Long-term investors and the yield curve

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1. What shapes the yield curve?

Current literature

- Uses **price data** alone to test preferred habitat theory (e.g. Greenwood and Vayanos 2010, Greenwood and Vissing-Jorgensen 2018).

This paper

- Uses **holdings data** to estimate demand curves of long-term investors.
  - Identification: change in regulatory yield curve
- Validates the findings using a model with mean-variance preferences in an asset liability context.

Main findings

- Investors that pay out in the distant future decrease long-term bond holdings to a larger extent compared to investors that pay out over a shorter horizon.
- Constrained investors decrease long-term bond holdings to a larger extent compared to less constrained investors.

Why is this important?

- Causality between demand and prices is difficult to obtain
  - This paper provides direct evidence that behavior of pension funds and insurers affects asset prices.

2. Motivating theory

Optimization problem

- Consider mean-variance preferences over capital (Sharpe and Tint 1990):

$$\max_{w_{t-1}} \quad \mathbb{E}[u(A_t - L_t)]$$
$$= \quad \max_{w_{t-1}} \mathbb{E}[A_t - L_t^E] - \frac{\gamma}{2}\mathrm{Var}[A_t - L_t^E] - \frac{\nu}{2}\lambda(F_t^R)\mathrm{Var}[A_t - L_t^R].$$

- Assets evolve as:

$$A_t = (1 + w_{t-1}' r_t) A_{t-1}.$$

- The economic value of liabilities evolves as:

$$L_t^E = (1 - D_L \triangle y) L_{t-1}^E,$$

- The regulatory value of liabilities evolves as:

$$L_t^R = (1 - \xi_L D_L \triangle y) L_{t-1}^R.$$

- Solving results in:

$$w_{t-1}^* = \underbrace{\frac{\mathbb{E}[r_t]}{A_{t-1}(\gamma + \nu\lambda(F_{t-1}^R))\mathrm{Var}[r_t]}}_{\text{speculative portfolio}} + \underbrace{\frac{\gamma}{\gamma + \nu\lambda(F_{t-1}^R)}(F_{t-1}^E)^{-1} D_L \frac{\mathrm{Cov}[r_t, \triangle y]}{\mathrm{Var}[r_t]}}_{\text{economic hedging portfolio}}$$
$$+ \underbrace{\frac{\nu\lambda(F_{t-1}^R)}{\gamma + \nu\lambda(F_{t-1}^R)}(F_{t-1}^R)^{-1}\xi_L D_L \frac{\mathrm{Cov}[r_t, \triangle y]}{\mathrm{Var}[r_t]}}_{\text{regulatory hedging portfolio}}$$

Testable implications

1. Institutional investors with long liability durations decrease long-term holdings more compared to institutional investors with short liability durations.
2. Institutional investors close to their capital requirement decrease long-term holdings more compared to institutional investors above their capital requirement.

3. Regulatory yield curve became less dependent on market interest rates

Change regulatory yield curve on July 2, 2012 in the Netherlands

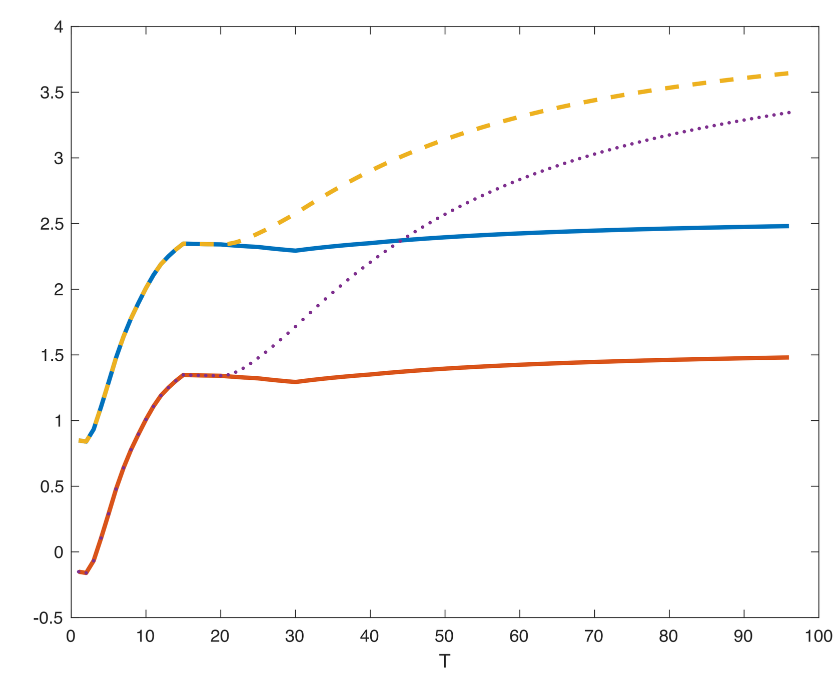

Figure 1*: This graph shows the economic yield curve (solid blue line) and the regulatory yield curve (dashed yellow line) at implementation of UFR on July 2, 2012. The graph also shows the economic (solid red line) and regulatory (dotted purple line) yield curve after a parallel shock in market interest rates of Δy = -1%.*

