Pledgeability and Asset Prices:

Evidence from the Chinese Corporate Bond Markets

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Introduction

- Equilibrium asset prices depend on both fundamentals and liquidity.
- One major important part of liquidity: Asset pledgeability.
  - ↪ Collateralized financing, a key building-block in macro-finance models (Kiyotaki-Moore, 1997);
  - ↪ Repo specialness (Duffie, 1996), margin-based "basis" (Garleanu-Pederson, 2011).
- Identification challenge: pledgeability endogenously linked to fundamentals.
  - ↪ Haircut h: asset market value of 1 dollar, you can borrow $1-h$;
  - ↪ Empirically, greater haircut h for worse/riskier assets.

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  - ↪ Haircut h: asset market value of 1 dollar, you can borrow $1-h$;
  - ↪ Empirically, greater haircut h for worse/riskier assets.
- Why Chinese bond markets (other than it is BIG)?
  - ↪ Unique institutional features:
    - ★ Two (segmented) markets for the same bonds: exchange and interbank markets.
    - ★ Different rules for repo.
  - ↪ An unexpected policy shock to pledgeability on one of the two markets.

Overview of results

- On 12/08/2014, the exchange suspended repo eligibility of all enterprise bonds rated below AAA.
  - ↪ Pleadgebility of AA+ and AA rated bonds was cut to **ZERO**
  - ↪ AAA and AA- bonds were (effectively) unaffected
  - ↪ Policy largely came as a surprise
- An event study of the exchange premium (interbank-exchange yield spread):
  - ↪ Treatment group (AA+, AA): down
  - ↪ Control group (AAA, AA-): up
- Pledgeability premium: If haircut rises from 0% to 100%, how much will be the increase in bond yield?
  - ↪ Based on exchange premium: 39 bps ⇒ likely downward biased
  - ↪ Based on spreads over matched AAA bonds: 85 bps ⇒ likely upward biased
  - ↪ They seem to be a bit higher than US and EU numbers
- Quantity effects: trading activities ↓ on the exchange

Two bond markets: cash market

- Amstad and He (2020), an overview of Chinese bond markets
  - ↪ Handbook of "China's Financial System" Edited by Amstad, Sun, and Xiong.
- Exchange market (EX) and interbank market (IB):
  - ↪ EX was dominant before 1997;
  - ↪ Several **common financial investors**: securities firms, mutual funds, etc.
- Two parallel markets:
  - ↪ Now more than 90% of enterprise bonds are dual listed.

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- Two parallel markets:
  - ↪ Now more than 90% of enterprise bonds are dual listed.
- Spot trading across two markets (liquidity measures comparable to U.S.)

	Mechanism	Trade Size	Trading Frequency	Investors/Traders
Exchange	Order-driven	Small	High	Mutual funds; security firms; insurance companies; retail investors
Interbank	Quote-driven	Large	Low	Banks; rural credit unions; mutual funds; security firms; insurance companies

Two bond markets: segmentation

Limits to cross-market arbitrage:

- Buying a bond on one market and selling it on the other requires application for transfer of depository.
- Lengthy process:
  - ↪ EX → IB: 3~4 days for enterprise bonds (1 day for Treasuries);
  - ↪ IB → EX: 5 days or more.
- Realized Sharpe ratio for cross-market arbitrage < 0.4 in our sample.
- Trading sizes are drastically different on two markets.

Differences in pledgeability + limits to arbitrage ⇒ same bond-date *it* traded at different prices on the two markets: **Ex premium**

$$EXpremium_{ijt} = yield^{IB}_{ijt} - yield^{EX}_{ijt}, \text{ where } j \in \{AAA, AA+, AA, AA-\}$$

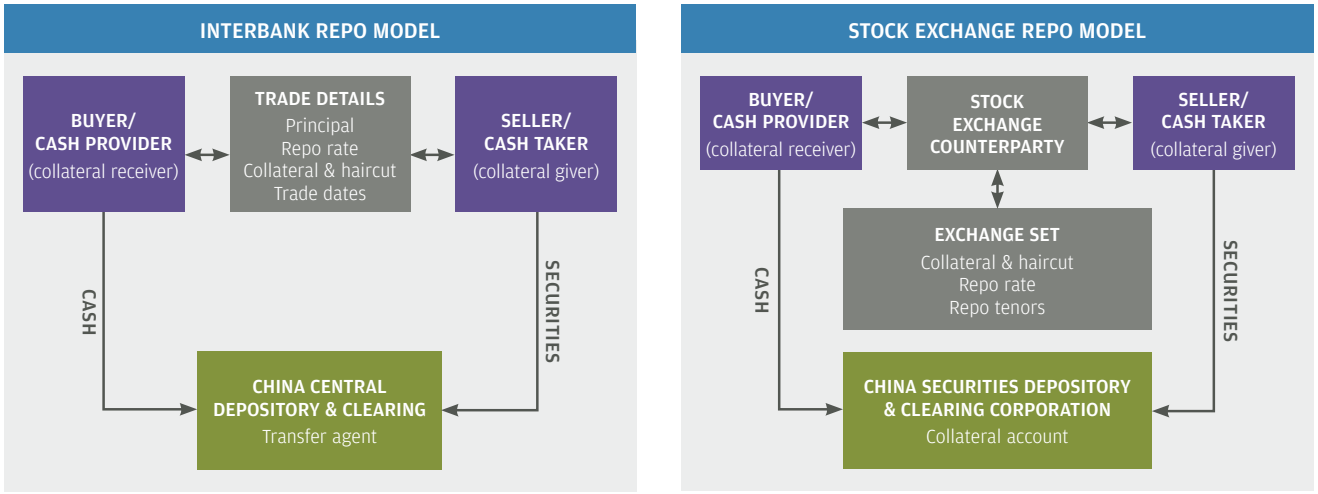
Two bond markets: repo market

IB: over-the-counter

- Like Tri-party repo in U.S., haircuts and other terms privately negotiated.

EX: centralized

- EX as the central counter-party (CCP) to all trades, no counterparty risk.
- Standardization: haircuts set by EX (mainly based on **ratings**).

