Composition Effects in OTC Transaction Costs

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Inventory Cost and Liquidity in Over the Counter Markets

- Post '08 crisis regulations affected OTC markets (Volcker Rule, Basel III).
  - Dealer's inventory costs increased.

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  - $\uparrow$ principal cost & $\downarrow$ principal share.

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! Customers' **speed-cost trade-off** affects the trading mechanism choice.

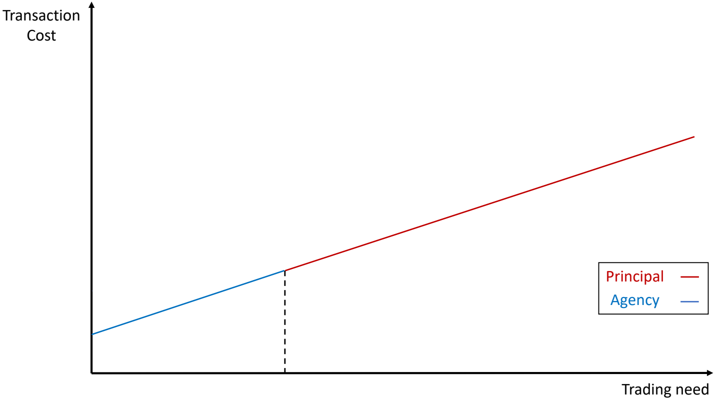
- Endogenous migration away from principal after a regulation change:

$\Longrightarrow$ **Composition bias:** samples pre and post regulation differ.

This Paper:

I build and estimate a quantitative search model to address:

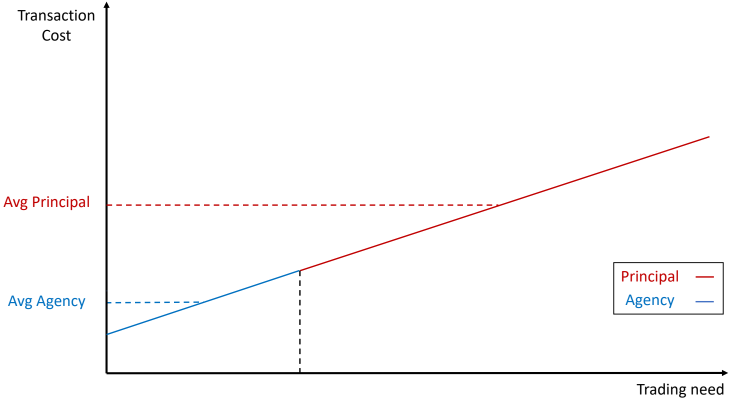
1. What determines customers' trading mechanism choice?



This Paper:

I build and estimate a quantitative search model to address:

2. How such mechanism choice affects transaction costs measures?



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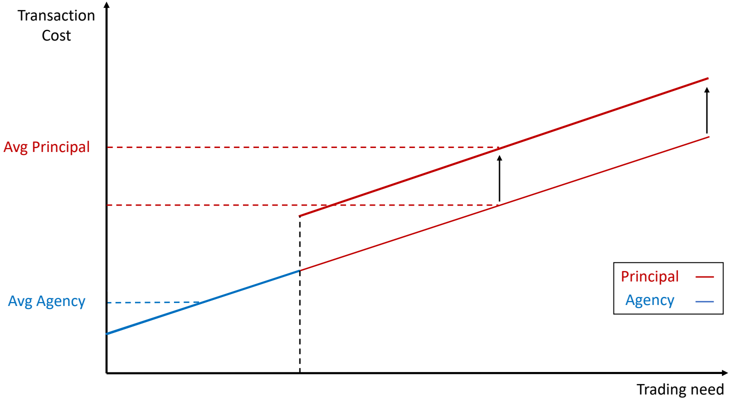

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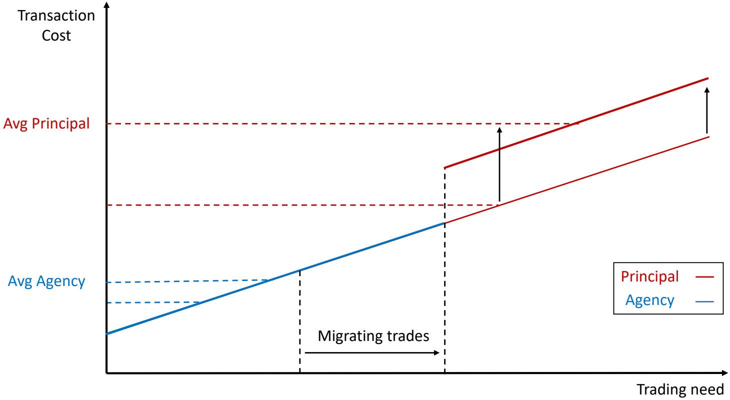
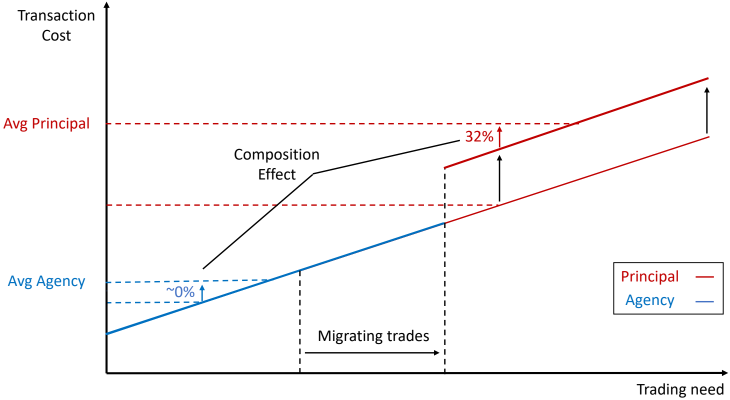


This Paper:

I build and estimate a quantitative search model to address:

4. What is the size and sign of the composition effect?



Contribution

1. Search literature of OTC markets.

   Duffie, Gârleanu and Pedersen (2005), Lagos and Rocheteau (2009), Weill (2020)

   + Endogenous trading mechanism as a customer choice.
   ✓ I study optimal mechanism choice as a function of key parameters.

2. Models of dealers' trading mechanism choice.

   Tse and Xu (2017); Cimon and Garriot (2019); An (2020); An and Zheng (2022); Saar et. al. (2023).

   + Customers' trading mechanism choice.
   ✓ I incorporate the endogenous response of customers to shocks.
   + Non-degenerate distribution of transaction costs and volume traded.
   ✓ I compute observable and counterfactual cost resembling empirical measures.

