An information-based theory of financial intermediation

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The views expressed here are the authors and not necessarily those of the Federal Reserve Bank of Richmond or the Federal Reserve System.
What do we do?

Develop a new theory of financial intermediation

- Builds on information frictions
- Private information on trade motives of investors
  Different hedging motives, wealth heterogeneity, etc

Main idea: Agents differ in their screening expertise

- Experts more likely to know their counterparty’s trade motives
- It makes them natural intermediaries

Theoretical results:

- Generates a core-periphery structure with experts at the core
  (Green, Hollifield and Schurhoff (2007), Bech and Atalay (2010), Li and Schurhoff (2014), Hollifield, Neklyudov and Spatt (2017), etc.)
- Screening experts trade faster and extract more rents
Empirical validation of the model

Large investors (over $100 million in assets) file Form 13F
Provide information about their asset positions

▶ We interpret this as revealing their trade needs/type

We use CDS trade data from DTCC to test the model predictions
▶ We have information about individual trades, identity of traders, date of trade, etc

We test unique predictions of our theory and we find that they hold in the data

These predictions do not hold in models of complete information
(Hugonnier, Lester and Weill (2014), Chang and Zhang (2015), Menzio, Jarosch, Farboodi (2016), Farboodi, Jarosch, Shimer (2017), etc.)
Model
Environment

Build on Duffie, Garleanu, and Pedersen (2005)

Time is continuous

Measure one of agents called investors with discount rate \( r > 0 \)

Investor have type \( \theta = (\alpha, \nu) \in [0, 1] \times \mathbb{R} := \Theta \)

- Call \( \alpha \) the screening expertise
- Call \( \nu \) the utility type

Types have distribution \( F(\theta) \), density \( f(\theta) \) and full support in \( \Theta \)
There are assets

Investors can hold either $a = 0$ or $a = 1$ of the asset

- if $a = 0$ the investor is called an *non-owner*
- if $a = 1$ the investor is called an *owner*

Instantaneous utility from holding an asset is $\nu$

There is transferable utility

To generate trade in steady state:

- Assets mature at Poisson rate $\mu > 0$
- Investors can issue an asset at no cost at Poisson rate $\eta > 0$
Environment

Investors randomly meet in pairs with arrival rate $\lambda$

Consider a type $\theta_o$ owner and a type $\theta_n$ non-owner:

- with probability $\alpha_o$, the owner knows (learns) $\theta_n$
- with probability $1 - \alpha_o$, he does not

The screening expertise determines the probability an investor knows his counterparty type $\theta$
Distributions: owners $\Phi_o(\theta_o)$ and non-owners $\Phi_n(\theta_n)$

Asset supply: $s \in [0, 1]$

Call $\Delta(\theta)$ the reservation value of a type $\theta$ investor

$\triangleright$ $M_o$ denotes the owners distribution of res. values

$\triangleright$ $M_n$ denotes the non-owners distribution of res. values

\[
M_o(\Delta_o) = \frac{1}{s} \int 1_{\{\Delta(\theta) \leq \Delta_o\}} d\Phi_o(\theta)
\]

\[
M_n(\Delta_n) = \frac{1}{1 - s} \int 1_{\{\Delta(\theta) \leq \Delta_n\}} d\Phi_n(\theta).
\]

Let $m_o$ and $m_n$ denote the densities of $M_o$ and $M_n$
Bilateral trade

In a meeting, one investor is selected to propose the terms of trade

- with probability $\xi_o$, it is the owner
- with probability $\xi_n = 1 - \xi_o$, it is the non-owner

When selected and knows the counter-party type

- the owner asks $\max\{\Delta(\theta_o), \Delta(\theta_n)\}$
- the non-owner bids $\min\{\Delta(\theta_o), \Delta(\theta_n)\}$

Otherwise, the investor designs an optimal trade mechanism

OBS: If $\alpha = 1$ for all investors, this is just Nash bargaining
Optimal ask and bid under incomplete information

