Do Firms Set Pension Discount Rates Strategically?

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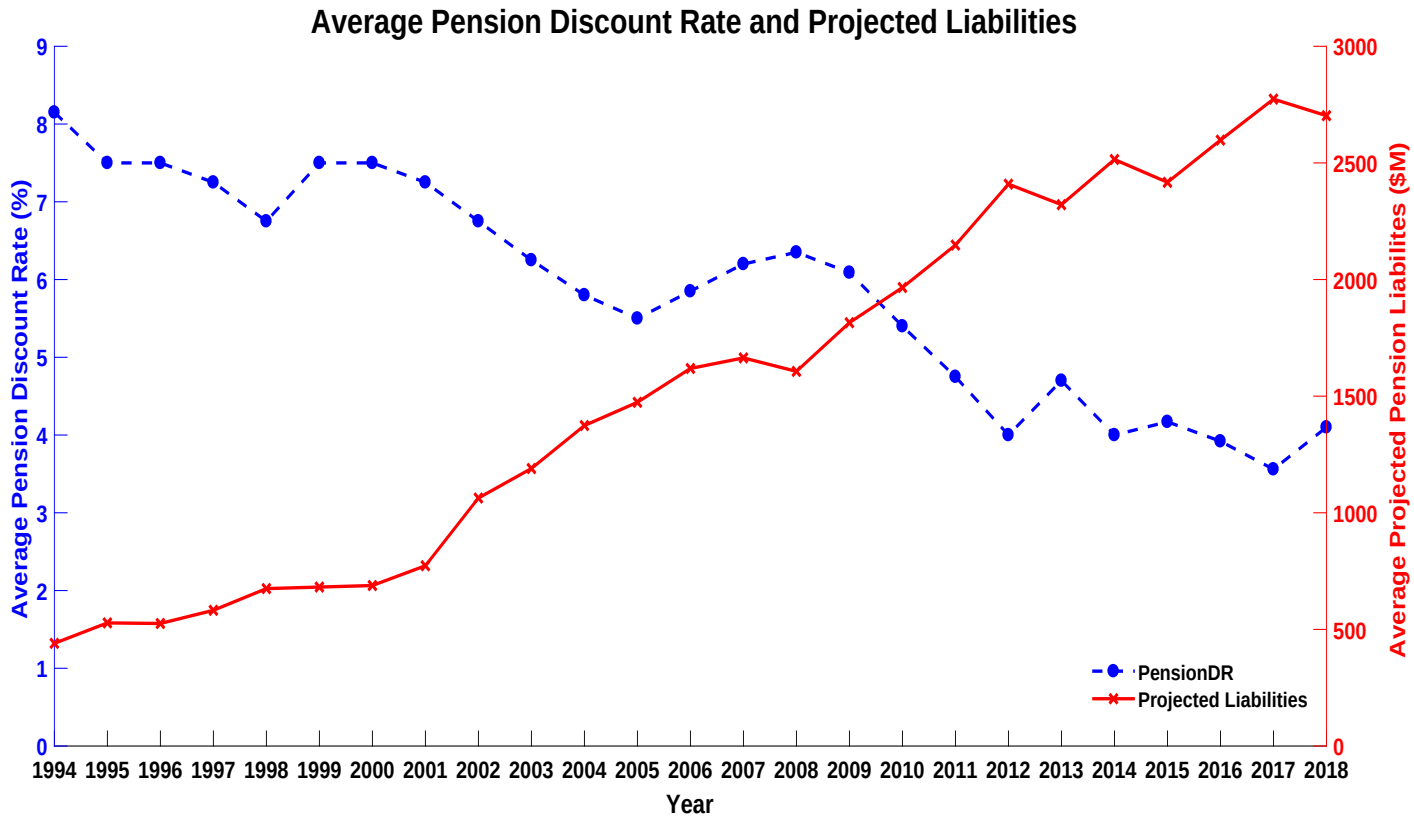
Motivation