3. Empirical literature of OTC market liquidity.

   Bao, O'Hara, and Zhou (2018), Bessembinder, Jacobsen and Venkataraman (2018), Dick-Nielsen and Rossi (2019), Goldstein and Hotchkiss (2020), O'Hara and Zhou (2021), Kargar et.al. (2021), Choi, Huh and Shin (2023), Rapp and Waibel (2023)

   + Model of endogenous trading mechanism choice.
   ✓ I quantify the composition bias when market conditions change.

Agenda

Model

Lagos and Rocheteau (2009):

- Continuous time and infinitely lived agents.
- Single asset in fixed supply, which is traded OTC.
- Customers have quasi-linear flow utility $u_i(a) + d$:
  - d is the net consumption of *numeraire* good, produced by customers.
  - a is the asset holding.
  - $u_i(a) = \epsilon_i u(a)$, where ϵ_i is a time-varying preference.

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Two trading mechanisms:

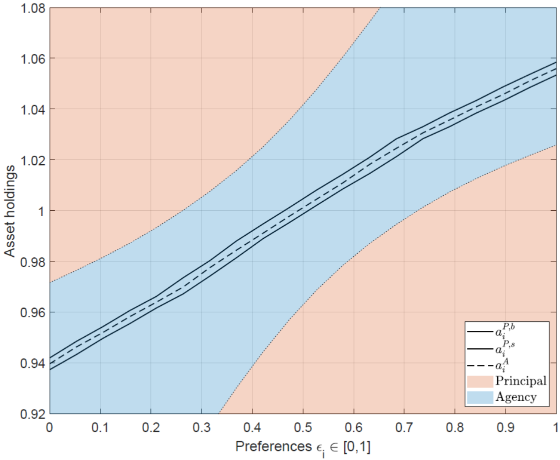
- At random time, customer contact dealers and choose:
  1. Principal: immediate exchange paying bargained fee.
  2. Agency: delayed exchange paying bargained fee.
- Dealers execute orders in a frictionless market, at price p.
  1. Principal: immediate access paying $\theta p|a' - a|$
  2. Agency: delayed access at random time.

Model details

Customers sort themselves across mechanisms

- $\uparrow |a' - a| \implies \uparrow$ Mg trading surplus.
- Principal costs are linear: as $\uparrow |a^P - a|$, speed benefit $>$ speed costs.

  $\implies$ More "desperate" customers pay principal premium.



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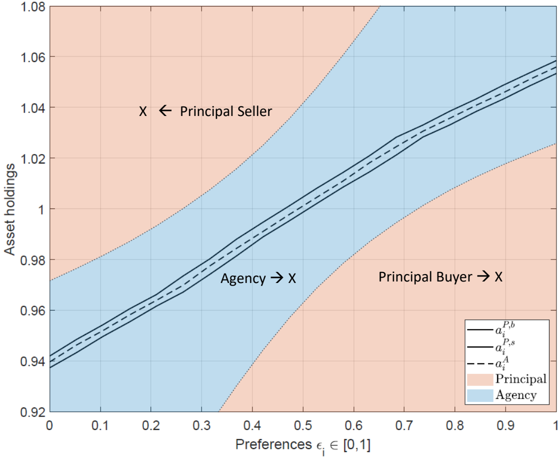

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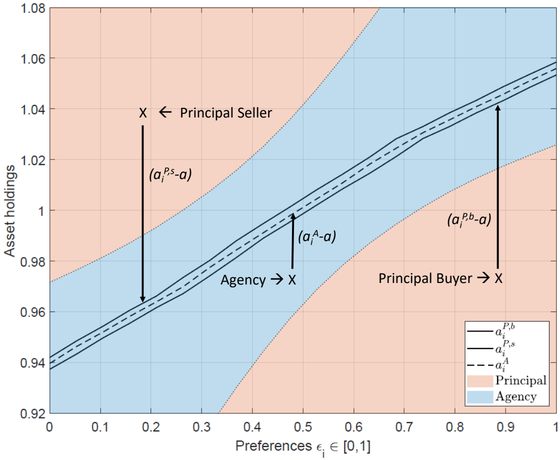

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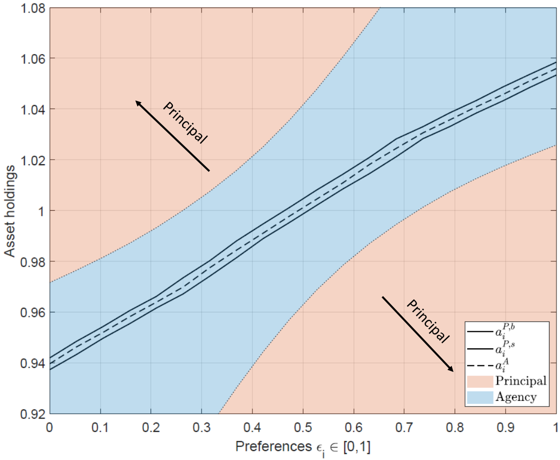
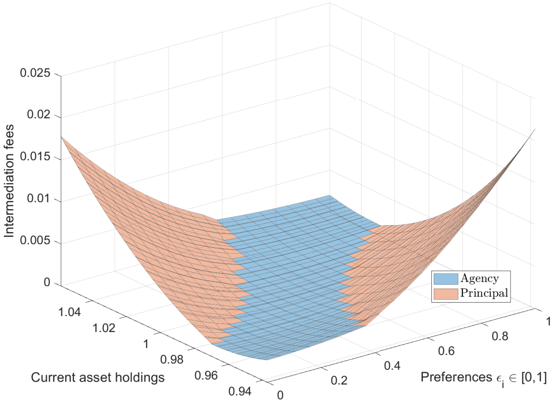


Transaction Costs are increasing in trading surplus.

- Bilateral (Nash) bargain: cost split trading surplus.
- Principal trades pay premium $\propto \theta p|a^P - a|$.



Spreads per dollar

Counterfactual Spreads and Composition Effect

1. Compute empirical measures $\mathcal{S}^P$ and $\mathcal{S}^A$ as vol weighted avg spreads.

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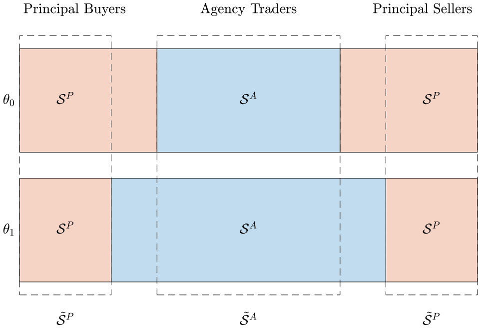
2. Increase parameter θ and compute counterfactuals $\tilde{\mathcal{S}}^P$ and $\tilde{\mathcal{S}}^A$ using only non-migrant trades.