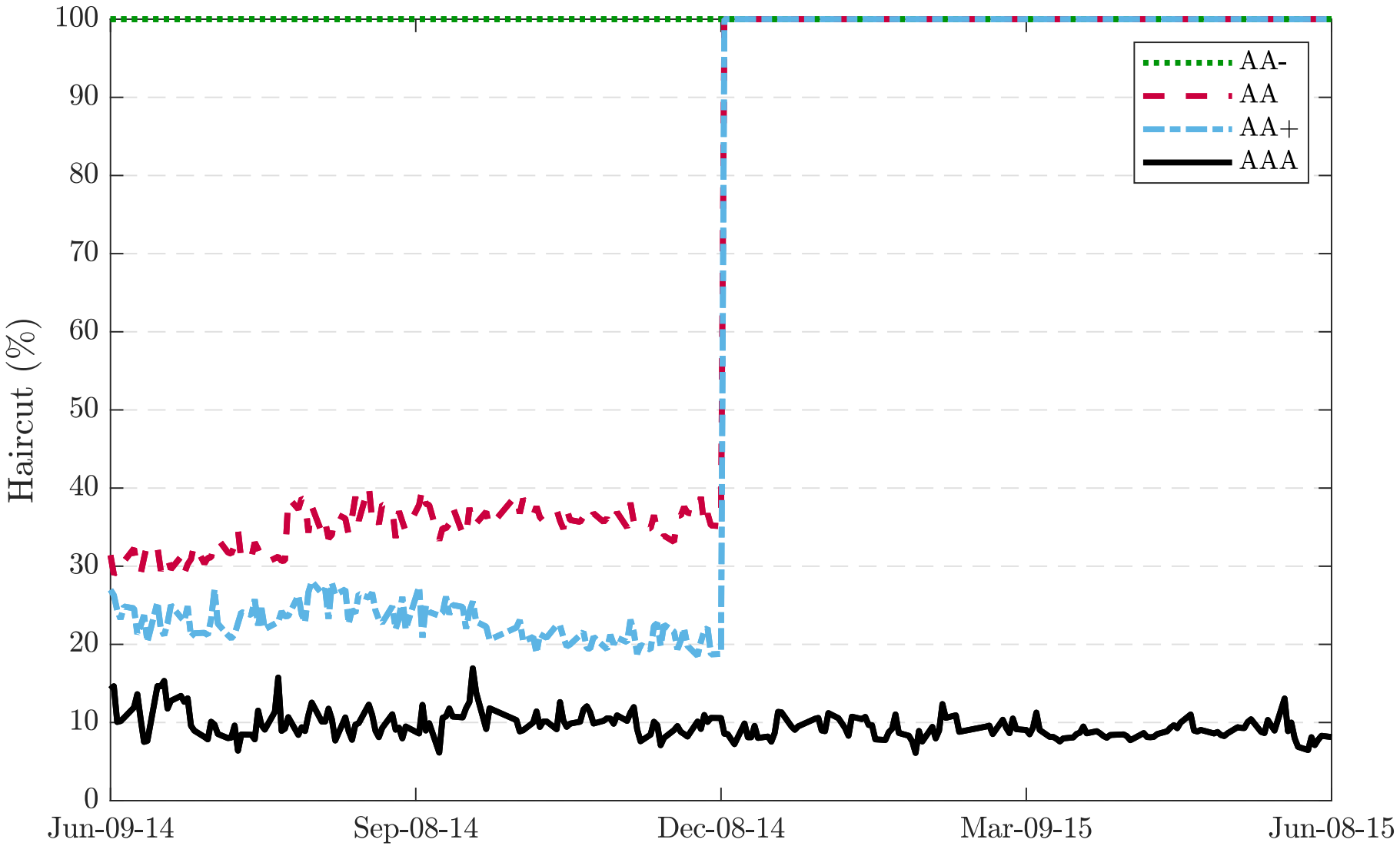


Source: J.P. Morgan Asset Management; as of May 31, 2015.

Policy shock: Dec 8, 2014

- Background: enterprise bonds related to China's **local government debt** and Municipal Corporate Bonds (Chengtou Bonds).
  - ↪ October of 2014, Document 43 released by the State Council;
  - ↪ Chen, He, and Liu, 2020, *Journal of Financial Economics*; Amstad and He, 2020.
- Night of Dec 8, 2014 (Monday), EX suspended repo eligibility of enterprise bonds rated below AAA.
  - ↪ AAA as control group; but AA- is control too (with almost zero pledgeability before shock).
- An **unexpected** policy shock suitable for our identification
  - ↪ Both markets took a handful of small-scale regulatory moves before 12/8, but ineffective.
    - ★ E.g., Exchange black-listed some individual bonds in five announcements since May to November in 2014, but triggered little market reactions (shown shortly).
  - ↪ Exchange took such an aggressive/sweeping move, though Interbank was viewed as the main gate-keeper/regulator of MCB.
    - ★ A blunt policy tool that depends on coarse (and often uninformative) ratings;
    - ★ This time, caused significant market reactions (especially in Exchange).

Average haircuts on EX



Data: public bond price/rating/haircut data from WIND

Market reactions: credit spreads

Panel A: Market reactions of the 12/8 policy shock

	EX market				IB market			
	AAA	AA+	AA	AA−	AAA	AA+	AA	AA−
$\Delta\text{Spread}^{12/8}$	-14.69	61.61***	37.64***	60.52***	-24.33	-7.97	-9.12	23.87
	(17.40)	(12.19)	(13.50)	(18.86)	(31.10)	(13.31)	(8.18)	(21.49)

Panel B: Market reactions of the five black-list announcements

	EX market				IB market			
	AAA	AA+	AA	AA−	AAA	AA+	AA	AA−
$\Delta\text{Spread}^{\textit{five lists}}$	-0.24	3.30	4.60	8.37	-4.42	8.14	4.89	-16.15
	(7.19)	(4.56)	(5.05)	(8.04)	(11.63)	(6.47)	(3.58)	(22.00)

Five black-list announcements were made on 2014/5/29, 2014/6/27, 2014/8/1, 2014/9/5, and 2014/11/3.

