Public-Sector Pension Plans and the Discount Rate Assumption: The Role of Political Incentives

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ABSTRACT

We provide evidence that political pressure creates incentives for elected officials to choose higher discount rates to value defined benefit pension promises, thus artificially reducing the short-term reported cost of these benefits. We generate our inferences using a unique panel dataset for all local pension plans from the state of Pennsylvania for 2003–2013, and by comparing the differential response to the GASB requirement to lower the discount rate after the Great Recession for plans that are managed by elected officials versus those that are managed by non-elected officials (i.e., municipal authority plans). We find that appointed officials in charge of municipal authority plans decreased their discount rate by 29 basis points more than elected officials in charge of municipal plans. This difference is not attributable to plan factors or financial reporting requirements, and suggests that political pressure leads to optimistic discount rate assumptions.

Keywords: Public-sector pensions, Defined benefit pensions, Discount rate, Municipal authorities

JEL Classifications: H75, M41, H83

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Paying employees a dollar now costs . . . a dollar! Promising them a dollar in the future can look way cheaper. All you need is the right assumptions. Assume people will contribute to the plan for a long time, assume they won't live too long afterwards – and, critically, assume high and reliable returns on investments in the plan – and that dollar in the future seems to come at a discount.¹

1. Introduction

State and local governments carry substantial amounts of off balance-sheet debt in the form of defined benefit (DB) pension promises. At the state level, prior research has indicated that the unfunded promises are in excess of \$4 trillion and that many plans are in danger of exhausting funds in the next decade (Brown and Wilcox, 2009; Novy-Marx and Rauh, 2011; Naughton, Petacchi, and Weber, 2015; Rauh, 2019). Among the most controversial issues with DB pension plans is the financial reporting regime, and in particular, the use of a discount rate assumption that does not reflect the true nature of the obligation. Within this literature, there are a few studies that examine the use of discretion in setting pension assumptions, as the manipulation of the discount rate assumption is a powerful lever through which costs can be obscured (e.g., Naughton, Petacchi, and Weber, 2015; Novy-Marx, 2013). These papers have generally suggested that fiscal concerns cause these plans to use greater latitude in setting the discount rate so as to mitigate short-term budgetary issues (e.g., Eaton and Nofsinger, 2004; Shnitser, 2014; Naughton, Petacchi, and Weber, 2015; Costello, Petacchi, and Weber, 2017; Beck, 2018) – a finding that is at odds with the long-term nature of public sector promises (Naughton and Spamann, 2015).

We extend these studies by examining whether political pressures also influence the setting of the discount rate. Elected officials, regardless of party, have incentives to promise generous retirement benefits to public sector workers to curry favor, while also having incentives to obscure

¹ <https://www.cdhowe.org/intelligence-memos/william-bp-robson-lesson-sears-disaster-fund-pensions-properly>

the true magnitude of these promises from taxpayers and other stakeholders. This second objective can be facilitated through the selection of a higher discount rates to value the pension promises. Given the time horizon of pension promises, the effects of choosing a higher discount rate are unlikely to be felt until several years later by which point the elected politicians who made these decisions would be out of office. Thus, the incentives to avoid politically fraught decisions such as cutting benefits or raising taxes, coupled with a lack of voter awareness about actuarial assumptions, result in a situation whereby entities with officials exposed to political pressure choose higher discount rates.

To test this hypothesis, we examine local pension plans from the state of Pennsylvania as its local governments offer over 1,400 retirement systems which account for more than 40 percent of all public-employee systems nationally.² The existence of such a large number of plans is driven by the plethora of local governments and by the fact that there has never been a state-wide consolidation of local plans. Additionally, we are able to construct an administrative high-quality dataset spanning the period from 2003 through 2013 which covers the universe of local pension plans and does not suffer from non-response bias. Fortunately for us, the time period spans the Great Recession of 2008–2009 and we can use that exogenous shock to examine the differential response of municipal plans run by elected officials vis-à-vis municipal authority plans run by appointed officials.

Analyzing the variation in the choice of assumptions made by local DB plans in the state, we find that pension plans run by municipal authorities decrease their discount rate by about 30 basis points more than municipal plans over the period 2003–2013. Additionally, we confirm the results of prior work in our sample that underfunded plans select higher discount rates that obscure the extent of underfunding (e.g. Chaney, Copley, and Stone, 2002; Giertz and Papke, 2007).

² Source: <https://www.census.gov/prod/2013pubs/g11-aspp-sl.pdf> (Ref. Table 5a). Of the 3,418 public-employee retirement systems in the United States, 1,422 (or, 41.6%) are local retirement systems from Pennsylvania.

2. Literature Review

This paper connects to a number of different strands of literature. Given that public pensions operate in a political environment, a number of papers examine the extent to which aspects of the political environment influence the operation of the pension plan. Eaton and Nofsinger (2004) use the presence of prohibitions imposed on investing in an asset class and requirements to make economically targeted investments to capture the existence of political pressure and finds that plans subject to political pressure assume higher discount rates and longer amortization periods. Andonov, Hochberg, and Rauh (2018) examine pension boards and find that state pension boards of trustees that are heavily populated by politicians underperform in terms of their private equity investments in part because of the incentives faced by these politicians. In a similar vein, Dove, Collins, and Smith (2018) find that having more elected members on a pension system's board is consistently associated with lower bond ratings (and higher borrowing costs) compared to having appointed and ex-officio board members.