The owner's problem:

$$\max_{\text{ask}} \ obj^o(\text{ask}) := [\text{ask} - \Delta_o] \ [1 - M_n(\text{ask})]$$

The non-owner's problem:

$$\max_{\text{bid}} \ obj^n(\text{bid}) := [\Delta_n - \text{bid}] \ M_o(\text{bid})$$

- Problem is analogous to a monopoly/monopsony
- We show in paper that bid/ask are optimal trade mechanisms
The owner’s problem:

\[
\frac{\partial obj^o}{\partial ask} \bigg|_{ask=\Delta_o} = 1 - M_n(\Delta_o) > 0
\]

\[
\frac{\partial obj^n}{\partial bid} \bigg|_{bid=\Delta_n} = -M_o(\Delta_n) < 0
\]

- Owner asks more than \( \Delta_o \) \( \implies \) trade is distorted
- Non-owner bids less than \( \Delta_n \) \( \implies \) trade is distorted
Gains from trade

The owner expected gain from trade is

\[ \pi_o(\theta_o) = \xi_o \left\{ \alpha_o \int_{\Delta_o}^{\infty} (\Delta_n - \Delta_o) \, dM_n + (1 - \alpha_o) (ask_o - \Delta_o) [1 - M_n(ask_o)] \right\} \]

\[ + \xi_n \int (1 - \alpha_n) (bid_n - \Delta_o) 1_{\{bid_n \geq \Delta_o\}} d\Phi_n(\theta_n) \frac{1}{1 - s} \]

The non-owner expected gain from trade is

\[ \pi_n(\theta_n) = \xi_n \left\{ \alpha_n \int_{0}^{\Delta_n} (\Delta_n - \Delta_o) \, dM_o + (1 - \alpha_n) (\Delta_n - bid_n) M_o(bid_n) \right\} \]

\[ + \xi_o \int (1 - \alpha_o)(\Delta_n - ask_o) 1_{\{\Delta_n \geq ask_o\}} d\Phi_o(\theta_o) \frac{1}{s} \]
The value function of investors are

\[ rV_o(\theta) = \max\{rV_n(\theta), \nu - \mu [V_o(\theta) - V_n(\theta)] + \lambda (1 - s)\pi_o(\theta)\} \]

\[ rV_n(\theta) = \eta [\max\{V_o(\theta), V_n(\theta)\} - V_n(\theta)] + \lambda s\pi_n(\theta) \]

And the reservation value is

\[ r\Delta(\theta) = \max\{\nu - (\mu + \eta)\Delta(\theta) + \lambda (1 - s)\pi_o(\theta) - \lambda s\pi_n(\theta), 0\} \]
The probability of trade of a type $\theta$ owner and non-owner are

$$\bar{q}_o(\theta) = \int q(\theta, \theta_n)\phi_n(\theta_n)d\theta_n, \quad \text{and} \quad \bar{q}_n(\theta) = \int q(\theta_o, \theta)\phi_o(\theta_o)d\theta_o$$

where

$$q(\theta_o, \theta_n) = \mathbb{1}_{\{\Delta_n \geq \Delta_o\}}$$

$$-\xi_o(1 - \alpha_o)\mathbb{1}_{\{ask_o > \Delta_n \geq \Delta_o\}} - \xi_n(1 - \alpha_n)\mathbb{1}_{\{\Delta_n \geq \Delta_o > bid_n\}}$$

The time change in the mass of owners with type $\theta$ is

$$\dot{\phi}_o(\theta) = \eta\phi_n(\theta)\mathbb{1}_{\{\Delta(\theta) > 0\}} - \mu\phi_o(\theta) + \lambda[\phi_n(\theta)\bar{q}_n(\theta) - \phi_o(\theta)\bar{q}_o(\theta)]$$
Equilibrium

**Definition**

A steady-state symmetric equilibrium is given by a family \( \{\Delta, \Phi_o, \Phi_n, s, \text{big, ask}\} \) satisfying the above conditions.