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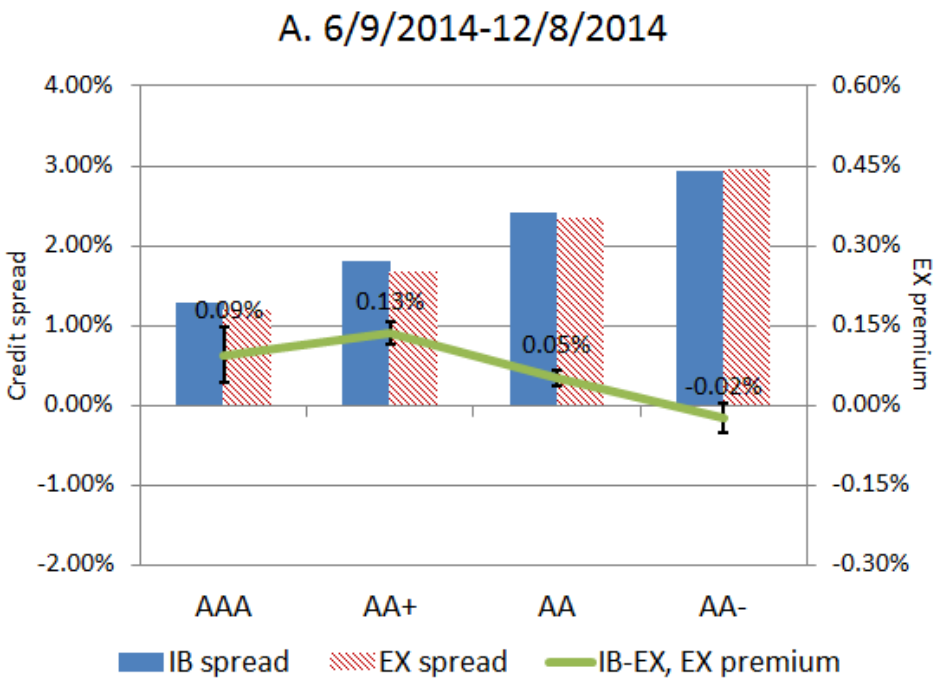
- Raw transaction data, not simultaneously-traded (the sample we study)
  - ↪ For AA−, the market reaction of its exchange premium on 12/9 was much smaller and insignificant

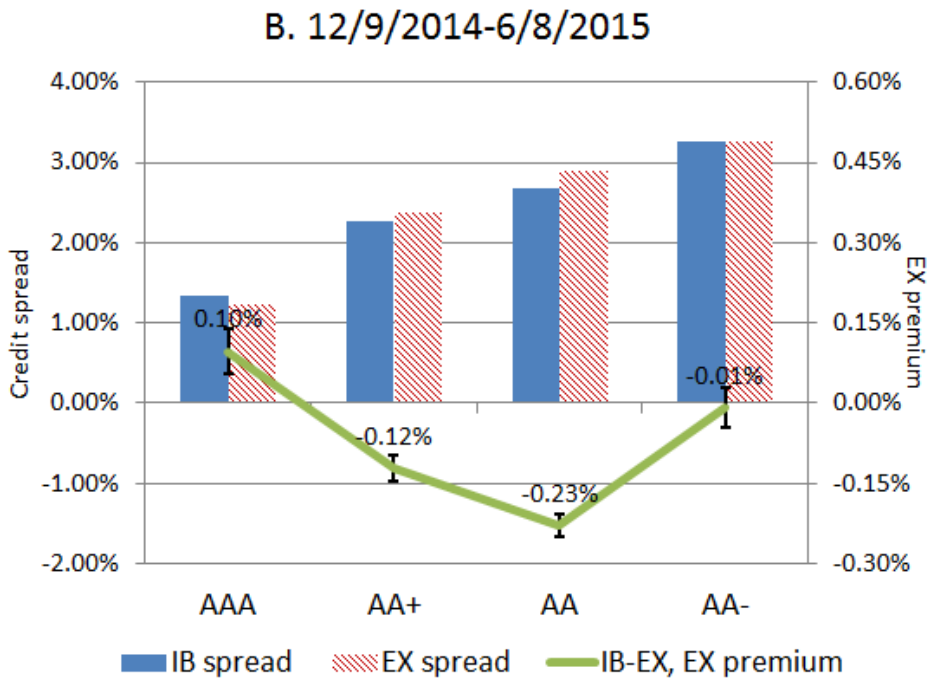
Market reactions: IB market haircuts

Sample period	AAA	AA+	AA	AA− & below
06/09/14–12/08/14	8.38	12.93	32.03	35.66
	(0.56)	(0.96)	(1.53)	(7.01)
12/09/14–06/08/15	13.76	14.38	31.23	37.20
	(0.44)	(1.25)	(1.28)	(8.89)

Data source: a major financial institution in China.

Average Exchange premium by ratings before and after the event





Pledgeability premium: a simple model

- Investors can (i) invest in a risky one-period bond with terminal payoff $\widetilde{Y}_t \leq F$; and (ii) borrow B against the risky bond subject to a haircut.

$$\max_{\{c_t, B_t, \pi_t\}} \mathrm{E}\left[\sum_{t=0}^{\infty} \beta^t u(c_t)\right]$$

subject to

$$c_t + \pi_t p_t = \pi_{t-1}\widetilde{Y}_t + B_t - B_{t-1}R_f$$
$$B_t \leq (1 - h_t)\pi_t$$

- Say at time t, bond with rating j has final cashflows Y:

$$p_t = \mathrm{E}\left[\widetilde{M}\widetilde{Y}_{t+1}\right] + \underbrace{\lambda_t(1-h_t)}_{\text{pledgeability premium}}$$

- The **shadow cost of capital** λ is related to "specialness" in Duffie (1996).
  - ↪ Garleanu-Pedersen (2011), Chen-Cui-He-Milbradt (2018):

$$\mathrm{E}[\lambda_t] = \text{Freq. of liquidity shocks} \quad \times \quad (R_{\text{uncol}} - r_{\text{col}})$$

