Long Rates, Life Insurers, and Credit Spreads

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Introduction

- *The corporate bond market* has expanded dramatically in recent years ($12 tn in 2025)
  - It has become the dominant funding source for US firms (vs. $3 tn C&I loans)
  - Credit spreads play an important role in firm borrowing and investment decisions

- *Life insurers* are the largest institutional investors in the US bond market (>20%) +

- How do life insurers matter for corporate bond pricing? Existing literature:
  1. risk-based capital constraint and fire sales (Ellul et al., 2011; Murray and Nikolova, 2022)
  2. stability in crises (Chodorow-Reich et al., 2021; Coppola, 2024)

  This Paper: a new channel through their *interest rate risk exposure*

The Duration Mismatch Channel

- After the GFC, life insurers have sustained large *negative duration gaps*
  - negative duration gap: $D_{\text{asset}} < D_{\text{liability}} \implies D_{\text{net worth}} < 0$
  - 1% $\uparrow$ in the 10-year Treasury yield $\implies$ 6% $\uparrow$ in insurers' market equity
- *The Duration Mismatch Channel*

$$\begin{aligned} \text{10-year Treasury yield} \uparrow &\implies \text{insurers' net worth} \uparrow \\ &\implies \text{risk-bearing capacity} \uparrow, \text{ risky bond demand} \uparrow \\ &\implies \text{equilibrium credit spreads} \downarrow \end{aligned}$$

- *This Paper:* *theoretical model* and *empirical evidence* on the duration mismatch channel

Main Results

- *An Intermediary Asset Pricing Model:*
  1. *Analytical insights:* long rate $\uparrow \implies$ credit spread $\downarrow$ when insurers' duration gap < 0
  2. *Extensions:* quantitative importance, duration management

- *Long Rates and Credit Spreads:*
  1. *Unconditional co-movement:* cov(long rate, credit spread) < 0, esp. in low credit ratings
  2. *High-frequency MP shocks:* long rate $\uparrow \implies$ credit spread $\downarrow$
  3. *Bond issuance:* long rate $\uparrow \implies$ HY bond issuance $\uparrow$ relative to IG bond issuance

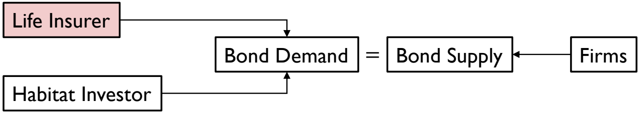
- *The Key Role of Life Insurers:*
  1. *Risk exposure:* life insurers face severe duration mismatch, rates $\uparrow \implies$ net worth $\uparrow$
  2. *Identification via RDD:* life insurer ownership $\uparrow \implies$ stronger co-movement
  3. *Bond transactions:* insurers rebalance towards risky bonds after long rates $\uparrow$

Road Map

1. A Model of the Bond Market
2. The Comovement between Long-term Rates and Credit Spreads
3. The Role of Life Insurers
4. Conclusions

The Duration Mismatch Channel

- I build a model of bond demand from *life insurers*



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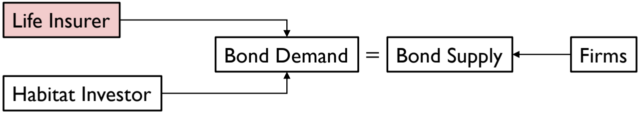

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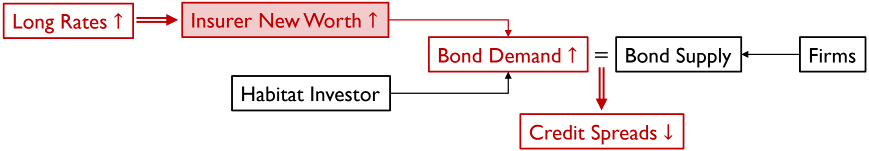

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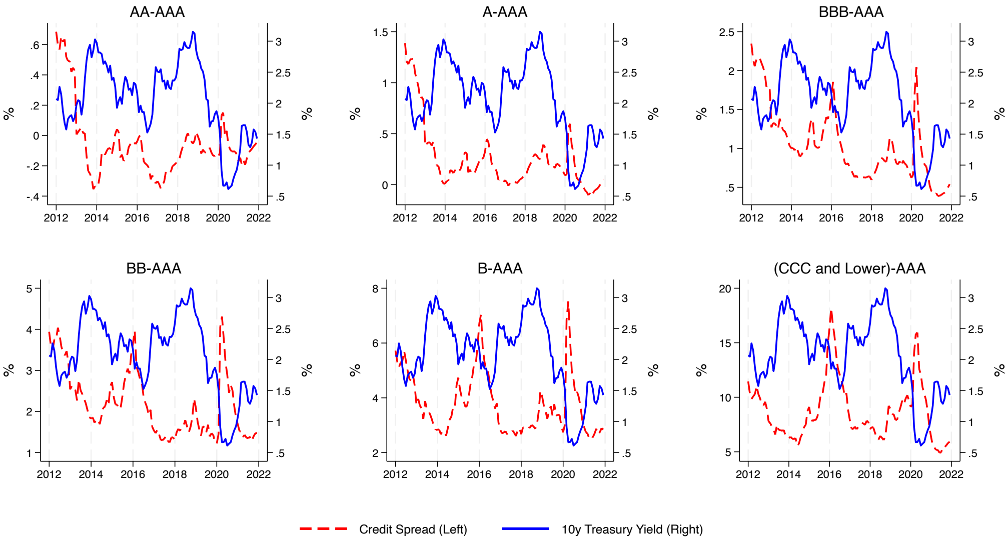
Data

