contribution rate  $>$  1%-point  
(Robustness check added)

## 2. No indexation

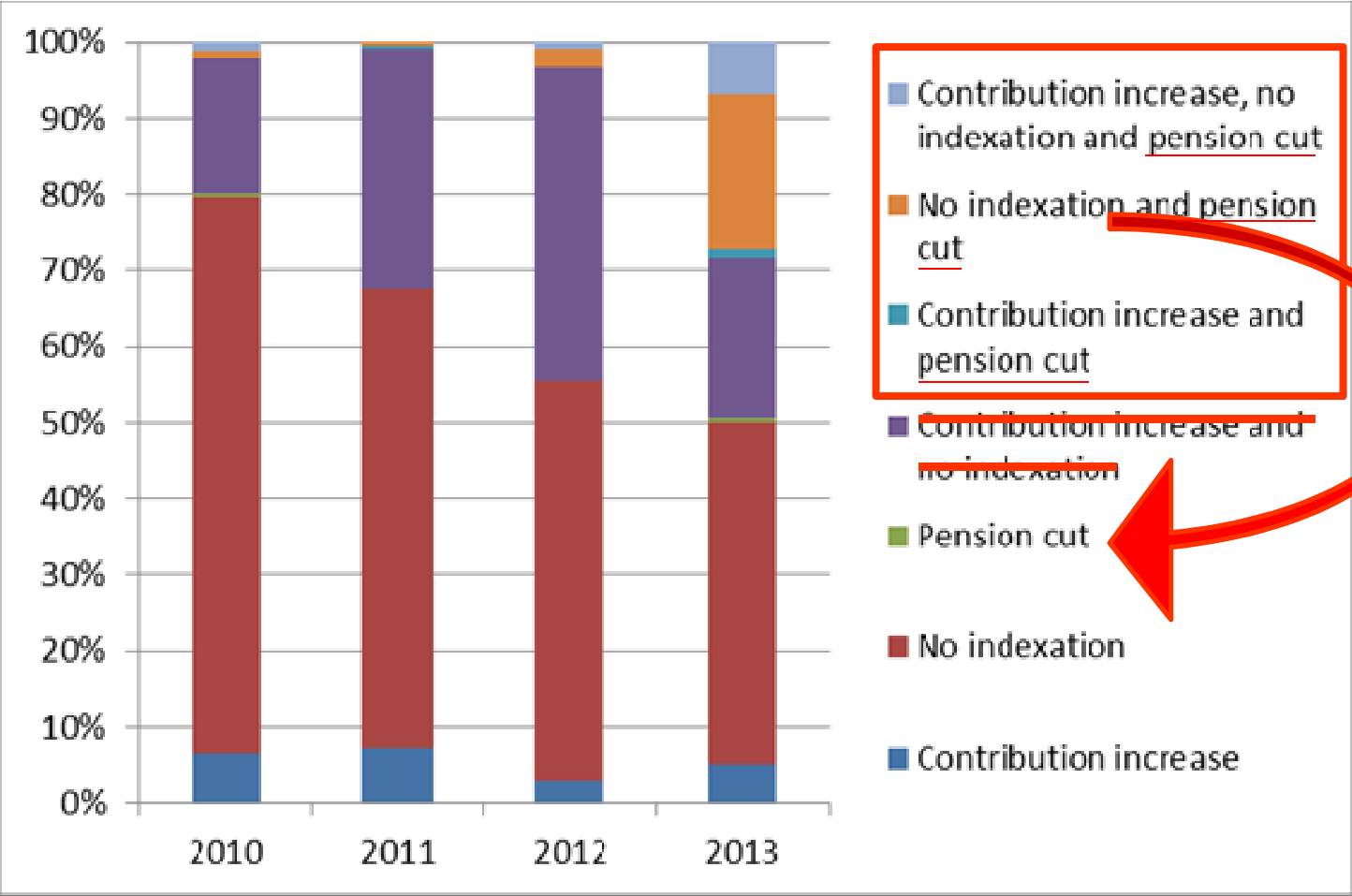
- Contribution of indexation to  $\Delta$ funding ratio = 0%