Road map

- Two methods to estimate the pledgeability premium.
  - ↪ One tends to be underestimate, the other tends to be overestimate.
- EX premium: spreads between IB and EX.
  - ↪ $ibex_{ijt} = yield^{IB}_{ijt} - yield^{EX}_{ijt}$;
  - ↪ Free of change in bond fundamentals;
  - ↪ Treatment group (AA+ and AA) vs. Control group (AAA and AA-);
  - ↪ Before vs. after the policy shock;
  - ↪ Likely underestimate.
- Matched-AAA premium in EX market.
  - ↪ AAA bonds minus AA bonds with similar haircuts
  - ↪ Before vs. after the policy shock
  - ↪ Likely overestimate

Empirical identification

- Bond i with rating j and haircut h_{jt}^{EX} / h_{jt}^{IB}, with cashflows $\widetilde{Y}$

$$\begin{aligned} p_{ijt}^{EX} &= \mathbb{E}\left[\widetilde{M}\widetilde{Y}_{it}\right] + \lambda\left(1 - h_{jt}^{EX}\right) + Liq_{ij}^{EX} + Liq_{t}^{EX}; \\ p_{ijt}^{IB} &= \mathbb{E}\left[\widetilde{M}\widetilde{Y}_{it}\right] + \lambda\left(1 - h_{jt}^{IB}\right) + Liq_{ij}^{IB} + Liq_{t}^{IB}. \end{aligned}$$

  - ↪ Same pricing kernel $\widetilde{M}$ and λ across two markets;
  - ↪ Securities firms / mutual funds active on both sides.

- Exchange premium:

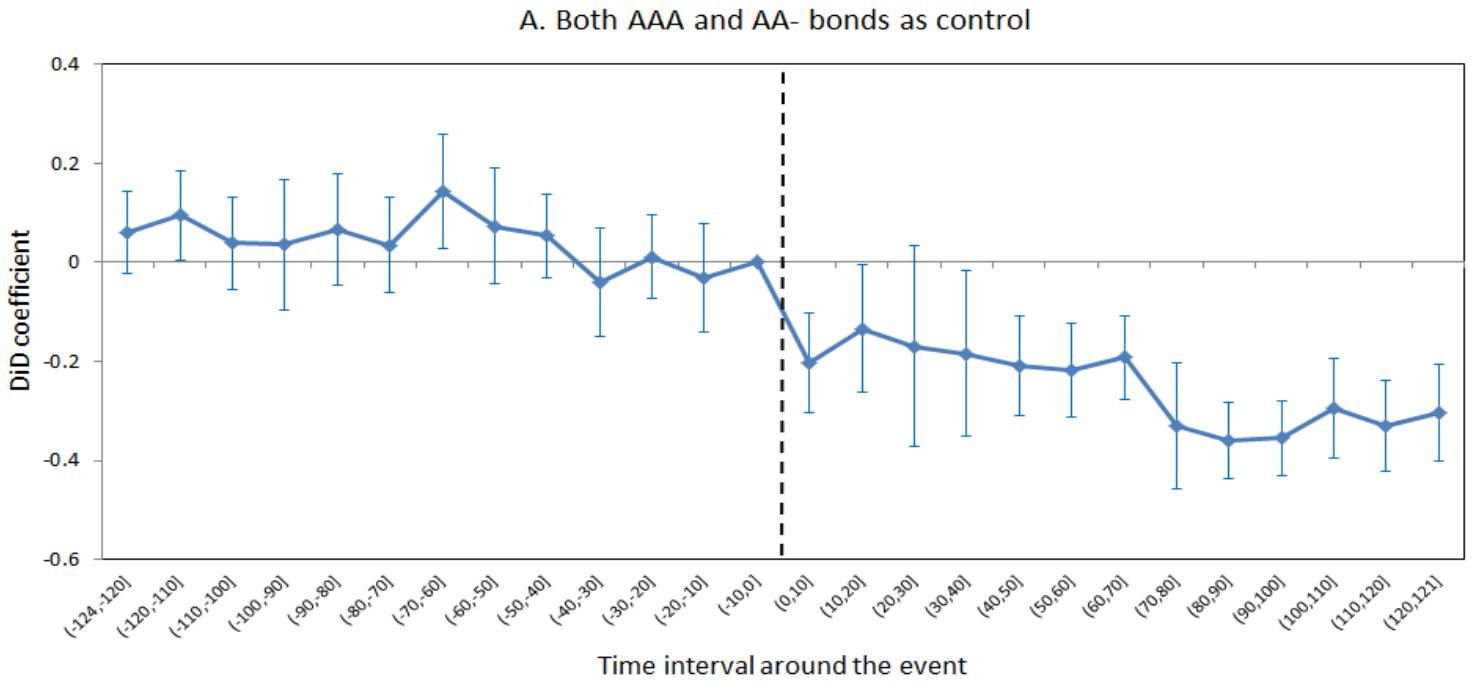
$$p_{ijt}^{EX} - p_{ijt}^{IB} = \lambda\left(1 - h_{jt}^{EX}\right) - \lambda\left(1 - h_{jt}^{IB}\right) + Liq_{ij}^{EX} - Liq_{ij}^{IB} + Liq_{t}^{EX} - Liq_{t}^{IB}.$$

- Policy shock: h_{jt}^{EX} jumps to 1 from $t = 0$ to $t = 1$ for $j \in \{AA, AA+\}$
- **Assumption:** $h_{jt}^{IB} = h_{j}^{IB} + \delta_t$**, largely supported by data**

$$p_{jt}^{EX} - p_{jt}^{IB} = \lambda\left(1 - h_{jt}^{EX}\right) - \underbrace{\lambda\left(1 - h_{j}^{IB}\right) + Liq_{ij}^{EX} - Liq_{ij}^{IB}}_{\alpha_{ij}\text{: bond/rating fixed effect}} + \underbrace{\lambda\delta_t + Liq_{t}^{EX} - Liq_{t}^{IB}}_{\alpha_t\text{: time fixed effect}}$$