Result: There exists a steady-state symmetric equilibrium.

Result: It is still an equilibrium if we allow for optimal contracts.
Trade probabilities, speed and centrality
Probability to sell

The probability to sell is

\[ \bar{q}_o(\theta) = \xi_o \left\{ \alpha [1 - M_n(\Delta_o)] + (1 - \alpha) [1 - M_n(\text{ask}(\Delta_o))] \right\} \]

\[ + \xi_n \mathbb{E} \left\{ \alpha_n \mathbb{1}_{\{\Delta_n \geq \Delta_o\}} + (1 - \alpha_n) \mathbb{1}_{\{\text{bid}(\Delta_n) \geq \Delta_o\}} \right\} \]

Uninformed owners don’t sell to non-owners \( \Delta_n \in [\Delta_o, \text{ask}(\Delta_o)) \)

which implies that \( \frac{\partial \bar{q}_o(\theta)}{\partial \alpha} \bigg|_{\Delta_o} = \xi_o \left\{ M_n(\text{ask}(\Delta_o)) - M_n(\Delta_o) \right\} > 0 \)

- Experts sell to more people
Probability to buy

The probability to buy is

\[
\bar{q}_n(\theta) = \xi_n \left\{ \alpha M_o(\Delta_n) + (1 - \alpha) M_o(\text{bid}(\Delta_n)) \right\}
\]

\[+ \xi_o \mathbb{E}\left\{ \alpha_o 1_{\{\Delta_n \geq \Delta_o\}} + (1 - \alpha_o) 1_{\{\Delta_n \geq \text{ask}(\Delta_o)\}} \right\} \]

Uninformed non-owners don’t buy from owners
\(\Delta_o \in (\text{bid}(\Delta_n), \Delta_n)\)

which implies that
\[
\frac{\partial \bar{q}_n(\theta)}{\partial \alpha} \bigg|_{\Delta_n} = \xi_n \left\{ M_o(\Delta_n) - M_o(\text{bid}(\Delta_n)) \right\} > 0
\]

Experts buy from more people
Trading speed

The effective trading speed

\[ speed_o(\theta) = \lambda \bar{q}_o(\theta) \quad \text{and} \quad speed_n(\theta) = \lambda \bar{q}_n(\theta) \]

For given \( \Delta_o \) and \( \Delta_n \), trading speed is increasing in expertise.

We get:

- same contact rate \( \lambda \), higher trading probability

Farboodi, Jarosch, and Shimer (2017):

- higher contact rate \( \lambda \), same trading probability
What is centrality?

Centrality is the degree in which an investor engages in the business of buying and selling assets

\[
c(\theta) = \frac{\lambda}{2Vol} \times \frac{\phi_o(\theta)\bar{q}_o(\theta) + \phi_n(\theta)\bar{q}_n(\theta)}{f(\theta)}
\]

where

\[Vol = \lambda \int \int q(\theta_o, \theta_n) d\Phi_o(\theta_o) d\Phi_n(\theta_n)\] is the trade volume

Note that \[\int c(\theta)f(\theta)d\theta = 1\]
Centrality is increasing in both: \( \bar{q}_o(\theta) \) and \( \bar{q}_n(\theta) \)

\[
\frac{\partial c(\theta)}{\partial \alpha} \bigg|_{\Delta(\theta) = \bar{\Delta}} > 0
\]
Centrality

Who is more central?

- Low $\nu$: too costly to buy an asset and wait to sell
- High $\nu$: too costly to sell an asset and wait to buy

$\alpha = 1$ (1.0, $\nu^*$)

Most central investor is among the best experts!
To wrap it up

Our theory says that

1. Information on counterparties determines trade probability
   - All else constant, experts—high $\alpha$ investors—trade faster

2. Therefore, more central investors will have high expertise

Now we take these predictions to the data
Empirical validation
How we test the theory?