- Data source
  - *Bond Indices:* Intercontinental Exchange (ICE) via FRED
  - *Individual Bond Price and Characteristics:* Mergent FISD and TRACE via WRDS Bond Return
  - *Insurer Holdings & Transactions:* National Association of Insurance Commissioners (NAIC)

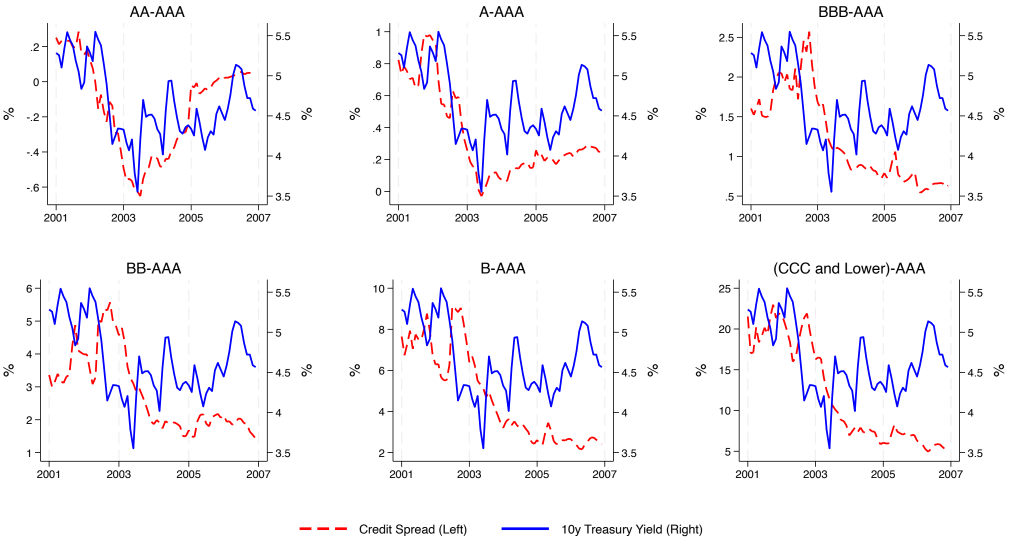
- Corporate bond ratings (Becker and Ivashina, 2015) Details

NAIC Category	Credit Ratings	Investment Grade	5-year Default Rate (1990-2010)	Capital Requirement
NAIC 1 (highest)	AAA, AA, A	✓	0.00%, 0.09%, 0.69%	0.3%
NAIC 2	BBB	✓	2.62%	0.96%
NAIC 3	BB	x	6.76%	3.39%
NAIC 4	B	x	8.99%	7.38%
NAIC 5	CCC	x	34.38%	16.96%
NAIC 6 (lowest)	CC, C, D	x	n.a.	19.50%

Long-term Rate and Credit Spreads (Post-GFC)



Long-term Rate and Credit Spreads (Pre-GFC)

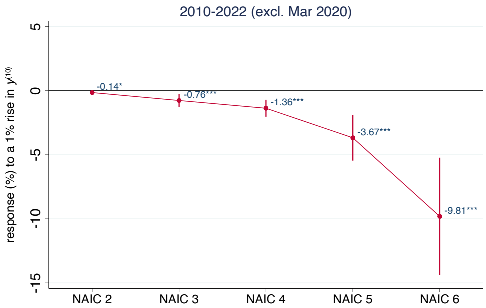


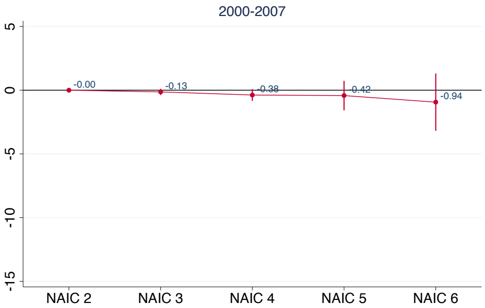
Long-term Rate and Credit Spreads

- I next estimate comovements between *credit spreads* and 10-year yields ‣ by maturity

$$\Delta y_{it} = \alpha_i + \alpha_{D(i),t} + \sum_{k=2}^{6} \beta_k \cdot \mathbf{1}_{\{\text{NAIC } k\}} \cdot \Delta y_t^{(10)} + \Gamma \mathbf{X}_{it} + \varepsilon_{it}$$

