TILBURG ◆ ❖ ◆ UNIVERSITY

Pension fund's illiquid assets allocation under liquidity and capital requirements

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This is shown by several studies

- Average illiquid asset allocation of large pension funds in 34 countries was 15 percent in 2014 (OECD (2015))
- Allocation to illiquid assets of the largest pension markets worldwide was 25 percent in 2017 (Willis Towers Watson (2018))

Yet, little is known about illiquid assets allocation decisions...

Benefits for pension funds to invest in illiquid assets

- Liquidity premium
- Portfolio diversification
- Liability hedging

# We chose the following asset classes to be illiquid

- Direct and non-listed real estate
- Mortgages
- Private equity
- Hedge funds
- Infrastructure

- Defined Benefit plans covering 90 percent of work force
- Total AUM equals 1.5 times the GDP of the Netherlands
- No quantitative investment restrictions
- Marked-to-market valuation of assets and liabilities
- Risk based capital requirements

Conventional wisdom says that a longer investment horizon allows to invest more in illiquid assets
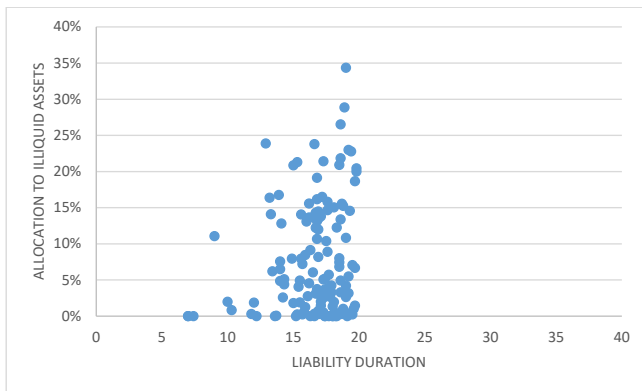
Research question - why do we observe that young pension funds do not invest more in illiquid assets compared to old pension funds?
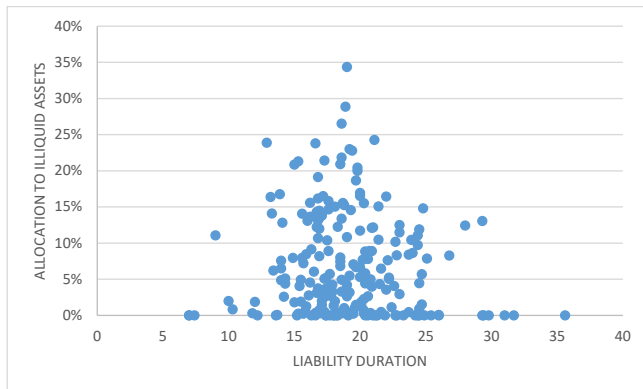
Liquidity requirements (Ang et al. (2014))

Pension funds require sufficient cash and highly liquid assets for

- short-term pension payments
- collateral on interest rate and currency derivatives

Capital requirements (Sias (2004), Andonov et al. (2016))

Pension funds need to have sufficient capital to manage

- market-, interest rate-, exchange rate- and longevity risk

- Liability duration
- Hedging using derivatives

- Higher liability duration implies fewer short term pension payments (less liquidity constrained)
- Higher liability duration implies a higher interest rate risk exposure (more capital constrained)

Hedging interest rate and currency risk also affects both liquidity and capital requirement

- Hedging interest rate and currency risk increases collateral requirements (more liquidity constrained)
- Hedging interest rate and currency risk decreases the exposure to interest rate and currency risk (less capital constrained)

Model based intuition

- Assume a homogeneous group of participants
- Pension benefit is A annually
- Mortality rate λ
- Flat term structure of market interest rates at r

The value of the liabilities equals

$$L = \int_0^\infty A \exp(-(r + \lambda)t)dt = \frac{A}{r + \lambda} \quad (1)$$

