

The Dark Side of Liquid Bonds in Fire Sales

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Fire sales of financial assets

- ▶ “What’s wrong with finance?” Economist 2015
 - ▶ Timothy F. Geithner “... We did not realise how ... fire sales ... could cause the kind of losses we thought could only happen in a full-blown economic depression.”
- ▶ “So What Exactly Caused the Financial Crisis?” WSJ 2010
 - ▶ Gary Gorton “Fire sales cause losses. The fundamentals of subprime [mortgages] were not bad enough by themselves to have created trillions in losses globally.”

Fire sales of financial assets

- ▶ banks selling financial assets as part of deleveraging in the crisis,
 - ▶ hedge or mutual funds liquidating assets to satisfy withdrawals,
 - ▶ P&C Insurance companies selling bonds to satisfy claims on natural catastrophes,
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- ▶ A group of institutions face correlated shocks and need to sell financial assets to raise funds
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- ▶ How should a financial institution liquidate assets in fire sales to minimize losses?
 - ▶ current literature: sell a **fixed proportion** of all assets (Greenwood et al., 2015; Cont and Schaanning, 2017).

Fire sales of financial assets

- ▶ Observed strategy: P&C insurance companies sell only 3 out of 100 bonds; sell mostly **liquid** bonds.
- ▶ However, during fire-sales liquid bonds exhibit **larger** price impact
 - ▶ Gorton (2010), Ellul et al. (2011), Massa and Zhang (2011), Boudoukh et al. (2016), Shin (2016).
- ▶ Do they act strategically?

Selling commonly-held assets & commitment

- ▶ During fire sales, price impact of an asset depends on selling behavior of **all** institutions holding **this** asset
- ▶ Liquidating a commonly-held asset imposes a **negative externality** on other institutions selling the same asset
 - ▶ if institutions cannot commit to a liquidation strategy, they sell too much of commonly-held assets
- ▶ Corporate bond market: there are only a few liquid bonds and they are commonly-held!
 - ▶ in fire sales, institutions oversell commonly-held liquid assets relative to separately-held illiquid assets,
 - ▶ price impact and losses on liquid assets are larger than on illiquid assets.

Model

- ▶ Two institutions and three assets $i \in \{A, B, C\}$
 - ▶ A is commonly, B and C are separately held
 - ▶ Each institution is required to raise funds I
 - ▶ Minimize transaction costs, i.e., price impacts on sold assets

- ▶ Price Impacts:
 - ▶ Chacko et al. (2008): $\rho_i(Q) = \frac{\bar{P}_i - P_i(Q)}{\bar{P}_i} = K_i \sqrt{Q}$
 - ▶ K_i is liquidity parameter

- ▶ Objective:
 - ▶ minimize $\sum_i \rho_i q_i$ subject to $\sum_i (1 - \rho_i) Q_i = I$

Over-selling of commonly held assets in fire sales

▶ Benchmark with commitment (first-best)

- ▶ equalize marginal losses

$$\rho'_A(Q_A^1 + Q_A^2) \cdot (Q_A^1 + Q_A^2) + \rho_A = \rho'_B \cdot Q_B^1 + \rho_B = \rho'_C Q_C^2 + \rho_C$$

- ▶ price impacts are the same

$$\rho_A^*(Q_A^{1*} + Q_A^{2*}) = \rho_B^*(Q_B^{1*}) = \rho_C^*(Q_C^{2*})$$

▶ Lack of commitment (second-best)

- ▶ equalize marginal losses for each firm

$$\rho'_A(Q_A^1 + Q_A^2) \cdot (Q_A^1) + \rho_A = \rho'_B \cdot Q_B^1 + \rho_B$$

- ▶ overselling of common asset causes larger price impact

$$\rho_A > \rho_A^* = \rho_B^* = \rho_C^* > \rho_B, \rho_C$$

Pre-selection of which assets to sell in fire sales

- ▶ Pre-selection: in general, the number of assets chosen to be sold is lower than the number of assets held.
 - ▶ minimum selling quantity
- ▶ **Liquidity**: liquid assets are more likely to be sold.
- ▶ **Commonality**: institutions are less likely to sell commonly-held assets.