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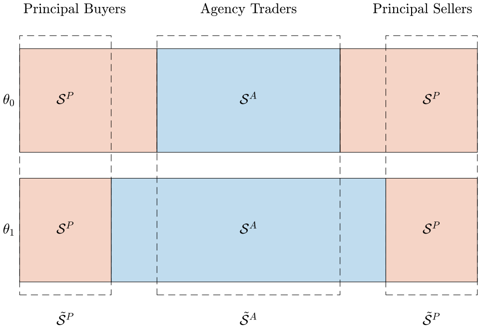


3. Compute Composition Effect (CE) in each mechanism as:

$$CE \equiv (\Delta\mathcal{S} - \Delta\tilde{\mathcal{S}})/\Delta\mathcal{S}$$

Details

Agenda

Baseline Calibration

$$\text{Unit of time} = 1 \text{ month} \mid u_i(a) = \epsilon_i \times \frac{a^{1-\sigma}}{1-\sigma}$$

Parameter	Description	Value
- Normalization-		
A	Asset supply	1
ϵ_i	Preference shifter	$\left\{\frac{i-1}{I-1}\right\}_{i=1}^{20}$
- External calibration-		
r	Discount rate	0.5%
π_i	Preference shifter distribution	$1/I$
η	Dealer's bargain power	0.95
- GMM calibration-		
α	Contact with dealer rate	9.15
δ	Preference shock rate	2.59
β	Agency execution rate	1.00
θ	Inventory cost	0.89 bp
σ	CRRA coeff.	2.73

θ Discussion

GMM Calibration

I estimate

$$\hat{\upsilon} = \arg\min_{\upsilon \in \Upsilon} [(m(\upsilon) - m_s) \oslash m_s]' W [(m(\upsilon) - m_s) \oslash m_s]$$

where $\upsilon = [\alpha, \delta, \beta, \theta, \sigma]$, $m = [\mathcal{S}^P, \mathcal{S}^A, \mathcal{T}, \gamma^P, \gamma^A]$, and $W = I$.

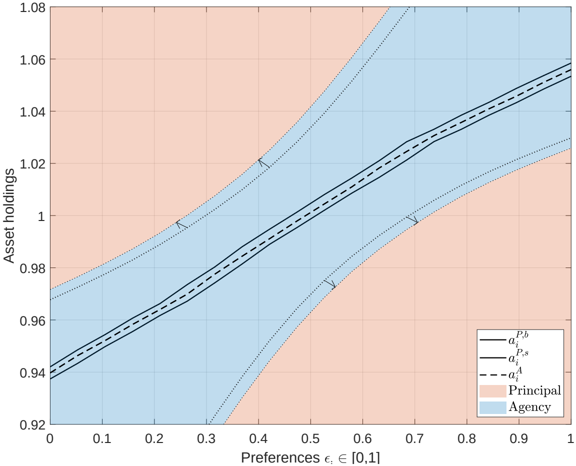
Moment	Empirical			Theoretical
	p50 (m_s)	p25	p75	
$\mathcal{S}^P$, Principal Vol Weighted Spread	9.12	5.87	14.20	10.29
$\mathcal{S}^A$, Agency Vol Weighted Spread	5.00	2.56	8.73	4.04
$\mathcal{T}$, Monthly Turnover	3.27	2.28	4.61	3.47
	$\hat{\gamma}$ (m_s)	$\hat{\gamma} - s.e.$	$\hat{\gamma} + s.e.$	
γ^P, Principal Spread-Size slope	1.45	1.33	1.58	1.31
γ^A, Agency Spread-Size slope	0.61	0.50	0.73	0.69

Sample moments computed from TRACE 2016-2019, using IG bonds with at least 10 observations in all variables used. Percentiles represent the cross section of bond level computed variables. n=2829 bonds.

Emp. moments details | Th. moments details | Vol-Spreads Trade-off | Moments choice discussion

Inventory costs increase: customers migrate away from principal.

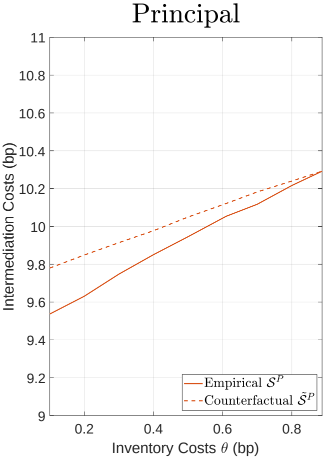
$$\theta : 0.1bp \rightarrow 0.89bp$$

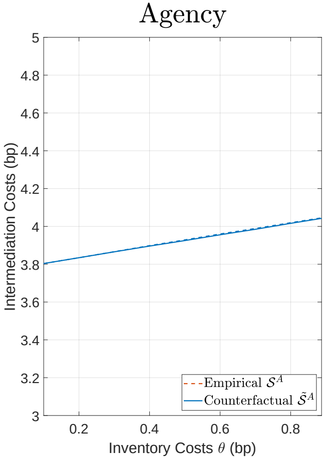


1. Principal trading migrate towards agency.
2. Migration is not random: stronger when closer to optimal positions.

The rise in principal costs are overestimated in $\approx 1/3$.

$$\theta : 0.1bp \rightarrow 0.89bp$$





- Turnover decreases 4.6%, and agency share increases 2.4%.
- $\Delta\mathcal{S}^P = 0.76bp$ and $\Delta\tilde{\mathcal{S}}^P = 0.51bp$: $\implies$ $CE^P = 32.2\%$
- $\Delta\mathcal{S}^A = 0.24bp$ and $\Delta\tilde{\mathcal{S}}^A = 0.24bp$: $\implies$ $CE^A = -1.2\%$

Conclusion

- OTC transaction cost measures are subject to a composition bias:
  - Trading mechanisms are endogenous.
  - Choice is a function of each customer' speed-cost trade off.
- I develop a model to account for it:
  - Secondary market with search frictions.
  - Immediate principal and delayed agency trading.
  - Speed-cost trade-off defines terms of trade of each customer
- I build counterfactual measure to quantify the composition bias:
  - Inventory Cost: 32.2% in principal, -1.2% in agency.
- Results suggest that policies affecting dealer's inventory costs had a smaller negative impact over market liquidity than previously thought.

