Rainy Day Liquidity

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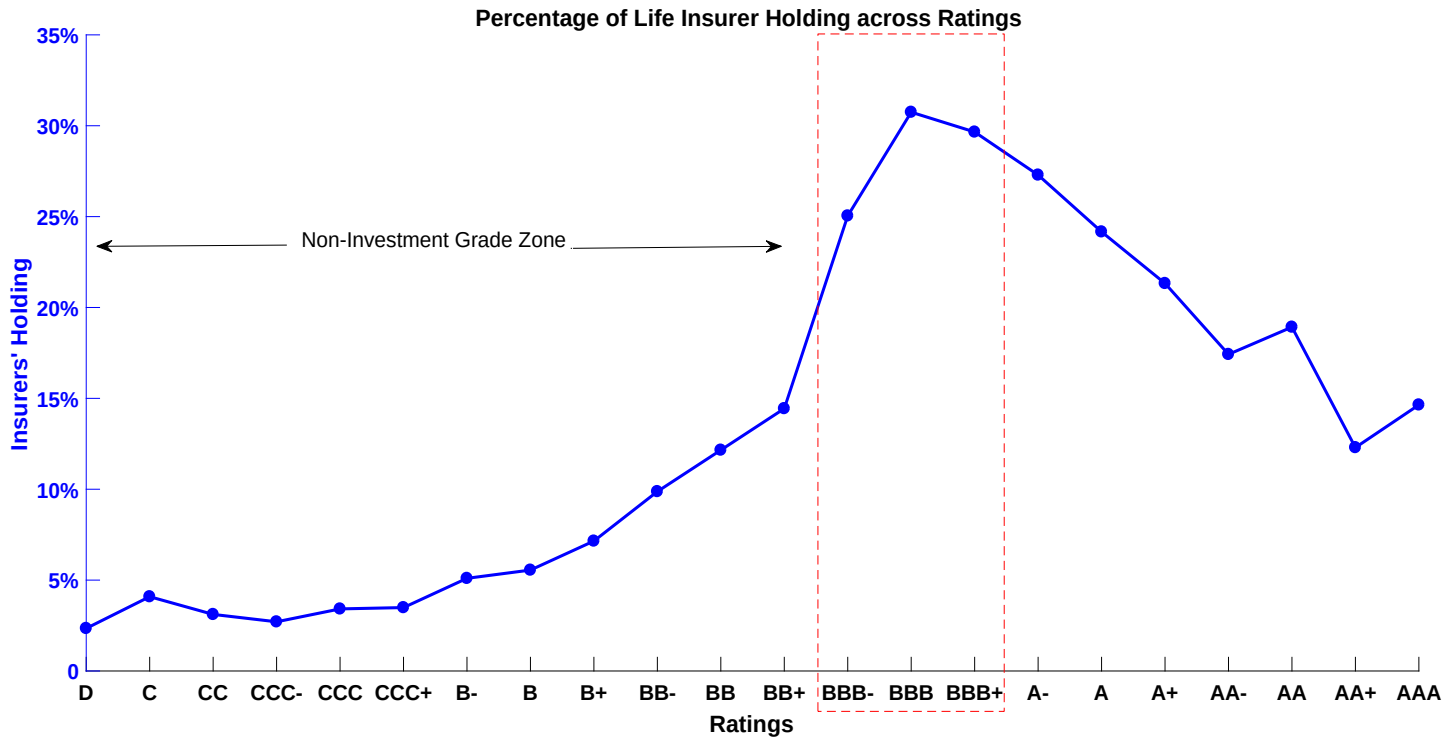
Motivations

