Who Sees the Trades? The Effect of Information on Liquidity in Interdealer Markets


Economics of Payments

November 2018

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The views expressed in this paper are those of the author and are not necessarily reflective of views at the Federal Reserve Bank of New York or the Federal Reserve System.
Intermediating Trade in Decentralized Markets

Large volume occurs in decentralized markets.

Opportunity for intermediaries to provide liquidity.

Risks in market-making:
- Liquidity costs
- Adverse selection
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Risks in market-making:
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- Adverse selection
Centralized Post-Trade Processing

In contrast, post-trade processes (e.g., clearing) are centralized. Economies of scale and network effects are achieved through a centralized entity performing post-trade activities. Access to valuable information for intermediaries includes market data by platforms. The value of transparency in decentralized markets is a significant consideration.

TRACE Economics of Payments (2018)

Interdealer Markets
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- Gains access to valuable information to intermediaries
  - Market data by platforms
- Value of transparency in decentralized markets
  - TRACE
Goal of Paper

1. Construct model in which Dealers make markets, subject to liquidity cost and adverse selection. Trading in interdealer market outcomes is endogenous.

2. Main questions:
   - How is interdealer market liquidity determined?
   - How does post-trade information disclosure affect liquidity and efficiency?
   - What disclosure environment might a strategic platform choose?
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   - Dealers make markets, subject to liquidity cost and adverse selection
   - Trading in interdealer market outcomes is endogenous
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Main Results

1. Feedback between market liquidity and interdealer liquidity
2. Effect of Post-trade disclosure
   - Perfect disclosure improves welfare
   - Nonmonotonic effect of disclosure
3. Strategic platform
   - Endogenize disclosure environment
   - Chooses disclosure that maximizes adverse selection
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Related Literature

- **Liquidity Provisions in Decentralized Markets.** Duffie, Garleanu and Pedersen (2005); Lagos and Rocheteau (2009); Arseneau et al. (2017); Cujean and Praz (2016); Dunne, Hau and Moore (2015)

- **Information Asymmetry and Disclosure.** Bessembinder, Maxwell and Venkataraman (2006); Edwards, Harris and Piwowar (2007); Bessembinder and Maxwell (2008); Benos, Payne and Vasios (2016); Loon and Zhong (2016)
Three dates $t = 1, 2, 3$

Two types of risk neutral agents
  - Measure 1 of dealers $i \in [0, 1]$
  - Measure 1 of traders $j \in [0, 1]$
Tiered Trading Structure

1. "Market-making" stage.
   Dealer to Trader.

2. "Interdealer" stage.
   Dealer to Dealer.
Tiered Trading Structure

1 “Market-making” stage. Dealer to Trader.
Tiered Trading Structure

1. “Market-making” stage. Dealer to Trader.

2. “Interdealer” stage. Dealer to Dealer.
Asset Value

\[
\begin{align*}
\text{Asset Value} & = v = \bar{v} + x \text{w.p. } \frac{1}{2} \bar{v} - x \text{w.p. } \frac{1}{2}
\end{align*}
\]

Trader valuation \( v_j \) privately observed \( v_j = v + d_j \) where \( d_j \sim U[-D, D] \)

\( D \) captures dispersion in private value
Asset has (unknown) value $v$

$$v = \begin{cases} 
\bar{v} + x & \text{w.p. } \frac{1}{2} \\
\bar{v} - x & \text{w.p. } \frac{1}{2}
\end{cases}$$
Asset Value

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- Trader $j$ valuation $v_j$
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  \end{cases} \]

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- Trader \( j \) valuation \( v_j \)
  - \( v_j \) privately observed
  - \( v_j = v + d_j \) where \( d_j \sim U[-D, D] \)
  - \( D \) captures dispersion in private value
Traders’ Valuation of Asset

\[ \bar{v} - x - D \]
\[ \bar{v} - x \]
\[ \bar{v} - x + D \]

\[ \bar{v} + x - D \]
\[ \bar{v} + x \]
\[ \bar{v} + x + D \]
Market-Making $t = 1$
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- Each dealer randomly matched to one trader
Market-Making \( t = 1 \)

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- Dealer \( i \) chooses bid-ask offer \((\bar{v} - \delta_i, \bar{v} + \delta_i)\)
Market-Making \( t = 1 \)

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- Dealer \( i \) chooses bid-ask offer \((\bar{v} - \delta_i, \bar{v} + \delta_i)\)

- Trader \( j \) accepts
  - bid offer if \( v_j < \bar{v} - \delta_i \)
  - ask offer if \( v_j \geq \bar{v} + \delta_i \)
Each dealer randomly matched to one trader