## 3. Pension cut

- Contribution of pension cut to  $\Delta$ funding ratio  $>$  0%

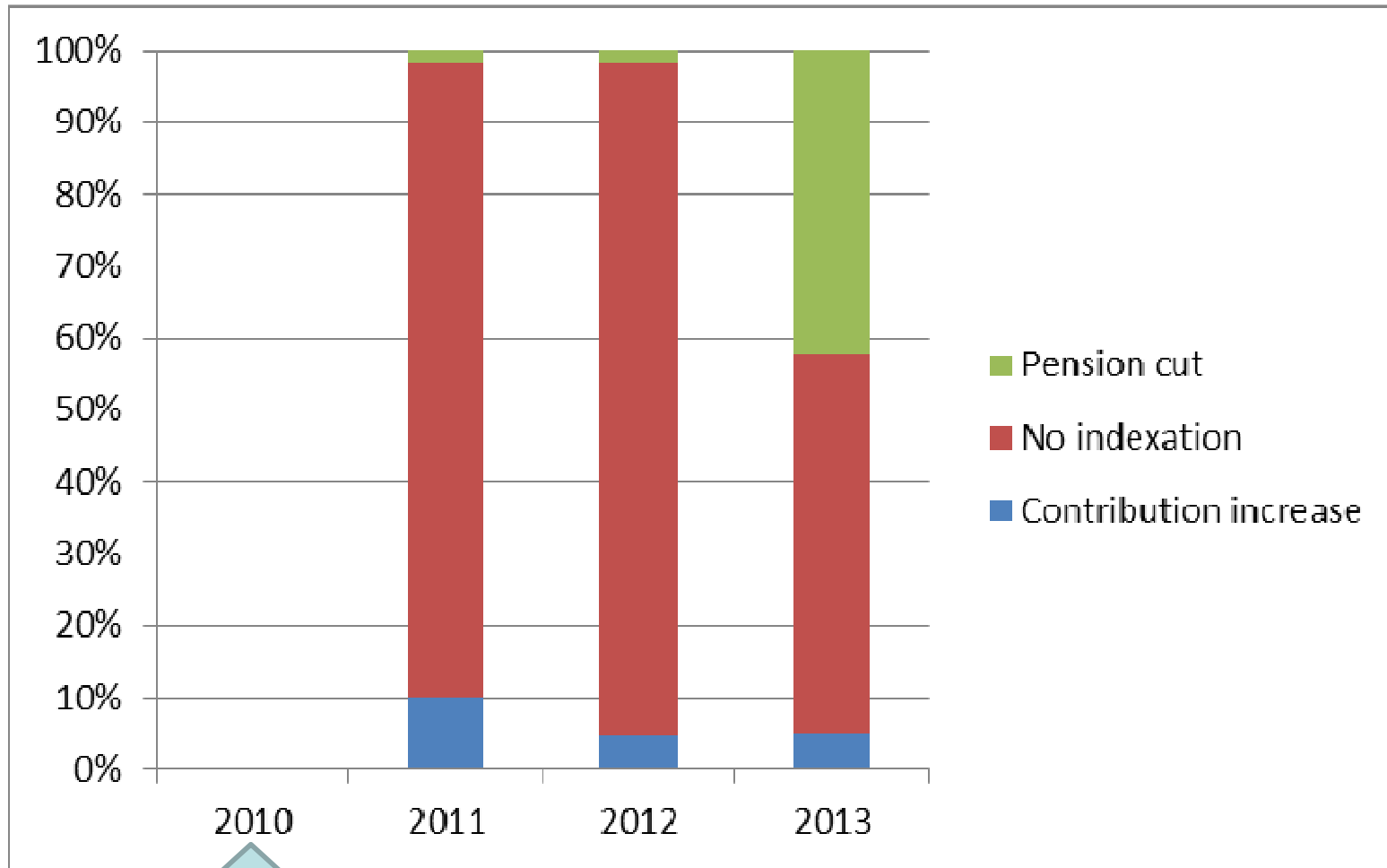


# Data



Robustness checks added

# Sample 213 pension funds



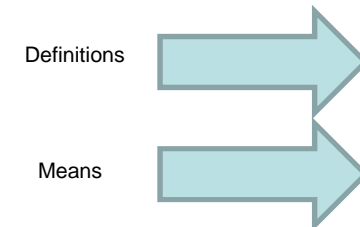
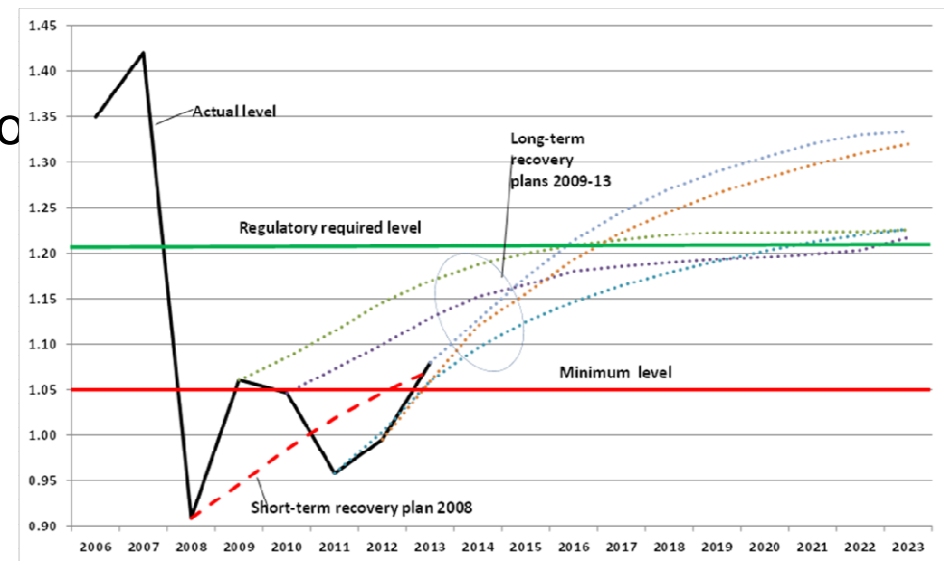
No data for  
explanatory  
variables

# Research question 1

What determines choice of recovery measure?

# Explanatory variables<sub>t-1</sub>

- Funding ratio
- Time left
- Deviation from original plan
- Deviation from last year's expectation
- Ambition (long term plan)
- Regulatory required funding ratio
- Size of pension fund
- Equity holdings
- Maturity
- New commitments
- Benefits
- Contribution coverage ratio
- Expected investment return



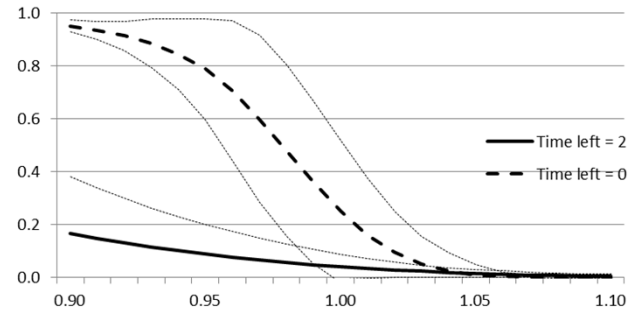
# Multinomial Logit model

- Discrete choice between 3 recovery measures  
1,2,3
- Codes 1,2,3 have no meaning (could also be 3,2,1)
- 381 observations
- 213 pension funds
- Standard errors adjusted for clustering within funds