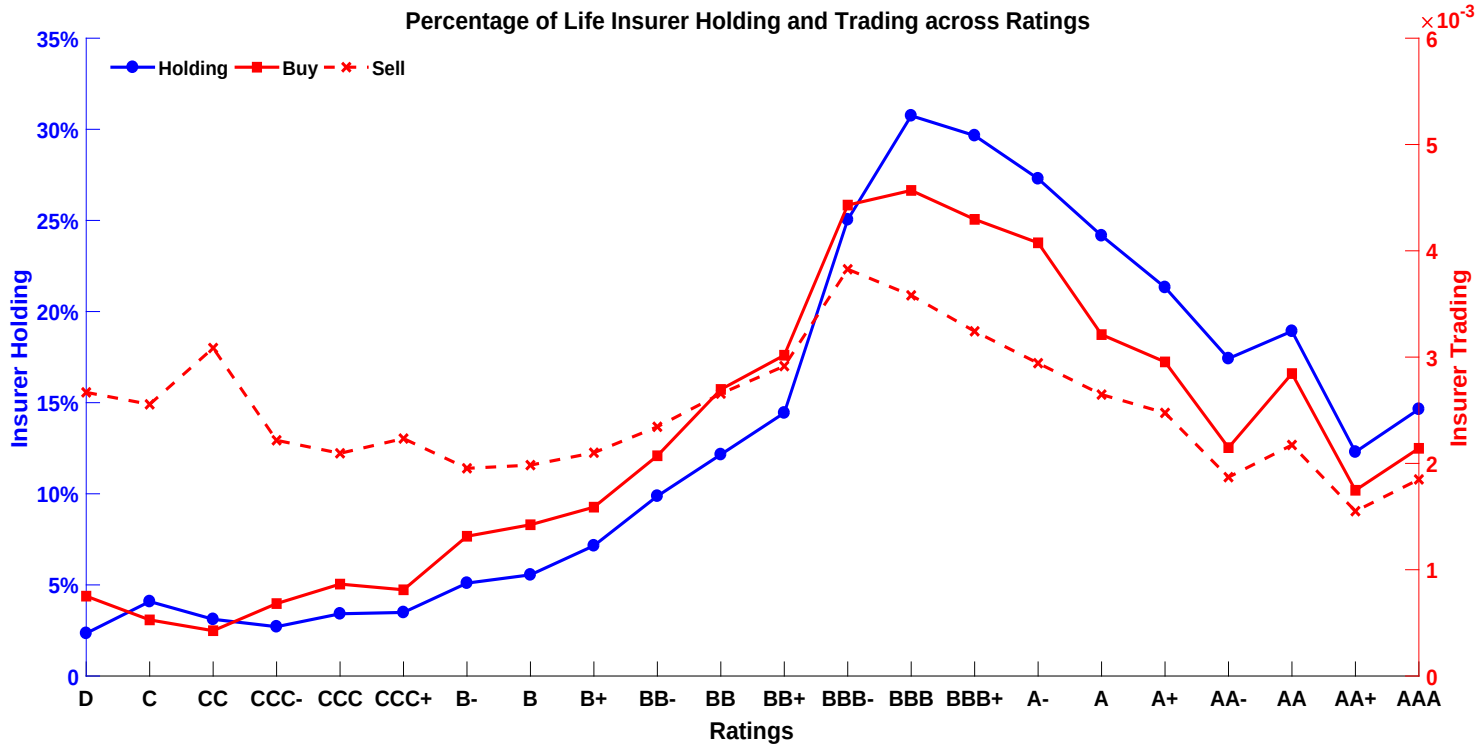
- Life insurers are the largest stakeholder of U.S. corporate bonds
  - According to Federal Reserve's Flow of Funds account: life insurers collectively hold 23% U.S. corporate and foreign bonds at the end of 2020
- As a group, life insurers are well capitalized and have stable cash flow from insurance products. They may provide liquidity in times of market stress

Insurer Holding / Par



Based on life insurance holding over the sample period from 2002 to 2015

Insurer Holding and Trading across Bond Ratings



Dealers and Corporate Bond Liquidity

- Corporate bond market is an over-the-counter (OTC) market
- Dealers' primary role in the corporate bond market is to supply liquidity
- Dealers' funding is restricted under stressful market conditions or due to unfriendly regulations, lowering their ability to supply liquidity
  - Brunnermeier and Pedersen (2008)
  - Bessembinder, Jacobsen, Maxwell, and Venkatarman (2018); Bao, O'Hara, and Zhou (2018); Macchiavelli and Zhou (2021)

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- Argument: With a constant cash flow from life insurance products, life insurers potentially are rainy day liquidity providers
- Approach: Apply and develop liquidity supply (LS) scores
  - Connecting non-dealer investor transactions with liquidity supply
- Empirics: Present evidence that life insurers are rainy day liquidity providers
  - Liquidity provisions in stressful periods
  - Liquidity provisions to downgraded bonds

A Decomposition of Liquidity Supply Scores

Liquidity Supply (LS) Score of a Non-Dealer Investor

- Introduced by Anand, Jotikashira, and Venkataraman (2021)

$$\text{LS}_{j,t} = \frac{\text{Liquidity Supplied}_{j,t} - \text{Liquidity Demanded}_{j,t}}{\sum_i \text{Buy}_{i,j,t} + \sum_i \text{Sell}_{i,j,t}}$$

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- A **liquidity supplying** transaction: when an investor j trades in the same direction as bond i's aggregate dealer inventories
- A **liquidity demanding** transaction: when an investor j trades in the opposite direction from bond i's aggregate dealer inventories
- Dealer inventories can be both positive and negative