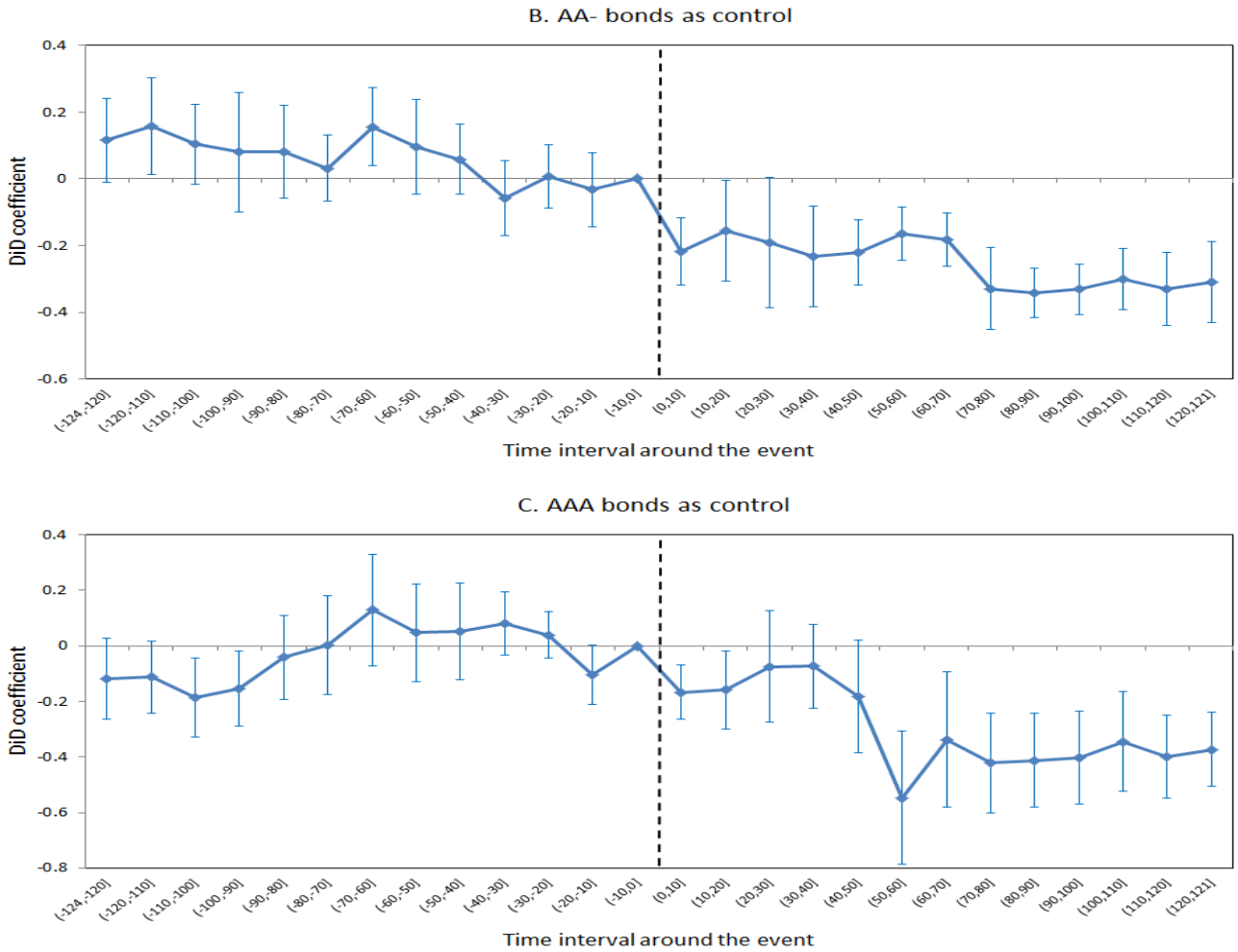
Exchange premium: Diff-in-Diff analysis

$$EXpremium_{ijt} = a_i + b_j + c_t + \sum_{k=1}^{26} d_k D_{jt}^k + X_{it}' e + u_{ijt}$$



- D_{jt}^k equals 1 for the treatment group and 0 otherwise.
- Common trend is observed before the event and the exchange premium between treatment and control groups is statistically significant after the event.

Exchange premium: Diff-in-Diff, two controls



- Higher-, lower-credit rating groups as control $\Longrightarrow$ rule out many alternative mechanisms (in which reactions tend to be monotonic in ratings)

Value of pledgeability: via exchange premium

- Instrument:

$$D_{jt} = \begin{cases} 1 & j \in \{AA+, AA\} \quad \& \quad t > 12/08/14 \\ 0 & otherwise \end{cases}$$

- 2SLS:
  - ↪ First stage:

$$haircut_{ijt} = \rho_i + \nu_j + \eta_t + \beta D_{jt} + X'_{it}\gamma + v_{ijt}$$

  - ↪ Second stage:

$$ibex_{ijt} = \alpha_i + \beta_j + \lambda_t + \delta \widehat{haircut}_{ijt} + X'_{it}\theta + \xi_{ijt}$$

  - ↪ Control variables:
    - ★ Bond-day level characteristics: time-to-maturity, turnover ratio, price, volatility
    - ★ Macro factors: term spread, GC001-SHIBOR, CDBSpot, stock market index
    - ★ Bond fixed effect, rating fixed effect, and weekly time fixed effect
    - ★ Standard errors clustered by week (or rating-week)
- Sample: simultaneous trading sample (same bond trading within $[t-2, t]$).