Conclusion

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08 Financial Crisis increased Principal Trading Costs

Basel III (finalized in 2013 in US)

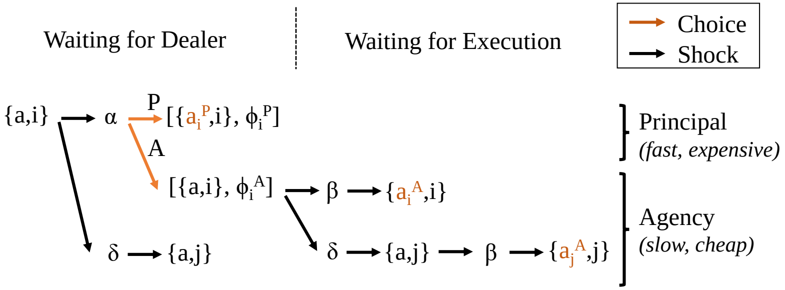
- Liquidity Coverage Ratio (LCR): "high-quality" assets in proportion to any borrowing with term 30 days or less.
- Net Stable Funding Ratio (NSFR): fund assets that mature at various terms less than one year with financing that has at least a matching term.
- Revised Capital Adequacy Ratio (CAR): larger minimum of equity and reserves as a percentage of risk-weighted assets.
- Leverage Ratio (LR), maintain a quantity of stock and cash equal to at least 3% (5% for G-SIBs) of assets.

Volcker Rule (full compliance by Jul 2015)

- Prohibits banks from engaging in proprietary trading of risky securities.
  - Market making is excepted, but the distinction is blurry.
  - Reports of measures as proxies for the underlying trading motive.

back

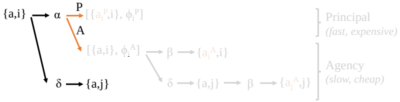
Customer's Path



Shocks:

- δ: preference shift.
- α: contact with dealers.
- β: execution of agency trade.

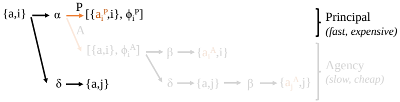
Customer's Value Function: contact dealers and choose mechanism.



$$V_{i_0}(a) = \mathbb{E}_{i_0}\left[\underbrace{\int_0^{\tau_\alpha} e^{-rs} u_{i_s}(a) ds}_{\text{utility of holding } a} + e^{-r\tau_\alpha} \max\left\{ \underbrace{V^P_{i_\alpha}(a)}_{principal}, \underbrace{V^A_{i_\alpha}(a)}_{agency} \right\} \right]$$

- τ_α: time it takes to contact a dealer.
- i_s: preference type at time $t = s$.
- $u_i(a)$: ut. function of customer $\{i, a\}$.
- $\mathbb{E}$ over:
  1. next contact with dealers $\rightarrow$ Poisson rate α.
  2. preference shocks $\rightarrow$ Poisson rate δ.
  3. execution of agency trade $\rightarrow$ Poisson rate β.

Principal Choice: customers pay ϕ^P to trade immediately.



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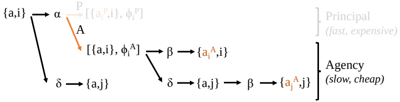
$$V^P_{i_\alpha}(a) = \underbrace{V_{i_\alpha}(a^P_{i_\alpha}) - p(a^P_{i_\alpha} - a) - \phi^P_{i_\alpha}}_{\text{immediate trade}}$$

- $a^P_{i_\alpha}$: optimal principal asset holdings of customer $\{i_\alpha, a\}$.
- p: inter-dealer price.
- $\phi^P_{i_\alpha}$: fee charged in the principal trade.

Back

Agency choice: customers pay ϕ^A and wait to trade.



$$V_{i_0}(a) = \mathbb{E}_{i_0}\left[\underbrace{\int_0^{\tau_\alpha} e^{-rs} u_{i_s}(a) ds}_{\text{utility of holding } a} + e^{-r\tau_\alpha} \max\left\{ V^P_{i_\alpha}(a), \underbrace{V^A_{i_\alpha}(a)}_{agency} \right\}\right]$$

$$V^A_{i_\alpha}(a) = \underbrace{\int_0^{\tau_\beta} e^{-rs} u_{i_{\alpha+s}}(a) ds}_{\text{utility of holding } a} + e^{-r\tau_\beta}\left(\underbrace{V_{i_\beta}(a^A_{i_\beta}) - p(a^A_{i_\beta} - a) - \phi^A_{i_\alpha}}_{\text{delayed trade}}\right)$$

- τ_β: time it takes to execute agency trades.
- $a^A_{i_\beta}$: optimal agency asset holdings of customer $\{i_\beta, a\}$. Chosen at execution.
- $\phi^A_{i_\alpha}$: fee charged when agency. Arranged at contact with dealers.

Dealer's Value Function: principal intermediation is costly.

Dealers pay inventory costs to intermediate on principal:

$$W_t = \mathbb{E}\Big[e^{-r(\tau_\alpha)} \int \Phi_{i_\alpha}(a) dH_{t+\tau_\alpha} + W(t+\tau_\alpha)\Big],$$

$$\Phi_i(a) = \begin{cases} \phi_i^P - \theta p |a_i^P - a| & \text{if principal,} \\ e^{-r(T_\beta - T_\alpha)} \phi_i^A & \text{if agency,} \end{cases}$$

where

- H_t: distribution of customers at time t.
- $\theta \in [0, \frac{r}{r+\beta})$ is the constant marginal inventory cost per dollar traded.

Back

Transaction Costs as functions of liquidity needs.

Nash Bargain where dealers hold η power

- Principal Problem: Immediate and costly execution

$$\phi_i^P(a) = \eta\Big[\underbrace{V_i(a_i^P) - p(a_i^P - a) - V_i(a)}_{\text{Customer's Surplus}}\Big] + (1-\eta)\Big[\underbrace{\theta p|a_i^P - a|}_{\text{Invetory Cost}}\Big]$$

- Agency Problem: Delayed and non costly execution

$$\mathbb{E}[e^{-r\tau_\beta}]\phi_{i_\alpha}^A(a) = \eta\Big[\underbrace{\mathbb{E}_{i_\alpha}\Big[\int_0^{\tau_\beta} e^{-rs}u_{i_{\alpha+s}}(a)ds + e^{-r\tau_\beta}\left(V_{i_\beta}(a_{i_\beta}^A) - p[a_{i_\beta}^A - a]\right)\Big] - V_{i_\alpha}(a)}_{\text{Customer's Surplus}}\Big]$$

- Both principal and agency fees are increasing in a consumers' surplus.
- Principal trades pay premium fee $(1-\eta)\theta p|a_i^P - a|$.