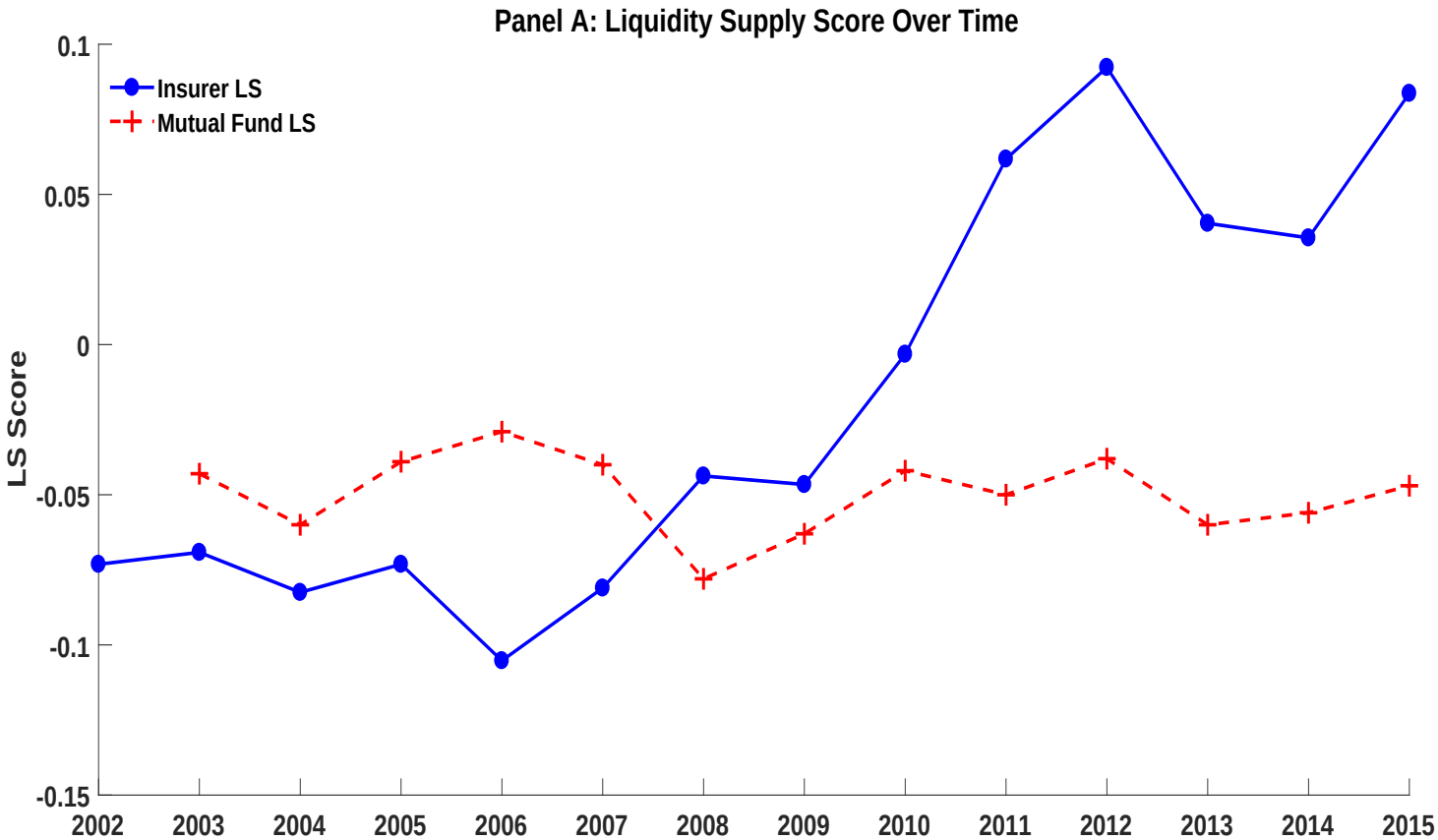
Dealer Cycles, Liquidity Supplied and Demanded Transactions

- A **Positive cycle**: Aggregate dealer inventories are positive
- A **Negative cycle**: Aggregate dealer inventories are negative

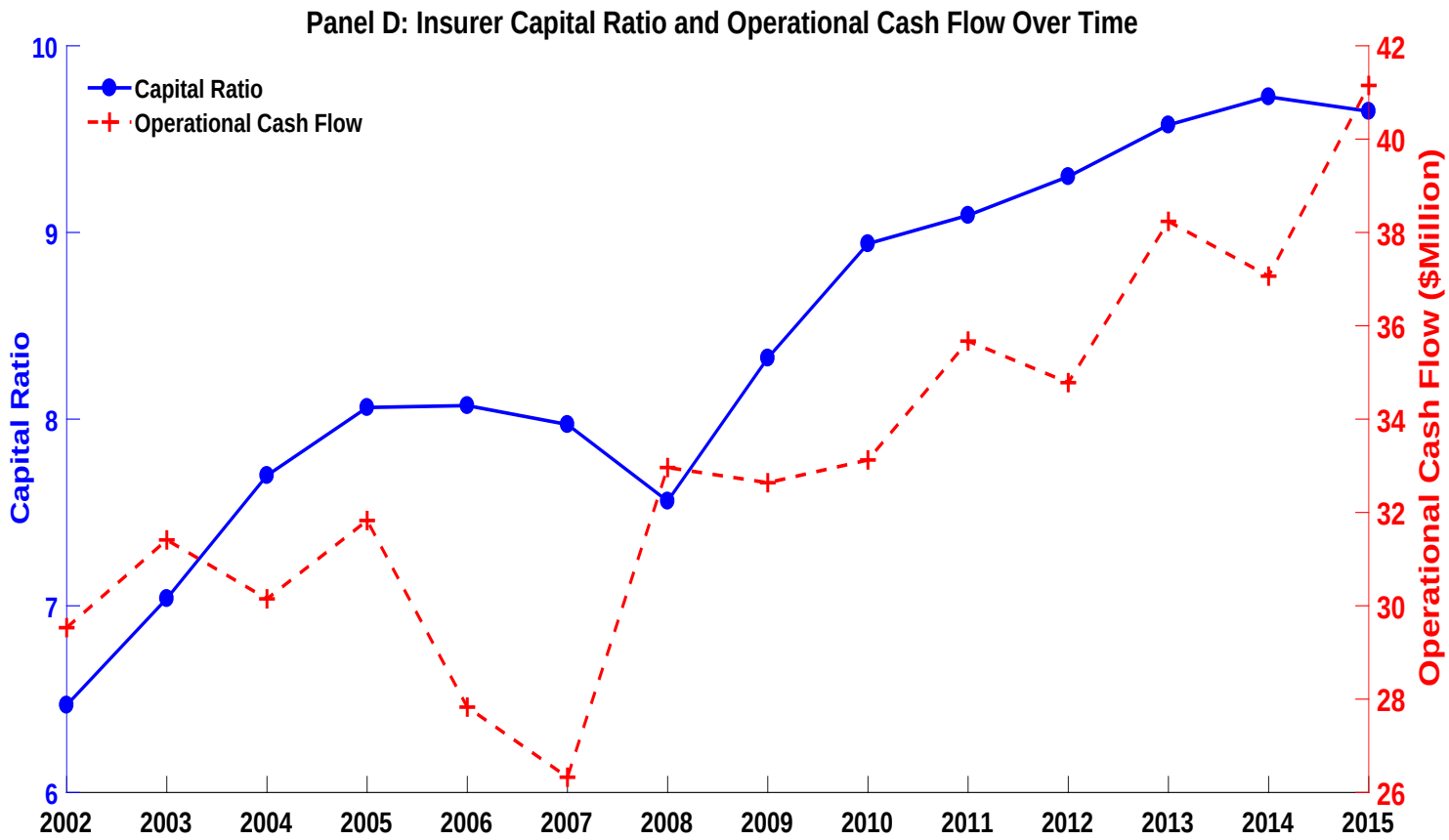
$$\text{Liquidity supplied}_{j,t} = \underbrace{\sum_i \text{Buy}_{i,j,t} * \mathbb{I}_{\{C_{i,t}>0\}}}_{\text{(1) buy; positive cycle}} + \underbrace{\sum_i \text{Sell}_{i,j,t} * \mathbb{I}_{\{C_{i,t}<0\}}}_{\text{(2) sell; negative cycle}}$$