Portfolio allocation prior to fire sales

- ▶ Institutions value liquidity, but avoid commonality
- ▶ **Scarcity** of liquid corporate bonds
- ▶ Liquid bonds are commonly held

Can commonality explain larger price impacts of liquid assets in fire sales?

- ▶ Focus on large natural catastrophes, US PC insurers & corporate bonds
 - ▶ Detailed data about insurers' holdings & transactions (NAIC annual statements)
 - ▶ Detailed data about corporate bond secondary market transactions (TRACE) and characteristics (FISD)
- ▶ Empirical Strategy:
 - ▶ Establish the fact of selling pressure: did natural catastrophes trigger fire-sales of bonds?
 - ▶ Controlling for commonality, revisit the relation between liquidity and price impacts.

Fire sales window & affected insurers

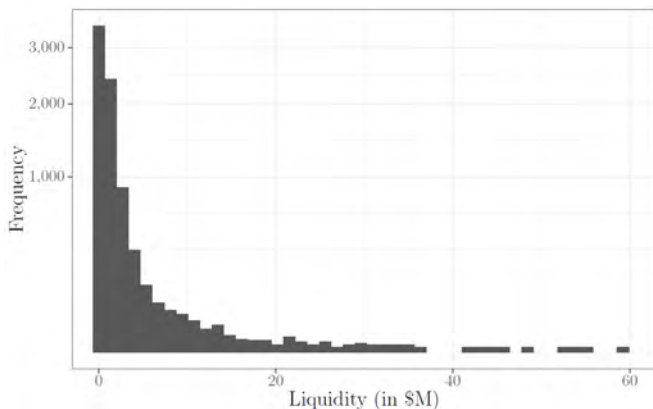
- ▶ **Large catastrophes** (insured damages $>$ \$10B):
2005 (Katrina, Rita, Wilma), 2008 (Ike), 2012 (Drought, Sandy)
- ▶ **Fire sale window**: two weeks prior until two weeks after catastrophe
- ▶ **Affected insurer**: losses paid (in affected states in following two quarters) relative to liquid asset holdings prior to fire sale window $>$ 75%

Bond liquidity measures

- ▶ Average daily **buy side trading volume** of a bond over 180 days prior to fire sale window
- ▶ **Advantage**: defined even when there are very few transactions
 - ▶ challenging for other measures, e.g. Amihud (2002), Roll (1984), Jankowitsch et al. (2011)
- ▶ **Robustness**:
 - ▶ Total trading volume
 - ▶ Implied order flow based on Chacko et al. (2008) price impact functions

Liquidity distribution prior to 2005 fire sales window

- ▶ Very few liquid bonds, a lot of highly illiquid bonds



Commonality measures

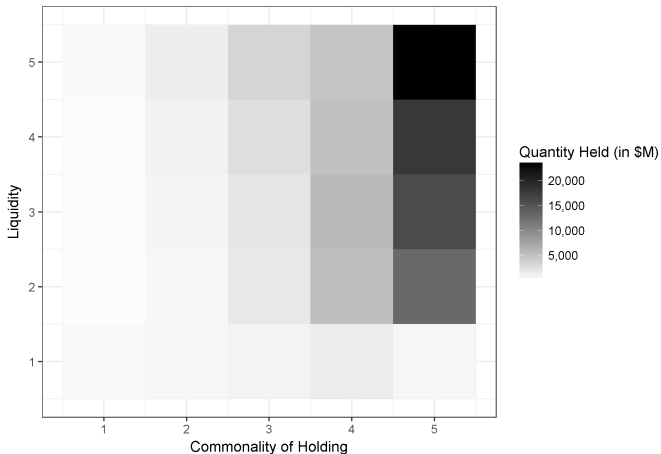
- ▶ **Commonality of holding** a bond measured by

$$h_i^{\text{com}} = \frac{\text{\# of companies holding bond } i}{\text{total \# of companies}}$$

- ▶ Costly to sell small quantities on OTC markets
 - ▶ insurers preselect which bonds to sell
 - ▶ during fire sales, insurers sell on average only 3 out of 100 different bonds they hold
- ▶ **Commonality of selling** a bond measured by number of sellers