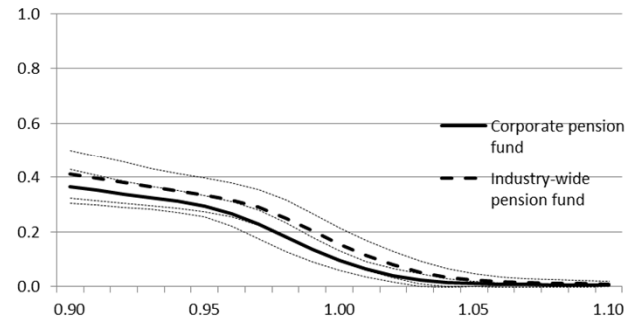


# Predicted relative frequency of a pension cut, by funding ratio

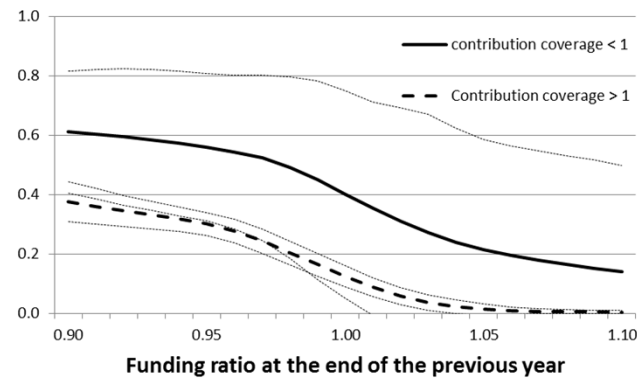
## A. By funding ratio and time left



## B. By funding ratio and pension fund type

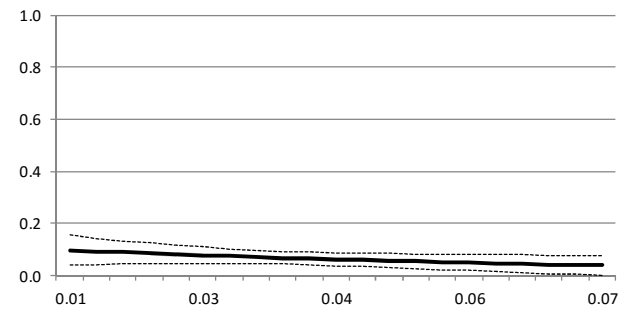


## C. By funding ratio and contribution coverage

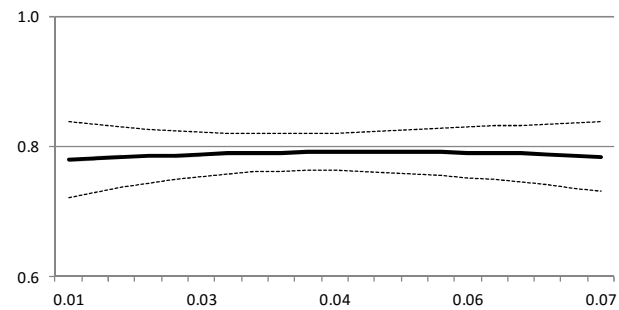


# Predicted relative frequencies of recovery measures, by new commitments

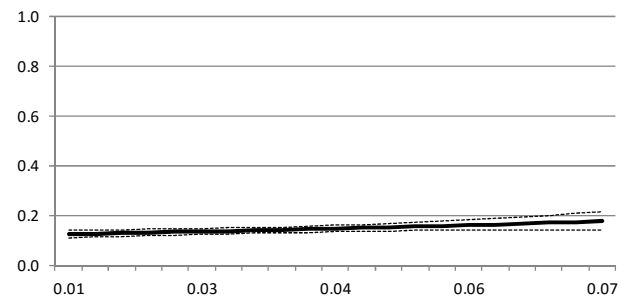
## A. Contribution increase



## B. No indexation



## C. Pension cut



New commitments at the end of the previous year

----- Upper 95% confidence level  
———— Prediction  
----- Lower 95% confidence level

# Model performance

- 91% correct predictions
- Pseudo-R<sup>2</sup> = 0.637
- Model predictions versus pension funds' expectations:

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



# Research question 2

Is there a hierarchy between recovery measures?

# Ordered probit model

(Random effects)

- Codes 1,2,3 imply hierarchy
- Estimation for 3 hierarchies:

Hierarchy	Premium increase	No index-ation	Pension cut	Log Likelihood	Rank at 1%	Rank at 5%	Pseudo-R2
<i>h1</i>	1	2	3	-127.86	1	1	0.484
<i>h2</i>	2	3	1	-144.97	2	2	0.415
<i>h3</i>	3	1	2	-193.63	3	3	0.219

Output *h1*



# Robustness checks

# Robustness check (1)

Alternative measure for contribution increase

- Code = 1 if increase employees' contributions per active pension fund participant  $> 3\%$

=> yields same preference hierarchy 1,2,3

# Robustness check (2)

Instead of dropping, including combined choice  
[contribution increase & no indexation] into sample

Two possible codings:

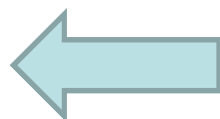
1. Code [ ] = 2.  
=> identical preference hierarchy 1,2,3
2. Code [ ] = 1.  
=> no preference between 1 and 2 at 1%  
significance level

# Conclusion

- 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
- Dutch pension funds consider recovery measures in the following order:
  1. contribution increase
  2. no indexation
  3. pension cut

Thank you

# Means (medians)

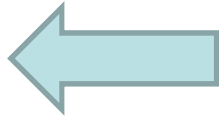


	Contribution increase	No indexation	Pension cut	Tests of differences in means (medians); p-values <sup>a</sup>		
	(1)	(2)	(3)	(1) vs (2)	(1) vs (3)	(2) vs (3)
Funding ratio <sub>t-1</sub>	1.074 (1.089)	1.005 (1.008)	0.934 (0.937)	0.000*** (0.000***)	0.000*** (0.000***)	0.000*** (0.000***)
Size <sub>t-1</sub>	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 <sub>t-1</sub>	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 <sub>t-1</sub>	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 <sub>t-1</sub>	-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 <sub>t-1</sub>	-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 <sub>t-1</sub>	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 commitments <sub>t-1</sub>	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 <sub>t-1</sub>	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