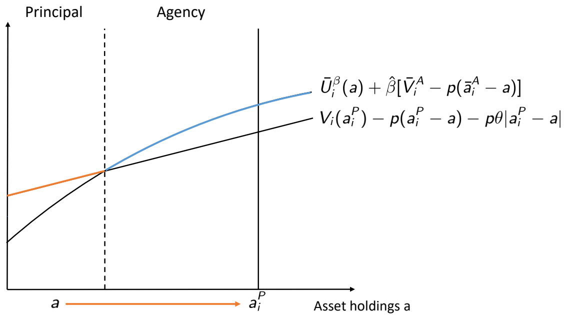
Back

Optimal Trading Mechanism: A speed-cost trade-off

Indifference Condition:

$$V_i(a_i^P) - p(a_i^P - a) - p\theta|a_i^P - a| = \bar{U}_i^\beta(a) + \hat{\beta}[\bar{V}_i^A - p(\bar{a}_i^A - a)]$$

Assume $a_i^P > a$:



- The larger the distance $|a_i^P - a|$, the bigger the marginal trading surplus.
- Principal costs are linear: as $\uparrow |a_i^P - a|$, speed benefit outweighs premium costs.

Flow Bellman Equation

Analytical expressions for expectations

$$V_i(a) = \bar{U}_i^{\kappa}(a) + \hat{\kappa}\left[(1-\hat{\delta})\max\left\{V_i^P(a), V_i^A(a)\right\} + \hat{\delta}\sum_j \pi_j \max\left\{V_j^P(a), V_j^A(a)\right\}\right]$$

where

$$\begin{aligned}
V_i^P(a) &= V_i(a_i^P) - p(a_i^P - a) - p\theta|a_i^P - a|, \\
V_i^A(a) &= \bar{U}_i^{\beta}(a) + \hat{\beta}[\bar{V}_i^A - p(\bar{a}_i^A - a)], \\
\bar{U}_i^{\nu}(a) &= \left[(1-\hat{\delta}_\nu)u_i(a) + \hat{\delta}_\nu \sum_j \pi_j u_j(a)\right]\frac{1}{r+\nu}, \\
\bar{V}_i^A &= (1-\hat{\delta}_\beta)V_i(a_i^A) + \hat{\delta}_\beta \sum_j \pi_j V_j(a_j^A), \\
\bar{a}_i^A &= (1-\hat{\delta}_\beta)a_i^A + \hat{\delta}_\beta \sum_j \pi_j a_j^A, \\
\hat{\kappa} &= \frac{\kappa}{r+\kappa}, \quad \hat{\beta} = \frac{\beta}{r+\beta}, \quad \hat{\delta}_\nu = \frac{\delta}{r+\delta+\kappa}, \quad \nu = [\kappa, \beta] \quad \kappa = \alpha(1-\eta).
\end{aligned}$$

Steady State Distribution

- Define $n_{[a,i,\omega]}$ as the mass of customers with:
  - $a \in \mathcal{A}^*$: Asset holdings
  - $i \in \{1 : I\}$: Preference shocks
  - $\omega \in \{\omega_1, \omega_2\}$: Waiting for dealer ($\omega_1$) or for execution ($\omega_2$)
- Flow across states:

$$\text{Contact dealer at rate } \alpha : \begin{cases} n_{[a,i,\omega_1]} \to n_{[a',i,\omega_1]} & \forall\{a,i\} \quad \text{if principal} \\ n_{[a,i,\omega_1]} \to n_{[a,i,\omega_2]} & \forall\{a,i\} \quad \text{if agency} \end{cases}$$

$$\text{Pref. shock at rate } \delta : \quad n_{[a,i,\omega]} \to n_{[a,j,\omega]} \quad \forall\{a,\omega\}$$

$$\text{Execution shock at rate } \beta : \quad n_{[a,i,\omega_2]} \to n_{[a',i,\omega_2]} \quad \forall\{i\}$$

- Shocks + Policy Functions $\to T_{[3I\times I\times 2]}$.

$$n = \lim_{k\to\infty} n_0 T^k$$

Back

Inflow-Outflow Equations

$$n_{[a_i^{P,b},i,\omega_1]}: \quad \delta\pi_i \sum_{j\neq i} n_{[a_i^{P,b},j,\omega_1]} + \alpha \sum_{a\in Buy_i^P} n_{[a,i,\omega_1]} = n_{[a_i^{P,b},i,\omega_1]} \left[\delta[1-\pi_i] + \alpha \mathbf{1}_{[a_i^{P,b}\notin NoT_i^P]}\right]$$

$$n_{[a_i^{P,s},i,\omega_1]}: \quad \delta\pi_i \sum_{j\neq i} n_{[a_i^{P,s},j,\omega_1]} + \alpha \sum_{a\in Sell_i^P} n_{[a,i,\omega_1]} = n_{[a_i^{P,s},i,\omega_1]} \left[\delta[1-\pi_i] + \alpha \mathbf{1}_{[a_i^{P,s}\notin NoT_i^P]}\right]$$

$$n_{[a_i^{A},i,\omega_1]}: \quad \delta\pi_i \sum_{j\neq i} n_{[a_i^{A},j,\omega_1]} + \beta \sum_{a\in \mathcal{A}^*} n_{[a,i,\omega_2]} = n_{[a_i^{A},i,\omega_1]} \left[\delta[1-\pi_i] + \alpha \mathbf{1}_{[a_i^{A}\notin NoT_i^P]}\right]$$

$$n_{[a,i,\omega_1]}: \quad \delta\pi_i \sum_{j\neq i} n_{[a_j,j,\omega_1]} = n_{[a_j,i,\omega_1]} \left[\delta[1-\pi_i] + \alpha \mathbf{1}_{[a_j\notin NoT_i^P]}\right], \quad a \in \cup_{j\neq i}\{a_j^{P,b}, a_j^{P,s}, a_j^{A}\}$$

$$n_{[a,i,\omega_2]}: \quad \delta\pi_i \sum_{j\neq i} n_{[a_i,j,\omega_2]} + \alpha n_{[a_i,i,\omega_1]} \mathbf{1}_{[a_i\in\Gamma_i^A]} = n_{[a_i,i,\omega_2]} \left[\delta[1-\pi_i] + \beta\right], \quad a \in \mathcal{A}^*$$

back

Steady State Equilibrium

The steady state equilibrium is defined as:

1. Optimal asset holdings $\{a_i^P(a), a_i^A\}_{i=1}^I$.
2. Fees $\{\phi_i^P(a), \phi_i^A(a)\}_{i=1}^I$.
3. Trading mechanism sets $\{\Gamma_i^P, \Gamma_i^A\}_{i=1}^I$ where $\Gamma = \{Buy, Sell, NoT\}$.
4. Stationary distribution $n_{[a,i,\omega]}$.
5. Inter-dealer price p.

Such that

1. Optimal assets maximize consumer trading surplus.
2. Fees maximize Nash products.
3. Sets $\{\Gamma_i^P, \Gamma_i^A\}_{i=1}^I$ are defined using thresholds satisfying the indifference conditions.
4. Distribution $n_{[a,i,\omega]}$ satisfies inflow-outflow equations.
5. Price satisfy $\sum_{j=1}^2 \sum_{i=1}^I \sum_{a\in\mathcal{A}^*} an_{[a,i,\omega_j]} = A$.