A subgroup of investors managers have to file Form 13F

- investment advisers, banks, insurance companies, broker-dealers, pension funds, and corporations

They report holdings of all securities regulated by the SEC

- include equities that trade on an exchange, certain options, shares of closed-end investment companies, and certain debts
- the information is made available to the public... even any of us can download it from the web

We interpret the report as revealing individual trading needs/types
How we test the theory?

Extend model (economy at steady state): a small group of investors get their type revealed at future time $T$

- Common knowledge by all market participants about this

Two main set of predictions (for both buyers and sellers). For those that reveal their type, around $T$,

1. Probability of trading increases after $T$
   - When counterparty makes offer under full information: **no** distortion

2. But less so if counterparty is central in trade (i.e. high $\alpha$)
   - When central counterparty makes offer: **small** distortion
Data

We use CDS trade data from the Trade Information Warehouse (TIW) made available to regulators by the Depository Trust and Clearing House Corporation (DTCC)

- Trade date
- Buyer/seller id
- Reference entity—we use centrally cleared CDS indexes
- Data range: 1st quarter 2013 - last quarter 2017

Note: Some trades occur through clearing houses. We excluded these trades, unless we were able to match them to a particular buyer and seller
## Summary statistics

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<thead>
<tr>
<th></th>
<th>North America</th>
<th>All</th>
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<tbody>
<tr>
<td>no. of trades</td>
<td>369,540</td>
<td>921,211</td>
</tr>
<tr>
<td>no. of traders</td>
<td>4,128</td>
<td>5,514</td>
</tr>
<tr>
<td>no. of traders who report at least once</td>
<td>52</td>
<td>63</td>
</tr>
<tr>
<td>no. of trades with reports in same quarter</td>
<td>37,359</td>
<td>86,557</td>
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<tr>
<td>fraction where only buyer reported in that quarter</td>
<td>0.49</td>
<td>0.48</td>
</tr>
<tr>
<td>fraction where only seller reported in that quarter</td>
<td>0.48</td>
<td>0.49</td>
</tr>
<tr>
<td>fraction where both reported in that quarter</td>
<td>0.03</td>
<td>0.03</td>
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</table>
Distribution of trades
Distribution of centrality and reporters

Number of traders in the top $x$ percent of centrality

<table>
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<tr>
<th>$x$</th>
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<th>Reporters</th>
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<tr>
<td>5</td>
<td>207</td>
<td>3</td>
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<tr>
<td>10</td>
<td>416</td>
<td>6</td>
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<td>25</td>
<td>1054</td>
<td>13</td>
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<td>2078</td>
<td>27</td>
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<tr>
<td>100</td>
<td>4128</td>
<td>52</td>
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</table>
Distribution of reports and delays

(1) large variation in number of reports

(2) institutions report late and there is variation in delays

delay = report - official
Implementation of test

Given delays, we cannot use the official, rather must use actual report day

Question: does a report affects the trade probability?

Approach:

- Assign randomly a report day to those traders in any trade with no reports
  - use empirical distribution of delays
  - some trades linked to a real report day; others linked to fake report day
- Question: is trade more likely when a real report happened in the previous $N$ weeks?
Empirical specification

Let \( \text{trader} \in \{ \text{buyer, seller} \} \)

\[ \mathcal{R}^N_{\text{trader}_j, i, k, t}: = 1 \text{ if trader } j \text{ in trade } i, \text{ trading asset CDS on entity } k \text{ at time } t, \]
had an \( \text{ard} \) within \( N \) weeks before the trade date

\[ \text{real}_{\text{trader}_j, i}: = 1 \text{ if trader } j \text{ ard in trade } i \text{ is real} \]

\[ \text{top}_{\text{trader}_j, i}: = 1 \text{ if tradr } j \text{ in trade } i \text{ is among the top 5 in centrality} \]

Specification:

\[ \mathcal{R}^N_{\text{trader}_j, i, k, t} = \gamma_1 \text{real}_{\text{trader}_j, i} + \gamma_2 \text{real}_{\text{trader}_j, i} \times \text{top}_{\text{trader}_-j, i} + \text{FE}_j + \text{FE}_k + \text{FE}_t \]