Dealer $i$ chooses bid-ask offer $(\bar{v} - \delta_i, \bar{v} + \delta_i)$

Trader $j$ accepts

- bid offer if $v_j < \bar{v} - \delta_i$
- ask offer if $v_j \geq \bar{v} + \delta_i$
- reject otherwise
Market-Making and Likelihood of Trade

\[ \bar{v} - x - D \quad \bar{v} - x \quad \bar{v} - x + D \]

\[ \bar{v} + x - D \quad \bar{v} + x \quad \bar{v} + x + D \]
Each dealer’s position \( \{-1, 0, 1\} \)
Dealer Positions after Market-Making

- Each dealer’s position \{−1, 0, 1\}
  - “long dealer” if 1
  - “neutral dealer” if 0
  - “short dealer” if −1
Dealer Positions after Market-Making

- Each dealer’s position $\{-1, 0, 1\}$
  - “long dealer” if 1
  - “neutral dealer” if 0
  - “short dealer” if $-1$

- Dealer type is private
Dealers randomly matched to each other
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With equal probability, one dealer $i$ makes ultimatum offer $(\sigma, P^d)$
Interdealer Trading at $t = 2$

- Dealers randomly matched to each other

- With equal probability, one dealer $i$ makes ultimatum offer $(\sigma, P^d)$
  - $\sigma \in \{buy, sell, no trade\}$
  - $P^d$ transaction price
Post Trade

Dealer are members of central counterparty (CCP)

Each dealer \( i \) must:
1. Report date 1 and 2 trades to CCP
2. After date 2, contribute capital proportional to net position
   \[ x_i \in \{-2, -1, 0, 1, 2\} \]

Dealer \( i \) incurs cost \( \Delta \cdot |x_i| \).

\( \Delta \) opportunity cost of capital
Post Trade

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- Dealer $i$ incurs cost $\Delta \cdot |x_i|$.
- $\Delta$ opportunity cost of capital
Timeline

\[ t=1 \] Dealers make markets for traders. Trades submitted to CCP.

\[ t=2 \] Dealers trade with dealers. Trades submitted to CCP. CCP demands capital from dealers. Dealers incur liquidity cost.

\[ t=3 \] CCP settles all positions, returns capital. Payoffs realized.

Solution concept: Symmetric-strategy PBE
$t = 1$ Dealers make markets for traders. Trades submitted to CCP.
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Market Making Strategies

Bid-ask spread $\delta_i$
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- Profits conditional on trade
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- Likelihood that trader accepts offer
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Bid-ask spread $\delta_i$
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- Beliefs on $v$ conditional on trader accepting offer
Market Making Strategies

Bid-ask spread $\delta_i$

- Profits conditional on trade
- Likelihood that trader accepts offer
- Beliefs on $v$ conditional on trader accepting offer
  - $\uparrow$ if trader buys
  - $\downarrow$ if trader sells
Market-making strategies:

- **Partially revealing offer** if he chooses a $\delta_i \in (0, D - x)$;
  - $\delta_i$ increases
    - Probability of trade ↓
    - More precise beliefs of $\nu$

- **Fully revealing offer** if he chooses a $\delta_i \geq D - x$. 


Increasing Bid-Ask Spread

\[
\begin{align*}
\tilde{v} - \delta' & \quad \tilde{v} - \delta \\
\tilde{v} - x - D & \quad \tilde{v} - x \\
\tilde{v} + x - D & \quad \tilde{v} + x \\
\tilde{v} + x + D &
\end{align*}
\]
Market Making Strategies

Market-making strategies:

- **Partially revealing offer** if he chooses a $\delta_i \in (0, D - x)$;
- **Fully revealing offer** if he chooses a $\delta_i \geq D - x$.
  - Probability of trade ↓
  - *Fully reveals* true value of $v$
Fully Revealing Market-Making

\[ \tilde{v} - \delta' \quad \tilde{v} - x - D \quad \tilde{v} - x \quad \tilde{v} - x + D \]

\[ \tilde{v} + x - D \quad \tilde{v} + x \quad \tilde{v} + x + D \]
Interdealer trading depends on the set of dealer types

Given set of long, short, neutral dealers, what happens?
Interdealer Markets with Identical $\delta_i$
Suppose all dealers chose $\hat{\delta}$
Suppose all dealers chose $\hat{\delta}$