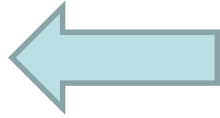


# Multinomial logit

	Marginal effects		
	Contribution increase	No indexation	Pension cut
Funding ratio <sub>t-1</sub>	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)
Size <sub>t-1</sub>	0.010 (0.011)	-0.004 (0.013)	-0.007 (0.005)
Equity holdings <sub>t-1</sub>	0.003 (0.143)	-0.136 (0.173)	0.132 (0.094)
Maturity <sub>t-1</sub>	-0.021 (0.215)	-0.061 (0.264)	0.037 (0.141)
Deviation from plan <sub>t-1</sub>	-0.335 (0.301)	-0.212 (0.343)	0.548*** (0.167)
Deviation from expectation <sub>t-1</sub>	0.365 (0.413)	-0.475 (0.449)	0.109 (0.238)
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)
Contribution coverage <sub>t-1</sub>	-0.027 (0.039)	0.123** (0.059)	-0.096** (0.049)
Contribution coverage <sub>t-1</sub> > 1 = 1	0.025 (0.040)	0.203 (0.191)	-0.229 (0.198)
New commitments <sub>t-1</sub>	-1.055 (0.843)	0.225 (0.898)	0.829** (0.334)
Benefits <sub>t-1</sub>	-0.320 (1.606)	0.237 (2.330)	0.082 (1.679)
Expected investment return	-0.560 (1.370)	3.161** (1.529)	-2.601*** (0.653)
Ambition	0.197 (0.203)	-0.334 (0.225)	0.136 (0.092)
Regulatory required funding ratio	0.221 (0.316)	-0.442 (0.409)	0.221 (0.226)
% Correct	91.3		
Log Likelihood	-89.85		
Pseudo-R <sup>2</sup>	0.637		
Number of observations	381		
Number of pension funds	213		

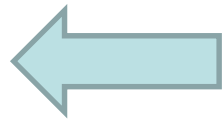
Explanatory note. Robust standard errors adjusted for clustering within parentheses. Marginal effects are evaluated at the mean values of the explanatory variables. \* indicates statistical

# Ordered probit



	Marginal effects		
	Contribution increase	No indexation	Pension cut
Funding ratio <sub>t-1</sub>	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)
Size <sub>t-1</sub>	0.003 (0.007)	-0.001 (0.001)	-0.003 (0.005)
Equity holdings <sub>t-1</sub>	-0.120 (0.112)	0.017 (0.023)	0.102 (0.098)
Maturity <sub>t-1</sub>	-0.006 (0.129)	0.001 (0.018)	0.005 (0.110)
Deviation from plan <sub>t-1</sub>	-0.109 (0.207)	0.016 (0.036)	0.093 (0.175)
Deviation from expectation <sub>t-1</sub>	-0.235 (0.335)	0.034 (0.060)	0.201 (0.283)
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)
Contribution coverage <sub>t-1</sub>	0.006 (0.031)	-0.015 (0.017)	0.008 (0.042)
Contribution coverage <sub>t-1</sub> > 1 = 1	0.045* (0.024)	0.082 (0.167)	-0.128 (0.189)
New commitments <sub>t-1</sub>	-1.146** (0.499)	0.168 (0.197)	0.978** (0.433)
Benefits <sub>t-1</sub>	-0.285 (1.021)	0.041 (0.167)	0.243 (0.859)
Expected investment return	0.484 (0.942)	-0.071 (0.146)	-0.412 (0.818)
Ambition	0.101 (0.131)	-0.014 (0.027)	-0.086 (0.109)
Regulatory required funding ratio	-0.011 (0.262)	0.001 (0.038)	0.009 (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 <sup>2</sup>	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%.



# Definitions of variables

	Definition
Funding ratio $t-1$	Assets $t-1$ /Pension Liabilities $t-1$
Size $t-1$	Log of Total Assets $t-1$
Equity holdings $t-1$	Equity holdings $t-1$ /Total Assets $t-1$
Maturity $t-1$	Inactive Participants $t-1$ /Total Participants $t-1$
Time left	2011 = 2, 2012 = 1, 2013 = 0
Deviation from plan $t-1$	Funding Ratio $t-1$ - Planned Funding Ratio $t-1$
Deviation from expectation $t-1$	Funding Ratio $t-1$ - Expected Funding Ratio $t-1$
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 $t-1$
New commitments $t-1$	Actuarially Required Contributions $t-1$ /Pension Liabilities $t-1$
Benefits $t-1$	Benefits $t-1$ /Pension Liabilities $t-1$
Expected investment return $t$	Expected rate of return on investment portfolio for current year
Ambition $t$	Final Goal Funding Ratio
Regulatory required funding ratio $t$	Regulatory Own Funds $t$ /Pension Liabilities $t$