4. Regulatory change increases long-term yields

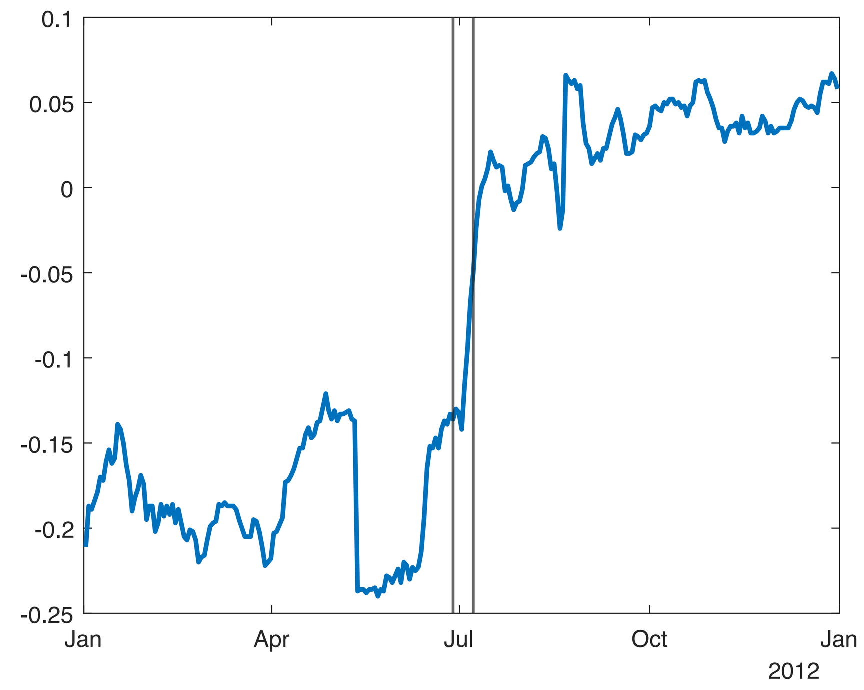

Figure 2*: This graph shows the 30-20 year Dutch government bond spread for 2012. The two vertical lines indicate two days before and after the change in the regulatory yield curve.*

5. Regulatory change decreases long-term bond holdings

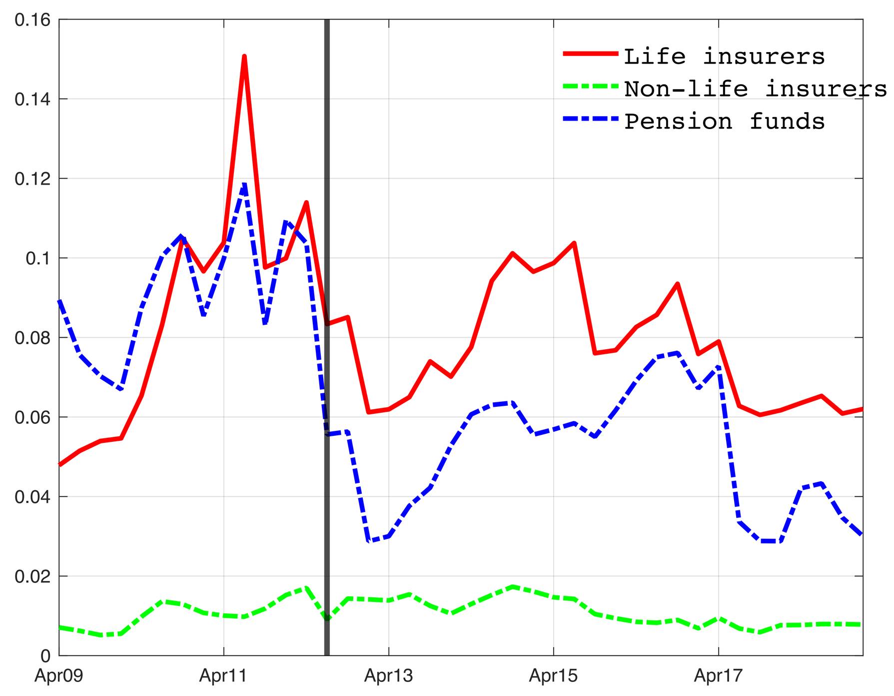

Figure 3*: This graph shows change in bond holdings with time-to-maturity 30 years or longer for life insurers, non-life insurers, and pension funds.*

6. Empirical methodology

1.
$$q_{it}^{long} = \alpha + \delta' \mathrm{UFR}_t + \beta' X_{it} + \epsilon_{it},$$

where $\delta = \delta_0 + \delta_1 \times \mathrm{D}_{L,i}^{2012q1}$.

	q^{long}	q^{long}
UFR	−0.012	
	(0.013)	
UFR × D_L	−0.003***	−0.003***
	(0.001)	(0.001)
Controls	Yes	Yes
Fund FE	No	Yes
Year FE	No	Yes
N	3,642	3,642
R^2	0.16	0.45

- Average euro amount decrease in long-term bond holdings equals 14 x -0.003 x 3.6 billion = 0.15 billion.
- Aggregate decrease in long-term bond holdings equals 10 billion.

2.
$$q_{it}^{long} = \alpha + \delta' \mathrm{UFR}_t + \beta' X_{it} +_i + \epsilon_{it},$$

where $\delta = \delta_0 + \delta_1 \times \mathrm{D}_{L,i}^{2012q1} + \delta_2 \times \mathrm{HF}_i^{2012q1}$.

	q^{long}	q^{long}
UFR	−0.101**	
	(0.077)	
UFR × D_L	−0.004**	−0.004**
	(0.002)	(0.002)
UFR × HF	0.065***	0.076***
	(0.023)	(0.029)
Controls	Yes	Yes
Fund FE	No	Yes
Year FE	No	Yes
N	1,462	1,462
R^2	0.09	0.36

- Funded pension funds decrease long-term bond holdings with 50% less compared to constrained pension funds.

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