Search Frictions and Product Design in the Municipal Bond Market

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Product design and search

- Call for standardization in insurance, annuities, mortgage, ...
- Products with unique features are hard to evaluate

  → product design may directly affect search costs
- Questions:
  - do producers benefit from designing overly complex products?
  - if so, is there a role for regulation concerning product design?

Context: US municipal bond market

- Finances 90% infrastructure projects by local govts ($4 tril.)

Municipal bond design

- Plain vanilla bond: face value, maturity & interest rate
- Often comes with nonstandard provisions
  - e.g. optional redemption allows government to call back debt
- Trade-off
  - flexibility in payment: e.g. ability to refinance if rates fall
  - higher trading frictions and interest costs
- SEC, Oct 2014: *"we should work to reduce the number of bespoke bond (...) if that would result in more liquidity"*

What this paper does

1. IV to quantify the effects and distortions in bond complexity
2. Build and estimate a model for bond design negotiation and decentralized trading
3. Study welfare impact of policies regulating bond design (standardization) and reducing distortions

Key mechanism for distortions: underwriters' dual role

- Negotiations btw underwriter and issuer set bond design
- Underwriter: investment bank (e.g., JP Morgan) buys bonds from government to sell them to investors
- Why might underwriters benefit from distorting bond design?
    - after origination, underwriter competes to intermediate trades
    - 0.54% underwriter's fee vs 2% dealer markups on round-trip

Related literature

- Firms' incentives to increase search frictions: Ellison & Ellison (2009), Ellison & Wolitzky (2012), Celerier & Vallee (2017), Brown & Jeon (2021)
  - $\rightarrow$ Novel mechanism: product design affects search frictions
  - $\rightarrow$ New empirical evidence (municipal bond market)
  - $\rightarrow$ Emphasis on vertical relations in intermediated markets
- Product design and search frictions: Bar-Isaac, Caruana & Cunat (2012), Menzio (2021)
  - $\rightarrow$ Search frictions as endogenously determined by bond design
- Conflicts of interest in financial markets: Lucca, Seru & Trebbi (2014), Egan, Matvos, and Seru (2019)
- Structural analyses on decentralized asset markets: Gavazza (2011, 2016), Allen, Clark & Houde (2019)

Background & Motivating Evidence

Municipal bonds: our sample

- Bonds issued in 2010-2013
  - county (7%), city (30%), school district (39%), other (25%)
  - median face value: $ 6 million
- 74% by retail investors (interest income tax exemptions)
- Low default rate but large search frictions
  - 10-year default rate 0.15%; intermediation spread 1.2%
  - corporate bonds? 10.29%; 0.3-0.6%
- Underwriting market
  - top 3 firms in a state cover 45%
  - 50% repeat relationship

Bond design determined at initial bond offering

- Months of negotiation between issuer and underwriter on price and bond design

Features	Nonstandard provisions
Maturity structure	Multiple maturities
Redemption provisions	Optional call
Collateral	Sinking fund
Coupon rate	Floating, flexible, etc.
Interest payment frequency	Not semiannual

- Measure of "bond complexity": number of nonstandard provisions

Trading bonds in the decentralized market

- Secondary markets provide liquidity after initial offering
  - investors' financial/tax circumstances and need for cash
- Transactions through dealers trading over the phone
- Salespeople in a dealer firm
  - offer clients the right security to match their needs
  - lengthy meeting walking clients through bond characteristics
- Underwriter's competitive advantage as a dealer
  - *"If an institution wants to buy or sell municipal bonds (...), it enlists (...) the underwriting syndicate (...) because it knows which clients bought bonds at the time they were issued"*
  - mkt share 12% vs 3%

Conflict of interest

- Government official negotiates bond design with underwriter
- Potential conflicts of interest have long been recognized
    - Gifts, campaign contributions, employment opportunities

- CFO for Cook County Treasurer (1997-2002)
- Comptroller for Forest Preserve District of Cook County (2002-2003)
- Government Client Manager for Bank of America Merril Lynch (2003-2012)

Revolving door regulations

- Limit post-government employment of public officials
  - aimed to reduce influence on officials and preferential access
- IV based on panel variation in revolving-door regulations
  - regulations can affect incentives of govt officials
  - as a result, bond design can change
- Enactment of revolving-door state laws (2010-2013)
  - AR (2011), IN (2010), ME (2013), NM (2011), VA (2011)
  - why? pressure from watchdogs:
    - *"23 Indiana newspapers are launching a campaign for major ethics reform"* (Indianapolis star)

Revolving door regulations and bond design

- Complexity index for negotiated bonds falls by 7% after regulations are in place More
- Larger effects for issuer who can be more “easily swayed” (e.g., concentrated financial advisor market, less experienced in bond issuance, electorally competitive) More
- No direct effects of regulations on the bond market and the complexity of auctioned bonds More
- No pre-trend More