Distribution of dealers

- $\frac{D-x-\hat{\delta}}{2D}$ long if $v = \bar{v} + x$ and $\frac{D+x-\hat{\delta}}{2D}$ if $v = \bar{v} - x$
- $\frac{D+x-\hat{\delta}}{2D}$ short if $v = \bar{v} + x$ and $\frac{D-x-\hat{\delta}}{2D}$ if $v = \bar{v} - x$
- $\frac{\hat{\delta}}{D}$ neutral
Interdealer offer strategy with Identical $\delta_i$
Interdealer offer strategy with Identical $\delta_i$

- Consider long dealer that makes offer to sell
Consider long dealer that makes offer to sell
Receiving dealers infers sell offer made by long dealer
Interdealer offer strategy with Identical $\delta_i$

- Consider long dealer that makes offer to sell
- Receiving dealers infers sell offer made by long dealer
- Offset position by selling asset $\rightarrow$ avoid liquidity cost $\Delta$
Gains from Trade in Interdealer Market

- The reservation price of a receiving dealer of type $\theta$:

$$E[v|\text{match between long and } \theta\text{-type dealer}] + \begin{cases} \Delta & \text{if } \theta = s \\ -\Delta & \text{if } \theta = l, n \end{cases}$$
The reservation price of a receiving dealer of type $\theta$:

$$E[v | \text{match between long and } \theta\text{-type dealer}] + \begin{cases} \Delta & \text{if } \theta = s \\ -\Delta & \text{if } \theta = l, n \end{cases}$$

- Gains from trade arise *only* when both dealers offset position
- Trade with other types "transfers" liquidity cost
The reservation price of a receiving dealer of type $\theta$:

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- Gains from trade arise only when both dealers offset position
- Trade with other types “transfers” liquidity cost
- $\therefore$ Long dealer maximizes payoff by offering short reservation price
Interdealer Trading with $\hat{\delta} < D - x$
Interdealer Trading with $\hat{\delta} < D - x$

- $\hat{\delta} < D - x \Rightarrow$ positive measure of long and short dealers
Interdealer Trading with $\hat{\delta} < D - x$

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- Interdealer trading *only* occurs between long-short dealers
Interdealer Trading with $\hat{\delta} < D - x$

- $\hat{\delta} < D - x \Rightarrow$ positive measure of long and short dealers
- Interdealer trading *only* occurs between long-short dealers
- All trades with surplus occur

\[\bar{v} - \delta \quad \bar{v} + \delta\]

\[\bar{v} - x - D \quad \bar{v} - x \quad \bar{v} - x + D\]

\[\bar{v} + x - D \quad \bar{v} + x \quad \bar{v} + x + D\]
Market Segmentation

No gains from trade with any dealer matches interdealer trading occurs.

\[ \bar{v} + x - D \bar{v} \]

\[ \bar{v} + x + D \bar{v} \]

\[ \bar{v} - x - D \bar{v} \]

\[ \bar{v} - x + D \bar{v} \]

\[ \bar{v}' + \delta \]

\[ \bar{v}' - \delta \]

\[ \delta > D - x \Rightarrow \text{long and short dealers do not coexist.} \]

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\( \hat{\delta} > D - x \Rightarrow \) long and short dealers do not coexist.
Market Segmentation

- \( \delta > D - x \Rightarrow \) long and short dealers do not coexist.
- No gains from trade with any dealer matches
Market Segmentation

- \( \hat{\delta} > D - x \Rightarrow \) long and short dealers do not coexist.
- No gains from trade with any dealer matches
- \emph{No} interdealer trading occurs.

\[
\begin{align*}
\bar{v} - \delta' & \quad \bar{v} - x - D \\
\bar{v} - x & \quad \bar{v} - x + D \\
\bar{v} + x - D & \quad \bar{v} + x \\
\bar{v} + x + D & \quad \bar{v} + x
\end{align*}
\]
Interdealer Markets

Interdealer trading occurs \iff \delta^* < D - x
Interdealer trading occurs $\Leftrightarrow \delta^* < D - x$
Interdealer trading occurs $\iff \delta^* < D - x$

When do dealers choose partially revealing offers in equilibrium?
Incentives to Deviate to Larger $\delta_i$
Incentives to Deviate to Larger $\delta_i$

Dealer’s marginal interdealer payoff given other dealers choose $\hat{\delta}$
Incentives to Deviate to Larger $\delta_i$

Dealer’s marginal interdealer payoff given other dealers choose $\hat{\delta}$

$$V_{\theta}(\delta_i, \hat{\delta}) = \left( \sum_v P(v|\theta)P(\text{match with opposite dealer}|v, \theta) \right) \Delta$$

- **gains from netting**
  $$\left( \sum_v P(v|\theta)P(\text{match with opposite dealer}|v, \theta) \right)$$