  - y_{it}: bond yield α_i: bond FE $\alpha_{D(i),t}$: duration-time FE $y_t^{(10)}$: 10-year yield $\mathbf{X}_{it}$: controls
  - β_k: change in the (NAIC k)−(NAIC 1) spread (%) when $y_t^{(10)}$ increases by 1% ‣ Merton EDF





High-Frequency Evidence from FOMC Meetings

- *Impulse responses* of spreads to high-frequency $y_t^{(10)}$ shocks ▸ Yield ▸ CDS ▸ News

$$\text{Spread}_{t+h} - \text{Spread}_{t-1} = \alpha_h + \beta_h \left(\Delta y_t^{(10)} \big|_{\text{FOMC}} \right) + \varepsilon_{t,h}$$

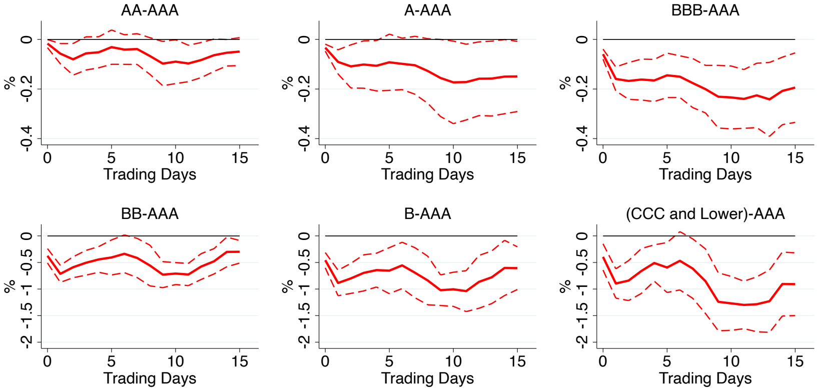


Figure: Cumulative responses to a 1% increase in $y_t^{(10)}$ and 90% confidence intervals **(2010-2022)**

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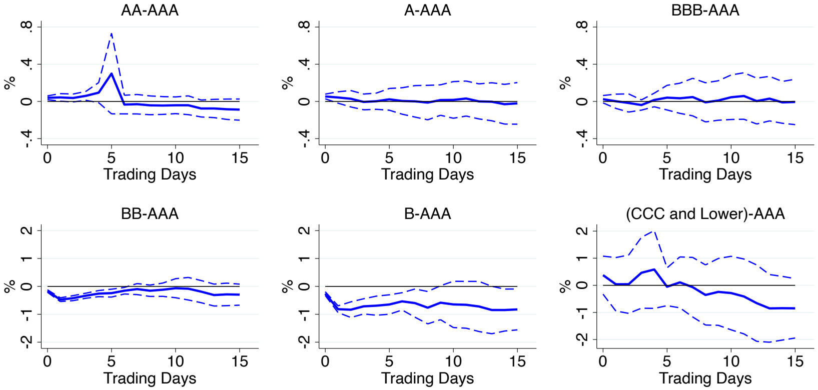
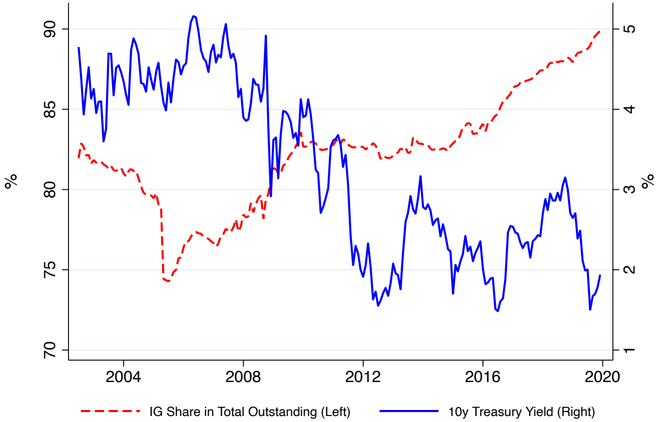


Figure: Cumulative responses to a 1% increase in $y_t^{(10)}$ and 90% confidence intervals **(1997-2007)**

Credit Spreads and Bond Issuance

- Long rate $\downarrow \implies$ Credit Spreads $\uparrow \implies$ HY yield $\uparrow$ against IG yield
- The bond market shifted towards the IG segment amid lower rates post-2008



Road Map

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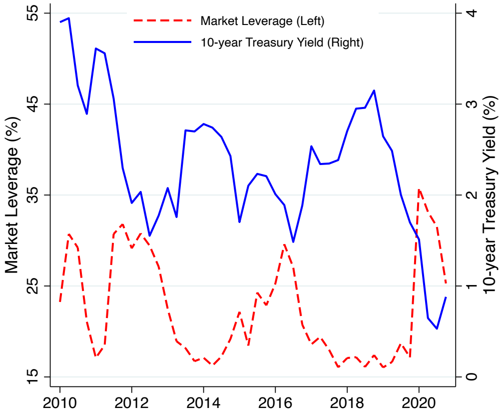
Interest Rate Exposure of Life Insurers