A second stream of literature analyzes the manipulation of assumptions that occurs so as to report lower pension liabilities and reduce the annual required contribution (ARC). Notably, Chaney, Copley, and Stone (2002) find that states under fiscal stress with balanced budget requirements meet those requirements in part by lowering the funding of their pensions and additionally, select higher discount rates so as to obscure the magnitude of underfunding. Eaton and Nofsinger (2004) examine the choice of actuarial assumptions and find that fiscally constrained states are more likely to increase their expected rate of return to discount future liabilities and to increase the period over which their liabilities are amortized. Finally, Diebold, McDonald, and Reitano (2018) note that with an increase in the generosity of a pension, administrators tend to adopt less prudent methods that defer the pension contributions required.

This paper contributes to both of these strands in the literature by simultaneously analyzing the role of incentives and the fiscal health of a plan in the choice of actuarial assumptions. Unlike prior work which uses the presence of political representatives on the board of a pension plan (or restrictions on investment choices) to operationalize political pressure, this paper examines the differential incentives faced by the elected and appointed officials who influence decisions about what discount rates to use. More precisely, it analyzes the incentives faced by officials elected to head general-purpose local governments such as cities, townships, and boroughs versus board members appointed to head municipal authorities and finds interesting differences in how these appointed officials conduct themselves vis-à-vis elected officials.

3. Institutional Background

We exploit unique three features of the public pension system in the state of Pennsylvania to generate our inferences. First, Pennsylvania has a large number of public retirement systems. It accounts for 40 percent of the nation's public-sector retirement systems, which is three times more than any other state. The existence of such a large number of retirement systems in Pennsylvania can be attributed to its complex system of local government where general purpose local governments total approximately 2,600 units. Second, most local governments in Pennsylvania establish separate pension plans for their police and non-uniformed employees and are not part of a larger state-wide plan. This distinguishes Pennsylvania from most other states with a large number of municipal governments, where local governments are part of larger multiple employer plans.

Third, Pennsylvanian municipalities have separate plans for municipal authorities, and there are over 1,500 active municipal authorities in the state (DCED, 2015). The existence of municipal authority pension plans is important for our research design because we compare choices made by municipality plans (with elected officials subject to political pressures) with those

at municipal authorities (without elected officials). Municipal authorities are typically organized around the provision of a particular function, such as the provision of parking or water. For example, the Pittsburgh Water and Sewer Authority manages the water and waste systems for the city of Pittsburgh. Authority board members are appointed by the governing body of the municipalities where they provide service for five-year overlapping terms. Therefore, unlike the governing body of a municipality that can change following an election, the appointed members serving on the board of an authority are insulated from the electoral will of voters.

Even though there are significant differences in the influence of political pressure on municipal governments versus municipal authorities, there is no difference in the financial reporting requirements for DB pension plans or in the geographic coverage of municipalities and municipal authorities across the state. Therefore, we suggest that the municipal authorities' independence from political pressure along with their ability to establish separate pension plans for their employees subject to the same financial reporting and funding standards as municipalities enables us to use authorities as a "control group." In our analyses, we contrast the stronger effects of political incentives on municipal plans managed by elected officials ("treatment") with municipal authority plans managed by appointed officials ("control"). Furthermore, we exploit the exogenous shock of the Great Recession of 2008 – 2009. As actuarial assets dropped sharply for pension plans because of the crash in the equity markets, and interest rates were cut throughout the broader economy by central banks,³ we examine whether elected officials behave differently than appointed officials over the period 2003 – 2013 when there was clear evidence that investment returns would be lower going forward and that the discount rate needed to be adjusted accordingly.

³ See <https://fred.stlouisfed.org/series/FEDFUNDS>, <https://fred.stlouisfed.org/series/BOERUKQ>, and <https://fred.stlouisfed.org/series/IR3TIB01EZM156N> for some examples.

4 Empirical analysis

4.1 Construction of Variables and Data Sources

Data regarding local pension plans from Pennsylvania are available biennially from 2003 through 2013 from the Pennsylvania Public Employee Retirement Commission (PERC). The data include the name of the municipal entity offering the plan, the employee group covered, the status of coverage by Social Security, the number of active members and beneficiaries, the funded ratio, and the interest rate assumed in discounting actuarial liabilities.

Summary statistics for all variables are presented in Table 1 below. The summary statistics raise an obvious question of whether pension plans are overfunded on average given that the average funded ratio exceeds 100 percent for municipal plans and for plans run by municipal authorities, with the median in excess of 90 percent for plans run by both types of entities. The actuarial funded ratio is based on numbers as reported by the municipalities themselves and, as indicated by Table 1, governments discount future actuarial liabilities at an interest rate ranging between 5.5–8.0%, the median being 7.0%. If we were to assume an interest rate of 3.5% for discounting actuarial liabilities, reflecting the nominal yield on long-term Treasury bonds and the essentially guaranteed nature of pension promises, the median actuarial funded ratio declines from 94 percent to 67 percent, reflecting significant underfunding in the median local plan in Pennsylvania.⁴

[Table 1 about here.]

