The Value of Data to Fixed Income Investors

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ABFER
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Data is a Valuable Asset!

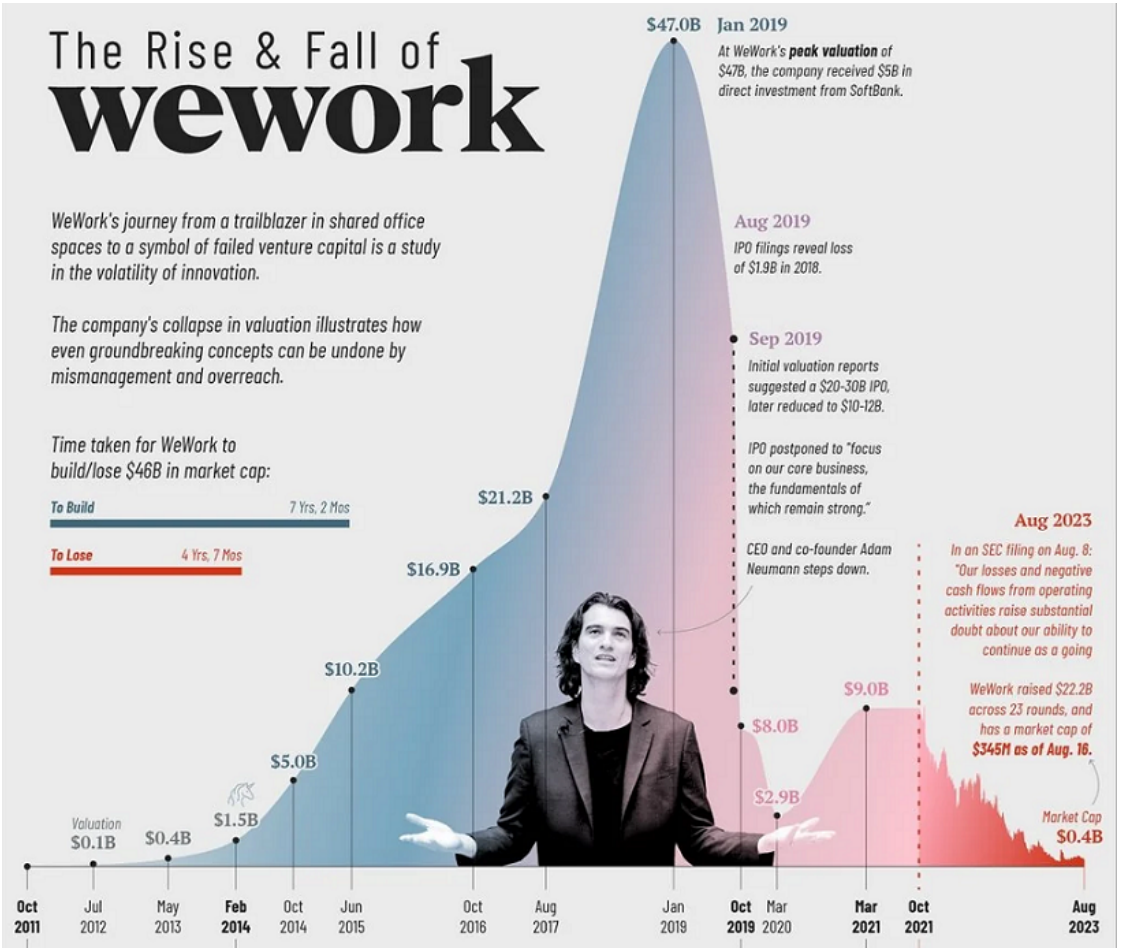

AIRBNB
GUESTS BOOK
747 STAYS
AMAZON
SHOPPERS SPEND
$455K
X
USERS SEND
360K
TWEETS
6.3M
SEARCHES
HAPPEN ON
GOOGLE
WHATSAPP
USERS SEND
41.6M
MESSAGES
LINKEDIN
USERS SUBMIT
6,060
RESUMES
VIEWERS WATCH
43 YEARS
OF STREAMING
CONTENT
3,720
USERS DOWNLOAD
INSTAGRAM
THREADS
CYBER-
CRIMINALS
LAUNCH 30 DDOS ATTACKS
EVERY MINUTE
01:00
OF THE DAY
PRESENTED BY
DOMO
CHATGPT
USERS SEND
6,944 PROMPTS
INSTAGRAM
USERS SEND
694K REELS VIA DM
FACEBOOK
USERS LIKE
4M POSTS
DOORDASH
DINERS PLACE
$122K
IN ORDERS
FANS STREAM A
TAYLOR SWIFT
SONG 69.4K TIMES
VENMO
USERS SEND
$463K
IN PAYMENTS
GLOBAL
INTERNET
USERS SPEND
25.1M
HOURS ONLINE
THE AVERAGE
PERSON
PRODUCES
102 MB
OF DATA
PEOPLE TRADE
$398M
IN TREASURY
BONDS
PEOPLE SEND
241M
EMAILS
TWITCH
USERS WATCH
48K
HOURS OF CONTENT

Data is a Valuable Asset!

- Data is digitized information for forecasting
- Advance in AI and machine learning and the availability of big data make data valuation increasingly important
- Research Question: How much are fixed-income investors willing to pay for data (information)?

How much would investors pay for information?

- Suppose you are a bond investor, and someone tries to sell you satellite image data that can improve WeWork's default prediction. How much would you like to pay?



- Would you be willing to pay more for info. of small or large firms?
- Does it matter if the bonds are highly-rated or long-dated?

This Paper

- Estimate the dollar value of private information for corporate bond investors using a model in Back and Baruch (2004)
  - Corporate bonds are infrequently traded
  - Bonds have binary payoffs at maturity and bounded prices between zero and the face value
  - The model takes into account illiquidity, uncertainty, maturity and trading size
- Document stylized facts in the cross-section and over time.
- Estimate the causal effect of investor composition on value of information (VOI)
  - Mutual fund shares increase VOI, by improving liquidity

Literature

- Theory: Grossman and Stiglitz (1980), Kyle (1985), Glosten and Milgrom (1985), Admati (1985), Back (1992), Back and Baruch (2004), Cabrales et al. (2013), Epstein et. al (2014), Foucault et al. (2015), Farboodi and Veldkamp (2020), Pavan et al. (2023) and many more...

- Empirics: Indirect measurement for information demand
  - Proxy for the value of data by its production cost

    Saunders and Brynjolfsson, 2016 (IT investment cost)
  - Imply the quantity of info through covariances with asset returns

    Bai, Philippon, and Savov (2016, JFE) (price informativeness), Martineau (2017,WP) (earnings announcements), Durnev, Morck, and Yeung (2004, JF) (R^2)
  - Other proxies for data or information

    Ben-Rephael et al. (2021, JF) (news consumption), Rabco et al. (2015,WP) (social media text), Hong and Kacperczyk (2010,QJE) and Kelly and Ljungqvist (2012, RFS) (analyst coverage)

The Literature: Empirics

Only recently, there are papers that directly quantify the value of info.

- Kadan and Manela (2019) study the value of macro-level info.
- Kadan and Manela (2020) use high-frequency data to estimate value of info in the equity market.
- Farboodi, Matray, Veldkamp and Venkateswaran (2022) estimate the initial value of a unit of precision and find that it is greater for large growth stocks.
- Farboodi, Singal, Veldkamp and Venkateswaran (2023) develop a sufficient statistics approach that allows for investor heterogeneity.
- This paper estimates value of info for corporate bond investors.