Theory predicts: \( \gamma_1 \) positive and \( \gamma_2 \) negative (for both buyer and seller)
## Results - North American entities

<table>
<thead>
<tr>
<th></th>
<th>(1) week</th>
<th>(2) week</th>
<th>(3) week</th>
<th>(4) week</th>
<th>(5) week</th>
<th>(6) week</th>
</tr>
</thead>
<tbody>
<tr>
<td>real&lt;sub&gt;buyer&lt;/sub&gt;</td>
<td>0.0374***</td>
<td>0.0278***</td>
<td>0.111***</td>
<td>0.0910***</td>
<td>0.130***</td>
<td>0.107***</td>
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<td></td>
<td>(0.00277)</td>
<td>(0.00308)</td>
<td>(0.00373)</td>
<td>(0.00413)</td>
<td>(0.00450)</td>
<td>(0.00498)</td>
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<td>real&lt;sub&gt;buyer&lt;/sub&gt; * top&lt;sub&gt;seller&lt;/sub&gt;</td>
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<td>0.0702***</td>
<td>0.107***</td>
<td>0.107***</td>
<td>0.107***</td>
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<td>348,903</td>
<td>348,012</td>
<td>348,903</td>
<td>348,012</td>
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<td>R-squared</td>
<td>0.001</td>
<td>0.016</td>
<td>0.004</td>
<td>0.027</td>
<td>0.006</td>
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<td>Within R-squared</td>
<td>.0003</td>
<td>0.014</td>
<td>0.0003</td>
<td>0.014</td>
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<th>(9) week</th>
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<th>(12) week</th>
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<td>0.0299***</td>
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<td>real&lt;sub&gt;seller&lt;/sub&gt; * top&lt;sub&gt;buyer&lt;/sub&gt;</td>
<td>-0.00731**</td>
<td>-0.0107***</td>
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<td>R-squared</td>
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<td>0.0012</td>
<td>0.0003</td>
<td>0.0012</td>
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<td>0.0012</td>
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FE: no trader qrt ent

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Concluding remarks

We construct a theory of financial intermediation

- Builds on information asymmetries
- Central investors are screening experts
- Generates the observed market structure

We derive and test two testable implications particular to our model

- An investor trade probability increases when information about his trade motives is publicly released
- Effect is muted when trading with central investors (i.e. experts, through the lens of our model)
- These predictions hold in the CDS data

These predictions follow from our theory of financial intermediation due to private information, but do not follow from any of the theories of financial intermediation relying on complete information
Private information and related literature

Economics has a long tradition of studying the role of information asymmetries in determining financial markets outcomes

- **Centralized markets**
  - Grossman and Stiglitz (1976), Radner (1979), Grossman and Stiglitz (1980), Milgrom and Stokey (1982), etc

- **Decentralized markets**

Study

- Prices
- Learning
- Efficiency
- What we do?
Private information and related literature

Economics has a long tradition of studying the role of information asymmetries in determining financial markets outcomes

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Study

▶ Prices
▶ Learning
▶ Efficiency
▶ What we do? Intermediation
Private information and related literature

Main focus has been **expertise** in the sense of
what people know about assets $\implies$ common value
  - profits of a firm, changes in interest rates, etc

We shift the focus to **expertise** in the sense of
what people know about other people $\implies$ private value
Myerson (1981), Myerson and Satterthwaite (1983), etc
  - hedge motives, liquidity needs, etc