4.2 Empirical Specification:

We use a differences-in-differences approach to examine whether political incentives induce elected officials in charge of municipal pension plans to assume higher discount rates than plans

⁴ These back-of-the-envelope calculations assume that the weighted average duration of pension liabilities is 11 years, as suggested by the most recent literature (e.g., Naughton, Petachhi, and Weber, 2015; Rauh, 2017).

run by municipal authorities and exploit the change in the strength of these incentives stemming from a decline in plan funding levels. Fortunately for our research purposes, the Great Recession of 2008 comes right in the middle of our sample period from 2003—2013. Given the sharp declines in equity markets that took place over 2008 and 2009,⁵ we use 2003, the starting year of our sample as the “pre-period” and 2013, the final year of our sample as the “post-period”. Thus,

$$Y_{imt} = \alpha + \beta_1 * M_i + \beta_2 * Post_t + \beta_3 * M_i * Post_t + \beta_4 * C_{it} + \beta_5 * X_{it} + \beta_6 * Z_{mt} + \lambda_c + \varepsilon_{imt} \quad (1)$$

where: M_i is a dummy variable that is set to 1 if plan i is operated by a municipality and zero otherwise; $Post_t$ is a dummy variable that is set to 1 for the year 2013 and zero for the year 2003; C_{it} are a set of dummy variables indicating which group of employees are covered by the plan (e.g. policemen or non-uniformed personnel, etc.); X_{it} includes a variety of plan-specific controls such as the coverage of employees under Social Security (1 = Yes, 0 = No), the fraction of employees covered by collective bargaining, the actuarial funded ratio, the log of number of active members, and the log of number of beneficiaries; Z_{mt} are time-variant controls at the municipal level, viz. the unemployment rate, the debt per capita, taxes as a share of per capita income, and the log of per capita income;⁶ λ_c are county fixed effects; and ε_{imt} is the error term. In all cases, we cluster standard errors at the county level.

5. Results

5.1 Baseline Specification

Before presenting the regression results, we present a visual representation of the raw data in Figure 1. The figure plots the discount rate used by plans run either by municipalities or by municipal authorities over the sample period from 2003 to 2013. The figure indicates that the

⁵ See <https://www.invesco.com/pdf/HAR-BRO-1.pdf> for data on returns across asset classes between 2005 and 2014.

⁶ The percentage of employees organized under collective bargaining is for 1982 from the Employment Summary Statistics of Census of Governments. Per capita income and unemployment rate are from the Census and the ACS. Taxes as a share of per capita income and debt per capita are based on annual data from 2003 to 2013 from the DCED.

discount rate assumed by both types of entities fell between 2003 and 2005, but the drop for municipal authorities at 30 basis points was larger than the corresponding drop for municipalities at 13 basis points. The discount rate assumed by plans largely stayed flat for the next six years from 2005 until 2011 but between 2011 and 2013, municipal authorities reduced their discount rate by 32 basis points, whereas municipalities reduced their assumed rate by 17 basis points.⁷ Over the entire sample period from 2003 to 2013, the discount rate assumed by municipal authorities fell by 64 basis points, whereas that assumed by municipalities fell by 34 basis points, yielding a raw differential of 30 basis points in a DID framework. Although we have not included any controls in these calculations, a more thorough examination in a multivariate regression framework that includes an extensive set of controls matches our findings from these calculations.

[Figure 1 about here.]

We now present estimates from our baseline specifications in Table 2. Column (1) of the table is our most parsimonious specification that includes few controls other than the dummy variable for municipal authorities, the dummy variable for the “post-period”, and the interaction of the two, along with dummy variables for municipal class (e.g. borough vs. township), the employee-groups covered, and county fixed effects. Column (2) augments that by adding a control for the funded ratio as reported by the plans themselves. Given that the reported funded ratio depends on the discount rate assumed by plans – our dependent variable – we “unskew” the reported funded ratio by using a common discount rate of 3.5% across all plans and assuming that the weighted average duration of liabilities equals 11 years. Cols. (4)–(6) replicate the patterns in cols. (1)–(3) but now we add an extensive battery of municipal- and plan-specific controls.

[Table 2 about here.]

⁷ As a point of reference, the Seasoned AAA Corporate Bond Yield was 6.17 percent in 2003, averaged around 5 percent between 2005 and 2010 but declined to about 4 percent in 2013 (<https://fred.stlouisfed.org/series/AAA>).

As the results in the second and third rows of Table 2 indicate, although discount rates declined by about 70 basis points for municipal authority plans, the declines were smaller for municipal plans by about 30 basis points. The funded ratio of the plans also plays a role in the choice of discount rates with a one percent decline in the funded ratio associated with an increase in the discount rate used by about 3-4 basis points (when using numbers reported by plans themselves) and about 7-8 basis points (when using the “unskewed” numbers).

5.2 The Role of Asset Allocation

Per GASB Statement No. 25 which establishes a financial reporting framework for DB pension plans, the discount rate assumption should be “based on an estimated long-term investment yield for the plan, with consideration given to the nature and mix of current and expected plan investments and the basis used to determine the actuarial value of assets.” Thus, a central issue for us to consider is whether the higher discount rates assumed by municipal plans following the Great Recession – evidence for which is provided in Table 2 – goes hand-in-hand with a shift in their asset allocation as well. Although such a finding would not negate the evidence that stronger political incentives experienced by elected municipal officials induce them to select higher discount rates, it would indicate that these incentives also result in changes to the actual investment strategies employed by elected officials in line with the results in Pennacchi and Rastad (2011) and Myers (2019).