Bond complexity and trade-off to government

$$y_i = \beta_s s_i + \beta_r r_i + \gamma \mathbf{X}_i + \kappa_{c(i)} + \theta_{t(i)} + \epsilon_i$$

	Number of negative rating events		Intermediation spread	
	OLS	2SLS	OLS	2SLS
Complexity index (log)	0.034	-0.243**	0.009**	0.046**
	(0.034)	(0.091)	(0.002)	(0.018)
Coupon rate	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Number of observations	13,008	13,008	11,078	11,078
Mean of the (raw) dependent variable	0.074	0.074	0.012	0.012
Effects (from 50^{th} to 75^{th})	-	-0.009	-	0.002
First stage F-stat	-	16.18	-	10.5

Notes: The instruments are revolving-door regulations, interacted with county/state-level attributes. SEs are adjusted for clustering at the state level.

Underwriter benefits from bond complexity

$$y_i = \beta_s s_i + \beta_r r_i + \gamma \mathbf{X}_i + \kappa_{c(i)} + \theta_{t(i)} + \epsilon_i$$

	Market Share		Gross Profit	
	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)
Complexity index (log)	0.082**	0.368**	2.26**	7.69**
	(0.022)	(0.181)	(0.003)	(0.035)
Coupon rate	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Number of observations	11,807	11,807	11,807	11,807
Mean of the (raw) dependent variable	0.122	0.122	1.752	1.752
Effects (from 50^{th} to 75^{th})	-	0.014	-	0.29
First stage F-stat	-	9.7	-	10.9

Notes: The instruments are revolving-door regulations, interacted with county/state-level attributes. SEs are adjusted for clustering at the state level.

Model

Model overview

1. **Bond design determined at origination**
    - o official & underwriter negotiate complexity s, rate r, price F
    - o underwriter purchases the bond at price F
2. **Trading subject to search frictions** $\rightarrow$ underwriter's incentive

- Heterogeneity: exogenous bond attributes
    - o observed: x (e.g., maturity T, size A)
    - o unobserved (to researcher): ξ

At origination

- **Underwriter's payoff**

$$\underbrace{V_U(s,r,x,\xi)}_{\text{from trading}} - F$$

- **Municipal government payoff**

$$F - c_0(s,x,\xi)A(1+rT)$$

  - $A(1+rT)$: principal and interest payment
  - $c_0(s,x,\xi)$: marginal financing cost depends on attributes

At origination

- **Underwriter's payoff**

$$\underbrace{V_U(s,r,x,\xi)}_{\text{from trading}} - F$$

- **Government official's payoff**

$$F - c_0(s,x,\xi)A(1+rT) + \psi(h)V_U(s,r,x,\xi)$$

  - $A(1+rT)$: principal and interest payment
  - $c_0(s,x,\xi)$: marginal financing cost depends on attributes
  - $\psi(h)$: underwriter's influence, dependent on revolving-door (h)

- Nash bargaining $\rightarrow$ bond design maximizes joint payoff

Model overview (continued)

1. **Bond design determined at origination**
   - official & underwriter decide complexity s, coupon r, price F
   - underwriter purchases the bond at price F
2. **Trading subject to search frictions** (based on Üslü 2019)
   - continuous-time, finite-horizon $t \in (0, T]$
   - investors
     - heterogeneous tastes + liquidity shocks
     - taste distribution depend on r and s
   - dealers
     - choose meeting rate at a (search) cost
     - meet investors at Poisson times
   - Nash bargaining determines prices and quantities

Search frictions

- Every instant dealers choose meeting rate λ given search costs

$$\exp(\lambda) \times \phi_0(s, x_d, x, \xi) \underbrace{\exp(-\phi_1(s, x, \xi) \log(b))}_{\text{network effect}}$$

- Two components determine search costs
  - base cost ϕ_0 depends on dealers' attributes x_d
  - network effects: "roledex model" of search
    - easier to sell a bond to investors who have already traded it
    - cost can decrease with client network b
    - $b =$ cumulative trade by the dealer

- Underwriter cost advantage thanks to initial sales if $\phi_1 > 0$

Bond attributes and model primitives

In sum, bond attributes (complexity, coupon, etc.) can affect

1. Investors' valuations
   - allow for both vertical and horizontal differentiation
2. Level of search costs
   - harder to explain to investors
3. Network effects
   - shape competition among dealers
4. Cost of financing for the issuer

"Too much" complexity?