Roadmap

1. Model and estimation
2. How does *VOI* vary cross-sectionally and over time?
3. The causal effect of investor composition on *VOI*

Salient Features of Corporate Bonds

- Corporate bonds are infrequently traded
- Corporate bonds have binary payoffs at maturity and bounded prices between zero and the face value.
- Corporate bonds are traded over the counter with a large cross-sectional variation in bid-ask spreads

Need a structural model rich enough to accommodate these features!

Sample Coverage Comparison

The Number of Bond-Month Observations

	Kyle >10	Kyle >20	Kyle t-stat>2	Baseline
AAA	10686	2283	1871	14294
AA	44114	9692	7458	57666
A	168922	29124	41678	291408
BBB	184887	28472	50330	329212
BB	59359	8984	14088	87519
B	42090	6020	11345	70530
CCC	15398	1878	4142	24953
Redeemable	422187	67927	103703	686142
Total	525456	86453	130912	875582
Coverage	60%	$<10\%$	15%	100%

Model: Back and Baruch (2004)

Assets

- Risky bond with uncertain payoff $\tilde{v} \in \{0, 1\}$, matures with intensity r
  $\Rightarrow$ better suited for fixed income securities
- Risk-free rate set to 0

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- Risk-free rate set to 0

Agents (all are risk-neutral)

- Liquidity traders:
  - Arrive exogenously with a Poisson rate β
    $\Rightarrow$ suited for accommodating infrequent trading
  - Fixed order size δ; equal probability of buy and sell
- Informed traders: know exactly the final payoff ($\tilde{v}$) of the bond and choose trading strategies optimally to maximize profit.
- Market makers: set bid (b) and ask (a) prices to break-even.
  - Bond price is equal to expected payoff: $p = E[\tilde{v}]$

Model: Informed Traders

Informed trader: knows exactly the final payoff ($\tilde{v}$) of the bond and chooses mixed optimal strategy to maximize profit

- Pretends to be a liquidity trader $\Rightarrow$ trade at size δ
- In equilibrium, the informed trader is indifferent between trading and not trading

Model: Informed Traders

Informed trader: knows exactly the final payoff ($\tilde{v}$) of the bond and chooses mixed optimal strategy to maximize profit

- Pretends to be a liquidity trader $\Rightarrow$ trade at size δ
- In equilibrium, the informed trader is indifferent between trading and not trading
- If $\tilde{v} = 1$, denote value function by $V(p; \beta, r, \delta)$

  When trading

$$\underset{\text{current value}}{V(p)} = \underset{\text{trading gain}}{(1-a)\delta} + \underset{\text{value at new price}}{V(a)}$$

  When not trading

$$\underset{\text{maturity prob.}}{rV(p)} = \underset{\text{price drift}}{V'(p)f(p)} + \underset{\text{uninformed order changes price}}{\beta[V(a) - V(p)] + \beta[V(b) - V(p)]}$$

Model: Informed Traders

Informed trader: knows exactly the final payoff ($\tilde{v}$) of the bond and chooses mixed optimal strategy to maximize profit

- Pretends to be a liquidity trader $\Rightarrow$ trade at size δ
- In equilibrium, the informed trader is indifferent between trading and not trading
- If $\tilde{v} = 0$, denote value function by $J(p; \beta, r, \delta)$.

  When trading

$$\underset{\text{current value}}{J(p)} = \underset{\text{trading gain}}{b\delta} + \underset{\text{value at new price}}{J(b)}$$

  When not trading

$$\underset{\text{maturity prob.}}{rJ(p)} = \underset{\text{price drift}}{J'(p)f(p)} + \underset{\text{uninformed order changes price}}{\beta[J(a) - J(p)] + \beta[J(b) - J(p)]}$$

Model: Defining *VOI*

- With boundary conditions, numerically solve for value functions $V(p)$, $J(p)$, and endogenous $a(p)$, $b(p)$.
- The expected value of information (*VOI*) for a bond with a face value of one dollar is

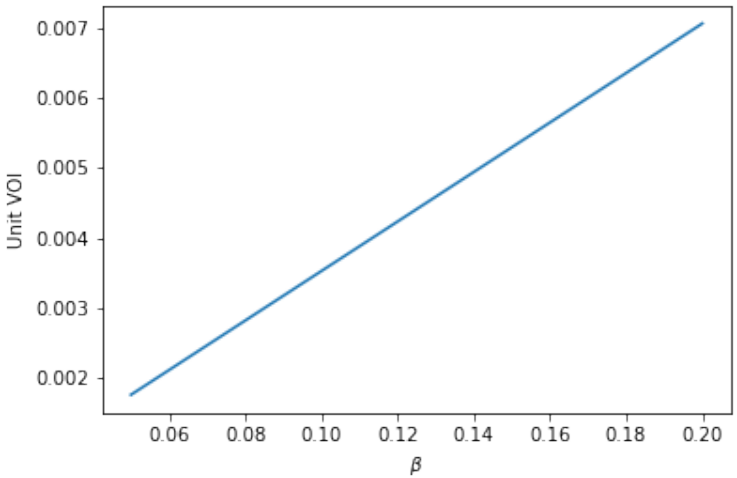
$$VOI = pV(p; \beta, r, \delta) + (1 - p)J(p; \beta, r, \delta)$$

- Total value of information *TVOI*

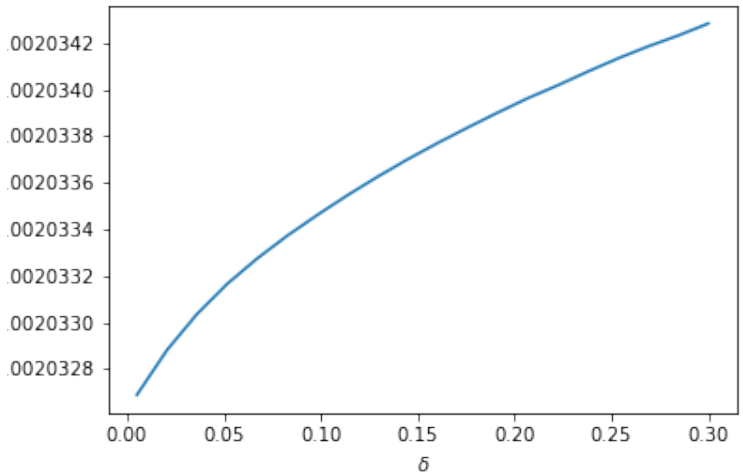
$$TVOI = \text{Amount outstanding} \times VOI$$