Unfortunately, the data from the PERC, rich as they are, do not include data on asset allocation used by the plans. In the absence of such data, we use a creative strategy to construct a proxy of the asset mix of local pension plans inspired by the fact that bond prices went up during 2008 whereas equity prices took a large hit.⁸ Overall though the decline in equity markets during 2008 and early 2009 resulted in the nation’s pension plans suffering a drop of about 20 percent in

⁸ http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histretSP.html & <https://tinyurl.com/yyeufsh7>

their assets' market value on average during fiscal year 2009.⁹ Actual investment losses however differed quite significantly from those averages in part because the proportions of assets in different categories varied across plans.¹⁰ Therefore we can use the drop in the value of actuarial assets between 2007 and 2009 (or alternatively, the drop in the actuarial funded ratio of a plan) as a proxy for the equity mix of the plan.¹¹ Thus, in Table 3, we augment our baseline specifications with a control for a change in the level of actuarial assets between 2007 and 2009.

[Table 3 about here.]

The results in Table 3 confirm our earlier results. Even though we obtain a negative and statistically significant coefficient on the change in actuarial assets between 2007 and 2009 as expected, we continue to find that municipal plans use discount rates higher by about 30 basis points relative to authorities.

6. Discussion and Conclusions

The paper confirms the results of prior work that the funding status of a pension plan exerts an influence on the choice of parameters but does so on a sample of *local* plans which have not been examined thus far. Underfunded pension plans, regardless of whether they are run by municipalities or municipal authorities, choose higher discount rates. The key contribution of this paper however lies in demonstrating the role that political incentives play in influencing the assumptions made by local DB plans. Following the Great Recession of 2008-09, the appointed officials in charge of municipal authority plans were more likely to reduce their assumed discount rate compared with elected officials in charge of municipal plans. This result is robust to numerous checks, including clustering standard errors at the municipal level (Table A.1), introducing municipality fixed effects

⁹https://www.pewtrusts.org/~/media/legacy/uploadedfiles/pcs_assets/2011/pewpensionsretireebenefitspdf.pdf

¹⁰ <https://www.brookings.edu/research/the-financial-crisis-effects-on-the-alternatives-for-public-pensions/>

¹¹ Tables A.6 and A.7 and Figures A.2 and A.3 confirm that the change in asset values (and funding ratios) between 2007 and 2009 were highly atypical of other two-year periods that we can construct between 2003 and 2013.

(Table A.2), eliminating all spatial fixed effects (Table A.3), or controlling for a proxy of the plan's asset allocation, viz. the change in funding ratio between 2007 and 2009 (Table A.4). Moreover, as Table A.5 shows, our results are starker for poorly funded pension plans with municipal plans that were funded less (more) than the median at the start of the period choosing a discount rate that is about 41 (16) basis points higher than municipal authority plans by 2013 – a message conveyed through Fig. A.1 as well.

The notion that political incentives may promote behavior oriented towards the short-term on issues that are less salient to voters, may be of much broader relevance than simply the context of public-sector pensions examined here. Like Kido, Petacchi, and Weber (2012) and Naughton, Petacchi, and Weber (2015), we encourage researchers to pay attention to the political environment in which government decisions are made and see if modeling the political dynamics can help them make better sense of their phenomena of interest.

Fig.1: Discount rate assumed by plans run by municipalities and municipal authorities for the period 2003–2013

Table 1: Summary Statistics

Variable	Units	Mean	Median	Standard deviation	Minimum	Maximum
Pension plan characteristics						
For municipal plans:						
Interest rate in 2003	In percent terms	7.04	7.00	0.660	5.50	8.00
Interest rate in 2013	In percent terms	6.69	7.00	0.958	5.50	8.00
Actuarial funded ratio	In percent terms	103.72	93.49	48.42	45.07	304.57
Number of active members		33.8	7	501.99	0	20540
Number of beneficiaries		33.2	3	593.10	0	23117
For plans run by municipal authorities:						
Interest rate in 2003	In percent terms	6.79	6.50	0.535	5.50	8.00
Interest rate in 2013	In percent terms	6.15	5.50	0.928	5.50	8.00
Actuarial funded ratio	In percent terms	104.73	98.43	36.60	45.07	304.57
Number of active members		21.2	9	37.95	0	361
Number of beneficiaries		9.16	2	24.38	0	212
Controls at the municipal level						
Unemployment rate	In percent terms	6.89	6.28	2.94	2.08	14.65
Debt per capita	In dollars	474.6	196.6	616.6	0	2135
Ratio of taxes to per capita income		1.20	1.08	0.55	0.36	2.60
Per capita income	In dollars	25510	23798	7816	14415	46643

Table 2: Baseline specification: DID effects of stronger incentives for elected officials on the discount rate chosen by pension plans