The duration of the liabilities equals

$$D_L = -\frac{1}{L}\frac{dL}{dr} = \frac{1}{r + \lambda} \quad (2)$$

The short-term pension payments equal

$$LR_P = \frac{A}{A(r+\lambda)^{-1}} = r + \lambda \tag{3}$$

Using the expression for duration this can be written as

$$LR_P = \frac{1}{D_L} \tag{4}$$

The pension fund hedges ϕ^R of interest rate risk inherent to the liabilities L with receiver swaps. The margin call requirement equals

$$MC_R = \phi^R D_L |dr| \tag{5}$$

The pension fund hedges ϕ^{FX} of fraction w^{FX} invested in foreign currencies with forwards. The margin call requirement equals

$$MC_{FX} = w^{FX} \phi^{FX} |dFX| \tag{6}$$

The capital requirement for interest rate risk equals
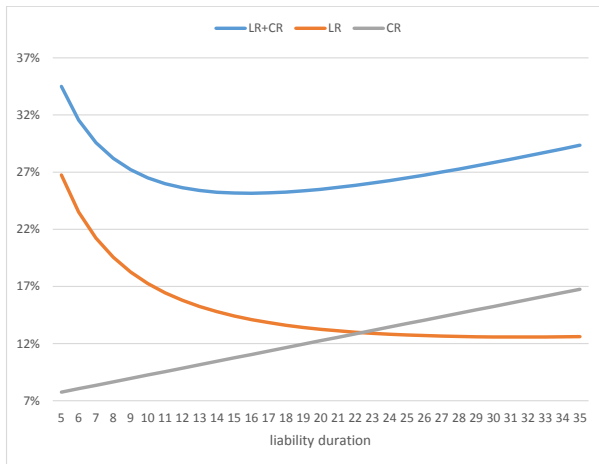
$$CR_R = (1 - \phi^R - \phi^B)D_L|dr| \tag{7}$$

The capital requirement for foreign exchange rate risk equals

$$CR_{FX} = w^{FX}(1 - \phi^{FX})|dFX| \tag{8}$$

We combine the liquidity and capital requirements

$$LR + CR = \frac{1}{D_L} + (1 - \phi^B)D_L|dr| + w^{FX}|dFX| \qquad (9)$$

- Sample period 2012-2017, quarterly data
- 220 Dutch pension funds
- Strategic asset allocations
- Liability duration
- Market value interest rate and currency derivatives
- Other controls: size, pension fund type, funding ratio

Summary statistics

Panel A: asset allocations	mean	std. dev.	p10	p50	p90	obs.
Liquid assets						
government bonds	0.33	0.20	0.05	0.33	0.60	4,997
stocks mature markets	0.29	0.13	0.16	0.27	0.43	4,997
credits	0.18	0.12	0.00	0.17	0.34	4,997
stocks emerging markets	0.05	0.04	0.00	0.05	0.10	4,997
inflation index-linked bonds	0.02	0.05	0.00	0.00	0.08	4,997
cash and short-term receivables	0.01	0.07	0.00	0.00	0.03	4,997
listed real estate	0.02	0.03	0.00	0.00	0.05	4,997
commodities	0.01	0.02	0.00	0.00	0.05	4,997
Illiquid assets						
non-listed real estate	0.04	0.05	0.00	0.03	0.12	4,997
mortgages	0.02	0.04	0.00	0.00	0.07	4,997
private equity	0.01	0.02	0.00	0.00	0.05	4,997
hedge funds	0.01	0.02	0.00	0.00	0.04	4,997

Summary statistics cont'd

Panel B: variables	mean	std. dev.	p10	p50	p90	obs.
Allocation to illiquid assets	0.08	0.08	0.00	0.06	0.20	4,997
Allocation to liquid risky assets	0.56	0.17	0.35	0.55	0.80	4,997
Liability duration	18.9	3.97	14.60	18.60	23.90	4,978
CR on interest rate derivatives	0.05	0.04	0.00	0.04	0.10	4,973
CR on currency derivatives	0.05	0.04	0.00	0.05	0.10	4,991
Liability hedging bonds	0.25	0.14	0.09	0.22	0.45	4,940
Foreign investments	0.22	0.22	0.00	0.20	0.51	3,682
Log of total AUM	5.84	0.81	5.00	5.79	6.86	4,997
Required funding ratio	1.16	0.07	1.10	1.16	1.23	4,992
Actual funding ratio	1.09	0.13	0.96	1.07	1.22	4,992