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Solution Method

1. Set an initial guess for the equilibrium price p.
   1.1 Set an asset holdings grid and an initial guess for $V_i(a)$
   1.2 Compute optimal asset holdings $\{a_i^P(a), a_i^A\}_{i=1}^I$ using eq. (4) and eq. (6).
   1.3 Compute trading mechanism choice for each pair $\{i, a\}$, using indifference condition.
   1.4 Fix $\{a_i^P(a), a_i^A\}_{i=1}^I$, and iterate h times the following steps:
      1.4.1 Update $V_i(a)$ using eq. (1).
      1.4.2 Compute trading mechanism choice for each pair $\{i, a\}$, using indifference condition
   1.5 Update $V_i(a)$ using eq. (1) until convergence with initial guess of step (a).
2. Define trading mechanism sets $\{\Gamma_i^P, \Gamma_i^A\}_{i=1}^I$ using thresholds.
3. Compute transition matrix T using inflow-outflow equations.
4. Set vector n_0 and obtain $n = \lim_{k \to K} n_0 T^k$, with K sufficiently large to reach convergence.
5. Compute total demand and update p until excess demand in market clearing equations converges towards zero.

Note: Our Bellman operator is a contraction mapping with modulus $\hat{\kappa}$ and operates in a complete normed vector space

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Discussion on Inventory Costs calibration

Inventory Costs θ:

- Suppose we want to capture the regulations-induced inventory costs.
- Greenwood et. al. (2017), Duffie (2018), Fed stress test (2019): Leverage Ratio Requirement as most important constraint for U.S. banks
  $\rightarrow$ LR: hold extra capital when including assets in inventory: 3% to 5%/
- LR cost $= p[a' - a][e^{zm} - 1]x\%$, where bank face $x\%$ of capital requirement and $z\%$ opportunity costs for such capital, and offload position after m days.
- Model cost $= 2\theta p[a' - a]$. $\implies \theta = [e^{zm} - 1]x\%/2$
- Take $z = r$ as the opportunity cost.
- Goldstein and Hotchkiss (2020), TRACE 02-11, $m = 10.6$ days.
- During sample period, 2016-2019, $x\% = 5\%$ for GSIB banks.

  $\implies \theta = 0.44 b.p.$.

My estimated $\hat{\theta} = 0.89 b.p.$, so arguably adding other cost on top of LR.

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Empirical moments details I

Data Sources

- TRACE Academic: US dealers corporate bond transactions.
  - Dealers with anonymous identifiers.
  - 2016m1 - 2019m12.
  - Standard filters: error cleaning + literature basics [1].
  - IG Bonds
- FISD (bond characteristics)

Principal-Agency classification.

- Keep only customer-dealer trades.
- Agency: trades that share the same dealer-bond executed within a 15 min.
  - $\geq$ 50% vol if partial match.
  - Competing trades sorted by time distance and volume.
- Principal trades: non-agency trades.

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[1] Among the most significant filters, I follow the literature and drop preferred, convertible or exchangeable, yankee bonds, bonds with sinking fund provision, variable coupon, with time to maturity $<$ 1 year, or issued $<$ 2 months)

Empirical moments details II

1) $\mathcal{S}$, Vol Weighted Spreads

- Remove micro trades ($\leq$\$100k)
- For each trade, compute Choi, Huh and Shin (2023)'s Spread1:

$$s_{i,b,d} = Q \times \left(\frac{p_{i,b,d} - p^{DD}_{b,d}}{p^{DD}_{b,d}}\right) \quad , \quad p^{DD}_{b,d} = \frac{\sum_{i \in DD_{b,d}} vol^{DD}_{b,d,i} p^{DD}_{b,d,i}}{\sum_{i \in DD_{b,d}} vol^{DD}_{b,d,i}}$$

where i=trade, b=bond, d=day, $Q = 1$ (-1) if customer buys (sells).

- $\mathcal{S}^P_b = \sum_{i,d}(s_{i,b,d} \times vol^P_{i,b,d}) / \sum_{i,d} vol^P_{i,b,d}$
- $\mathcal{S}^A_b = \sum_{i,d}(s_{i,b,d} \times vol^A_{i,b,d}) / \sum_{i,d} vol^A_{i,b,d}$

2) $\mathcal{T}$, Monthly Turnover

- k_b = numbers of days between offering and maturity, within the period sample.
- iao_b = the average amount outstanding of bond during k_b days.
- $\mathcal{T}_b = \left(\sum_i vol_{i,b}/iao_b\right)/\left(k_b/30.5\right)$.

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Empirical moments details III

3) γ, Spread-Size slopes

- $s_{i,d,b} = \alpha + \beta FE + \gamma(vol^P_{i,d,b}/iao_b) + \epsilon_{i,d,b}$, with $FE = [dealer, bond, day]$.
- $\hat{\gamma}^P$ and $\hat{\gamma}^A$ are OLS estimates over corresponding subsamples.
- SE clustered by bond-day.

Dependent Variable:	Transaction Cost (bp)	
	Principal	Agency
Trade size (pp)	1.45***	0.61***
	(0.13)	(0.12)
Dealer FE	Yes	Yes
Bond FE	Yes	Yes
Day FE	Yes	Yes
Observations	1,505,133	97,305
Adjusted R^2	0.108	-0.023

Clustered (Bond & Day) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

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Theoretical moments details

1) $\mathcal{S}$, Vol Weighted Spreads

$$\mathcal{S}^P = \sum_{i \in \mathcal{I}} \sum_{a \in \Gamma_i^P} \frac{n_{[a,i,\omega_1]}|a_i^P - a|}{\sum_{i \in \mathcal{I}} \sum_{a \in \Gamma_i^P} n_{[a,i,\omega_1]}|a_i^P - a|} \frac{\phi_{a,i}^P}{|a_i^P - a|p}$$

$$\mathcal{S}^A = \sum_{i \in \mathcal{I}} \sum_{a \in \Gamma_i^A} \frac{n_{[a,i,\omega_1]} rav_{a,i}}{\sum_{i \in \mathcal{I}} \sum_{a \in \Gamma_i^A} n_{[a,i,\omega_1]} rav_{a,i}} \frac{\phi_{a,i}^A}{rav_{[a,i]}p}$$

where realized agency volume $rav_{a,i} = (1 - \hat{\delta})|a_i^A - a| + \hat{\delta} \sum_{j \in \mathcal{I}} \pi_j |a_j^A - a|$