$$\text{Liquidity demanded}_{j,t} = \underbrace{\sum_i \text{Buy}_{i,j,t} * \mathbb{I}_{\{C_{i,t}<0\}}}_{\text{(3) buy; negative cycle}} + \underbrace{\sum_i \text{Sell}_{i,j,t} * \mathbb{I}_{\{C_{i,t}>0\}}}_{\text{(4) sell; positive cycle}}$$

LS Scores: Life Insurers vs Mutual Funds



Life Insurer Capitalization and Cash Flow



Buy and Sell LS Scores

$$\mathrm{LS}_{j,t} = \underbrace{\eta^b_{j,t}\lambda^b_{j,t}}_{LS^b_{j,t}} + \underbrace{(1-\eta^b_{j,t})\lambda^s_{j,t}}_{LS^s_{j,t}}$$

where

$$\eta^b_{j,t} = \frac{\sum_i \mathrm{Buy}_{i,j,t}}{\sum_i \mathrm{Buy}_{i,j,t} + \sum_i \mathrm{Sell}_{i,j,t}}$$

$$\lambda^b_{j,t} = \sum_i [w^b_{i,j,t} * C^b_{i,t}]$$

$$w^b_{i,j,t} = \frac{\mathrm{Buy}_{i,j,t}}{\sum_i \mathrm{Buy}_{i,j,t}}$$

$$C^b_{i,t} = -1, 0, 1$$

Buy and Sell LS Scores: Positive and Negative Cycles

$$\lambda^{b}_{j,t} = p^{b^+}_{j,t} - p^{b^-}_{j,t}$$
$$\lambda^{s}_{j,t} = p^{s^+}_{j,t} - p^{s^-}_{j,t}$$

$$\mathrm{LS}_{j,t} = \underbrace{\eta^{b}_{j,t}(p^{b^+}_{j,t} - p^{b^-}_{j,t})}_{LS^{b}_{j,t}} + \underbrace{(1-\eta^{b}_{j,t})(p^{s^+}_{j,t} - p^{s^-}_{j,t})}_{LS^{s}_{j,t}}$$

$\mathbf{LS}_{j,t}$: $LS^{b}_{j,t}$ and $LS^{s}_{j,t}$

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- Insurers' liquidity supply scores are mainly determined by the buy side liquidity supply scores;
- Life insurers' engagement in the corporate bond market is correlated with their operational characteristics, such as cash flow, capitalization, and investment horizon;
- Life insurers provide liquidity in stressful market conditions and to downgraded bonds.