- The lower interest rate results in significant inflation of pension liability



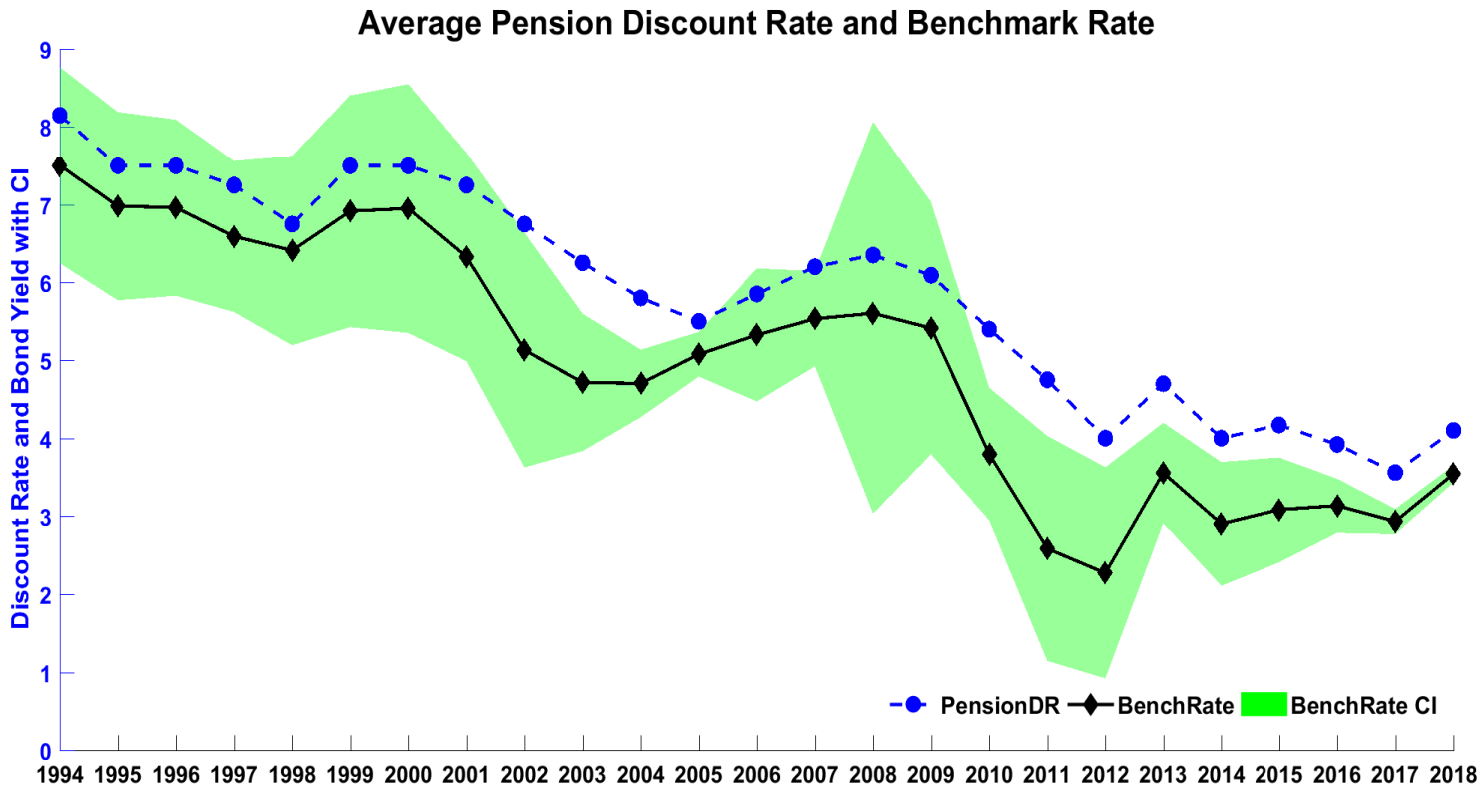
Questions

- Can firms discretionarily set pension discount rates (within some bounds)?
  - Yes
- Do firms strategically manage their pension discount rates?
  - Yes
- Are discount rate management effective to firm operating performance?
  - Yes