- After the GFC, the duration of life insurers' liabilities exceeded their assets (e.g., Hartley et al., 2016, Ozdagli and Wang 2020) Source D_A, D_L Rolling Estimates

$$y_t^{(10)} \uparrow \Longrightarrow \textit{market equity} \uparrow, \textit{market leverage} \downarrow$$

	Pre-2007	Post-2019
$\Delta y_t^{(10)}$	-0.0723	6.008***
	[0.947]	[0.000]
S&P 500 Return	✓	✓
$\Delta y_t^{(1m)}$	✓	✓
Observations	260	663

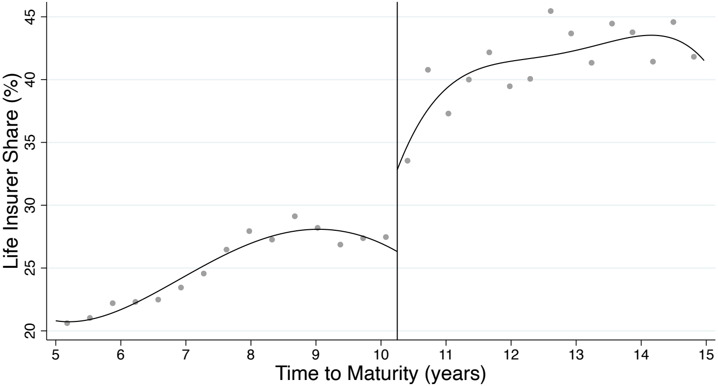
($^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$)



Causal Impact of Life Insurers' Bond Holdings

- Next, I study causal impact of *life insurers' bond holdings* on the negative comovement
- Identification: *regression discontinuity design*
  - Many mutual funds are mandated to invest in bonds with maturity $\leq$ 10 years

  $\Rightarrow$ A discontinuity in investor composition



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  - Many mutual funds are mandated to invest in bonds with maturity $\leq$ 10 years
  - $\Rightarrow$ A discontinuity in investor composition
- Specification: interact $y_t^{(10)}$ with life insurer share $\varphi_{it}^{\text{Ins}}$

$$\Delta y_{it} = \alpha_t + \left(\beta + \gamma \varphi_{it}^{\text{Ins}}\right) \mathbf{1}_{\{\text{NAIC } 3-6\}} \Delta y_t^{(10)} + \Gamma \mathbf{X}_{it} + \varepsilon_{it}.$$

  - β measures comovements between HY-IG spreads and $y_t^{(10)}$ in bonds not held by insurers
  - γ measures how life insurers' ownership enhances the comovement
  - *RDD:* I use the discontinuity to instrument for insurer share $\varphi_{it}^{\text{Ins}}$

$$\varphi_{it}^{\text{Ins}} = \alpha + \delta \cdot \mathbf{1}_{\{\text{maturity}_{it} > c\}} + \Gamma \mathbf{X}_{it} + \varepsilon_{it}$$

First Stage: Discontinuity

- First stage

$$\varphi_{it}^{\text{Ins}} = \alpha + \beta \cdot \mathbf{1}_{\{\text{maturity}_{it} > c\}} + \Gamma \mathbf{X}_{it} + \varepsilon_{it}$$

- I test the validity of the discontinuity using the robust bias-corrected method developed by Calonico, Cattaneo, and Titiunik (2014)

Method	δ	p-value	[95% Conf. Interval]
OLS	4.73	0.000	[4.15, 5.32]
RDD, Conventional	4.43	0.000	[2.46, 6.39]
RDD, Bias-corrected	4.52	0.000	[2.55, 6.48]
RDD, Bias-corrected, Robust	4.52	0.000	[2.22, 6.81]

Second Stage: Life Insurers and Credit Spreads

$$\Delta y_{it} = \alpha_t + \left(\beta + \gamma \varphi_{it}^{\text{Ins}}\right) \mathbf{1}_{\{\text{NAIC } 3-6\}} \Delta y_t^{(10)} + \Gamma \mathbf{X}_{it} + \varepsilon_{it}.$$

- *Hypothesis:* $\gamma < 0$ (i.e., insurance ownership $\uparrow \implies$ stronger negative comovements)
- Post-GFC, the negative comovement is stronger in *bonds owned more by life insurers*

	Pre-2007	Post-2009
γ	-1.529	-13.81***
	[0.593]	[0.001]
Controls	✓	✓
Time FE	✓	✓
Kleibergen-Paap F-stat	131.927	79.925
Observations	4447	10795

▸ Cutoff ▸ Holding Stats ▸ Pass-through ▸ Robustness: Excluding New Bonds, Issuance Maturity > 10yrs

Life Insurers' Bond Transactions

- Next, I examine how insurers adjust *bond transactions* following changes in $y_t^{(10)}$

$$\Delta\left(\frac{\text{Net Purchase}_t^{\text{HY}, h}}{\text{Net Purchase}_t^{\text{Total}, h}}\right) = \alpha + \beta \cdot \Delta y_t^{(10)} + \Gamma \mathbf{X}_t + \varepsilon_t$$