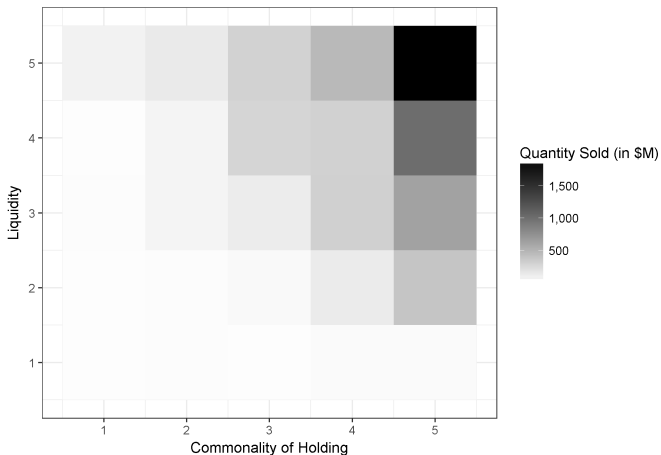
Holding commonality of P&Cs prior to 2005 fire sales window

- ▶ More liquid bonds are more commonly-held



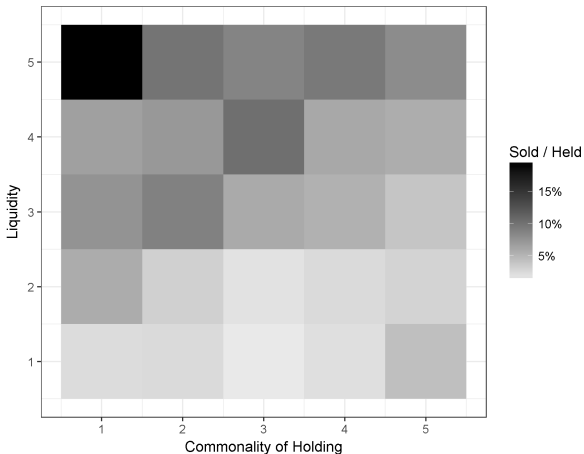
Sell volume of P&Cs in 2005 fire sales window

- ▶ Selling mostly liquid and commonly-held bonds



Sell/Holding volume of P&Cs in 2005 fire sales window

- ▶ Prefer to sell liquid and not-commonly held bonds



Evidence for selling pressure in fire sales windows

	Probability of Bond Being Sold			
	All (1)	Stock (2)	Mutual (3)	Others (4)
Affected dummy	0.030*** (0.010)	0.047*** (0.012)	-0.078*** (0.027)	0.188*** (0.030)
Log(Buy Volume)	0.064*** (0.006)	0.058*** (0.006)	0.109*** (0.016)	0.043*** (0.015)
Log(Commonality)	-0.079*** (0.007)	-0.076*** (0.008)	-0.071*** (0.017)	-0.090*** (0.017)
Bond Controls	Yes	Yes	Yes	Yes
Company Controls	Yes	Yes	Yes	Yes
Fire Sale Window Dummies	Yes	Yes	Yes	Yes
Observations	335,593	240,686	58,945	35,962

Note:

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table: bond controls: issue size, life, age, investment grade, downgrade; insurer controls: bond holding, total assets, risk-based capital

Price impacts

- ▶ deviations of transaction prices from the fundamental value.
- ▶ Proxy for the fundamental price
 - ▶ Datastream price (clean mid-quote two weeks prior to the fire sale window)
- ▶ **Market-wide** price impacts - TRACE prices
- ▶ **Company-specific** price impacts
 - ▶ Compare reported NAIC prices to the fundamental proxy
 - ▶ for bond i sold by company j

$$\text{Price impact}_{i,j} = \left(1 - \frac{\text{NAIC Price}_{i,j}}{\text{Fundamental Proxy}_i}\right)^+$$

Company-specific price impacts

$$\text{Price impact}_{i,j} = \left(1 - \frac{\text{NAIC Price}_{i,j}}{\text{Fundamental Proxy}_i}\right)^+$$

