Strategic Bargaining and Portfolio Choice in Intermediated Markets

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Summary

Over-the-counter (OTC) financial assets typically trade in intermediated markets, where dealers serve as intermediaries while investors trade with dealers bilaterally. **Features:**

- Imperfect search and matching → trading delays and illiquidity
- Strategic investor-dealer relationship → terms of trade determined by strategic bargaining

Question: How does asset liquidity, defined as the ease of trading an asset, affect investors' dynamic portfolio choice and equilibrium asset prices?

Main Results:

- Relationship between asset prices and asset liquidity in intermediated markets is non-monotonic
  - Price-liquidity relationship is positive for relatively liquid assets, but negative for very illiquid assets
- Transaction costs are asymmetric between investor buy and sell trades
  - Transaction costs are higher for investor sales than for investor purchases

Model Environment

Time is continuous with $t \in [0, \infty)$.

Risky Asset

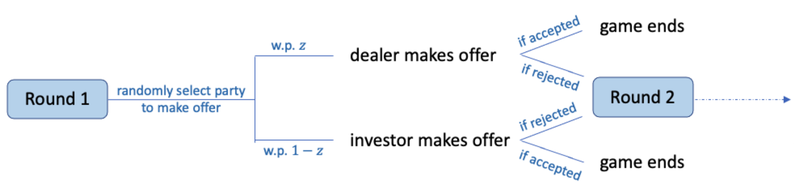
- Asset is in fixed supply $s > 0$
- Cumulative dividend flow D_t follows $dD_t = \bar{D}dt + \sigma dZ_t$
- Traded OTC, intermediated by a unit measure of dealers
  - Bilateral investor-dealer trading with random search + competitive inter-dealer market
  - Dealers discount time at rate $r > 0$
  - Investor-dealer search intensity λ, capturing asset liquidity

Investors

- Measure one of investors. An investor holding x units of risky asset derives mean-variance flow benefit $u(x) = \bar{D}x - \frac{\gamma}{2}\sigma^2 x^2$
- Idiosyncratic patience shocks:
  - Investor is either patient and discounts time at rate r or impatient and discounts time at $r + \epsilon$
  - Patience type $\xi \in \{h, l\}$, transitions $h \to l$ with intensity ζ_{hl} and $l \to h$ with intensity ζ_{lh}
  - Steady-state proportion of impatient investors $\pi = \frac{\zeta_{hl}}{\zeta_{hl}+\zeta_{lh}}$

Strategic Bargaining

- When investor and dealer meet, they enter into a Rubinstein-style bargaining game that occurs in virtual time



- Key feature: investors' bargaining powers are endogenous and depend on their patience types
- Intuition: an impatient investor is more averse to bargaining delays that could happen. Such investor has lower ability to capture surplus (i.e., lower bargaining power).

Equilibrium

Bargaining Outcome: When an investor with patience type $\xi \in \{h, l\}$ and asset holding x meets a dealer in a trading session, trade price $P_\xi(x)$ and trade quantity $q_\xi(x)$ satisfy

- *Pareto Optimality:* $V'_\xi(x + q_\xi(x)) = \bar{P}$
- *Surplus Split:* $P_\xi(x)q_\xi(x) = (1 - \theta_\xi)\big[V_\xi(x + q_\xi(x)) - V_\xi(x)\big] + \theta_\xi \bar{P} q_\xi(x)$

  → investor receives fraction $\theta_\xi = \frac{(1-z)r}{r+z\epsilon\mathbb{I}_{\{\xi=l\}}}$ of joint trade surplus

Asset Demand: Optimal asset holding by type h and type l investors are

$$x_h = \frac{\bar{D} - \left(r + \frac{\zeta_{hl}\epsilon}{r+\epsilon+\zeta_{lh}+\zeta_{hl}+\lambda\theta_l}\right)\bar{P}}{\gamma\sigma^2}$$

$$x_l = \frac{\bar{D} - \left(r + \epsilon - \frac{\zeta_{lh}\epsilon}{r+\zeta_{lh}+\zeta_{hl}+\lambda\theta_h}\right)\bar{P}}{\gamma\sigma^2}$$

- Due to illiquidity, investors hold less extreme positions (attenuate demand)
- Patient investors attenuate demand more than impatient investors

Intuition

- Investors hold less extreme positions
  - Trading delays expose investors to risk of holding imbalances
  - To "hedge" against this risk, investors hold less extreme positions
- Patient investors attenuate demand more than impatient investors
  - Due to strategic bargaining, investors' bargaining powers weaken when they become impatient
  - Knowing that they will receive worse terms of trade when trading upon shocks, patient investors lower asset demand to begin with

Stationary Equilibrium: there exists a unique stationary equilibrium in the economy