First Stage

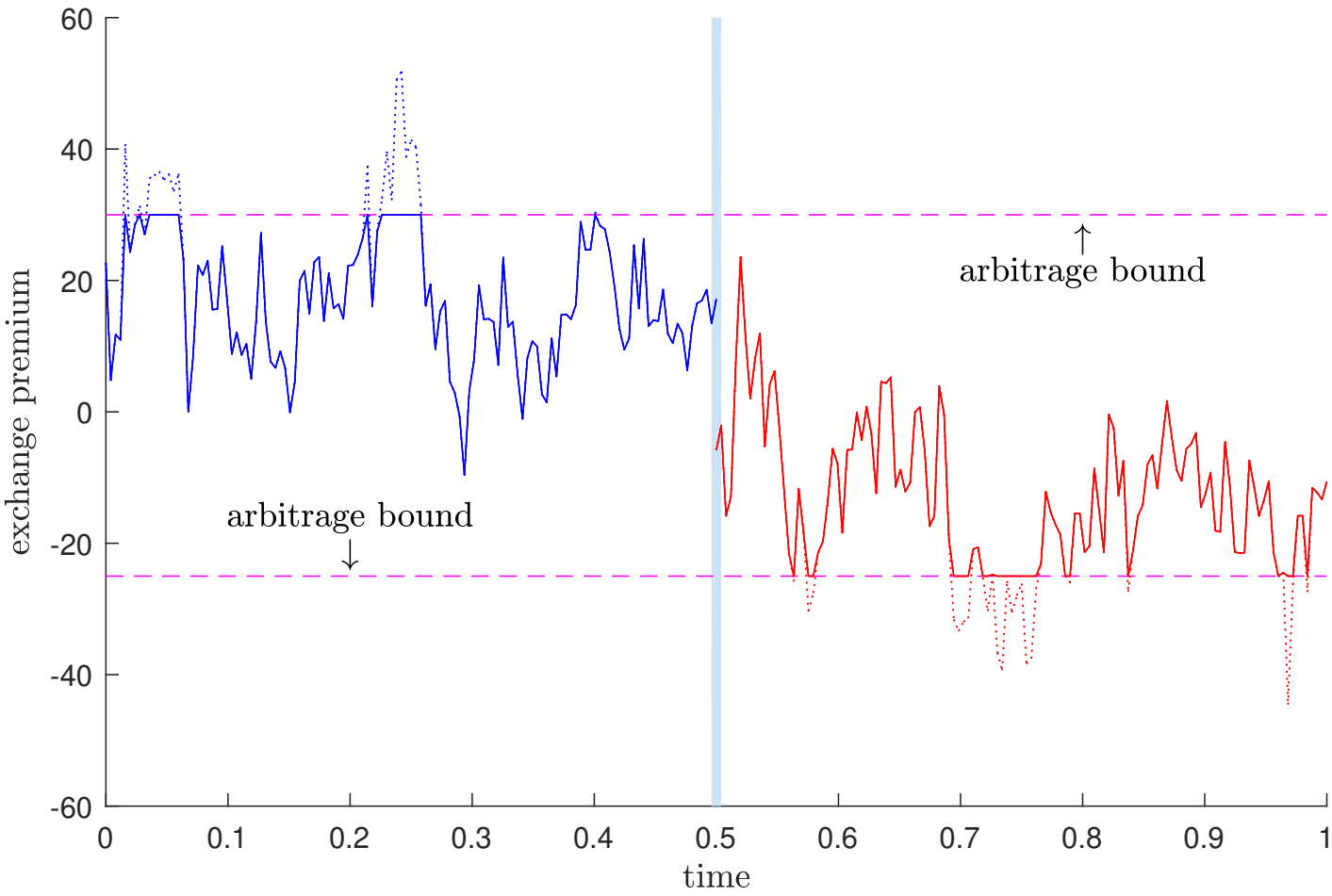
Dependent: Haircut	Full		Exclude AAA	Exclude AA-	Exclude AA	Exclude AA+
	(1)	(2)	(3)	(4)	(5)	(6)
Shock	67.89***	68.28***	68.38***	68.00***	75.05***	63.57***
	(0.57)	(0.74)	(0.76)	(0.74)	(0.98)	(1.28)
Controls	–	✓	✓	✓	✓	✓
Bond FE	–	✓	✓	✓	✓	✓
Rating FE	✓	✓	✓	✓	✓	✓
Week FE	✓	✓	✓	✓	✓	✓
R-square	0.85	0.95	0.95	0.95	0.97	0.96
N	10270	10107	9651	8584	5008	7065

- *Standard errors clustered by week*

Second Stage

Dependent: EX Premia	Full		Exclude AAA	Exclude AA-	Exclude AA	Exclude AA+
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{Haircut}$	-0.39***	-0.39***	-0.40***	-0.32***	-0.40***	-0.38***
	(0.05)	(0.05)	(0.05)	(0.08)	(0.05)	(0.09)
Maturity		2.12***	2.34***	2.52***	2.82***	1.08
		(0.71)	(0.73)	(0.83)	(0.85)	(0.79)
Turnover		0.12	0.10	0.13	0.20	0.10
		(0.09)	(0.09)	(0.11)	(0.14)	(0.09)
Market price		-0.00	-0.00	-0.00	-0.01*	-0.00
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Volatility		-0.04	-0.13	0.13	-0.86	0.24
		(0.95)	(0.97)	(1.03)	(1.47)	(0.75)
CDB_{spot}		-12.95	-13.01	-15.76	-14.30	-9.90
		(8.60)	(8.68)	(11.29)	(12.63)	(8.97)
Term spread		3.14	1.16	4.18	-5.63	12.25
		(7.17)	(6.45)	(7.72)	(13.81)	(8.06)
GC001-SHIBOR		-0.19	-0.21*	-0.15	-0.15	-0.23
		(0.12)	(0.11)	(0.13)	(0.14)	(0.15)
Ret_{stock}		0.11	0.08	0.18	0.05	0.11
		(0.27)	(0.29)	(0.34)	(0.40)	(0.35)
Bond FE	–	✓	✓	✓	✓	✓
Rating FE	✓	✓	✓	✓	✓	✓
Week FE	✓	✓	✓	✓	✓	✓
R-square	0.12	0.48	0.47	0.49	0.41	0.53
N	10270	10107	9651	8584	5008	7065