  – *Hypothesis ($\beta > 0$):* $y_t^{(10)} \uparrow \implies$ risk-bearing capacity $\uparrow \implies$ more risky bond purchases

	Pre-2007		Post-2009	
	$h = 3m$	$h = 6m$	$h = 3m$	$h = 6m$
β	-0.269	0.562	0.750*	2.346***
	[0.571]	[0.280]	[0.071]	[0.000]
R^2	.537	.723	.305	.387
Observations	54	54	114	111

Life Insurers' Bond Transactions

- *Variable annuity (VA) insurers* are more exposed than non-VA insurers
  - VAs typically have minimum return guarantees (e.g., 2% for 10 years), which have very high convexity and caused negative duration gaps post-2008 (Koijen Yogo, 2022; Sen, 2022)
- VA insurers should adjust their bond purchases more in response to long rates

$$\Delta\left(\frac{\text{Net Purchase}_{jt}^{\text{HY}, h}}{\text{Net Purchase}_{jt}^{\text{Total}, h}}\right) = \alpha_j + \alpha_t + \beta \cdot (\text{VA Share})_{j,2009} \cdot \Delta y_t^{(10)} + \Gamma \mathbf{X}_{jt} + \varepsilon_{jt}$$

	$h = 3m$		$h = 6m$	
$(\text{VA Share})_{j,2009} \cdot \Delta y_t^{(10)}$	0.133^{**}	0.152^{**}	0.926^{***}	0.963^{***}
	[0.016]	[0.012]	[0.000]	[0.000]
Insurer FE	✓	✓	✓	✓
Time FE		✓		✓
R^2	.009	.021	.019	.034
Observations	27518	27518	23755	23755

Quantity Purchased and Back-of-the-Envelope Calculations

- How net purchases of HY bonds move relative to net purchases of IG bonds

$$\text{Net Purchase}_t^{\text{NAIC } k,\, h} = \alpha_t + \sum \beta_k \cdot \mathbf{1}_{\{\text{NAIC } k\}} \cdot \Delta y_t^{(10)} + \Gamma \mathbf{X}_t + \varepsilon_t$$

  - $\beta_k = \Delta(\text{NAIC } k \text{ purchases}) - \Delta(\text{IG purchases})$ if $y_t^{(10)} \uparrow 1\%$

	Pre-2007	Post-2009
β_3	0.712	6.112^{**}
	[0.855]	[0.017]
β_4	0.549	6.900^{**}
	[0.892]	[0.014]
β_{5-6}	0.659	7.268^{**}
	[0.878]	[0.013]
Time FE	✓	✓
R^2	.162	.108
Observations	270	582

- Excess HY purchase = 6.11 + 6.90 + 7.27 = 20.28 bn
- Total HY outstanding = 727.6 bn
- Fraction purchased = 20.28 / 727.6 = 2.8%
- Active MF elasticity = 0.75 (Darmouni et al., 2025)
- Price impact = 2.8%/0.75 = 3.73%
- HY bond duration = 4.45 yrs
- *Spread impact ≈ 3.73%/4.45 = 0.84%*
- *Empirical counterpart: 1.27%*

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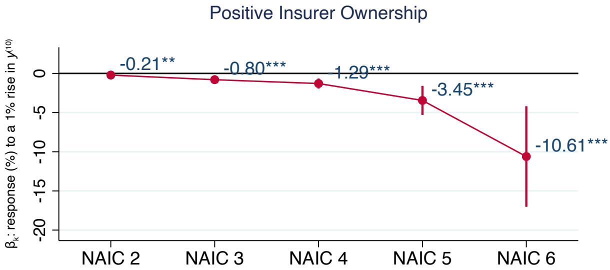
Conclusions

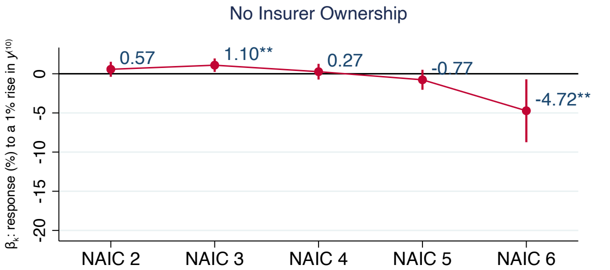
- I propose a *duration mismatch channel* where life insurers' interest rate risk exposure affects corporate bond pricing
  - long rates $\uparrow \implies$ net worth $\uparrow \implies$ risk-bearing capacity $\uparrow \implies$ credit spreads $\downarrow$
- Consistent with the channel, I find an *empirical shift* in how bond credit spreads co-moves with long rates
  - after the GFC, credit spreads tighten when the 10-year Treasury yield increases
- In the *cross-section*, the channel is stronger in bonds held more by life insurers
- Implications for (unconventional) *monetary policy*