Information asymmetry has **built-in** a theory of intermediation
<table>
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<tr>
<th></th>
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<td>real_{buyer} * top_{seller}</td>
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<td>69,636</td>
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<td>R-squared</td>
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<td>0.029</td>
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</tr>
<tr>
<td>Within R-squared</td>
<td>0.0004</td>
<td></td>
<td>0.0033</td>
<td></td>
<td>0.0043</td>
<td></td>
</tr>
</tbody>
</table>

|                 | (7)                  | (8)                  | (9)                  | (10)                 | (11)                 | (12)                 |
| 1 week          |                      |                      |                      |                      |                      |                      |
| real_{seller}  | 0.0540***            | 0.0504***            | 0.116***             | 0.0823***            | 0.144***             | 0.00822              |
|                | (0.00590)            | (0.00757)            | (0.00781)            | (0.0100)             | (0.00966)            | (0.0124)             |
| real_{seller} * top_{buyer} | -0.0482***          | -0.0162              | -0.0762***           | -0.0411**            | -0.0610***           | -0.00914             |
|                | (0.00781)            | (0.0158)             | (0.0103)             | (0.0209)             | (0.0128)             | (0.0258)             |
| Constant       | 0.0373***            | 0.0669***            |                      | 0.108***             |                      |                      |
|                | (0.000739)           | (0.000979)           |                      | (0.00121)            |                      |                      |
| Observations   | 69,661               | 69,316               | 69,661               | 69,316               | 69,661               | 69,316               |
| R-squared      | 0.001                | 0.032                | 0.004                | 0.035                | 0.004                | 0.041                |
| Within R-squared | 0.0007              | 0.0004               | 0.0010               | 0.0001               |                      |                      |

**FE** no trader qrt ent no trader qrt ent

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
## Results - All assets

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 week</td>
<td>1 week</td>
<td>2 weeks</td>
<td>2 weeks</td>
<td>3 weeks</td>
<td>3 weeks</td>
</tr>
<tr>
<td>$real_{buyer}$</td>
<td>0.0481***</td>
<td>0.0484***</td>
<td>0.109***</td>
<td>0.0999***</td>
<td>0.130***</td>
<td>0.111***</td>
</tr>
<tr>
<td></td>
<td>(0.00168)</td>
<td>(0.00197)</td>
<td>(0.00225)</td>
<td>(0.00264)</td>
<td>(0.00270)</td>
<td>(0.00316)</td>
</tr>
<tr>
<td>$real_{buyer} * top_{seller}$</td>
<td>-0.0253***</td>
<td>-0.0204***</td>
<td>-0.0480***</td>
<td>-0.0414***</td>
<td>-0.0256***</td>
<td>-0.0240***</td>
</tr>
<tr>
<td></td>
<td>(0.00200)</td>
<td>(0.00211)</td>
<td>(0.00268)</td>
<td>(0.00281)</td>
<td>(0.00321)</td>
<td>(0.00337)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0370***</td>
<td>0.0680***</td>
<td>0.102***</td>
<td>0.0370***</td>
<td>0.0680***</td>
<td>0.102***</td>
</tr>
<tr>
<td></td>
<td>(0.00212)</td>
<td>(0.000284)</td>
<td>(0.000341)</td>
<td>(0.000284)</td>
<td>(0.000341)</td>
<td>(0.000341)</td>
</tr>
<tr>
<td>Observations</td>
<td>865,094</td>
<td>864,092</td>
<td>865,094</td>
<td>864,092</td>
<td>865,094</td>
<td>864,092</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.001</td>
<td>0.009</td>
<td>0.004</td>
<td>0.015</td>
<td>0.006</td>
<td>0.019</td>
</tr>
<tr>
<td>Within R-squared</td>
<td>0.0007</td>
<td>0.0018</td>
<td>0.0018</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
<th>(11)</th>
<th>(12)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1 week</td>
<td>1 week</td>
<td>2 weeks</td>
<td>2 weeks</td>
<td>3 weeks</td>
<td>3 weeks</td>
</tr>
<tr>
<td>$real_{seller}$</td>
<td>0.0365***</td>
<td>0.0436***</td>
<td>0.0981***</td>
<td>0.0985***</td>
<td>0.123***</td>
<td>0.128***</td>
</tr>
<tr>
<td></td>
<td>(0.00170)</td>
<td>(0.00204)</td>
<td>(0.00227)</td>
<td>(0.00272)</td>
<td>(0.00272)</td>
<td>(0.00326)</td>
</tr>
<tr>
<td>$real_{seller} * top_{buyer}$</td>
<td>-0.0174***</td>
<td>-0.0127***</td>
<td>-0.0448***</td>
<td>-0.0378***</td>
<td>-0.0298***</td>
<td>-0.0214***</td>
</tr>
<tr>
<td></td>
<td>(0.00203)</td>
<td>(0.00215)</td>
<td>(0.00270)</td>
<td>(0.00286)</td>
<td>(0.00324)</td>
<td>(0.00342)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0392***</td>
<td>0.0711***</td>
<td>0.107***</td>
<td>0.0392***</td>
<td>0.0711***</td>
<td>0.107***</td>
</tr>
<tr>
<td></td>
<td>(0.000217)</td>
<td>(0.000289)</td>
<td>(0.000347)</td>
<td>(0.000347)</td>
<td>(0.000347)</td>
<td>(0.000347)</td>
</tr>
<tr>
<td>Observations</td>
<td>865,094</td>
<td>864,265</td>
<td>865,094</td>
<td>864,265</td>
<td>865,094</td>
<td>864,265</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.001</td>
<td>0.009</td>
<td>0.003</td>
<td>0.013</td>
<td>0.005</td>
<td>0.017</td>
</tr>
<tr>
<td>Within R-squared</td>
<td>no</td>
<td>0.0006</td>
<td>0.0016</td>
<td>0.0016</td>
<td>0.0023</td>
<td></td>
</tr>
</tbody>
</table>