	Price Impact _{i,j}	
	(1)	(2)
Log(Buy Volume)	0.35** (0.17)	-0.04 (0.16)
Log(Commonality)		-1.71*** (0.25)
Number of Sellers		0.55*** (0.07)
Log(Issue Size)	-0.43 (0.30)	0.40 (0.34)
Log(Bond Age)	0.21 (0.18)	0.06 (0.18)
Log(Bond Life)	1.14*** (0.23)	0.85*** (0.22)
Fire Sale Window FE	Yes	Yes
Insurer FE	Yes	Yes
Observations	4,089	4,089
Adjusted R ²	0.53	0.56

Note: * p<0.1; ** p<0.05; *** p<0.01

Policy implications: Measurement

- ▶ Commonality of liquid assets exaggerates fire sales losses.
 - ▶ Liquid assets are more likely to be sold in fire sales (recall pre-selection)
 - ▶ If they are commonly held, they are over-sold
- ▶ Measuring systemic risk due to common assets:
 - ▶ We argue for **higher weights** on liquid assets.
 - ▶ (Equal weights) similarity of portfolios
 - ▶ Getmansky et al. (2016)
 - ▶ similarity can be low, but commonality in liquid bonds might be high
 - ▶ (Low weights on liquid assets) 'fire sale cascades'
 - ▶ Greenwood et al. (2015); Cont and Schaanning (2017)
 - ▶ assumption - liquidate equal % of all assets in the portfolio.

Conclusion

- ▶ Commonly-held assets are over-sold in fire sales due to lack of commitment.
- ▶ Insurance companies sell **3 out 100** bonds in fire sales:
 - ▶ mostly **liquid** bonds,
 - ▶ they exhibit **larger price impacts** than less liquid bonds,
 - ▶ which is due to their **commonality of holdings**.
- ▶ Commonality of liquid bonds exaggerates fire sales losses.
- ▶ Policymakers should encourage diversity of holdings.

Share of invested volume per liquidity category

- ▶ Share of liquid assets decreased after crisis

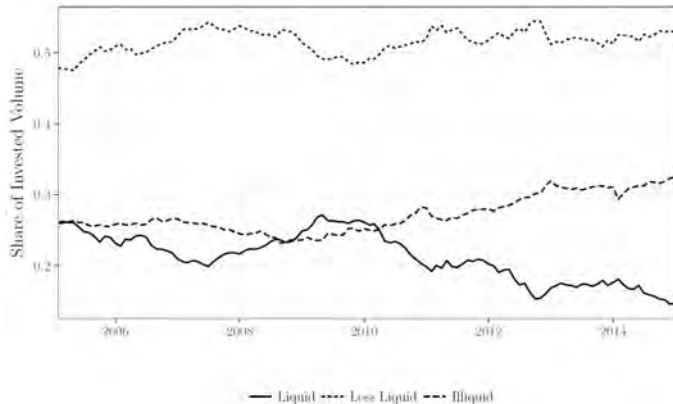


Figure: liquid: top 10 % of most liquid bonds; illiquid: bottom 50% of least liquid bonds; less liquid: the rest

Average commonality per liquidity category over time

- ▶ highest in liquid bonds but increasing in less liquid bonds

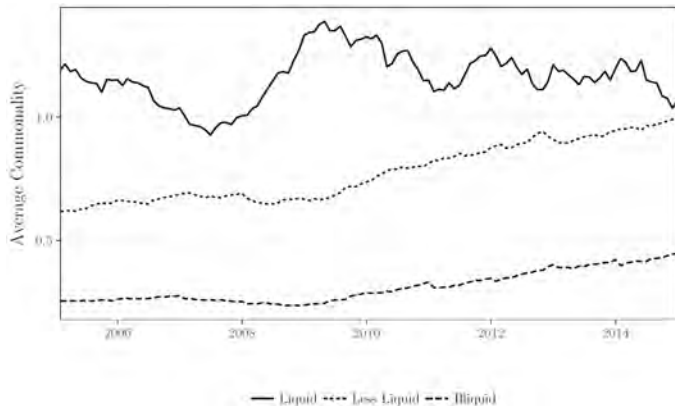


Figure: liquid: top 10 % of most liquid bonds; illiquid: bottom 50% of least liquid bonds; less liquid: the rest

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