	(1)	(2)	(3)	(4)	(5)	(6)
Dummy variable for municipality	-0.00878 (0.145)	-0.00536 (0.126)	-0.00187 (0.111)	-0.160 (0.117)	-0.144 (0.109)	-0.124 (0.0996)
Dummy variable for “Post-period”	-0.638*** (0.0410)	-0.666*** (0.0421)	-0.630*** (0.0421)	-0.778*** (0.0475)	-0.789*** (0.0482)	-0.751*** (0.0476)
Dummy variable for municipality X Dummy variable for “Post-period”	0.291*** (0.0391)	0.281*** (0.0387)	0.262*** (0.0382)	0.299*** (0.0426)	0.292*** (0.0419)	0.274*** (0.0408)
Funded ratio as reported by plans themselves		-4.316*** (0.385)			-2.814*** (0.371)	
Funded ratio adjusted assuming a discount rate of 3.5% and a maturity of liabilities = 11 years			-8.493*** (0.611)			-6.625*** (0.542)
Coverage of employees under Social Security (0 = No, 1 = Yes)				-0.119*** (0.0422)	-0.0836** (0.0413)	-0.0514 (0.0388)
Fraction of employees covered under collective bargaining				0.189** (0.0775)	0.190** (0.0739)	0.182*** (0.0685)
Log of number of active members				0.185*** (0.0282)	0.150*** (0.0256)	0.116*** (0.0238)
Log of number of beneficiaries				0.0689*** (0.0206)	0.0670*** (0.0204)	0.0621*** (0.0204)
Unemployment rate				0.00199 (0.00473)	0.00257 (0.00452)	0.00298 (0.00427)
Debt per capita				0.0183 (0.0302)	0.0232 (0.0292)	0.0261 (0.0273)
Ratio of taxes to per capita income				17.78*** (4.428)	16.34*** (4.221)	14.44*** (3.910)
Log of per capita income				0.333*** (0.0925)	0.309*** (0.0859)	0.273*** (0.0782)
Constant	7.346*** (0.126)	7.776*** (0.104)	7.918*** (0.103)	3.384*** (0.918)	3.963*** (0.852)	4.560*** (0.766)
<i>N</i>	3951	3951	3951	3951	3951	3951
<i>R</i> ²	0.30	0.35	0.41	0.41	0.42	0.47

Standard errors clustered by county in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The dependent variable and all control variables have been winsorized at the 2.5% and 97.5% levels.

Table 3: Baseline specification, augmented with a control for the change in level of assets between 2007 and 2009 as a proxy for the asset mix

	(1)	(2)	(3)	(4)	(5)	(6)
Dummy variable for municipality	-0.0565 (0.145)	-0.0539 (0.124)	-0.0479 (0.111)	-0.163 (0.116)	-0.146 (0.107)	-0.128 (0.0977)
Dummy variable for “Post-period”	-0.636*** (0.0411)	-0.666*** (0.0425)	-0.629*** (0.0421)	-0.732*** (0.0492)	-0.743*** (0.0504)	-0.706*** (0.0495)
Dummy variable for municipality X Dummy variable for “Post-period”	0.291*** (0.0392)	0.281*** (0.0388)	0.263*** (0.0381)	0.293*** (0.0430)	0.285*** (0.0423)	0.268*** (0.0410)
Funded ratio as reported by plans themselves		-4.465*** (0.331)			-3.078*** (0.318)	
Funded ratio adjusted assuming a discount rate of 3.5% and a maturity of liabilities = 11 years			-8.254*** (0.542)			-6.558*** (0.471)
Change in the actuarial assets between 2007 and 2009	-0.0163*** (0.00110)	-0.0167*** (0.000998)	-0.0157*** (0.000900)	-0.0150*** (0.00119)	-0.0154*** (0.00112)	-0.0148*** (0.00102)
Coverage of employees under Social Security (0 = No, 1 = Yes)				-0.143*** (0.0427)	-0.105** (0.0410)	-0.0757* (0.0386)
Fraction of employees covered under collective bargaining				0.130* (0.0757)	0.130* (0.0721)	0.124* (0.0672)
Log of number of active members				0.228*** (0.0243)	0.191*** (0.0223)	0.159*** (0.0213)
Log of number of beneficiaries				0.000498 (0.0206)	-0.00352 (0.0206)	-0.00558 (0.0205)
Unemployment rate				0.000384 (0.00468)	0.000970 (0.00449)	0.00137 (0.00428)
Debt per capita				0.0237 (0.0271)	0.0291 (0.0259)	0.0313 (0.0242)
Ratio of taxes to per capita income				14.91*** (4.109)	13.26*** (3.864)	11.64*** (3.588)
Log of per capita income				0.328*** (0.0889)	0.301*** (0.0811)	0.268*** (0.0739)
Constant	7.437*** (0.134)	7.883*** (0.110)	7.989*** (0.107)	3.589*** (0.893)	4.228*** (0.809)	4.751*** (0.732)
<i>N</i>	3951	3951	3951	3951	3951	3951
<i>R</i> ²	0.38	0.44	0.49	0.47	0.50	0.54

Standard errors clustered by county in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The dependent variable and all control variables have been winsorized at the 2.5% and 97.5% levels.