Simulation

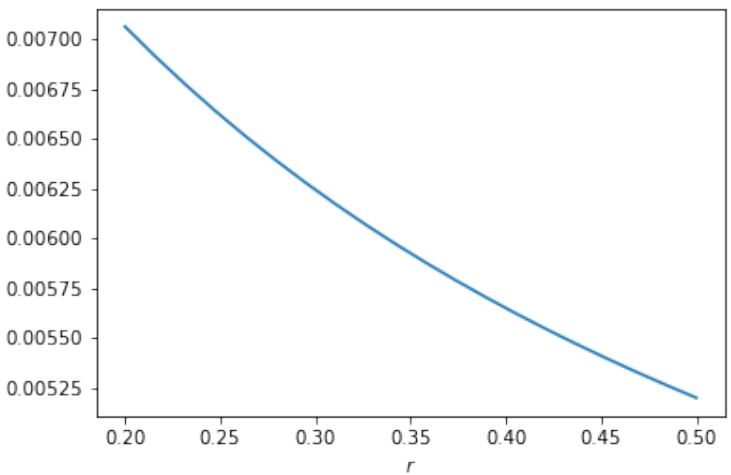
β



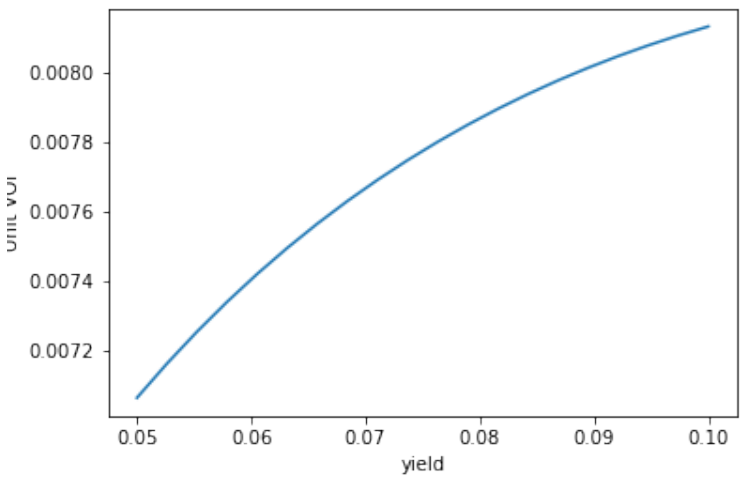
δ



r



Yield



Estimation

- Estimate *VOI* at the bond-month level. For bond i in month m,
  - Set $\delta_{i,m}$ to match the average trading size
  - Set $\frac{1}{r_{i,m}}$ to match duration
  - Calibrate $\beta_{i,m}$ to match the empirically observed bid-ask spread
- Unlike Kyle-based measures, we do not rely on high-frequency data $\Rightarrow$ larger sample coverage
- Data
  - Bond trading data from TRACE
  - Bond characteristics from Mergent FISD
  - Sample period from Nov 2002 to Sep 2020; exclude bonds below CCC−
- Final sample: 875,582 bond-month observations for a unique list of 22,872 bonds

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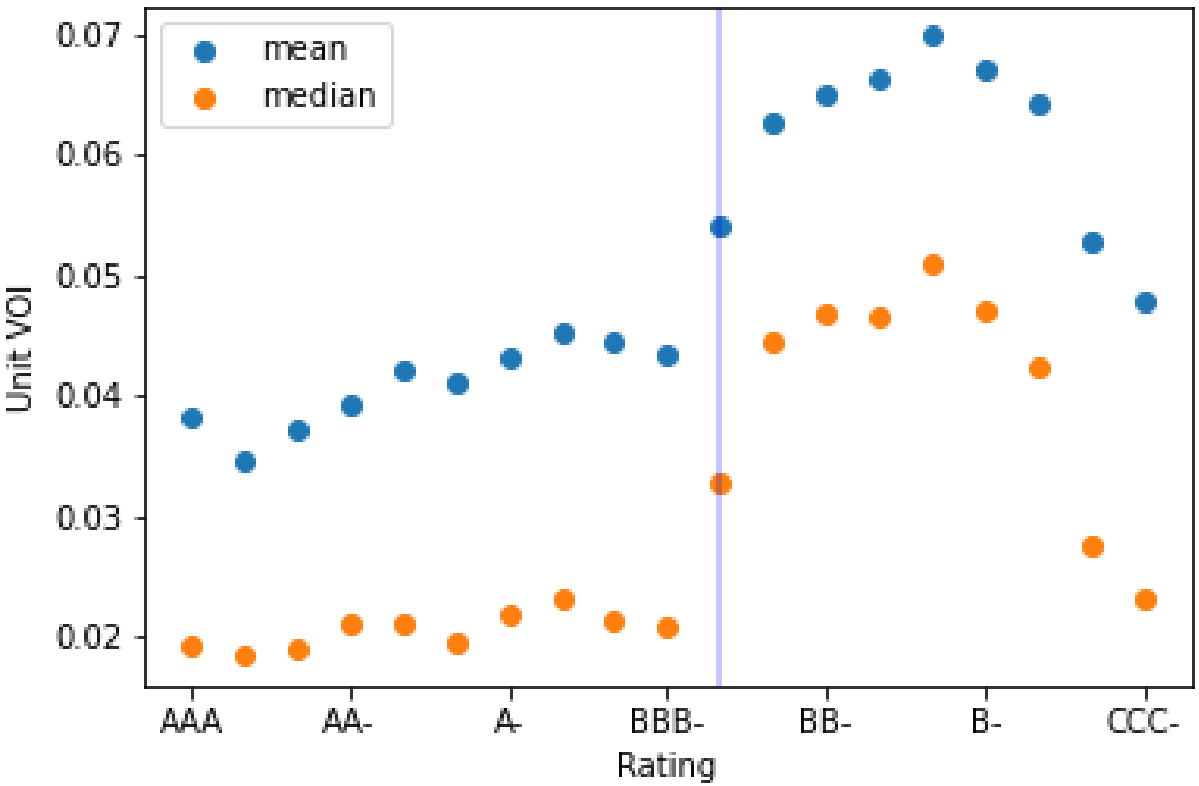
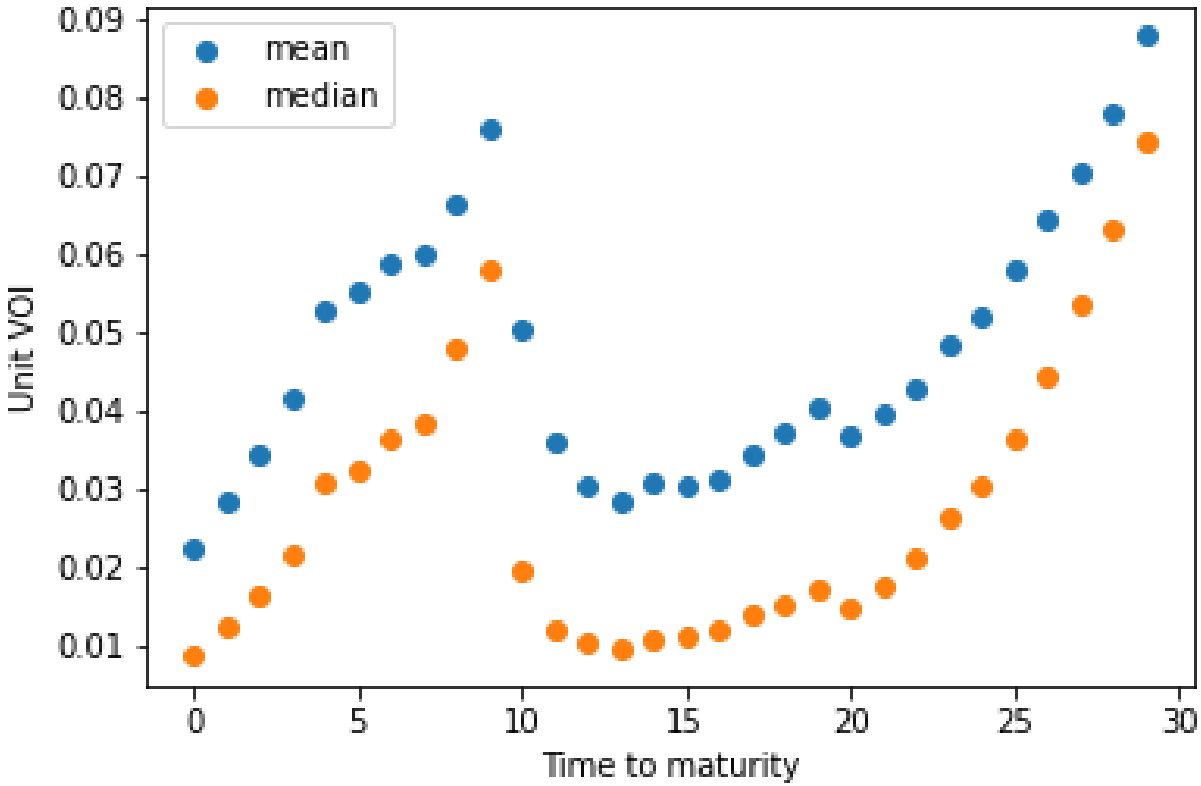
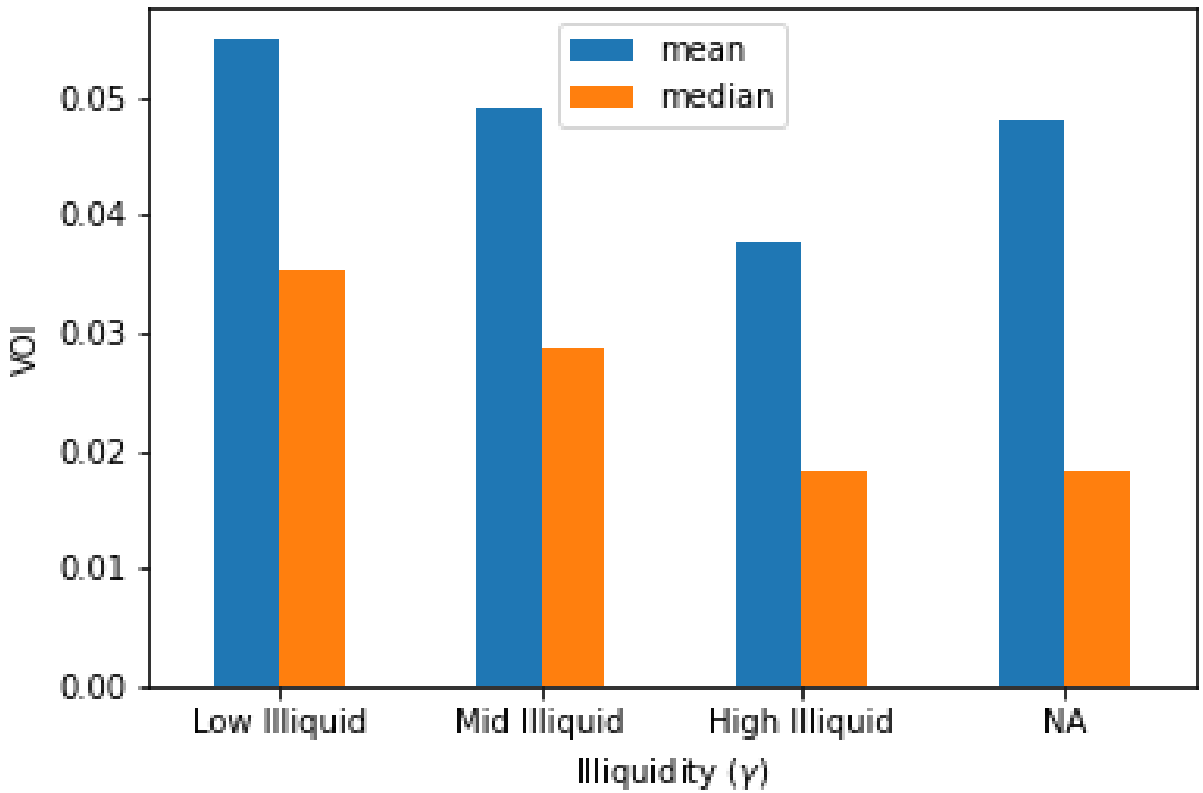
VOI and Bond Characteristics - Credit Rating