Pension Discount Rate Regulations

- Statement of Financial Accounting Standards (SFAS) 87 and 158: Yields of high quality bonds
  - "fixed income debt securities that receive one of the two highest ratings given by a recognized ratings agency"
  - A guidance, **Not** law
- 25-year historical average in 2012 – Moving Ahead for Progress in the 21st Century Act (MAP)
  - approved by US Congress

Pension Discount Rate versus AA Bond Yields



Benchmark rate: 10-year AA bond rate

- Following Brown and Wilcox (2009), Brown and Weisbenner (2014)

A Simple Model

- Infinite horizon
- Consider probability of default and profitability upon solvency

Model: Firm Objective

Objective function:

$$v_t = p_t * [\underbrace{(f(i_t) - i_t) + (h(c_t) - c_t)}_{\text{profit in year t}} + \underbrace{\beta v_{t+1}}_{\text{PV}(v_{t+1})}]$$

Setting $v_t^* = (f(i_t) - i_t) + (h(c_t) - c_t) + \beta v_{t+1}$, we have

$$\frac{\partial v_t}{\partial c_t} = \frac{\partial p_t}{\partial c_t} v_t^* + \frac{\partial v_t^*}{\partial c_t} p_t = 0$$

Three scenarios: 1) $\frac{\partial p_t}{\partial c_t} = 0$; 2) $\frac{\partial p_t}{\partial c_t} < 0$; 3) $\frac{\partial p_t}{\partial c_t} > 0$.

First Scenario

p_t is independent of c_t; that is $\frac{\partial p_t}{\partial c_t} = 0$.

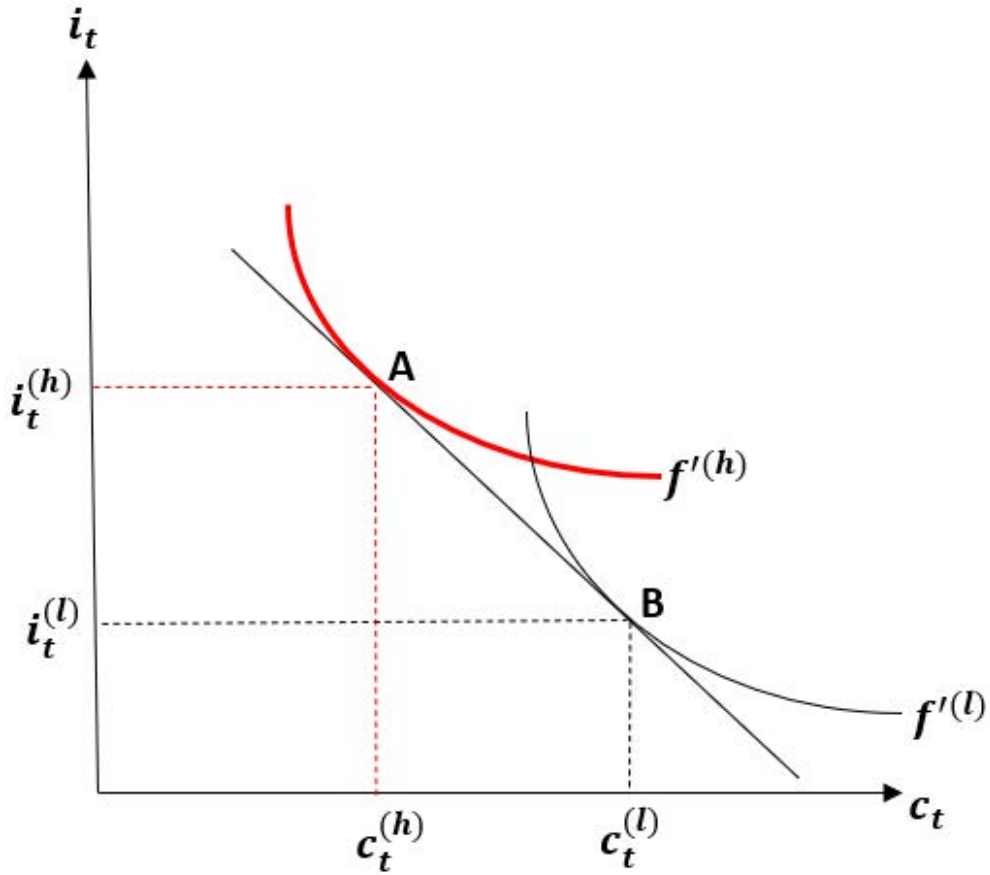
The first order condition is $\frac{\partial v_t^*}{\partial c_t} = 0$.
With pension funding constraint and time consistent relation $\frac{\partial v_t}{\partial c_t} = \frac{\partial v_{t+1}}{\partial c_{t+1}}$