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Online Appendix

Table A.1: Robustness check 1 – Results hold up if we cluster standard errors at the municipality level

	(1)	(2)	(3)	(4)	(5)	(6)
Dummy variable for municipality	-0.00878 (0.164)	-0.00536 (0.152)	-0.00187 (0.139)	-0.160 (0.139)	-0.144 (0.135)	-0.124 (0.127)
Dummy variable for “Post-period”	-0.638*** (0.0351)	-0.666*** (0.0364)	-0.630*** (0.0361)	-0.778*** (0.0446)	-0.789*** (0.0446)	-0.751*** (0.0436)
Dummy variable for municipality X Dummy variable for “Post-period”	0.291*** (0.0383)	0.281*** (0.0399)	0.262*** (0.0395)	0.299*** (0.0384)	0.292*** (0.0393)	0.274*** (0.0389)
Funded ratio as reported by plans themselves		-4.316*** (0.290)			-2.814*** (0.295)	
Funded ratio adjusted assuming a discount rate of 3.5% and a maturity of liabilities = 11 years			-8.493*** (0.399)			-6.625*** (0.411)
Coverage of employees under Social Security (0 = No, 1 = Yes)				-0.119*** (0.0382)	-0.0836** (0.0375)	-0.0514 (0.0359)
Fraction of employees covered under collective bargaining				0.189*** (0.0680)	0.190*** (0.0661)	0.182*** (0.0622)
Log of number of active members				0.185*** (0.0246)	0.150*** (0.0248)	0.116*** (0.0240)
Log of number of beneficiaries				0.0689*** (0.0222)	0.0670*** (0.0218)	0.0621*** (0.0209)
Unemployment rate				0.00199 (0.00645)	0.00257 (0.00631)	0.00298 (0.00599)
Debt per capita				0.0183 (0.0243)	0.0232 (0.0236)	0.0261 (0.0223)
Ratio of taxes to per capita income				17.78*** (4.350)	16.34*** (4.220)	14.44*** (3.970)
Log of per capita income				0.333*** (0.0898)	0.309*** (0.0879)	0.273*** (0.0834)
Constant	7.346*** (0.165)	7.776*** (0.157)	7.918*** (0.144)	3.384*** (0.934)	3.963*** (0.918)	4.560*** (0.872)
<i>N</i>	3951	3951	3951	3951	3951	3951
<i>R</i> ²	0.30	0.35	0.41	0.41	0.42	0.47

Standard errors clustered by municipality in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Results include county fixed effects, dummies for municipal class and employee groups.

Table A.2: Robustness check 2 – Results hold up if we introduce municipality FE

	(1)	(2)	(3)	(4)	(5)	(6)
Dummy variable for “Post-period”	-0.643*** (0.0500)	-0.653*** (0.0503)	-0.637*** (0.0492)	-0.714*** (0.0743)	-0.708*** (0.0749)	-0.673*** (0.0748)
Dummy variable for municipality	0.298*** (0.0481)	0.293*** (0.0470)	0.280*** (0.0453)	0.305*** (0.0492)	0.300*** (0.0481)	0.286*** (0.0460)
X Dummy variable for “Post-period”						
Funded ratio as reported by plans themselves		-1.658*** (0.490)			-1.353*** (0.494)	
Funded ratio adjusted assuming a discount rate of 3.5% and a maturity of liabilities = 11 years			-4.573*** (0.724)			-4.326*** (0.743)
Coverage of employees under Social Security (0 = No, 1 = Yes)				-0.176*** (0.0581)	-0.154*** (0.0558)	-0.118** (0.0519)
Log of number of active members				0.0366 (0.0329)	0.0159 (0.0354)	-0.0147 (0.0367)
Log of number of beneficiaries				0.0518 (0.0355)	0.0410 (0.0367)	0.0235 (0.0375)
Unemployment rate				0.00520 (0.00663)	0.00439 (0.00673)	0.00314 (0.00675)
Debt per capita				0.0245 (0.0296)	0.0250 (0.0290)	0.0244 (0.0275)
Ratio of taxes to per capita income				18.31*** (6.307)	16.79** (6.563)	14.06** (6.755)
Log of per capita income				-0.123 (0.200)	-0.146 (0.204)	-0.175 (0.201)
Constant	7.105*** (0.0812)	7.272*** (0.0982)	7.422*** (0.0989)	8.099*** (2.006)	8.521*** (2.061)	9.056*** (2.036)
<i>N</i>	3951	3951	3951	3951	3951	3951
<i>R</i> ²	0.81	0.81	0.82	0.81	0.82	0.82

Standard errors clustered by county in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Results include **municipality** fixed effects, dummies for municipal class and employee groups.

Table A.3: Robustness check 3 – Results hold up if we do not include any FE, either county or municipality