Underestimation due to arbitrage

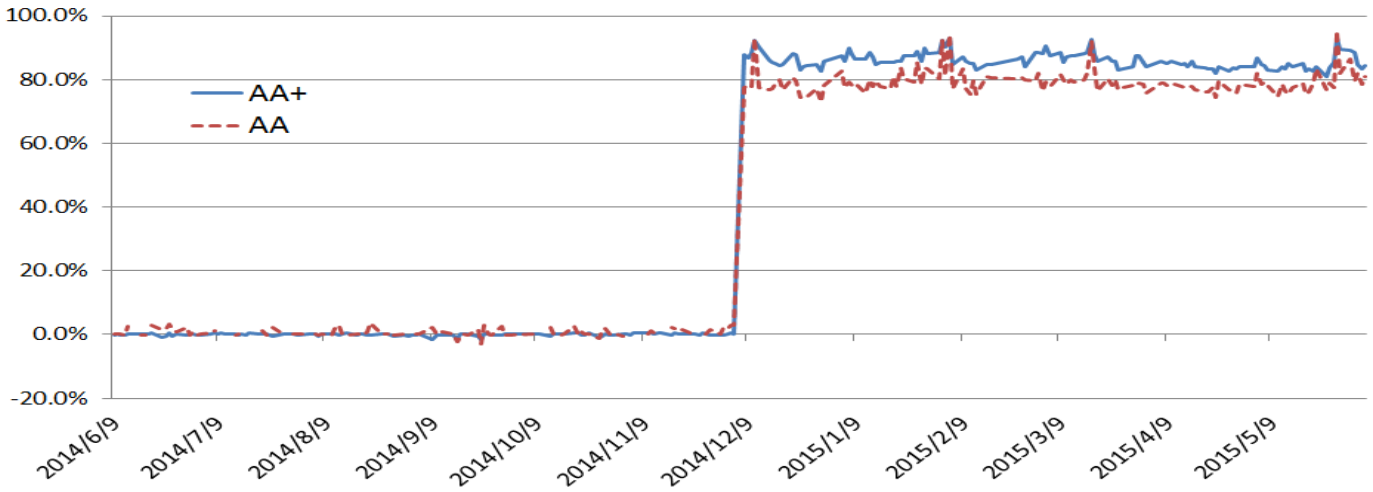


- $p_{jt}^{EX} - p_{jt}^{IB}$ is capped by the arbitrage bounds
- Alternative empirical approach that leads to **overestimation**?

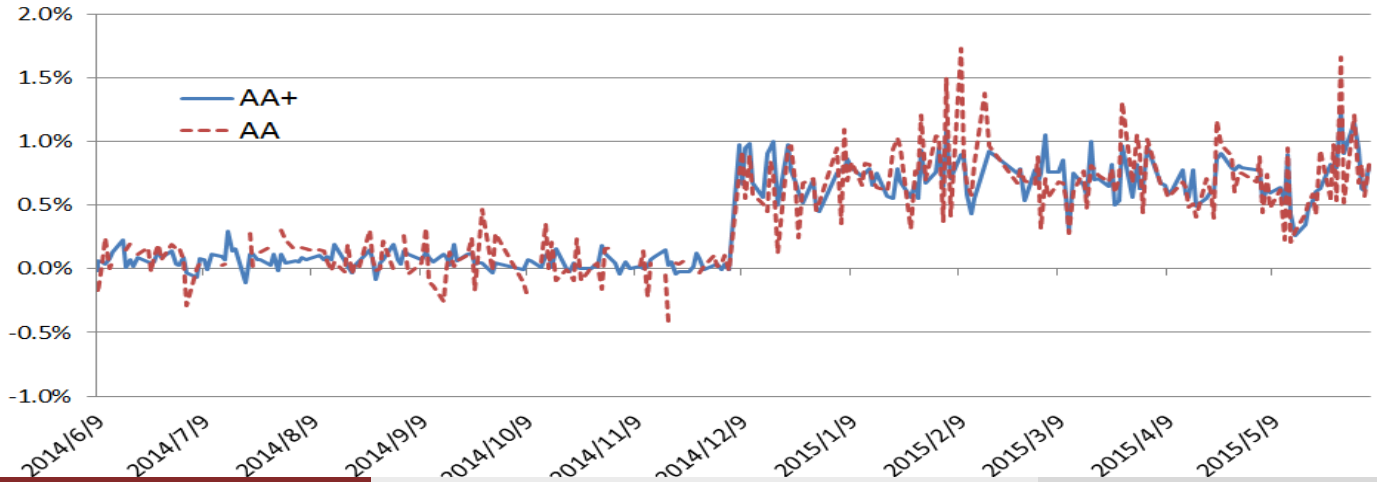
Value of pledgeability: matched AAA bonds as control (1)

- Take any bond in treatment group $\{AA+, AA\}$, construct matched-AAA.
- Similar haircuts and similar yield spreads ("same" fundamentals).

A: Differences in haircuts



B: Differences in credit spreads



Value of pledgeability: matched AAA bonds as control (2)

- Following the previous setting

$$\begin{aligned} p^{EX}_{AA,t} &= \mathbb{E}\left[\widetilde{M}\widetilde{Y}_{AA,t}\right] + \lambda\left(1 - h^{EX}_{AA,t}\right) + Liq^{EX}_{AA} + Liq^{EX}_{t}. \\ p^{EX}_{AAA,t} &= \mathbb{E}\left[\widetilde{M}\widetilde{Y}_{AAA,t}\right] + \lambda\left(1 - h^{EX}_{AAA,t}\right) + Liq^{EX}_{AAA} + Liq^{EX}_{t}; \end{aligned}$$

- Policy shock
  - ↪ at $t = 0$, $h^{EX}_{AA,t} - h^{EX}_{AAA,t} = 0$ (by design)
  - ↪ at $t = 1$, $h^{EX}_{AA,t} - h^{EX}_{AAA,t}$ ⇑
- Matched-*AAA* premium:

$$p^{EX}_{AAA,t} - p^{EX}_{AA,t} = \underbrace{\mathbb{E}\left[\widetilde{M}\left(\widetilde{Y}_{AAA,t} - \widetilde{Y}_{AA,t}\right)\right]}_{\text{0 if matched well}} + \underbrace{\lambda\left(h^{EX}_{AA,t} - h^{EX}_{AAA,t}\right)}_{\text{identifies } \lambda} + \underbrace{Liq^{EX}_{AAA} - Liq^{EX}_{AA}}_{\text{constant}}$$

  - ↪ $\mathbb{E}\left[\widetilde{M}\left(\widetilde{Y}_{AAA,t} - \widetilde{Y}_{AA,t}\right)\right]$ is likely to jump upward at $t = 1$—**overestimate** of λ
  - ↪ Say, flight-to-quality, policy-maker's private info, etc
- We obtain an estimate of 85 bps.