VOI and Bond Characteristics - Time-to-Maturity



VOI and Bond Characteristics - Illiquidity



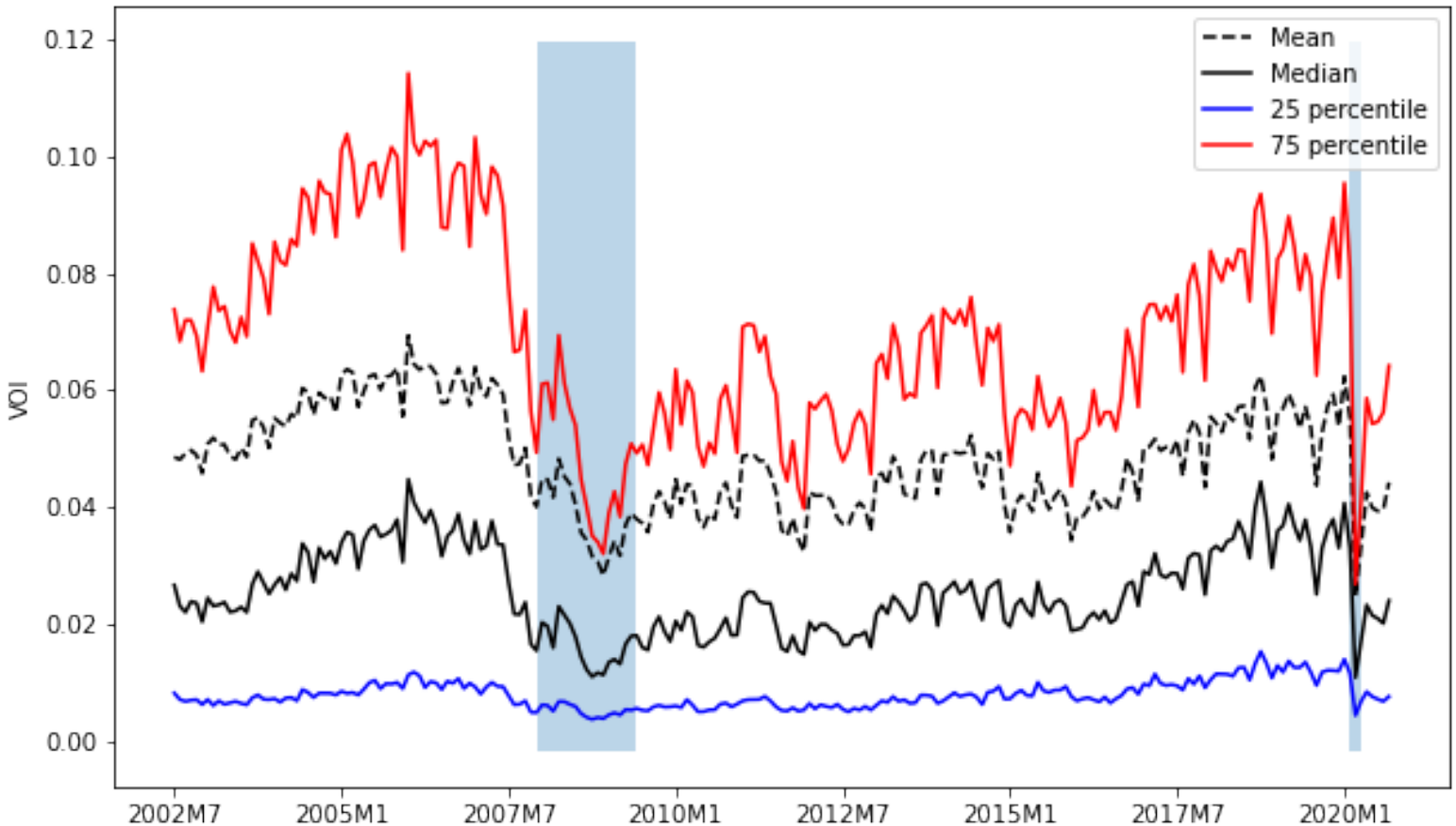
γ is the illiquidity measure from Bao, Pan and Wang (2011).