$$\max_{(s,r)} \quad -c_0(s,x,\xi)A(1+rT)+(1+\psi(h))V_U(s,r,x,\xi)$$

- Underwriter value V_U does not fully incorporate investor surplus and dealers' search costs
- Why would underwriter benefit from complex bonds?
  1. Intermediaries might benefit from increasing search frictions
     - Increase costs, but also market power
  2. Vertically integrated underwriter can "raise rivals' costs"
     - exclusive initial sales $\rightarrow$ large client network ahead of others
     - complex bonds might strengthen network effects
- Underwriter's influence on officials *magnifies* distortion

Estimation Results

Estimation outline

- Primitives to recover
  - Dealers' and investors' preferences
  - Search costs
  - Government officials' preferences
- Observables: For each bond
  - Trading prices, quantities, and timing
  - Dealer's state (inventory and experience)
  - Bond attributes (x, s, r) and regulation h

Estimation strategy

1. For each bond i, use trading data to estimate search cost and investor preference parameters, θ_i
2. Use estimates $\hat{\theta}_i$ to recover the impact of attributes on search costs and preferences
   - Recall $\theta_i = \theta(s_i, r_i, x_i, \xi_i)$
   - IV approach based on revolving-door regulations
3. Estimate government preferences ($\psi(h)$ and $c_0(x, s, \xi)$) by employing GMM based on FOC for (s, r)

Search costs

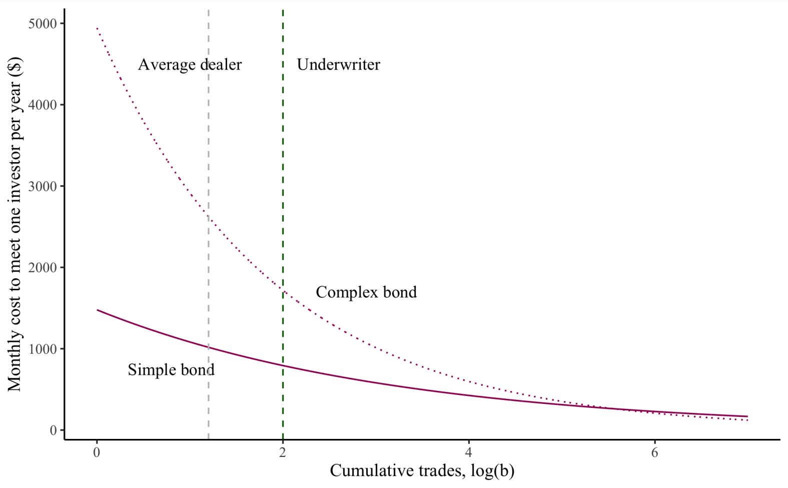
For an average bond, per month

	Average dealer	Underwriter
Average search cost	\$2,625	\$3,045
Average search cost at $\lambda = 1$	\$1,911	\$960
Initial search cost at $\lambda = 1$, ϕ_0	\$3,216	\$3,609
Average cost advantage from client network, $\exp(-\phi_1 \log(b))$	0.50	0.34
Average meeting rate	0.19	0.23

Notes: This table presents the equilibrium search costs and meeting rates of a bond with the median values of the first-step trading market parameters, $\hat{\theta}_i$.

- Average search cost is 10% of the gross profit in a month
- Dealer geographic concentration matters for baseline cost
- Underwriter have higher baseline cost than a median dealer

Search costs and bond design



Government cost

Recall government's payoff:

$$F - c_0(s,x,\xi)A(1+rT) + \psi(h)V_U(s,r,x,\xi)$$

- $c_0(s,x,\xi)$ measures marginal cost of paying debt
  - Convex in bond complexity
  - Depends on local economic circumstances (unemployment, government finances)
- $\psi(h)$ measures conflict of interest:
  - With revolving-door regulations: Normalized to be zero
  - Without revolving-door regulations: 0.34 ($\psi V_U/\text{total} = 7\%$)

Counterfactual analyses

Three counterfactual policies

1. Standardization: mandates a plain-vanilla bond without nonstandard provisions
   - coupon rate is still negotiated
2. Issuer-driven design: issuer chooses the cost-minimizing level of complexity and then coupon rate is negotiated
3. Banning underwriter from intermediating after six months

Policy implications

	Current	Standardization	Issuer-driven design
Bond attributes			
Complexity index	1.41	0	1.14
Interest rate (%)	2.81	2.16	2.37
Search frictions			
Average dealer's yearly meeting rate	0.208	0.270	0.215
Issuer cost			
Principal and interests ($A(1+rT)$, \$K)	8,349	7,997	8,113
Marginal financial cost (c_0)	0.615	0.871	0.623

Notes: The numbers presented in this table are based on the median bond.