**FE** no trader qrt ent no trader qrt ent no trader qrt ent

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
### Results - All assets; reporters only

<table>
<thead>
<tr>
<th></th>
<th>(1) 1 week</th>
<th>(2) 1 week</th>
<th>(3) 2 weeks</th>
<th>(4) 2 weeks</th>
<th>(5) 3 weeks</th>
<th>(6) 3 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>real_{buyer}</strong></td>
<td>0.0488***</td>
<td>0.0499***</td>
<td>0.115***</td>
<td>0.0989***</td>
<td>0.139***</td>
<td>0.110***</td>
</tr>
<tr>
<td></td>
<td>(0.00186)</td>
<td>(0.00254)</td>
<td>(0.00247)</td>
<td>(0.00338)</td>
<td>(0.00294)</td>
<td>(0.00401)</td>
</tr>
<tr>
<td><strong>real_{buyer} * top_{seller}</strong></td>
<td>-0.0253***</td>
<td>-0.0199***</td>
<td>-0.0480***</td>
<td>-0.0385***</td>
<td>-0.0256***</td>
<td>-0.0214***</td>
</tr>
<tr>
<td></td>
<td>(0.00212)</td>
<td>(0.00226)</td>
<td>(0.00283)</td>
<td>(0.00301)</td>
<td>(0.00336)</td>
<td>(0.00358)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>0.0364***</td>
<td>0.0625***</td>
<td>0.0933***</td>
<td>0.0364***</td>
<td>0.0625***</td>
<td>0.0933***</td>
</tr>
<tr>
<td></td>
<td>(0.000552)</td>
<td>(0.000736)</td>
<td>(0.000875)</td>
<td>(0.000552)</td>
<td>(0.000736)</td>
<td>(0.000875)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>180,725</td>
<td>180,696</td>
<td>180,725</td>
<td>180,696</td>
<td>180,725</td>
<td>180,696</td>
</tr>
<tr>
<td><strong>R-squared</strong></td>
<td>0.005</td>
<td>0.009</td>
<td>0.018</td>
<td>0.024</td>
<td>0.025</td>
<td>0.034</td>
</tr>
<tr>
<td><strong>Within R-squared</strong></td>
<td>0.0021</td>
<td>0.0047</td>
<td>0.0021</td>
<td>0.0047</td>
<td>0.0021</td>
<td>0.0047</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th></th>
<th>(7) 1 week</th>
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<th>(9) 2 weeks</th>
<th>(10) 2 weeks</th>
<th>(11) 3 weeks</th>
<th>(12) 3 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>real_{seller}</strong></td>
<td>0.0384***</td>
<td>0.0589***</td>
<td>0.0989***</td>
<td>0.108***</td>
<td>0.119***</td>
<td>0.103***</td>
</tr>
<tr>
<td></td>
<td>(0.00311)</td>
<td>(0.00461)</td>
<td>(0.00408)</td>
<td>(0.00606)</td>
<td>(0.00486)</td>
<td>(0.00721)</td>
</tr>
<tr>
<td><strong>real_{seller} * top_{buyer}</strong></td>
<td>-0.0316***</td>