- Inter-dealer clearing price is

$$\bar{P} = \frac{\bar{D} - \gamma\sigma^2 s}{r + \pi\epsilon + \Delta}$$

where demand wedge

$$\Delta = \frac{\zeta_{hl}\zeta_{lh}\epsilon}{\zeta_{hl}+\zeta_{lh}} \frac{\lambda(\theta_h - \theta_l) - \epsilon}{(r + \epsilon + \zeta_{lh} + \zeta_{hl} + \lambda\theta_l)(r + \zeta_{lh} + \zeta_{hl} + \lambda\theta_h)}$$

Asset Liquidity and Prices: $\Delta'(\lambda) > 0$ if $\lambda < \bar{\lambda}$ and $\Delta'(\lambda) < 0$ if $\lambda > \bar{\lambda}$

$$\bar{\lambda} = \frac{\epsilon\theta_l\theta_h + \sqrt{\epsilon^2\theta_l^2\theta_h^2 + (\theta_h - \theta_l)\theta_l\theta_h[(\theta_h - \theta_l)k_1k_2 + \epsilon(k_1\theta_h + k_2\theta_l)]}}{(\theta_h - \theta_l)\theta_l\theta_h}$$

- Sufficiently liquid asset ($\lambda > \bar{\lambda}$), liquidity ↑ → lower Δ and higher $\bar{P}$
- Highly illiquid asset ($\lambda < \bar{\lambda}$), liquidity ↑ → higher Δ and lower $\bar{P}$

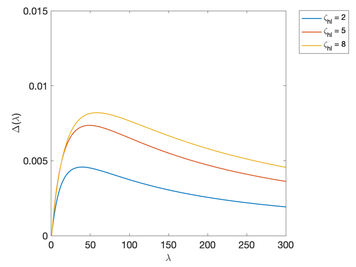
Discussion

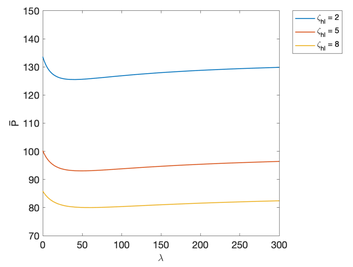
Existing literature takes axiomatic approach to bargaining where bargaining powers are fixed

- Type-dependent bargaining powers key departure from literature
- To compare with existing models, shut down strategic bargaining by setting $\theta_h = \theta_l = 1 - z$
- $\Delta \doteq 0 \Rightarrow X$ and $\bar{P}$ first-order converge to Walrasian benchmark
- Intuition: demand attenuations by patient and impatient investors net out in aggregate

Price-Liquidity Relation: Intuition

- $\lambda \to 0$
  - Asset is perfectly illiquid → no trading or bargaining in this limit
  - Demand wedge results from strategic bargaining, and bargaining is irrelevant in this limit case
  - No demand wedge $\Delta \to 0$, and price → Walrasian benchmark
- $\lambda \uparrow$
  - Effect of bargaining becomes pertinent → positive demand wedge emerges and price ↓
  - Demand attenuations by both patient and impatient investors ↓, Δ shrinks
- $\lambda \to \infty$
  - No demand attenuations by investors, zero demand wedge and price → Walrasian benchmark





Empirical Evidence

Empirical setting: U.S. corporate bond market

Asset Liquidity and Prices: non-monotonic price-liquidity relationship

- Credit spreads of sufficiently liquid bonds are positively related to transaction costs
- Credit spreads of highly illiquid bonds are negatively related to transaction costs
- Empirical Strategy: 2SLS exploiting institutional feature that newly-issued bonds are more liquid than older bonds of same issuer

	Panel A: First Stage					
	Transaction Cost (bps)					
	(1)	(2)	(3)	(4)	(5)	(6)
New Bond	-3.061***	-6.026***	-4.631***	-2.852***	-2.529***	-5.415***
	(0.135)	(0.768)	(0.163)	(0.574)	(0.205)	(0.188)
	Panel B: Second Stage					
	Credit Spread (bps)					
	(1)	(2)	(3)	(4)	(5)	(6)
Transaction Cost	0.424***	-0.502*	0.801***	-2.760***	2.538***	0.938***
	(0.156)	(0.297)	(0.094)	(1.017)	(0.368)	(0.097)
Sample	Low Cost	High Cost	IG	HY	ST	LT
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Issuer-Day FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.461	0.433	0.331	0.505	0.465	0.368
Observations	3,303,875	563,984	3,527,369	835,465	485,363	3,381,645

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Asymmetric Transaction Costs: transaction costs are higher for selling investors than for buying investors

	Transaction Cost (bps)			
	(1)	(2)	(3)	(4)
Investor Sell	2.544*	6.161***	4.523***	3.337**
	(1.376)	(1.936)	(1.701)	(1.537)
Sample	Full	VIX Filter	DEF Filter	B/S Filter
Issue-Day-Size FE	Yes	Yes	Yes	Yes
R^2	0.050	0.044	0.038	0.052
Observations	6,591,026	4,556,170	5,203,854	5,374,874

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$