2) $\mathcal{T}$, Monthly Turnover

$$\mathcal{T} = \sum_{i \in \mathcal{I}} \alpha \Big[\sum_{a \in \Gamma_i^P} n_{[a,i,\omega_1]}|a_i^P - a| + \sum_{a \in \Gamma_i^A} n_{[a,i,\omega_1]} rav_{a,i} \Big]$$

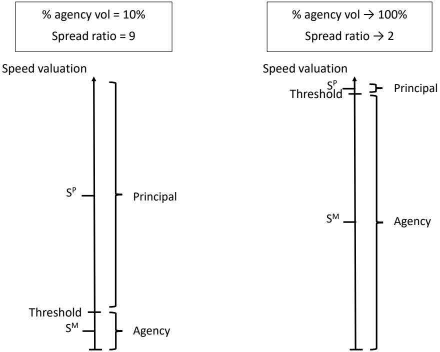
3) γ, Spread-Size slopes

$$\hat{\gamma}^P = \frac{cov(\phi^P/(|a^P - a|p), |a^P - a|)}{var(|a^P - a|)} \quad , \quad \hat{\gamma}^A = \frac{cov(\phi^A/(rav * p), rav)}{var(rav)}$$

Matching % Agency Volume *vs* Spread ratio

- Assume trading costs are an increasing linear function in speed valuation.
- Assume mass of traders is uniformly distributed across speed valuation line.
- Unique threshold split principal and agency trades.

$\Longrightarrow$ Max spread ratio $=2$, achieved when % agency volume $\to$ 100%.



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Moments Choice Discussion I

Moments' relevance for the paper's goal

- The main goal of the paper is to characterize the Composition Effect, which is determined by:
  - Migration of trades.
  - Differential spreads paid by migrants and non migrants.
- In the model migration occurs when trading mechanism thresholds change.
- Migrants are thus located in the extreme of the trading size distribution conditional on preference type.

  $\Longrightarrow$ matching the slope of spreads on trading size informs of the differential of spreads paid by migrant and non migrants.

Moments as sources of identification

- All parameters affect prices and quantities in the model (whether directly or through GE effects)

  $\Longrightarrow$ Moments chosen cover both prices, quantities, and the relation among them

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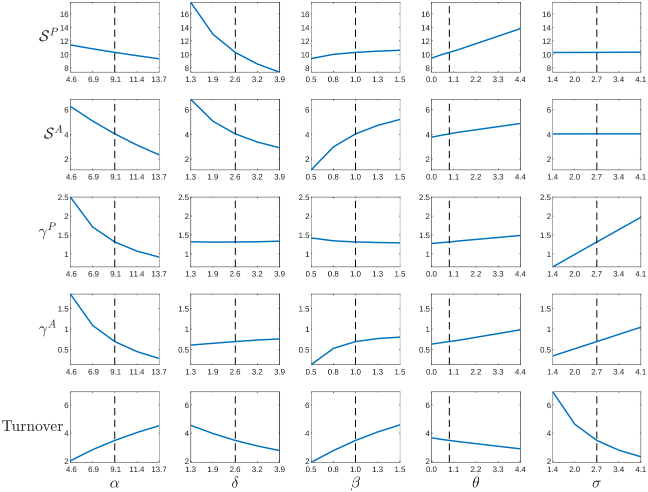
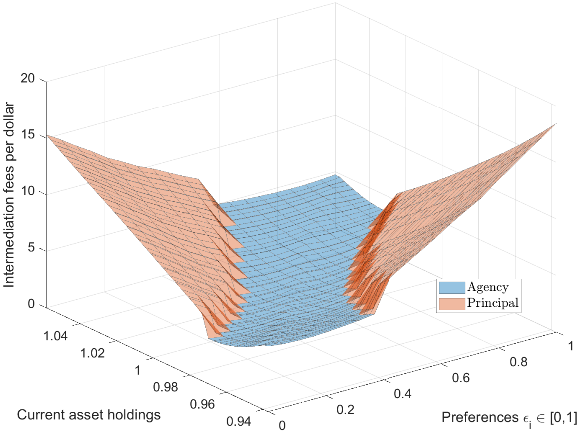
Moments Choice Discussion II

Theoretical moments as parameters change around $\hat{\upsilon}$



Spreads per dollar: $\dfrac{\phi_i(a)}{|a' - a|}\dfrac{10000}{p}$



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Spread Decomposition: Principal Trades

$$\mathcal{S}^P = \sum_{i\in\mathcal{I}} \sum_{a\in\Gamma_i^P} \underbrace{\frac{n_{[a,i,\omega_1]}|a_i^P - a|}{\sum_{i\in\mathcal{I}}\sum_{a\in\Gamma_i^P} n_{[a,i,\omega_1]}|a_i^P - a|}}_{\text{steady state vol weight}} \underbrace{\frac{\phi_{a,i}^P}{|a_i^P - a|p}}_{\text{fee per dollar}}$$

Spread Decomposition: Consider change in parameter $q \in \{0, 1\}$

$$\mathcal{S}^P(q=0) = \mathcal{S}^{P,0}_{P^0,P^1} \times w^{P,0}_{P^0,P^1} + \mathcal{S}^{P,0}_{P^0,A^1} \times w^{P,0}_{P^0,A^1} + \mathcal{S}^{P,0}_{P^0,NT^1} \times w^{P,0}_{P^0,NT^1}$$

$$\mathcal{S}^P(q=1) = \mathcal{S}^{P,1}_{P^0,P^1} \times w^{P,1}_{P^0,P^1} + \mathcal{S}^{P,1}_{A^0,P^1} \times w^{P,1}_{A^0,P^1} + \mathcal{S}^{P,1}_{NT^0,P^1} \times w^{P,1}_{NT^0,P^1}$$

$$\Delta\mathcal{S}^P = \underbrace{\mathcal{S}^{P,1}_{P^0,P^1} \times w^{P,1}_{P^0,P^1} - \mathcal{S}^{P,0}_{P^0,P^1} \times w^{P,0}_{P^0,P^1}}_{\text{ongoing principals}}$$

$$\underbrace{+\mathcal{S}^{P,1}_{A^0,P^1} \times w^{P,1}_{A^0,P^1}}_{\text{agency} \to \text{principal}} \underbrace{+\mathcal{S}^{P,1}_{NT^0,P^1} \times w^{P,1}_{NT^0,P^1}}_{\text{no trader} \to \text{principal}}$$

$$\underbrace{-\mathcal{S}^{P,0}_{P^0,A^1} \times w^{P,0}_{P^0,A^1}}_{\text{principal} \to \text{agency}} \underbrace{-\mathcal{S}^{P,0}_{P^0,NT^1} \times w^{P,0}_{P^0,NT^1}}_{\text{principal} \to \text{no trader}}$$