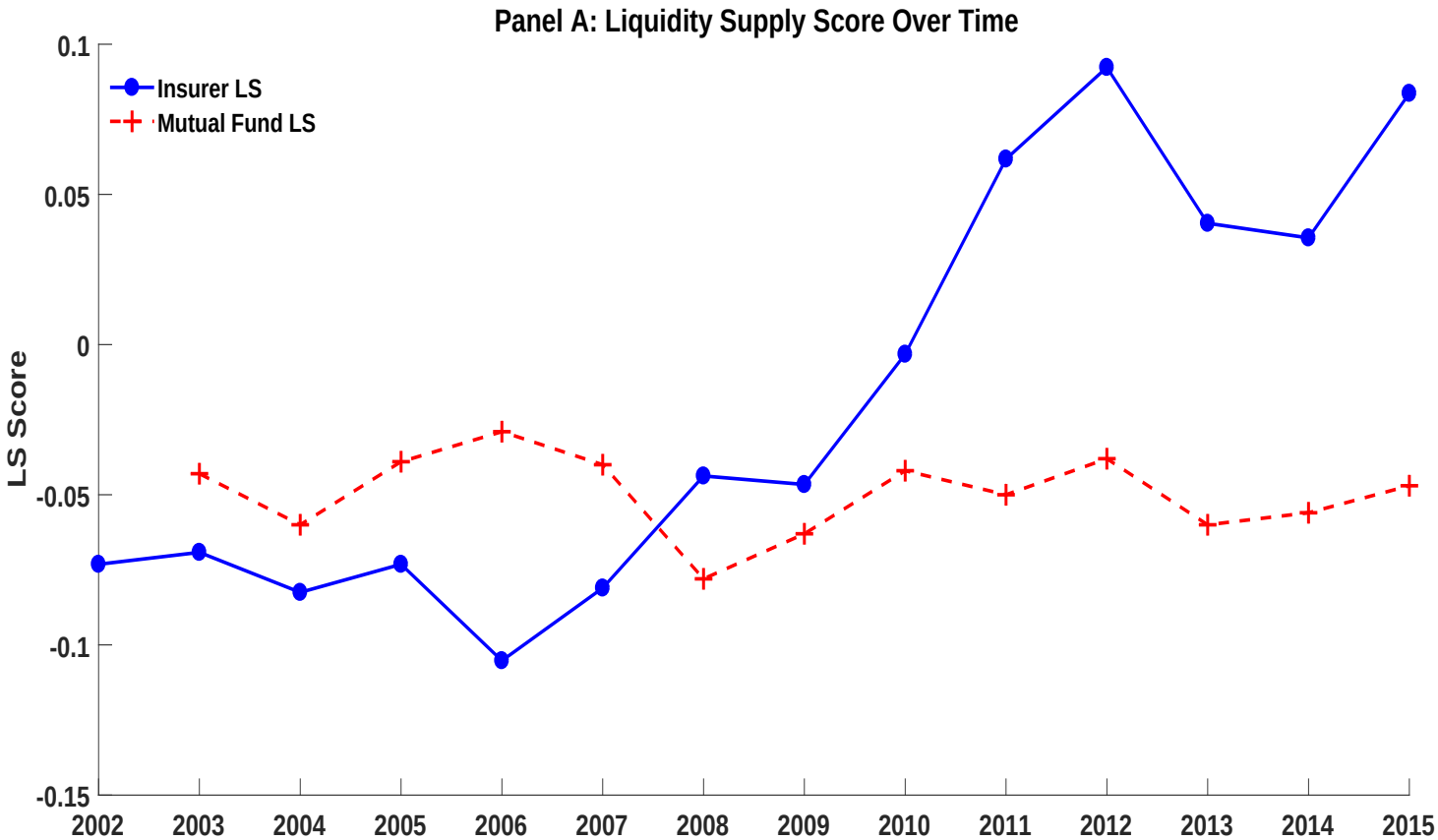
Data

- Sample period: July 2002 - December 2015
- Three data sources:
  - Life insurers' bond holdings and trades from NAIC Schedule D
    - NAIC has annual holding and transaction data. We obtain a sample of insurer holding and trading at the bond-insurer level in the monthly frequency
    - Aggregate across insurers to obtain a monthly holding and trading data at bond level
  - Bond illiquidity measures from TRACE
  - Other bond information from Mergent FISD

Bond Illiquidity Measures

- *Roll*'s autocorrelation measure:
  $Roll_{j,m} = 2\sqrt{-cov(R_{j,t,m}, R_{j,t-1,m})}$, where $R_{j,t,m}$ and $R_{j,t-1,m}$ are returns of two consecutive available trading days
- *Amihud* measure: $Amihud_{j,m} = \frac{1}{N}\sum_{t=1}^{N}\frac{R_{j,t}}{Q_{j,t}}$
  where N is the number of positive-volume trading days for bond j in a given month m. $R_{j,t}$ and $Q_{j,t}$ are the return and dollar trading volume for bond j in day t
- Corwin and Schultz's *Highlow*: $Highlow_{j,m} = \frac{2\cdot(e^{\alpha}-1)}{1+e^{\alpha}}$
  where α comes from the high-low price ratio on consecutive days
  - A good measure of bond liquidity (Schestag, Schuster, and Uhrig-Homburg, 2016)