Stylized Facts

In general, investors are willing to pay more for information of the following bonds, those with

- Higher credit risk and uncertainty
- Longer maturity
- Higher liquidity
- Larger size

VOI: Time-Series Evolution

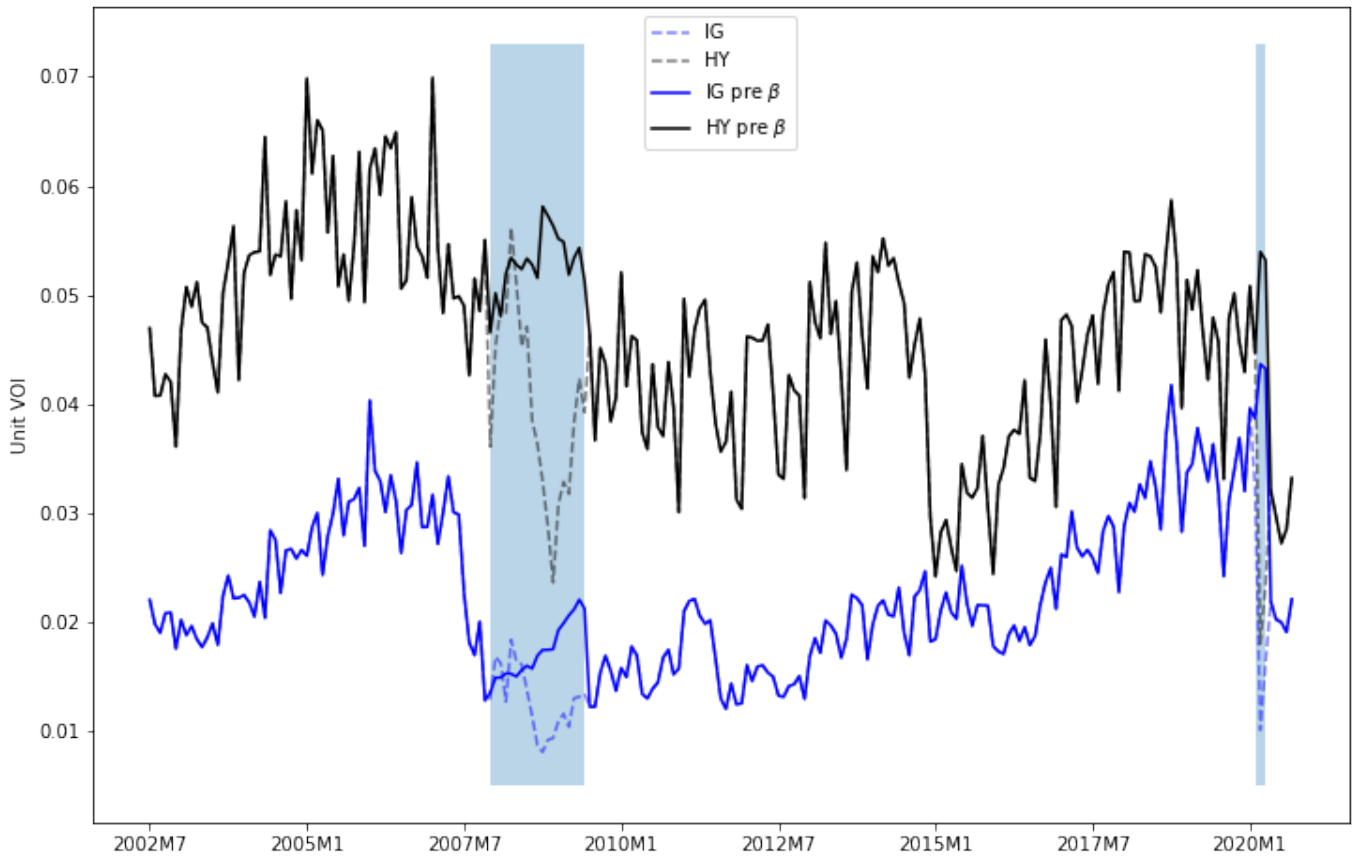


VOI: Time-Series Patterns

Bond market: *VOI* decreased in stressed times (this paper)
Equity market: *VOI* increased in stressed times (Kadan and Manela, 2020)

- Both markets became more volatile $\Rightarrow \uparrow$ *VOI*
- Both markets became less liquid $\Rightarrow \downarrow$ *VOI*
- The volatility effect dominates for stocks, whereas the liquidity effect dominates for bonds, resulting in a lower *VOI* for bonds.

VOI Time-Series Patterns



Dotted lines: real-time *VOI*; Solid lines: using pre-crisis liquidity

Comparison with a Kyle-based Measure

Our method	Kyle Model
accounts for infrequent trading	assumes continuous trading
can uses low-frequency data	relies on high-frequency data
accounts for binary payoffs	assumes normal payoffs
thus bounded uncertainty	thus more volatility

Apply the Kyle model used in the equity market to estimate VOI or bond investors.
Panel A: Sample coverage (unit: the number of observations)

	Kyle >10	Kyle >20	Kyle t-stat>2	Baseline
AAA	10686	2283	1871	14294
AA	44114	9692	7458	57666
A	168922	29124	41678	291408
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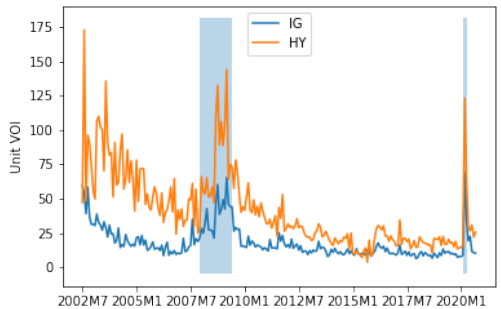
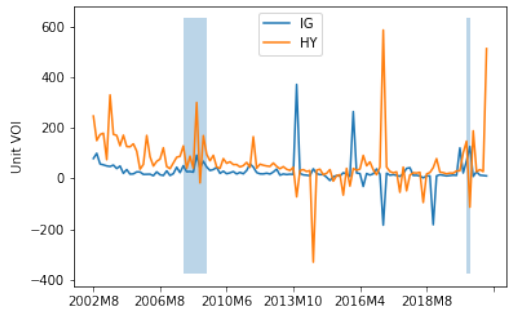
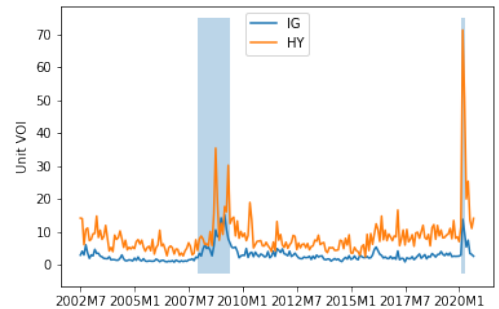
Comparison with a Kyle-based Measure