Spread Decomposition: Agency Trades

$$\mathcal{S}^A = \sum_{i \in \mathcal{I}} \sum_{a \in \Gamma_i^A} \frac{n_{[a,i,\omega_1]} rav_{a,i}}{\sum_{i \in \mathcal{I}} \sum_{a \in \Gamma_i^A} n_{[a,i,\omega_1]} rav_{a,i}} \frac{\phi_{a,i}^A}{rav_{[a,i]} p}$$

where $rav_{a,i}$ accounts for realized agency volume:

$$rav_{a,i} = (1 - \hat{\delta}) |a_i^A - a| + \hat{\delta} \sum_{j \in \mathcal{I}} \pi_j |a_j^A - a|$$

Spread Decomposition:

$$\begin{aligned} \Delta \mathcal{S}^A = & \underbrace{\mathcal{S}_{A^0,A^1}^{A,1} \times w_{A^0,A^1}^{A,1} - \mathcal{S}_{A^0,A^1}^{A,0} \times w_{A^0,A^1}^{A,1}}_{\text{ongoing agency traders}} \\ & + \underbrace{\mathcal{S}_{P^0,A^1}^{A,1} \times w_{P^0,A^1}^{A,1}}_{\text{principal} \to \text{agency}} + \underbrace{\mathcal{S}_{NT^0,A^1}^{A,1} \times w_{NT^0,A^1}^{A,1}}_{\text{no traders} \to \text{agency}} \\ & - \underbrace{\mathcal{S}_{A^0,P^1}^{A,0} \times w_{A^0,P^1}^{A,0}}_{\text{agency} \to \text{principal}} - \underbrace{\mathcal{S}_{A^0,NT^1}^{A,0} \times w_{A^0,NT^1}^{A,0}}_{\text{agency} \to \text{no traders}} \end{aligned}$$

Counterfactual Measures

Composition-free spread under parametrization $q \in \{0,1\}$:

- Only those customer who would not migrate when q changes.

$$\tilde{\mathcal{S}}^P(q) \equiv \mathcal{S}^{P,q}_{P^0,P^1},$$
$$\tilde{\mathcal{S}}^A(q) \equiv \mathcal{S}^{A,q}_{A^0,A^1}.$$

Composition-free spread changes:

- Change in spread fixing the set of customers to those non-migrants.

$$\Delta\tilde{\mathcal{S}}^P \equiv \mathcal{S}^{P,1}_{P^0,P^1} - \mathcal{S}^{P,0}_{P^0,P^1},$$
$$\Delta\tilde{\mathcal{S}}^A \equiv \mathcal{S}^{A,1}_{A^0,A^1} - \mathcal{S}^{A,0}_{A^0,A^1},$$

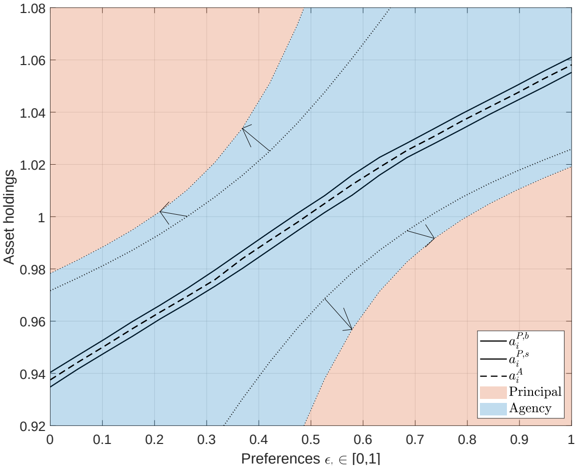
Composition effect bias:

- Percentage difference between avg and composition-free measures.

$$CE^P \equiv (\Delta\mathcal{S}^P - \Delta\tilde{\mathcal{S}}^P)/\Delta\mathcal{S}^P,$$
$$CE^A \equiv (\Delta\mathcal{S}^A - \Delta\tilde{\mathcal{S}}^A)/\Delta\mathcal{S}^A.$$

Execution speed increase: customers migrate towards agency.

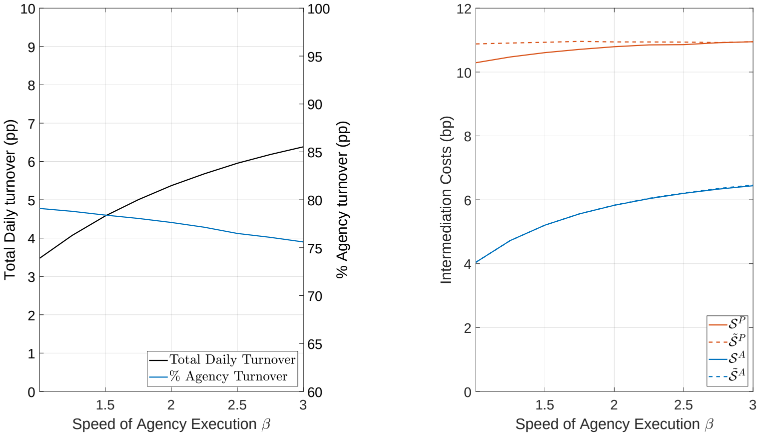
$$\beta : 1 \to 3$$



1. Principal trades migrate towards agency.
2. Non-random migration.

The rise in principal cost is mostly explained by the composition effect.

$$\beta : 1 \to 3$$



- Turnover increases and agency share decreases.
- $\Delta \mathcal{S}^P = 0.65bp$ and $\Delta \tilde{\mathcal{S}}^P = 0.07bp$: $\implies CE^P = 89.5\%$
- $\Delta \mathcal{S}^A = 2.40bp$ and $\Delta \tilde{\mathcal{S}}^A = 2.42bp$: $\implies CE^A = -1.03\%$

Quantitative Exercises Robustness Checks

I compute the composition effect (CE) in both quantitative exercises using:

- Alternative preference distribution, $\pi_i \sim Beta(\lambda, \lambda)$
- Alternative dealer's baragin power η.

		Composition Effect					
		λ			η		
		0.2	1	5	0.91	0.95	0.99
$\Delta\theta$	CE^P	18.49	32.19	28.65	25.99	32.19	34.58
	CE^A	-0.20	-1.19	0.42	0.50	-1.19	-16.78
$\Delta\beta$	CE^P	79.64	89.54	101.38	74.71	89.54	105.18
	CE^A	-1.14	-1.03	0.26	-1.09	-1.03	-4.08

$$CE^P \equiv (\Delta\mathcal{S}^P - \Delta\tilde{\mathcal{S}}^P)/\Delta\mathcal{S}^P, \; CE^A \equiv (\Delta\mathcal{S}^A - \Delta\tilde{\mathcal{S}}^A)/\Delta\mathcal{S}^A$$

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