LS Scores: Life Insurers vs Mutual Funds



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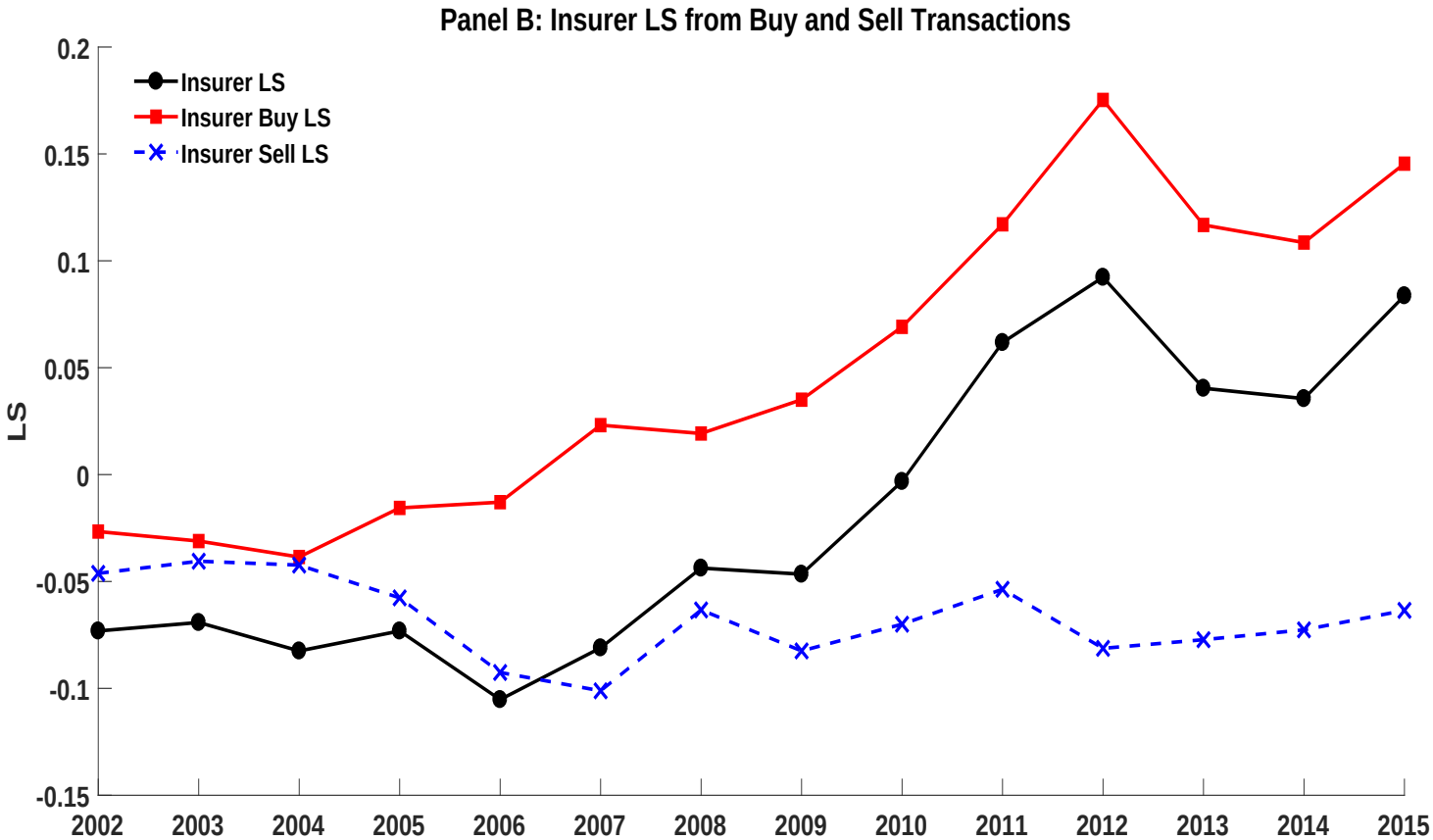
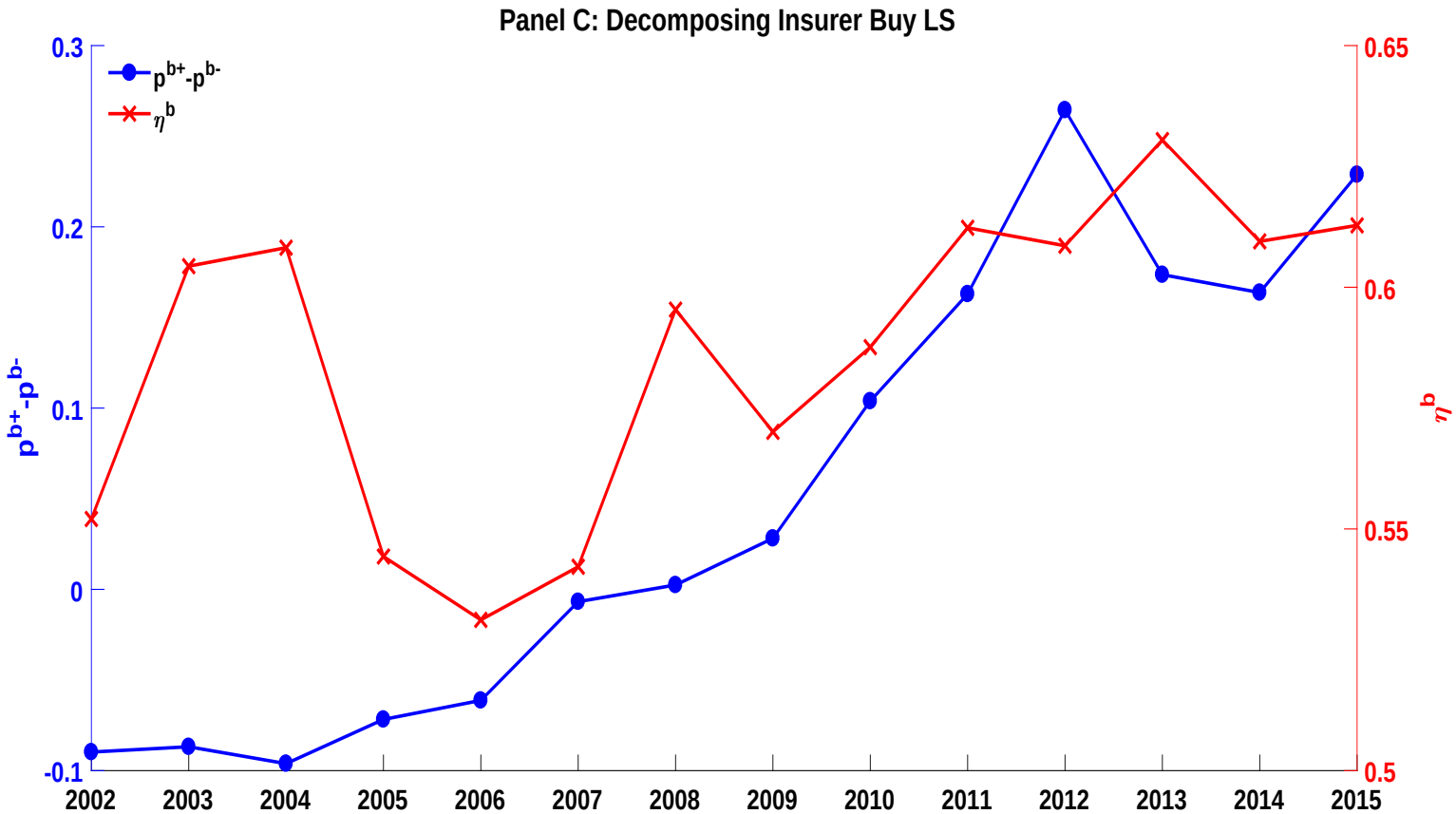