$$\frac{\partial v_t^*}{\partial c_t} = \frac{[f'(i_t) - 1]\frac{\partial i_t}{\partial c_t} + [h'(c_t) - 1]}{1 + \beta r_p} = 0$$

Then,

$$\frac{\partial i_t}{\partial c_t} = -\frac{h'(c_t) - 1}{f'(i_t) - 1}$$

Tradeoff between investment and pension contributions



- Firms with a higher investment productivity invest more and contribute less to pension
- That is, $i^{(h)} > i^{(l)}; c^{(h)} < c^{(l)}$

Effect of Pension Underfunding

Mandatory Contribution vs. Optimal Contribution:

$$c_t \geq c_t^r = \begin{cases} s_t, & \eta_t \geq l_t \\ s_t + (l_t - \eta_t)/30, & \eta_t < l_t \end{cases}$$

$$c_t = max(c_t^*, c_t^r)$$

- s_t: Present value of pension cost for employee service provided in the current year, known as service cost
- η_t is pension asset; l_t is pension liability; c_t^* is optimal pension contribution; c_t^r is required pension contribution
- If $c_t^r > c_t^*$: firms set pension discount rate to lower c_t^r and reduce the deviation from c_t^*

Prediction 1

When pension contribution does not affect firm solvency probability, firms with greater marginal investment productivity set higher pension discount rates.

Second Scenario

p_t is inversely related to c_t; That is, $\frac{\partial p_t}{\partial c_t} < 0$.
Solely considering the inverse relation between p_t and c_t, firm would minimize the contribution to pension when c_t negatively affects the probability of solvency.

Subcase 1: $\frac{\partial v_t^*}{\partial c_t} p_t$ is not enough to switch the sign of $\frac{\partial v_t}{\partial c_t}$ from negative to positive. Then the inverse relation between investment and pension contribution does not hold.
Subcase 2: $\frac{\partial v_t^*}{\partial c_t} p_t > 0$ is strong enough to offset $\frac{\partial v_t}{\partial c_t} < 0$. Then the condition that high investment productivity firms are more likely to set higher pension discount rate continues to hold.

Prediction 2

For firms whose pension contribution increases firm default probability (with low solvency), they would minimize pension contribution by choosing higher pension discount rates. In the meantime, investment is less sensitive to pension contribution.

Third Scenario

p_t is positively related to c_t; That is, $\frac{\partial p_t}{\partial c_t} > 0$.
This is the case that firms over-invest in pension. It is generally unlikely to occur considering a low pension productivity.

Hypotheses

- H1 (Pension Discount Rates over Time): Corporates are more likely to set higher pension discount rates when interest rates **significantly drop**.
- H2 (Investment Productivity and Pension Discount Rates): **Highly productive** firms are more likely to set higher pension discount rates. The effect is stronger among **low financial risk** firms.
- H3 (Corporate Default and Pension Discount Rates): **Higher financial risk** firms set greater pension discount rates.
- H4 (Pension Discount Rates and Funding and Investment): All others being equal, pension funding is higher for firms setting **higher pension discount rates**.
- H5 (Pension Discount Rates and Profitability): Firm **investments and profitability** are higher for firms setting higher pension discount rates. This effect is stronger among firms with **lower financial risk**.