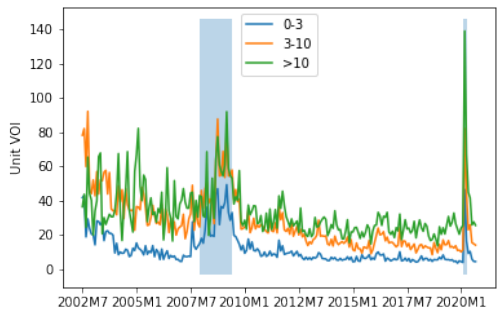
(a) By rating

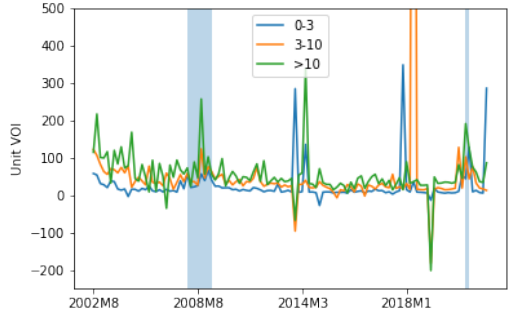


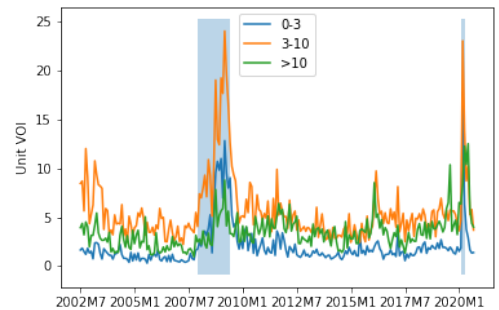




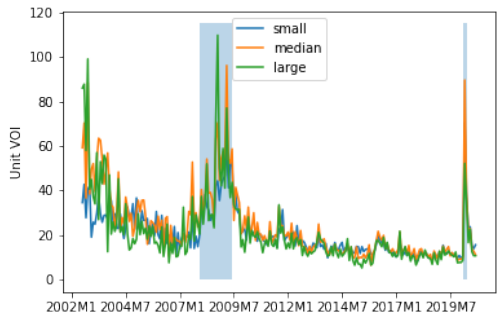
(b) By maturity

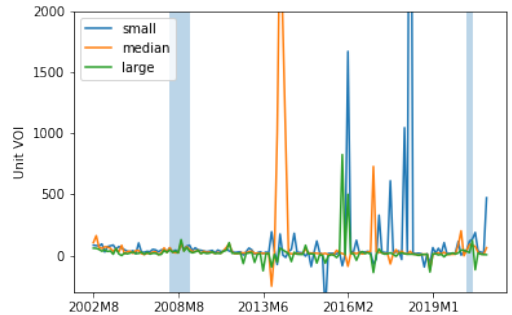


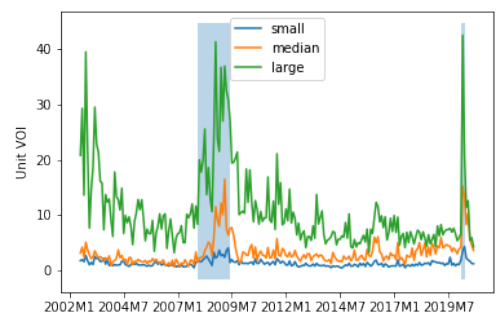




(c) By size



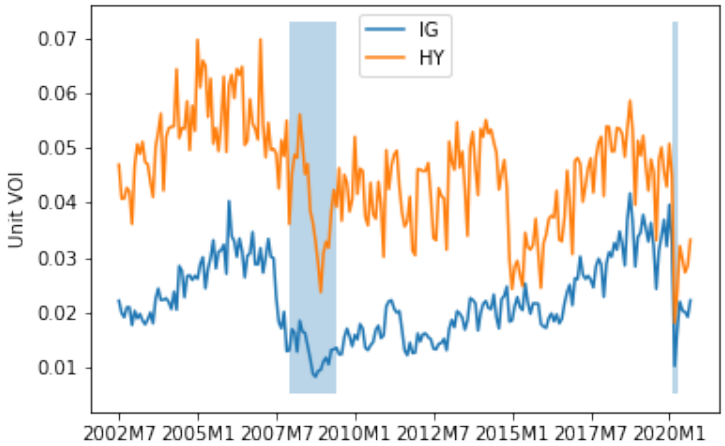




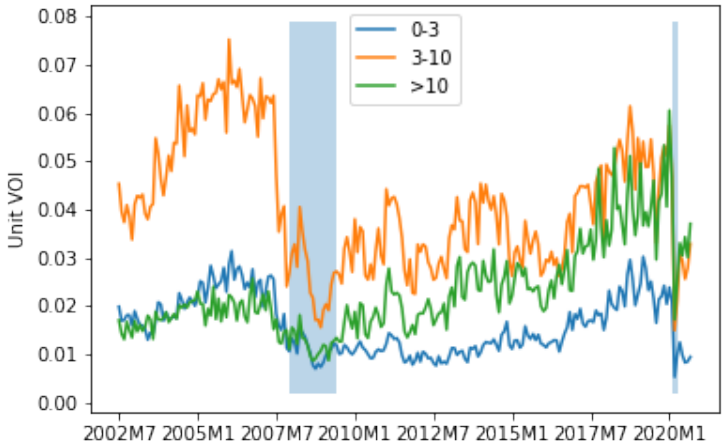
A.$>$ 10 obs. B.$>$ 20 obs. C. t-stats >2