Appendix

Life Insurers and Long Rate Pass-through

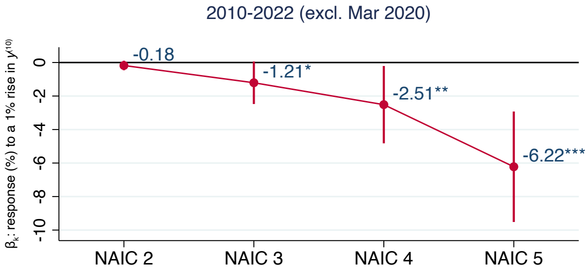
Return

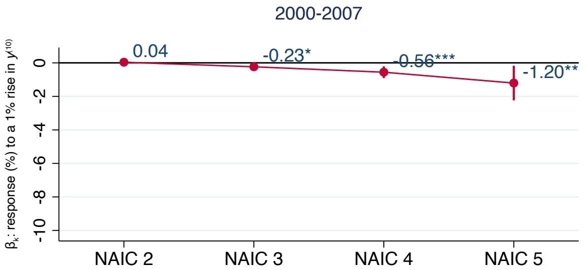




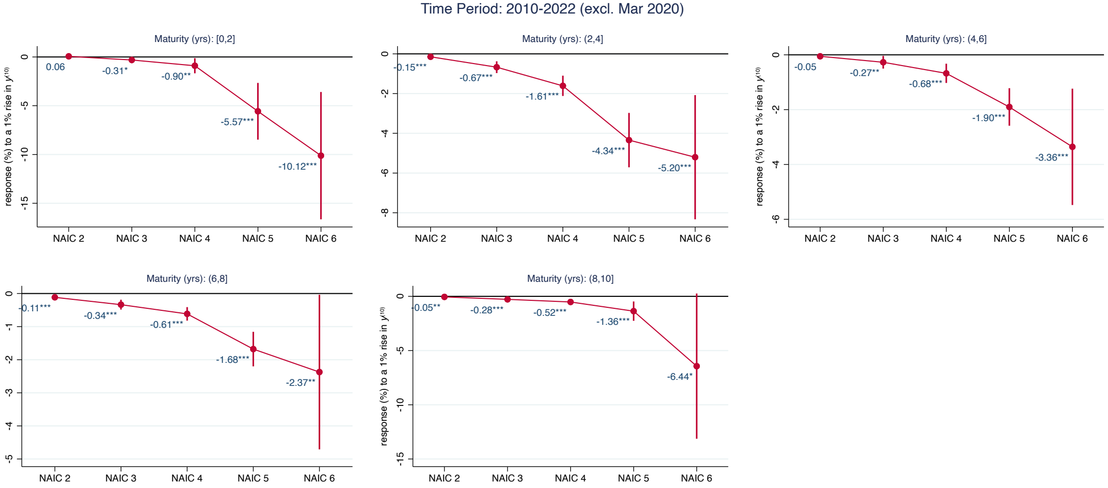
Controlling for Merton's Expected Default Frequency (EDF)

◂ Return





Results for Different Maturity Categories

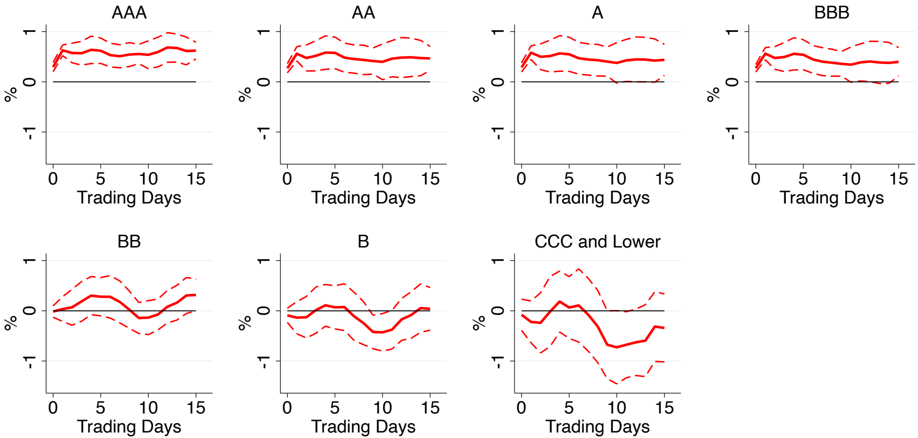


Return

Local Projection

- *Impulse responses* of bond yield indices

$$\text{Yield}_{t+h} - \text{Yield}_{t-1} = \alpha_h + \beta_h \left(\Delta y_t^{(10)} \Big|_{\text{FOMC}} \right) + \varepsilon_{t,h}$$