Data and Sample

- Data
  - Compustat and CRSP
  - Bond prices & yields from Enhanced TRACE
  - Other bond information from Mergent FISD

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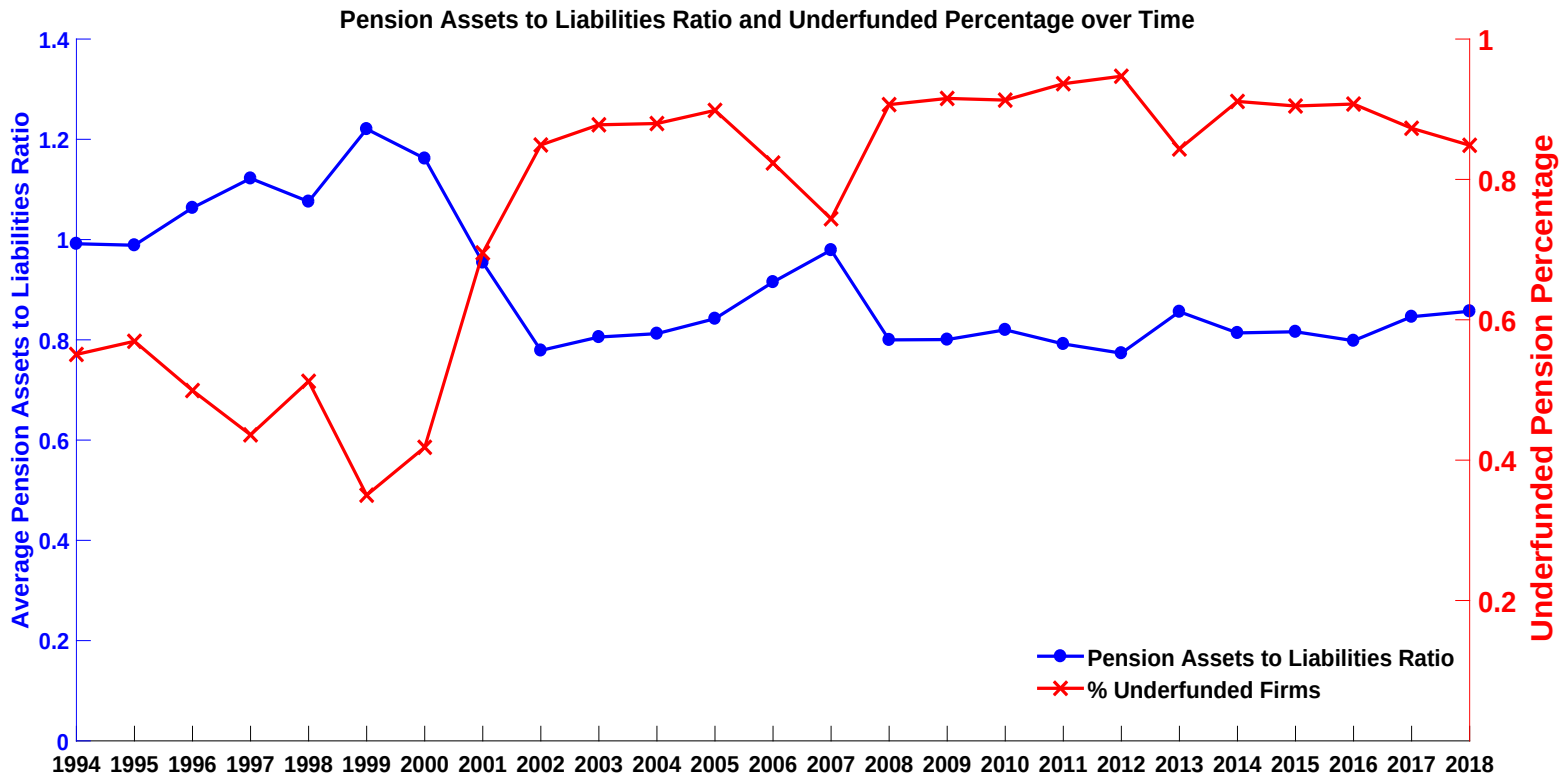
  - Bond prices & yields from Enhanced TRACE
  - Other bond information from Mergent FISD
- Sample
  - 1994-2018
  - Firms having defined benefit pensions (i.e., pension assets and liabilities are available)
  - Having pension discount rate data