VOI: Time-Series Evolution

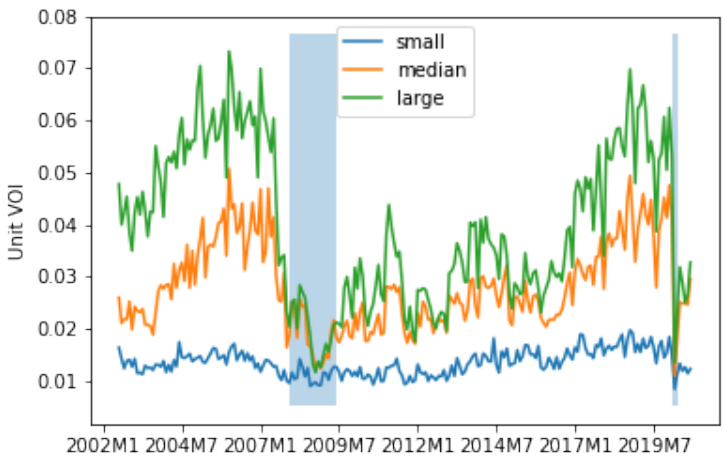
Rating



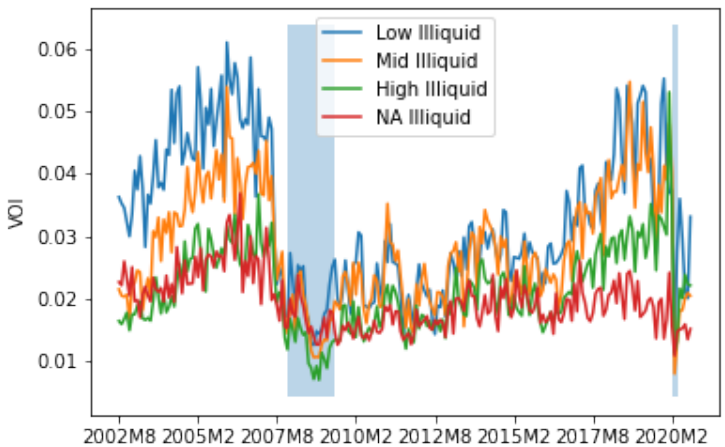
Time-to-Maturity



Size



Illiquidity



Roadmap

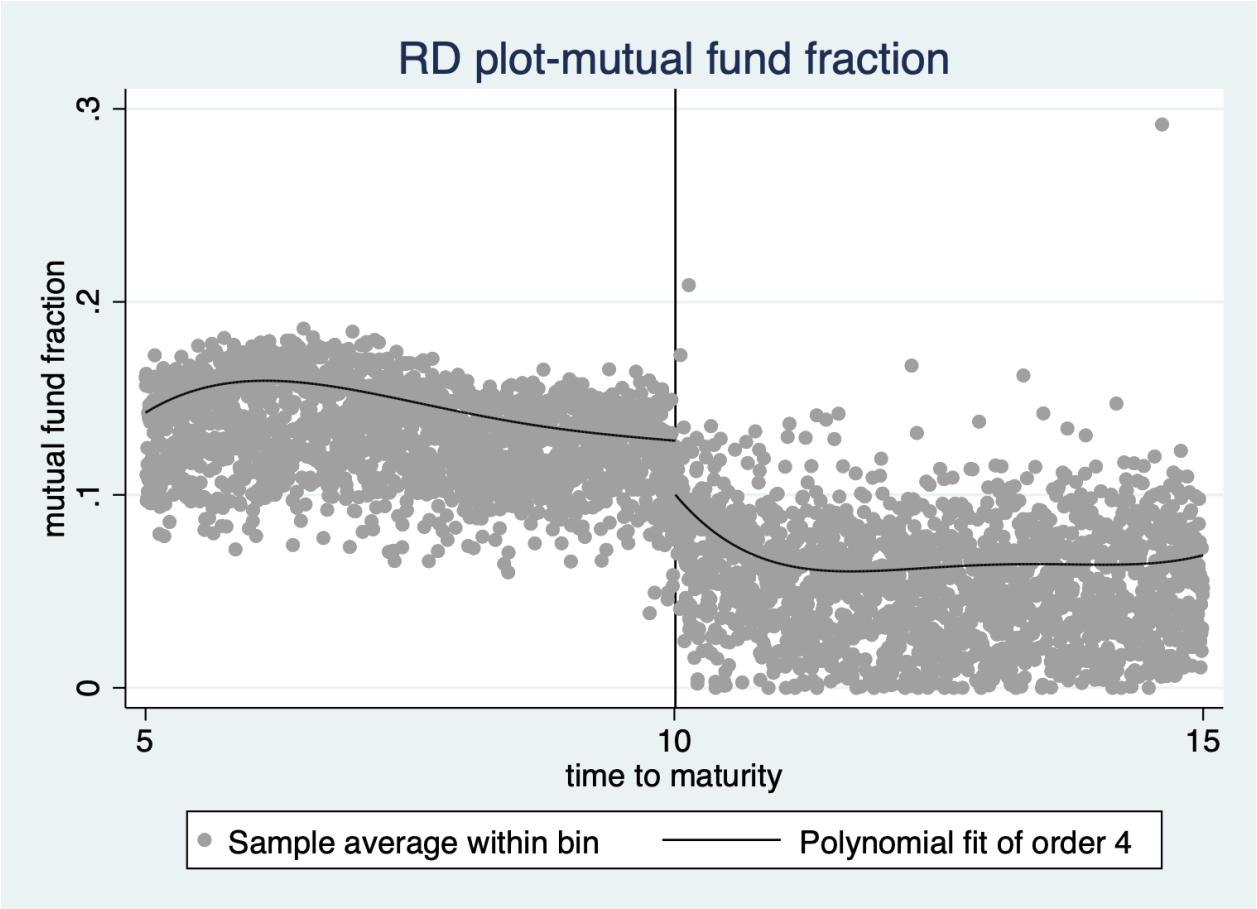
1. Model and estimation
2. How does *VOI* vary cross-sectionally and over time?
3. The causal effect of investor composition on *VOI*

Investor Composition in the Corporate Bond Market

- Main investors: insurance companies and mutual funds
  - Insurance companies $\sim$ 38%
  - Mutual funds $\sim$ 30%
- Intermediate bond funds: largest bond fund type by AUM
  - Restricted to holding bonds with maturity less than 10 years
  - Mutual fund (MF) shares increase discontinuously for bonds right below the 10-year maturity cutoff
  - Leverage this discontinuity to estimate the casual effect of investor composition on *VOI*