	(1)	(2)	(3)	(4)	(5)	(6)
Dummy variable for municipality	0.159 (0.176)	0.150 (0.149)	0.138 (0.131)	-0.118 (0.129)	-0.0945 (0.121)	-0.0696 (0.110)
Dummy variable for “Post-period”	-0.636*** (0.0403)	-0.670*** (0.0421)	-0.628*** (0.0422)	-0.766*** (0.0508)	-0.777*** (0.0521)	-0.738*** (0.0511)
Dummy variable for municipality X Dummy variable for “Post-period”	0.288*** (0.0387)	0.277*** (0.0385)	0.257*** (0.0382)	0.296*** (0.0433)	0.288*** (0.0427)	0.270*** (0.0416)
Funded ratio as reported by plans themselves		-4.980*** (0.410)			-2.945*** (0.372)	
Funded ratio adjusted assuming a discount rate of 3.5% and a maturity of liabilities = 11 years			-9.380*** (0.638)			-6.838*** (0.553)
Coverage of employees under Social Security (0 = No, 1 = Yes)				-0.136*** (0.0417)	-0.0985** (0.0406)	-0.0644* (0.0381)
Fraction of employees covered under collective bargaining				0.155** (0.0756)	0.154** (0.0725)	0.145** (0.0675)
Log of number of active members				0.216*** (0.0273)	0.182*** (0.0254)	0.147*** (0.0240)
Log of number of beneficiaries				0.0542** (0.0224)	0.0515** (0.0218)	0.0471** (0.0214)
Unemployment rate				0.000809 (0.00680)	0.00223 (0.00663)	0.00336 (0.00625)
Debt per capita				0.0168 (0.0311)	0.0228 (0.0295)	0.0263 (0.0271)
Ratio of taxes to per capita income				17.71*** (4.631)	15.51*** (4.472)	13.03*** (4.227)
Log of per capita income				0.331*** (0.102)	0.308*** (0.0949)	0.273*** (0.0863)
Constant	7.427*** (0.131)	7.899*** (0.110)	8.017*** (0.109)	3.450*** (1.048)	4.012*** (0.958)	4.587*** (0.869)
<i>N</i>	3951	3951	3951	3951	3951	3951
<i>R</i> ²	0.19	0.26	0.35	0.36	0.38	0.43

Standard errors clustered by county in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Results **do not include any fixed effects**, either county or municipality. Results include dummies for municipal class and employee groups.

Table A.4: Robustness check 4 – How do results change if we control for a proxy of the plan’s asset allocation, the change in funding between 2007 & 2009?

	(1)	(2)	(3)	(4)	(5)	(6)
Dummy variable for municipality	0.0866 (0.164)	0.0994 (0.142)	0.0977 (0.125)	-0.0699 (0.133)	-0.0463 (0.123)	-0.0298 (0.111)
Dummy variable for “Post-period”	-0.639*** (0.0408)	-0.670*** (0.0422)	-0.631*** (0.0420)	-0.788*** (0.0464)	-0.801*** (0.0472)	-0.761*** (0.0467)
Dummy variable for municipality	0.292***	0.281***	0.261***	0.300***	0.292***	0.274***
X Dummy variable for “Post-period”	(0.0391)	(0.0389)	(0.0382)	(0.0426)	(0.0419)	(0.0407)
Change in the funded ratio as reported by plans themselves	-0.00844*** (0.00156)	-0.00924*** (0.00151)	-0.00879*** (0.00136)	-0.00829*** (0.00141)	-0.00885*** (0.00141)	-0.00860*** (0.00131)
Funded ratio as reported by plans themselves		-4.623*** (0.388)			-3.147*** (0.374)	
Funded ratio adjusted assuming a discount rate of 3.5% and a maturity of liabilities = 11 years			-8.603*** (0.608)			-6.766*** (0.546)
Coverage of employees under Social Security (0 = No, 1 = Yes)				-0.138*** (0.0404)	-0.100** (0.0387)	-0.0702* (0.0365)
Fraction of employees covered under collective bargaining				0.165** (0.0731)	0.165** (0.0684)	0.157** (0.0629)
Log of number of active members				0.175*** (0.0280)	0.135*** (0.0253)	0.104*** (0.0235)
Log of number of beneficiaries				0.0801*** (0.0187)	0.0788*** (0.0186)	0.0738*** (0.0186)
Unemployment rate				0.00384 (0.00438)	0.00464 (0.00424)	0.00498 (0.00413)
Debt per capita				0.0196 (0.0268)	0.0252 (0.0254)	0.0277 (0.0236)
Ratio of taxes to per capita income				17.93*** (4.194)	16.33*** (3.913)	14.51*** (3.607)
Log of per capita income				0.341*** (0.0837)	0.315*** (0.0756)	0.280*** (0.0688)
Constant	7.179*** (0.154)	7.623*** (0.131)	7.751*** (0.123)	3.157*** (0.842)	3.789*** (0.760)	4.348*** (0.685)
<i>N</i>	3948	3948	3948	3948	3948	3948
<i>R</i> ²	0.33	0.39	0.45	0.44	0.46	0.51

Standard errors clustered by county in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Results include county fixed effects, dummies for municipal class and employee groups and change in funding ratio of the plan between 2007 & 2009.

Table A.5: Robustness check 5 – Splitting the sample of municipal plans based on their (recalibrated) funding ratio in 2003