- Standardization: trade-off btw liquidity and flexibility

Policy implications

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Bond attributes			
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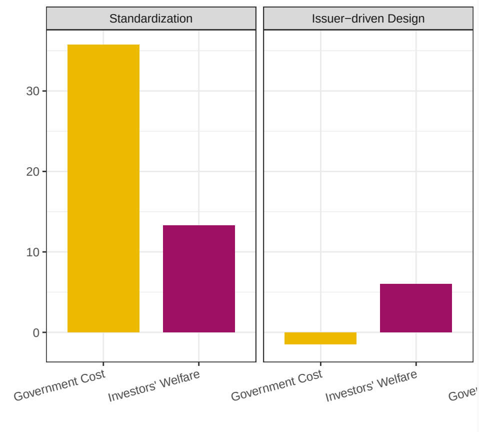
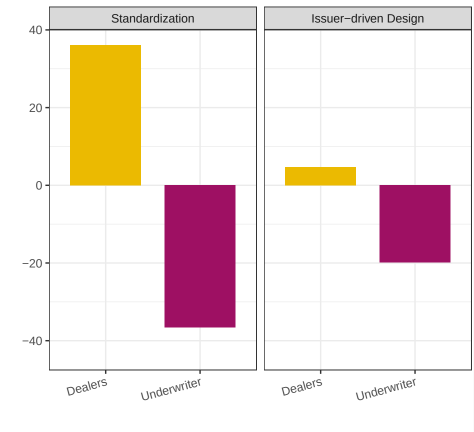
- Issuer-driven design: removing underwriter's distortion improves trade-off

Welfare implications: Government and investors



- Government cost: Interest vs. flexibility (marginal cost)
- Investor: Interest vs. liquidity (& direct value of complexity)

Welfare implications: Intermediaries



- Underwriter's competitive advantage decreases
- Other dealers benefit from simpler bonds, despite lower intermediation spread

Conclusion

- Empirical evidence and market institutions suggest that
  - underwriters' and government officials' rent-seeking behavior increases prevalence of complex bonds
  - they benefit, at the expense of taxpayers and investors
- Using our estimated model quantify impact of bond design on search frictions and welfare
  - trade-off between liquidity and flexibility
  - distortions from underwriters' dual role in both primary and secondary markets

Appendix

Revolving door regulations reduces complexity (1/2) Back

$$\text{complexity} = \beta \text{law}_i + \gamma X_i + \kappa_{c(i)} + \theta_{t(i)} + \epsilon_i$$

	complexity index (log)			
	(1)	(2)	(3)	(4)
Local officials regulated	-0.072***	-0.064***	-0.073***	-0.064***
	(0.012)	(0.013)	(0.012)	(0.013)
State officials regulated			-0.020***	-0.010
			(0.008)	(0.010)
Bond attributes†	Yes	Yes	Yes	Yes
Issuer attributes††	No	Yes	No	Yes
Year-month FE, County FE	Yes	Yes	Yes	Yes
Number of observations	13,118	13,086	13,118	13,086
R^2	0.645	0.647	0.645	0.647

Notes: This table reports OLS estimates. Standard errors are adjusted for clustering at the state level; †: Bond size, maturity, security type, new vs. refinancing; ††: Government type (county, city, school district, other), median household income, senior population, poverty rate, population growth, unemployment rate, government finances

Revolving door regulations reduces complexity (2/2) Back

$$\text{complexity} = \beta \text{law}_i + \gamma X_i + \kappa_{c(i)} + \theta_{t(i)} + \epsilon_i$$

	Complexity index (log)				
	(1)	(2)	(3)	(4)	(5)
Local officials regulated	-0.076***	-0.064***	-0.062***	-0.059***	-0.060***
	(0.011)	(0.013)	(0.013)	(0.012)	(0.013)
State officials regulated	0.019	-0.018*	-0.010	-0.006	-0.010
	(0.023)	(0.010)	(0.011)	(0.012)	(0.009)
Local × Financial advisor HHI	-0.040***				
	(0.009)				
Local × Issuer experience		0.019**			
		(0.009)			
Local × Electorally competitive			-0.018**		
			(0.008)		
State × Divided government				0.067**	
				(0.027)	
Local × Frac. individual investors					-0.014**
					(0.006)
Bond/issuer attributes, Year-month FE, County FE	Yes	Yes	Yes	Yes	Yes
Number of observations	13,086	13,086	13,086	13,086	13,086
R^2	0.648	0.648	0.648	0.648	0.648

Notes: This table reports OLS estimates. Standard errors are adjusted for clustering at the state level.

Revolving door regulations as an instrument (1/2) Back

- Direct impact on the bond market? We found no effects of these regulations on
  - Credit rating for existing bonds
  - Bond issuance amount
  - Length of bond maturity
- No effects on complexity for auctioned bonds

Revolving door regulations as an instrument (2/2) Back