Discontinuity in Corporate Bond Shares held by MF

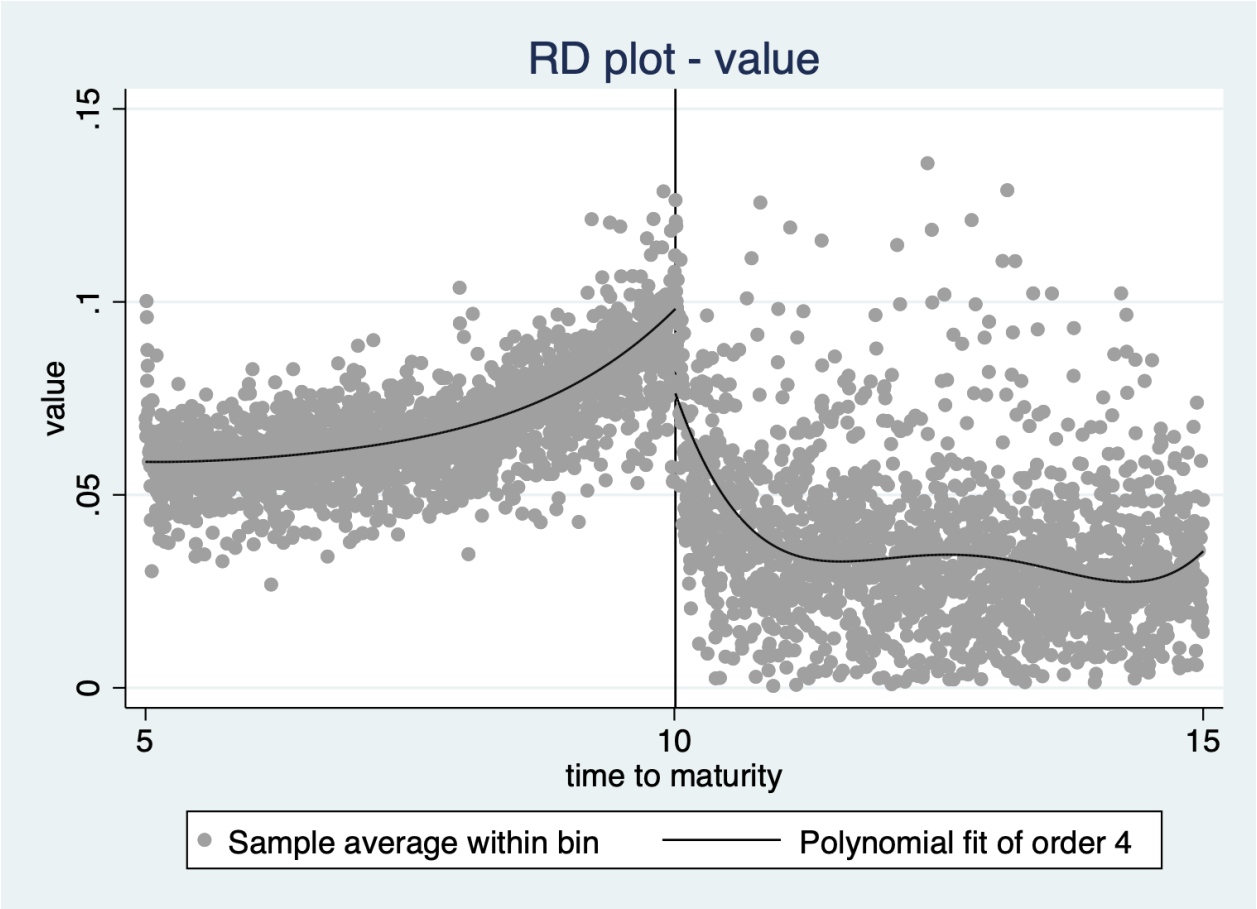
LHS: MF Shares



MF share increases from 9% to 13% as the bond crosses the 10yr cutoff.

Reduced-Form Effects based on the Maturity Discontinuity

LHS: VOI



VOI increases by 25% as the bond crosses the 10yr cutoff.

Treatment Effects based on the Maturity Discontinuity

Variables are normalized by standard deviations

	VOI	β	YTM	δ
Conventional	1.456***	1.482***	0.00395	-0.549**
	(7.20)	(7.67)	(0.85)	(-2.71)
Bias-corrected	1.549***	1.597***	0.00355	-0.664**
	(7.66)	(8.27)	(0.76)	(-3.27)
Robust	1.549***	1.597***	0.00355	-0.664**
	(7.44)	(8.15)	(0.76)	(-2.92)
Bandwidth	2.176	2.269	3.147	2.206

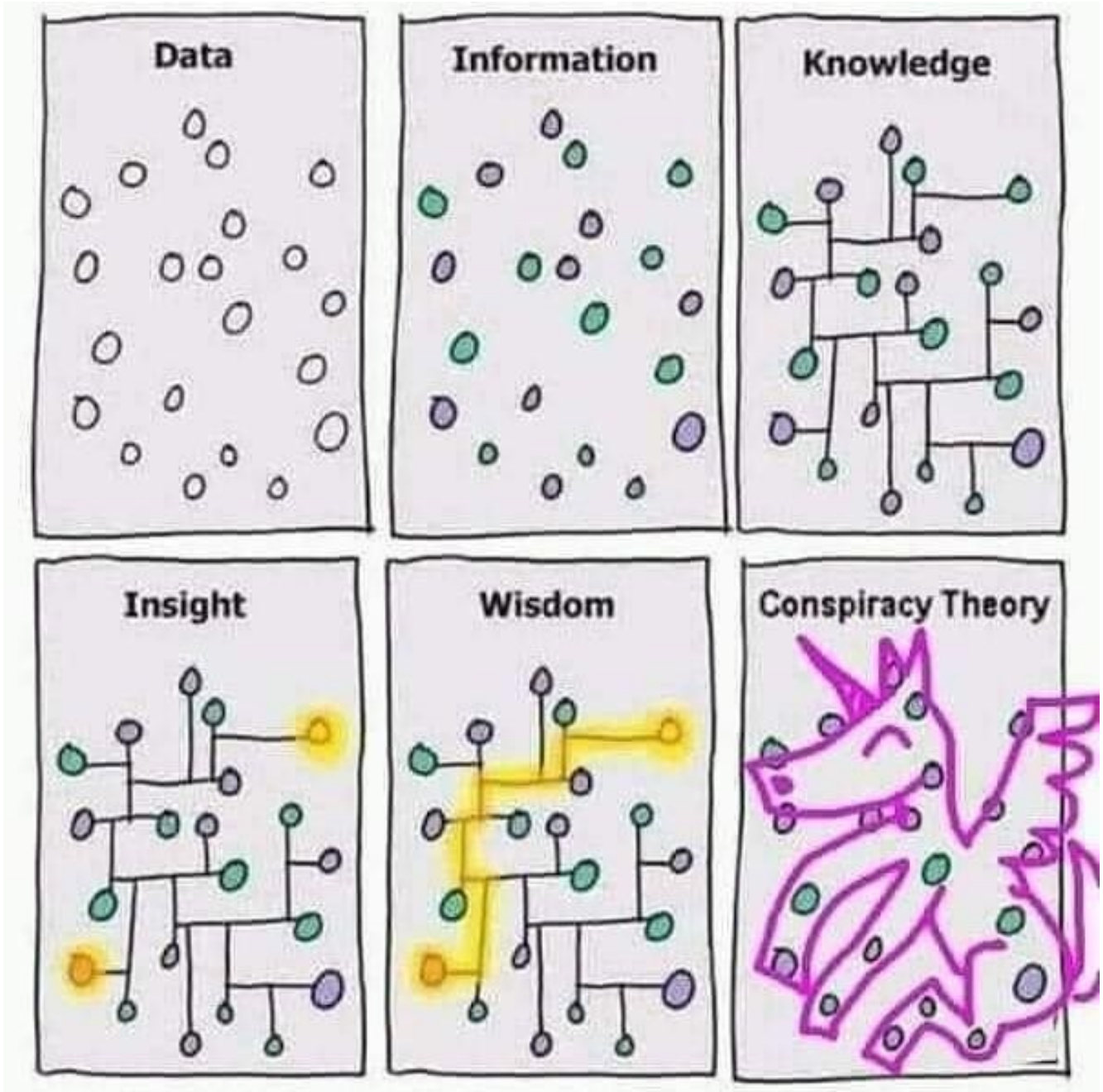
- Economically, a 1-σ increase in MF share increase *VOI* by 1.5-σ. A 10% increase in MF shares increases *VOI* by 9 cents per dollar of face value.
- An increase in mutual fund share means more (uninformed) liquidity trades (larger β), and a greater ability for informed investors to profit from their info.

Conclusion

- The paper provides the first empirical estimates of the value of data (information) to fixed income investors.
- Document stylized facts in the cross-section and over time.
- Provide the first causal evidence on the drivers of the value of data in any asset market.

THANK YOU!

www.jenniebai.com


Data
Information
Knowledge
Insight
Wisdom
Conspiracy Theory