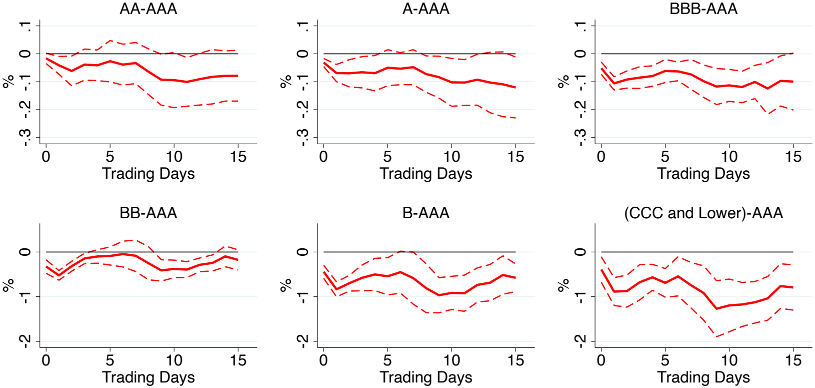


Return

Controlling for CDS Spreads

- Control for 1-month rate shocks and average CDS spreads of each category

$$\text{Spread}^k_{t+h} - \text{Spread}^k_{t-1} = \alpha_h + \beta_h \left(\Delta y_t^{(10)} \big|_{\text{FOMC}} \right)$$
$$+ \gamma_h \left(\Delta y_t^{(1m)} \big|_{\text{FOMC}} \right) + \delta_h \left(\Delta(\text{CDS Spread})_t^{\text{Rating } k-AAA} \big|_{\text{FOMC}} \right) + \varepsilon_{t,h}.$$



Return

Endogenous Policy Response

- Monetary policy might respond to economic news (Bauer and Swanson, 2022)
  - But, such news mostly impacts near-term rates and should have small effects on long rates
  - Shocks to $y_t^{(10)}$ mostly reflect changes in expected future interest rates

- Hillenbrand (2023):

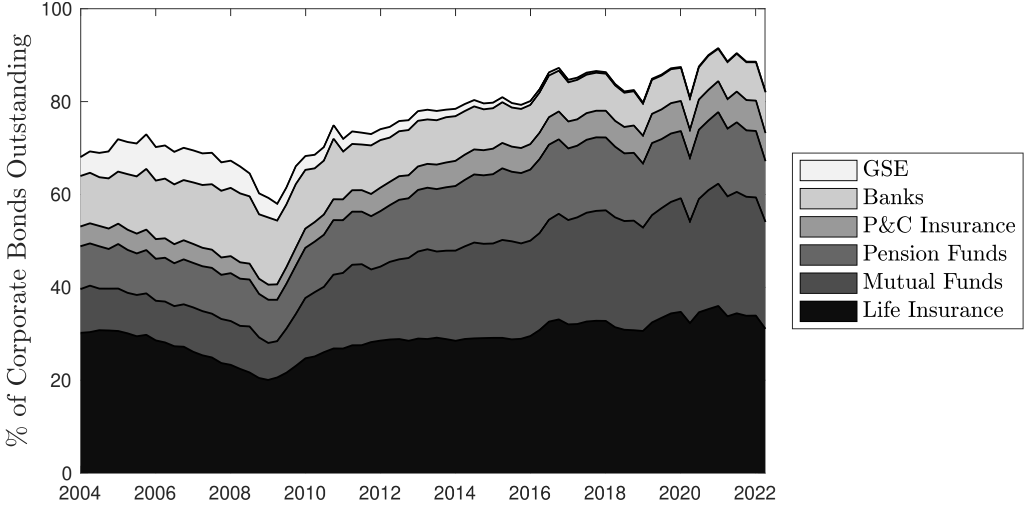
$$\Delta y_{t_i}^{(10)}\Big|_{\text{FOMC}_i} = \beta_0 + \beta_1 X_{t_i-2} + \varepsilon_i$$

None of the main variables in Bauer and Swanson (2022) predicts changes in $y_t^{(10)}$

  - (changes in the) level and slope of the yield curve
  - stock returns, Δcommodity prices, ΔVIX
  - economic activity indices, labor market surprises
  - NBER recessions

Return

Bond Ownership



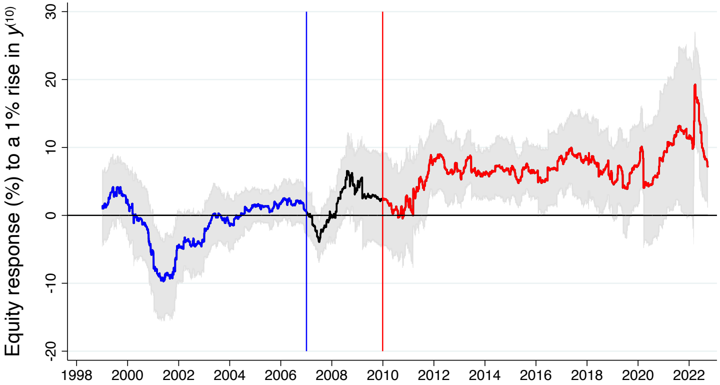
Return

Life Insurer Duration Mismatch

- Two-year rolling estimates of

$$\text{ExcessReturn}_{i,t} = \alpha + \beta \Delta y_t^{(10)} + \text{Controls} + \varepsilon_{i,t}$$