- **information rents**
  $$(\bar{v} - E_i[v|\text{trade}])$$
Expected Payoffs at $t = 1$

$$
\Pi_i(\delta_i, \hat{\delta}) = P(\gamma_j(P^b, P^a) = \text{accept}|\delta_i) \cdot (\bar{v} + \delta_i - E[v|\delta_i] - \Delta) \\
\equiv A, \text{ market-making payoff}
$$

$$
+ \sum_{\theta} P(\theta_i = \theta|\delta_i) \cdot V_\theta(\delta_i, \hat{\delta}) \\
\equiv B, \text{ interdealer payoff}
$$
Two Types of Equilibria

Result.

- For $x < x^{\text{trade}}$, equilibrium with interdealer trading exists;
- For $x > x^{\text{seg}}$, equilibrium with market segmentation exists.
measuring market liquidity

- measure $\mu$ of offers accepted by traders
- For $x \in (x^{seg}, x^{trade})$, interdealer trading improves market liquidity

- Comparative statics of market liquidity $\mu$
  - decreases in $\Delta$
  - decreases in $x$
  - increases in $D$
Post-Trade Information Disclosure

Interdealer liquidity \( \downarrow \Rightarrow \) dealers' liquidity provision \( \downarrow \)

Efficiency can be improved by limiting private benefits

Gains from post-trade information disclosure.

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Interdealer Markets
Gains to become more informed break down interdealer trading.
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Interdealer liquidity $\downarrow \Rightarrow$ dealers’ liquidity provision $\downarrow$
Gains to become more informed break down interdealer trading.

- Interdealer liquidity ↓ ⇒ dealers’ liquidity provision ↓
- Efficiency can be improved by limiting private benefits
Post-Trade Information Disclosure

- Gains to become more informed break down interdealer trading.
- Interdealer liquidity $\downarrow \Rightarrow$ dealers’ liquidity provision $\downarrow$
- Efficiency can be improved by limiting private benefits
- Gains from **post-trade information disclosure**.
At date 2, CCP publicly discloses anonymized trades in date 1.
Value of Post-Trade Information

**Result.** Suppose that a dealer observes the set of successful trades made at $t = 1$. Then, the dealer perfectly infers the true value of $v$. 
Effect of Post-Trade Disclosure

\[ V_\theta (\delta_i, \hat{\delta}) = \frac{1}{2} \left( \sum_v P(v|\theta)P(\text{match with opposite dealer}|v, \theta) \right) 2\Delta \]

- gains from netting
- information rents
**Result.** Under disclosure, equilibrium with interdealer trading exists if $x < x^{\text{trade, disclosure}}$.

1. Interdealer trading occurs for larger $x$
2. Tighter bid-ask spreads
Key Takeway from Full Post-Trade Disclosure

Market efficiency increases with perfect disclosure of information
Market efficiency increases with perfect disclosure of information

- Interdealer trading occurs for greater x
Market efficiency increases with perfect disclosure of information

- Interdealer trading occurs for greater $x$
- Transparency $\Rightarrow$ dealers increase liquidity provision
Partial Post-Trade Disclosure

Dealers may be asymmetrically informed.

Rational inattention bars all dealers from incorporating info in time.

Selective disclosure to subset of dealers.

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Interdealer Markets
Dealers may be asymmetrically informed
Partial Post-Trade Disclosure

- Dealers may be asymmetrically informed
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Partial Post-Trade Disclosure

- Dealers may be asymmetrically informed
  - Rational inattention bars all dealers from incorporating info in time
  - Selective disclosure to subset of dealers
General Disclosure Environment with $\lambda$

- At date 2, fraction $\lambda \in [0, 1]$ of dealers become randomly informed.
General Disclosure Environment with $\lambda$

- At date 2, fraction $\lambda \in [0, 1]$ of dealers become randomly informed.
- Earlier cases:
  - No disclosure ($\lambda = 0$)
  - Perfect disclosure ($\lambda = 1$)
Case: $\lambda \approx \epsilon$

- Small deviation from no disclosure case ($\lambda = 0$)
- When $\lambda$ very small
Case: $\lambda \approx \epsilon$

- Small deviation from no disclosure case ($\lambda = 0$)
- When $\lambda$ very small
- Almost all dealers are “uninformed” in interdealer markets
- Most matches in interdealer between uninformed
Case: $\lambda \approx \epsilon$

- Small deviation from no disclosure case ($\lambda = 0$)
- When $\lambda$ very small
- Almost all dealers are “uninformed” in interdealer markets
- Most matches in interdealer between uninformed
- ∴ Facilitate trades between uninformed
Case: $\lambda \approx 1 - \epsilon$