	(1)	(2)	(3)	(4)	(5)	(6)
Dummy variable for municipal plans with funding ratio less than the median in 2003	0.163 (0.136)	0.0952 (0.123)	0.0412 (0.112)	-0.00990 (0.113)	-0.0386 (0.107)	-0.0735 (0.0997)
Dummy variable for municipal plans with funding ratio more than the median in 2003	-0.217 (0.132)	-0.136 (0.126)	-0.0662 (0.112)	-0.311*** (0.108)	-0.262** (0.109)	-0.184* (0.0986)
Dummy variable for “Post-period”	-0.637*** (0.0410)	-0.658*** (0.0415)	-0.631*** (0.0416)	-0.761*** (0.0475)	-0.771*** (0.0476)	-0.745*** (0.0474)
Dummy variable for municipality with funding less than the median X Dummy variable for “Post-period”	0.392*** (0.0374)	0.420*** (0.0367)	0.417*** (0.0367)	0.398*** (0.0409)	0.412*** (0.0399)	0.414*** (0.0388)
Dummy variable for municipality with funding more than the median X Dummy variable for “Post-period”	0.191*** (0.0469)	0.149*** (0.0480)	0.115** (0.0474)	0.202*** (0.0504)	0.178*** (0.0514)	0.142*** (0.0507)
Funded ratio as reported by plans themselves		-3.101*** (0.385)			-1.720*** (0.367)	
Funded ratio adjusted assuming a discount rate of 3.5% and a maturity of liabilities = 11 years			-7.381*** (0.532)			-5.592*** (0.473)
Coverage of employees under Social Security (0 = No, 1 = Yes)				-0.102** (0.0410)	-0.0834** (0.0407)	-0.0522 (0.0388)
Fraction of employees covered under collective bargaining				0.179** (0.0741)	0.181** (0.0727)	0.178** (0.0683)
Log of number of active members				0.169*** (0.0265)	0.151*** (0.0254)	0.119*** (0.0238)
Log of number of beneficiaries				0.0638*** (0.0201)	0.0624*** (0.0199)	0.0580*** (0.0200)
Unemployment rate				0.00242 (0.00452)	0.00292 (0.00441)	0.00356 (0.00415)
Debt per capita				0.00929 (0.0269)	0.0130 (0.0268)	0.0180 (0.0257)
Ratio of taxes to per capita income				15.94*** (3.827)	15.33*** (3.783)	13.82*** (3.583)
Log of per capita income				0.279*** (0.0851)	0.273*** (0.0819)	0.251*** (0.0757)
Constant	7.372*** (0.114)	7.675*** (0.101)	7.857*** (0.100)	3.998*** (0.846)	4.250*** (0.820)	4.729*** (0.749)
<i>N</i>	3951	3951	3951	3951	3951	3951
<i>R</i> ²	0.36	0.38	0.44	0.45	0.46	0.49

Standard errors clustered by county in brackets* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Results include county fixed effects, dummies for municipal class and employee groups. Municipal plans has been split into two groups based on their recalibrated 2003 funding ratio – those funded less than the median and those funded more than the median.

Fig. A.1: Discount rate assumed by plans run by municipalities (split by funding status in 2003) and municipal authorities for the period 2003–2013

Notes: The sample of municipal plans was split by funding status as of 2003. In order to remove the influence of discount rate in arriving at the reported funding ratio, we “unskew” the reported ratio by using a common discount rate of 3.5% across all plans and assuming that the weighted average duration of liabilities equals 11 years.

Table A.6: Change in level of assets between any two consecutive years in the data computed at various percentiles in the distribution

Current year	Prior year	N	p1	p5	p10	p25	p50	p75	p90	p95	p99
2005	2003	1666	-18.54	-4.12	0.99	8.52	16.16	29.76	51.29	80.63	224.48
2007	2005	2015	-13.16	-1.35	3.31	8.50	15.34	24.91	39.79	54.13	99.82
2009	2007	2015	-30.86	-21.95	-15.58	-6.55	5.29	15.56	25.73	34.81	61.39
2011	2009	2015	-17.67	-6.08	-0.91	6.13	12.89	22.74	36.55	48.55	71.25
2013	2011	2015	-22.26	-8.11	-2.15	4.74	10.88	17.61	26.20	31.72	45.26

This table supports the decision to use the change in level of assets as a proxy for the asset mix (particularly, the equity allocation) of the plan. We can also see that the distributions are different – in particular, there is a much longer left tail in the distribution of change in level of assets between 2007 and 2009 than what we see in other years. Recognize that also because of use of asset smoothing techniques, not all of the drop in the level of assets between 2007 and 2009 may be reflected in the level of assets reported in 2009.

Fig. A.2: Change in actuarial assets for each two-year period between 2003 and 2013 (e.g. 2003 and 2005, 2005 and 2007, etc.)

Table A.7: Change in funding ratio between any two consecutive years in the data computed at various percentiles in the distribution

Current year	Prior year	N	p1	p5	p10	p25	p50	p75	p90	p95	p99
2005	2003	1672	-69.20	-28.79	-17.65	-8.40	-0.60	8.19	19.99	30.37	69.25
2007	2005	2012	-43.40	-19.09	-11.18	-3.33	1.33	7.93	15.55	22.44	45.61
2009	2007	2012	-77.69	-41.20	-31.05	-17.72	-7.51	0.41	7.16	12.08	31.07
2011	2009	2013	-41.51	-17.85	-11.86	-5.45	0.00	6.04	14.70	21.04	45.34
2013	2011	2011	-37.99	-17.00	-11.94	-5.93	-1.13	3.20	8.86	14.47	39.29

This table supports the decision to use the change in funding ratio as a proxy for the asset mix (particularly, the equity allocation) of the plan. We can also see that the distributions are different – in particular, there is a much longer left tail in the distribution of change in funding ratios between 2007 and 2009 than what we see in other years.

Fig. A.3: Change in funding ratio for each two-year period between 2003 and 2013 (e.g. 2003 and 2005, 2005 and 2007, etc.)