Empirical Findings

Pension Funding Status Over Time



Determinants of Pension Discount Rates (Table 3)

$$\text{Pension Discount Rate}_{i,t} = \beta_1 \text{Benchmark Rate}_t + \beta_2 \text{Pension Discount Rate}_{i,t-1}$$
$$\Delta\text{Pension Discount Rate}_{i,t} = \beta_1 \Delta\text{Benchmark Rate}_t + \beta_2 \Delta\text{Benchmark Rate}_t^-$$

	Pension Discount Rate		ΔPension Discount Rate	
Benchmark Rate	0.82***	0.52***		
	(35.76)	(20.82)		
Pension Discount Rate$_{t-1}$		0.43***		
		(12.90)		
ΔBenchmark Rate			0.44***	0.64***
			(19.95)	(10.85)
ΔBenchmark Rate$^-$				-0.31***
				(-5.15)
Industry FE	Yes	Yes	Yes	Yes
Adj R^2	0.77	0.88	0.13	0.14
N	45,447	40,511	40,511	40,511

- Prior pension discount rates have a **strong** effect on the pension discount rate in the current period
- Benchmark rates have an **asymmetric** effect on firm choices of pension discount rates (Hypo. 1)

Determinants of EDR (Table 4)

$$EDR_{i,t} = \beta_1 MPK_{i,t-1} + \beta_2 SOL_{i,t-1} + \beta_3 MPK_{i,t-1} SOL_{i,t-1} + Control_{i,t-1}$$

SOL Proxy:		Rating	Z-Score	DD	Rating	Z-Score	DD
MPK	0.65***				0.33*	0.31	0.36*
	(3.48)				(1.71)	(1.48)	(1.82)
SOL		-0.15***	-0.14***	-0.13***	-0.14***	-0.13***	-0.13***
		(-3.57)	(-3.18)	(-2.97)	(-3.21)	(-2.96)	(-3.07)
MPK*SOL					0.69***	0.62***	0.68***
					(3.34)	(3.02)	(3.28)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.46	0.46	0.46	0.49	0.46	0.46	0.49
N	41,703	45,447	45,447	32,013	41,703	41,703	31,236

- Highly productive firms are more likely to set higher EDR
- The positive association between EDR and investment productivity intensifies among **solvent firms** (Hypo. 2)
- Highly defaultable firms set high pension discount rates (Hypo. 3)

Large Drop Interest Rate Period (Table 5)

Solvency Proxy:		Rating	Z-Score	DD	Rating	Z-Score	DD
Down	0.92***	0.91***	0.88***	0.90***	0.93***	0.89***	0.91***
	(7.63)	(8.13)	(8.22)	(7.17)	(8.38)	(8.33)	(7.38)
MPK	0.41**				0.26	0.22	0.21
	(2.47)				(1.50)	(1.01)	(0.98)
MPK*Down	0.37**				0.12	0.10	0.12
	(2.18)				(0.89)	(0.75)	(0.88)
SOL		-0.11***	-0.12***	-0.11***	-0.11***	-0.12***	-0.10***
		(-2.79)	(-2.95)	(-2.74)	(-2.83)	(-2.88)	(-2.70)
SOL*Down		-0.03*	-0.05**	-0.03	-0.03	-0.08**	-0.01
		(-1.93)	(-2.28)	(-1.10)	(-1.49)	(-2.49)	(-0.42)
MPK*SOL					0.40***	0.38***	0.39***
					(2.88)	(2.80)	(2.81)
MPK*SOL*Down					0.43***	0.38***	0.37***
					(3.18)	(2.95)	(2.94)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.30	0.29	0.29	0.32	0.30	0.30	0.32
N	41,703	45,447	45,447	32,013	41,703	41,703	31,236

- Pension underfunded and mandatory pension contribution is more binding under low interest rates, making productive firms have a greater incentive to set higher rates