Regression model (Tobit):

$$w_{it}^{ILLIQ} = \beta_0 + \beta_1 D_{L,it} + \beta_2 D_{L,it}^2 + \beta_3 CRr_{it} + \beta_4 CRcurr_{it} + \beta_5 \phi_{it}^B + \beta_6 w_{it}^{FX}$$
$$+ \beta_7 Size_{it} + \beta_8 Type_i + \beta_9 Rfr_{it} + \beta_{10} Fr_{it} + \lambda_t + \epsilon_{it}$$
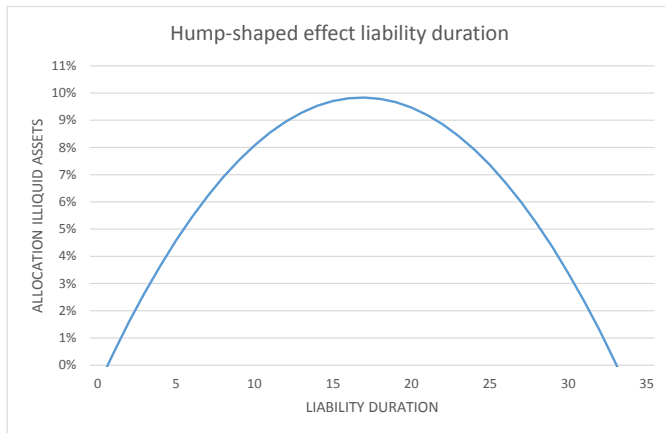
where

$$CRr_{it} = \frac{|(MV_{s,it}^r - MV_{c,it}^r)|}{AUM_{it}} \qquad \text{(proxy for } \phi_{it}^R\text{)}$$

$$CRcurr_{it} = \frac{|(MV_{s,it}^{curr} - MV_{c,it}^{curr})|}{AUM_{it}} \qquad \text{(proxy for } \phi_{it}^{FX}\text{)}$$

	strategic w_{it}^{ILLIQ}	actual w_{it}^{ILLIQ}
$D_{L,it}$	0.0123***	0.0071**
	(0.0039)	(0.0035)
$D^2_{L,it}$	-0.0004***	-0.0002***
	(0.0001)	(0.0001)
Controls	Yes	Yes
Time FI	Yes	Yes

The average liquidity and capital requirement is lowest for pension funds with a liability duration equal to 17 years.

Interest rate hedging does not affect the illiquid asset allocation, whereas currency hedging affects the illiquid asset allocation positively (capital requirement)

	strategic w_{it}^{ILLIQ}	actual w_{it}^{ILLIQ}
CRr_{it}	-0.0141	0.0397
	(0.0405)	(0.0364)
$CRcurr_{it}$	0.1371^{***}	0.0255
	(0.0255)	(0.0229)
Controls	Yes	Yes
Time FI	Yes	Yes

Larger pension funds invest more in illiquid assets and corporate pension funds invest less in illiquid assets

	strategic w_{it}^{ILLIQ}	actual w_{it}^{ILLIQ}
Size$_{it}$	0.0566***	0.0486***
	(0.0075)	(0.0064)
Corp$_i$	-0.0454***	-0.0351***
	(0.0144)	(0.0001)
Prof$_i$	0.0068	0.0050
	(0.0288)	(0.0239)
Controls	Yes	Yes
Time FI	Yes	Yes

Answer: Young pension funds have a high capital requirement (high interest rate risk exposure) which limits opportunities to invest in illiquid assets.

What about illiquid assets allocation in different regulatory frameworks?

- often absence of a risk-based capital requirement
  - $\rightarrow$ empirically observe higher illiquid assets allocation in Canada and the U.S.