- Small deviation from perfect disclosure case ($\lambda = 1$)
- When $\lambda$ very large
Case: $\lambda \approx 1 - \epsilon$

- Small deviation from perfect disclosure case ($\lambda = 1$)
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- Almost all dealers are “informed” in interdealer markets
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Case: $\lambda \approx 1 - \epsilon$

- Small deviation from perfect disclosure case ($\lambda = 1$)
- When $\lambda$ very large
- Almost all dealers are “informed” in interdealer markets
- Most matches in interdealer between informed dealers
- $\therefore$ Facilitate trades between informed
Equilibrium with $\lambda$

- For $\lambda \in [0, \bar{\lambda}]$, 
  - Dealers trade at “uninformed prices”
  - Informed dealers extract information rents
- For $\lambda \in (\bar{\lambda}, 1]$, 
  - Dealers trade at “informed prices”
  - Uninformed dealers use prices to screen
Nonmonotonicity with $\lambda$

**Result.** When $x$ and $D$ are sufficiently large, liquidity is nonmonotonic over the interval of $\lambda \in (0, 1)$. 
Competing Effects with Partial Disclosure

- **Information Effect.** As $\lambda$ increases, more dealers become informed
- **Adverse Selection Effect.** Uninformed dealers face adverse selection
Competing Effects with Partial Disclosure

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- **Adverse Selection Effect.** Uninformed dealers face adverse selection

For small $\lambda$, adverse selection cost outweighs benefits of information
Competing Effects with Partial Disclosure

- **Information Effect.** As $\lambda$ increases, more dealers become informed.
- **Adverse Selection Effect.** Uninformed dealers face adverse selection.

- For small $\lambda$, adverse selection cost outweighs benefits of information.
- As $\lambda$ increases, benefits of information dominate.
Competing Effects with Partial Disclosure

- **Information Effect.** As $\lambda$ increases, more dealers become informed.
- **Adverse Selection Effect.** Uninformed dealers face adverse selection.

For small $\lambda$, adverse selection cost outweighs benefits of information.

As $\lambda$ increases, benefits of information dominate.

Intermediate $\lambda$ worse than all or no information.
Strategic Platform

Potential reason for $\lambda < 1$ is due to costly access. Platforms may charge dealers for timely access to info.
Potential reason for $\lambda < 1$ is due to costly access
Platforms may charge dealers for timely access to info
Strategic Platform

- Potential reason for $\lambda < 1$ is due to costly access
- Platforms may charge dealers for timely access to info
- Endogenize $\lambda$
At date 2, Platform chooses cost $c$ at which dealer can observe trades.
Determination of Cost $c$

Choose $c$ to maximize $c \cdot \lambda(c)$

If $c$ sufficiently low $\rightarrow$ all dealers acquire info ($\lambda = 1$)

Alternatively, platform may set $c$ to maximize value of information adverse selection greatest at $\bar{\lambda}$ can charge highest $c$

Result.

For sufficiently large $x$ and $D$, a strategic platform selects some cost $c^\diamond > 0$ that induces $\bar{\lambda}$. 

Choose $c$ to maximize $c \cdot \lambda(c)$
Determination of Cost $c$

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- If $c$ sufficiently low $\rightarrow$ all dealers acquire info ($\lambda = 1$)
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**Result.** For sufficiently large $x$ and $D$, a strategic platform selects some cost $c^\diamond > 0$ that induces $\bar{\lambda}$. 
What do platforms do?

- Platforms regularly sell information products

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What do platforms do?

- Platforms regularly sell information products
  - Asymmetric access to relevant market info
  - Post-trade info access in options market
  - Special access order types that reveal private info
What do platforms do?

- Platforms regularly sell information products
  - Asymmetric access to relevant market info
  - Post-trade info access in options market
  - Special access order types that reveal private info
- SEC ruling against exchanges over raising market-data fees.
What do platforms do?

- Platforms regularly sell information products
  - Asymmetric access to relevant market info
  - Post-trade info access in options market
  - Special access order types that reveal private info
- SEC ruling against exchanges over raising market-data fees.
- Market participants’ concern when competing banks operate post-trade platforms
Conclusion

- Develop model of decentralized market with tiered trading structure
- Dealers dealt with adverse selection and liquidity costs
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Main Takeaways:
- Link between market liquidity and interdealer liquidity
- Welfare gains from perfect disclosure
- Nonmonotonic effect of disclosure
- Suboptimal outcome with strategic platform