Decomposing Buy-side LS Scores



Connect Transactions with Liquidity Supply: Cross Sectional Tests

Insurer Operational Characteristics associated with Liquidity Supply

- Capital ratio (CR): the ratio of total capital to required risk-based capital;
- Cash flow (CF): the sum of an individual life insurer's operational cash flow;
- Cash flow volatility (CFV): the standard deviation of Cf scaled by insurer size in the past ten years;
- Horizon (HR): average holding period of insurer bond portfolio;
- Percentage of inferior bond purchased by insurers (INF): the fraction of below A- rated bonds purchased to all purchased bonds;
- Firm size ($SIZE$): the logarithm of total assets of the firm;
- Extract an insurer funding stability (FS) using the first principal component of CR, CF, and CFV.

Determinants of Insurers Liquidity Supply Scores (Table 4)

DepVar	LS (1)	LS^b (2)	LS^s (3)
CR	0.15***	0.15***	0.03
	(3.35)	(3.16)	(0.77)
CF (%)	0.16***	0.11***	0.04*
	(4.82)	(2.83)	(1.71)
CFV (%)	-0.73**	-0.51**	-0.11
	(-2.01)	(-2.18)	(-1.46)
HR	0.73***	0.63***	0.11
	(3.34)	(4.08)	(0.73)
INF (%)	0.05***	0.04***	0.02***
	(3.39)	(2.81)	(1.28)
ASSETS	0.77	0.77	0.81
	(1.36)	(1.28)	(1.32)
YIELD	-7.05***	-6.87***	-0.19
	(-16.06)	(-14.47)	(-0.47)
VIX	0.23	0.22	0.05
	(0.94)	(1.05)	(1.12)
S&P	-0.02	0.05	-0.07*
	(-0.53)	(0.94)	(-1.65)
Adj R^2	0.06	0.10	0.02
N	19,905	19,905	19,905

Panel Regressions of Bond Illiquidity: Own Bond Effect (Table 5)

Dep Var: ΔILQ (Δ*Roll*)

	LS (1)	FS (2)	HR (3)	INF (4)
NP_i	5.01	5.18*	4.84	5.12
	(1.56)	(1.72)	(1.54)	(1.61)
NP_iX	-5.62*	-6.04**	-5.30*	-5.17
	(-1.94)	(-2.05)	(-1.82)	(-1.59)
$\Sigma_j NP_{i,j}H_j$	-6.01**	-6.59***	-5.97**	-6.12**
	(-2.37)	(-2.68)	(-2.35)	(-2.41)
$\Sigma_j NP_{i,j}H_jX$	-12.44***	-12.49***	-13.05***	-12.23***
	(-5.14)	(-5.17)	(-5.45)	(-4.86)
Bond FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Adj R^2	0.29	0.29	0.28	0.29
N	144,654	144,654	144,654	144,654

H: a dummy for insurers with high liquidity supply scores and high liquidity supply characteristics

X: stressed period: 2007-2015 (Crisis + DF)

Panel Regressions of Bond Illiquidity: Cross Bond Spillover (Table 6)