Second stage (vs. matched AAA)

Dependent:	Full		AA+	AA
Spread$^{matched-AAA}$	(1)	(2)	(3)	(4)
$\widehat{Haircut}$	-0.74***	-0.85***	-0.84***	-0.84***
	(0.03)	(0.05)	(0.05)	(0.09)
Maturity		0.03	0.07	-0.09
		(0.11)	(0.10)	(0.21)
Turnover		2.22***	1.23*	5.94***
		(0.82)	(0.73)	(2.13)
Market price		-0.00	-0.00	0.01
		(0.00)	(0.00)	(0.01)
Volatility		0.12	-1.03	2.19**
		(0.83)	(1.05)	(1.05)
CDB_{spot}		-10.28***	-10.32***	-7.96
		(3.78)	(3.43)	(9.25)
Term spread		-0.91	-3.54	5.72
		(4.97)	(4.51)	(8.94)
GC001-SHIBOR		-0.17	-0.12	-0.43
		(0.31)	(0.26)	(0.55)
Ret_{stock}		0.77	1.00*	0.11
		(0.55)	(0.51)	(0.89)
Bond FE	–	✓	✓	✓
Rating FE	✓	✓	✓	✓
R-square	0.15	0.55	0.56	0.54
N	9940	9897	7548	2349

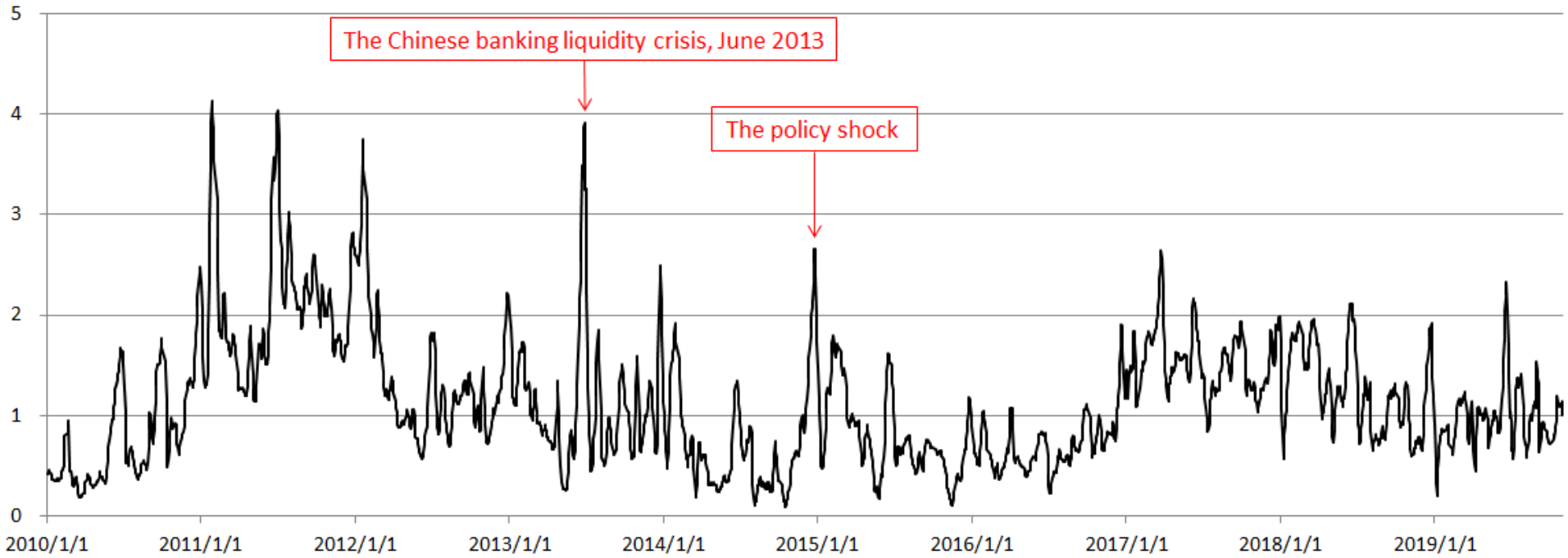
Shadow cost of capital

$$\text{Premium} = \text{Freq. of liquidity shocks} \quad \times \quad \underbrace{\lambda}_{\text{shadow cost of capital}}$$

- With the pledgeability premium estimates, one can infer the shadow cost of capital (a form of financing risk premium).
  - $\hookrightarrow$ $\lambda = R_{\text{uncol}} - r_{\text{col}}$
- Before event, about 35% of the enterprise bonds on the exchange were posted as collateral on a typical day.
- Average haircut of treated bonds before event: about 25%.
- Implied shadow cost of capital:
  1. Based on exchange premium (39 bps): 1.1%
  2. Based on rating match (85 bps): 2.4%

Putting things in perspective

Spread between interbank repo rate and CDB bond yield



Conclusion

- An estimate of the causal effect of changes in pledgeability on asset prices
  - ↪ Dual-list bonds, free of fundamental concerns
  - ↪ Differential reactions based on ratings
- A 100% increase in haircut translates into 39 to 85 bps increase in yields, or on average, or 2.1% to 4.5% price drop for an average dual-listed enterprise bond.
  - ↪ Significant implied shadow cost of capital
  - ↪ After the shock, enterprise bonds in custody on the exchange market decline. Compare treasuries and enterprise bonds
- Chinese corporate bond markets provide a nice laboratory for studying corporate financing, default risk, liquidity, government guarantees ...
  - ↪ Fang, Wang, Wu (2020): Monetary policy in China