- Estimated exposure to interest rate risk $\hat{\beta}_t$



Return

Drivers of Insurers' Duration Mismatch Post-2008

1. Low interest rates increased the duration of liabilities more than assets

$$\frac{\partial D_L}{\partial(-y)} = \text{Convexity}_L > \text{Convexity}_A = \frac{\partial D_A}{\partial(-y)}$$

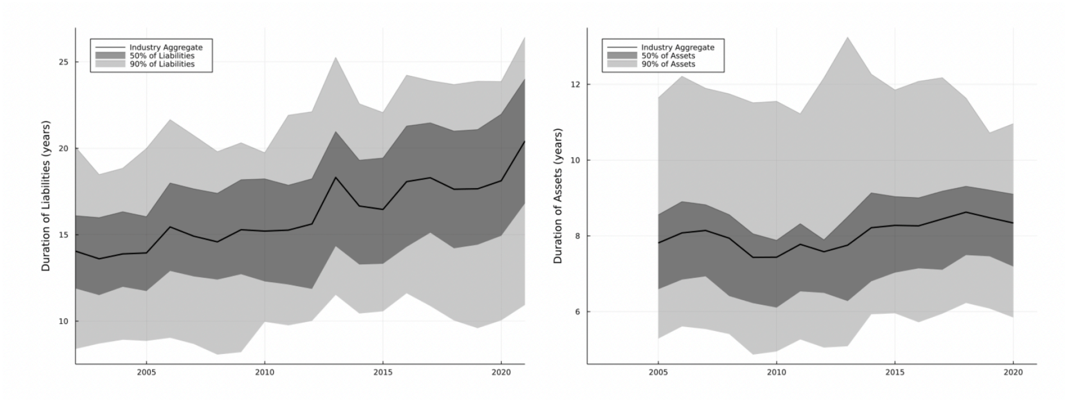
   - Liabilities are longer
   - Embedded options in annuity liabilities exercised less when rates are low, effectively extending the duration of annuities

2. Institutional factors
   - Market incompleteness / Scarcity of long-term assets
     - the typical duration of bonds and MBS is 8-10 years
     - the duration of insurers' liabilities increased from 13-15 years to almost 20 years
   - Regulatory distortions (Sen, 2022; Huber, 2022)
     - regulatory equity is a mix of book equity and market equity

◂ Return: Intro ◂ Return: Section 3

Life Insurer Duration Mismatch

- The duration of life insurers' liabilities and assets (Huber, 2022)



Return to Intro Return to Section 3

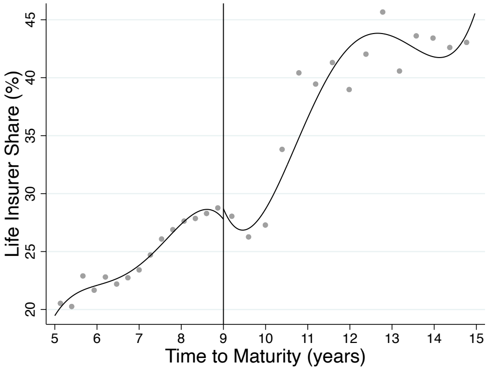
Life Insurer Bold Holdings

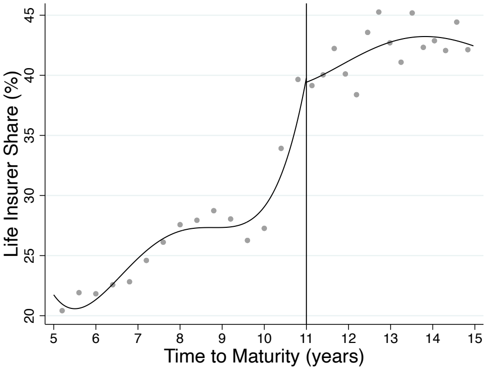
	$\mathbf{1}\{\varphi_{it}^{\text{Ins}} > 0\}$	$\mathbb{E}_t[\varphi_{it}^{\text{Ins}} \mid \varphi_{it}^{\text{Ins}} > 0]$	$\max \varphi_{it}^{\text{Ins}}$	Amount Outstanding ($ bn)
NAIC 1	88.7%	29.4%	100%	2268.3
NAIC 2	93.6%	31.7%	100%	1821.2
NAIC 3	89.3%	13.0%	98.0%	381.3
NAIC 4	79.5%	5.6%	90.9%	254.0
NAIC 5	58.8%	3.4%	75.7%	80.2
NAIC 6	31.5%	2.4%	64.9%	12.1
NAIC 1-2	91.0%	30.5%	100%	4089.5
NAIC 3-6	80.9%	9.3%	98.0%	727.6

Table: Life Insurance Ownership (2010-2019).

Return: Data Return: Insurer Return: RDD

First Stage: Cutoff Choice





Return

Robustness: Excluding New Issues & Maturity at Issuance

	Bond Age $> 1m$	Issuance Maturity > 10.25
γ	-13.78***	-12.02***
	[0.001]	[0.000]
Controls	✓	✓
Time FE	✓	✓
Kleibergen-Paap F-stat	79.859	75.024
Observations	10680	3427

Note: t-statistics based on clustered standard errors in brackets. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Return