	Δ Roll$_k$			
	LS	FS	HR	INF
	(1)	(2)	(3)	(4)
$\Sigma_i w_{i,k} \mathrm{NP}_i$	3.37	3.46	3.43	3.29
	(1.45)	(1.50)	(1.64)	(1.44)
$\Sigma_i w_{i,k} \mathrm{NP}_i \mathrm{X}$	-3.49	-3.66*	-3.58	-3.22
	(-1.50)	(-1.73)	(-1.54)	(-1.46)
$\Sigma_i \Sigma_j w_{i,k} \mathrm{NP}_{i,j} \mathrm{H}_j$	-4.21**	-4.05**	-4.20**	-4.32***
	(-2.42)	(-2.19)	(-2.39)	(-2.62)
$\Sigma_i \Sigma_j w_{i,j} \mathrm{NP}_{i,j} \mathrm{H}_j \mathrm{X}$	-8.92***	-8.98***	-8.54***	-8.47***
	(-3.91)	(-4.03)	(-3.68)	(-3.21)
Bond FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Adj R^2	0.29	0.29	0.28	0.29
N	144,654	144,654	144,654	144,654

Bond k: not traded by any insurers; having a similar maturity, the same rating, and the same SIC codes

Life Insurer Liquidity Provision to Downgraded Bonds

Insurer Transactions of Downgraded Bonds (Table 7, Panel A)

	Within IG			Fallen Angel			Within NIG		
	B	S	NP	B	S	NP	B	S	NP
./H	2.71	1.19	1.52	1.50	5.53	-4.02	2.86	6.83	-3.90
	(11.03)	(5.68)	(6.85)	(3.26)	(5.93)	(-4.25)	(3.73)	(8.28)	(-3.74)
./Par	0.48	0.21	0.27	0.28	1.03	-0.75	0.23	0.55	-0.32
	(27.61)	(9.24)	(9.43)	(8.34)	(9.53)	(-5.79)	(14.87)	(15.66)	(-6.32)

Modest net seller of fallen angels and within non-investment downgrades

How does life insurers' corporate bond purchase before downgrades affect downgraded bond prices?

Insurer Trading and Dealer Purchase Price Changes (Table 7, Panel C)

	$\mathbb{I}_{\{C_{i,t}>0\}}$		$\mathbb{I}_{\{C_{i,t}<0\}}$		$\mathbb{I}_{\{C_{i,t}=0\}}$	
	$\log(P_1/P_{-21})$	N	$\log(P_1/P_{-21})$	N	$\log(P_1/P_{-21})$	N
Within Investment-Grade Downgrades						
Ins Buy	-1.06	1,161	-1.33	437	-1.06	942
Ins Not Buy	-2.89	961	-1.47	996	-1.50	1,148
Diff	1.83***		0.14		0.44	
	(3.66)		(0.61)		(1.32)	

Insurer Trading and Dealer Purchase Price Changes (Table 8)

Dep Var: $\log(P_{i,1}/P_{i,-21})$

	$\log(P_{i,1}/P_{i,-21})$		
	Within IG	Fallen Angel	Within NIG
NP	27.32***	32.84***	23.85***
	(4.05)	(5.49)	(2.93)
$Cycle^{+}$	-0.53***	-0.59**	-0.48**
	(-2.88)	(-2.49)	(-2.32)
NP*$Cycle^{+}$	27.51***	27.90***	20.94**
	(3.74)	(3.44)	(2.10)
Coupon	0.06	0.03	0.05
	(1.02)	(0.24)	(0.93)
BondAge	-0.32**	0.14	0.03
	(-2.43)	(0.41)	(0.14)
Maturity	-0.33***	-1.33***	-0.01
	(-3.66)	(-5.73)	(-0.03)
BondSize	-0.46***	-0.30	0.38**
	(-4.89)	(-1.06)	(2.55)
Trace NP	0.29	-0.80	-0.24
	(0.76)	(-0.38)	(-0.75)
Rating FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes

Do high liquidity supply insurers purchase more?

Regressions of Insurer Purchase of Downgraded Bonds (Table 9)
Dep Var: $NP_{i,j,t}$ (Individual insurer net purchase of an individual bond)

	Within IG	Fallen Angels	Within NIG
Cycle^{+}	0.44***	0.31**	0.26
	(3.61)	(2.04)	(1.57)
FS	-1.26	-1.92	-1.49
	(-0.69)	(-1.41)	(-0.83)
FS*Cycle^{+}	5.87***	5.95***	3.74*
	(4.52)	(4.79)	(1.83)
HR	-0.04	-0.05	-0.02
	(-0.95)	(-1.38)	(-0.79)
HR*Cycle^{+}	0.24***	0.21***	0.20***
	(4.98)	(4.22)	(4.03)
INF	-0.16	-0.18	-0.20
	(-0.82)	(-0.42)	(-0.74)
INF*Cycle^{+}	0.45***	0.67**	0.30*
	(3.12)	(2.50)	(1.72)
Rating Dummies	Yes	Yes	Yes
Month FE	Yes	Yes	Yes

Summary

- Connect insurer characteristics with insurer liquidity supply scores
- Present evidence that insurers with high liquidity scores (and consistent characteristics) provide bond liquidity in stressful periods and to downgraded bonds

Thank You!