Pension Funding and EDR (Table 6)

$$\text{Stage 1} \quad : \quad \text{EDR}_{i,t} = \beta \text{EDR}_{ind,t} + \text{Control}_{i,t}$$

$$\text{Stage 2} \quad : \quad \text{Funding}_{i,t} = \beta \widehat{\text{EDR}}_{i,t-1} + + \text{Control}_{i,t-1}$$

	Funding Ratio		Funding Rank	
$\widehat{\text{EDR}}$	0.15***	0.13***	2.03***	1.80***
	(5.32)	(5.94)	(6.13)	(6.03)
SIZE		0.03***		0.37***
		(3.15)		(3.66)
PenLiab		0.33***		3.11***
		(3.98)		(3.25)
TAX		0.11***		1.71***
		(4.05)		(3.85)
PRET		0.39***		6.03***
		(3.88)		(4.06)
Time FE	Yes	Yes	Yes	Yes
Adj R^2	0.16	0.25	0.06	0.14
N	48,343	46,924	48,343	46,924

- We use industry average EDR as the proxy for individual firm EDR
- Firms with higher discount rate has better pension funding (Hypo. 4)

Discount Rate Effect on Corporate Investment (Table 7)

$$X_{i,t} = \beta_1 \widehat{EDR}_{i,t-1} + \beta_2 SOL_{i,t-1} + \beta_3 \widehat{EDR}_{i,t-1} * SOL_{i,t-1} + Control_{i,t-1}$$

Solvency Proxy:	Rating		Z-Score		DD	
	I/K	IG	I/K	IG	I/K	IG
$\widehat{EDR}$	0.64*	0.79	0.58*	0.61	0.58*	0.64
	(1.90)	(1.51)	(1.75)	(1.03)	(1.81)	(1.19)
SOL	2.04***	3.02***	1.84***	3.52***	3.08***	4.56***
	(3.29)	(5.59)	(2.98)	(6.81)	(4.14)	(7.97)
$\widehat{EDR} * SOL$	1.73***	2.08***	1.67***	1.94***	1.61***	1.87***
	(4.51)	(3.69)	(4.37)	(3.48)	(4.19)	(3.40)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.04	0.05	0.07	0.05	0.06	0.06
N	42,207	41,574	42,207	41,574	30,604	30,210

- I/K: capital expenditure/lagged fixed assets
- IG: capital expenditure growth rate
- Setting higher pension discount rates improves investment of **high solvent** firms

EDR Effect on Firm Operating Performance (Table 8)

$$R_{i,t} = \beta_1 \widehat{EDR}_{i,t-1} + \beta_2 SOL_{i,t-1} + \beta_3 \widehat{EDR}_{i,t-1} * SOL_{i,t-1} + Control_{i,t-1}$$

Solvency Proxy:	Rating		Z-Score		DD	
	ROA	ROE	ROA	ROE	ROA	ROE
$\widehat{EDR}$	0.38**	0.75**	0.29*	0.78**	0.31**	0.74**
	(2.11)	(2.35)	(1.81)	(2.46)	(2.03)	(2.20)
SOL	2.84***	5.09***	3.96***	5.79***	3.89***	6.49***
	(5.64)	(5.54)	(7.15)	(6.21)	(6.89)	(7.32)
$\widehat{EDR} * SOL$	0.45***	1.28***	0.41***	1.06***	0.40***	1.08***
	(3.19)	(3.90)	(2.89)	(3.17)	(2.81)	(3.29)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.09	0.06	0.19	0.09	0.16	0.10
N	44,395	44,389	44,395	44,389	31,977	31,976

- Setting higher pension discount rates improves profitability of **high solvent** firms (Hypo. 5)

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- Firms are more likely to inflation pension discount rate during large interest rate drop period
- Firms with better investment opportunity are more likely to set higher pension discount rates
  - The positive relationship is intensified for low financial risk firms
- A higher pension discount rate increases firms pension funding
- A higher pension discount rate increases firms investment and improves operating performance, especially for low financial risk firms

Thank You!