<td>-0.00482</td>
<td>-0.0651***</td>
<td>-0.0162**</td>
<td>-0.0556***</td>
<td>-0.00217</td>
</tr>
<tr>
<td></td>
<td>(0.00458)</td>
<td>(0.00587)</td>
<td>(0.00602)</td>
<td>(0.00771)</td>
<td>(0.00716)</td>
<td>(0.00918)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>0.0415***</td>
<td>0.0734***</td>
<td>0.109***</td>
<td>0.0415***</td>
<td>0.0734***</td>
<td>0.109***</td>
</tr>
<tr>
<td></td>
<td>(0.000485)</td>
<td>(0.000638)</td>
<td>(0.000759)</td>
<td>(0.000485)</td>
<td>(0.000638)</td>
<td>(0.000759)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>180,725</td>
<td>180,251</td>
<td>180,725</td>
<td>180,251</td>
<td>180,725</td>
<td>180,251</td>
</tr>
<tr>
<td><strong>R-squared</strong></td>
<td>0.001</td>
<td>0.020</td>
<td>0.003</td>
<td>0.023</td>
<td>0.004</td>
<td>0.024</td>
</tr>
<tr>
<td><strong>Within R-squared</strong></td>
<td>0.0009</td>
<td>0.0018</td>
<td>0.0009</td>
<td>0.0018</td>
<td>0.0009</td>
<td>0.0012</td>
</tr>
</tbody>
</table>

**FE** | no | trader qrt ent | no | trader qrt ent | no | trader qrt ent |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Extension

Same economy as before and in steady state

A measure zero of investors receive a shock

These investors have to reveal their types in period $T > 0$

Call these the $13F$ investors

All the equilibrium conditions extend in a trivial way

- before time $T$: trades use the appropriate mechanism
- after time $T$: there is complete information of $13F$ investors
Results

Let $\bar{q}_{ot}^{13F}(\theta)$ be the probability that a $13F$ owner of type $\theta$ sell an asset in period $t$ on a meeting with a non-owner investor

For $t < T$

$$
\bar{q}_{ot}^{13F}(\theta) = \xi_o \left\{ \alpha \left[ 1 - M_n(\Delta_{ot}^{13F}) \right] + (1 - \alpha) \left[ 1 - M_n(ask(\Delta_{ot}^{13F})) \right] \right\}
$$

$$+
\xi_n \mathbb{E} \left\{ \alpha n \mathbbm{1} \{ \Delta_n \geq \Delta_{ot}^{13F} \} + (1 - \alpha_n) \mathbbm{1} \{ bid_t^{13F}(\Delta_n) \geq \Delta_{ot}^{13F} \} \right\}
$$

For $t \geq T$

$$
\bar{q}_{ot}^{13F}(\theta) = \xi_o \left\{ \alpha \left[ 1 - M_n(\Delta_{ot}^{13F}) \right] + (1 - \alpha) \left[ 1 - M_n(ask(\Delta_{ot}^{13F})) \right] \right\}
$$

$$+
\xi_n \mathbb{E} \left\{ \mathbbm{1} \{ \Delta_n \geq \Delta_{ot}^{13F} \} \right\}
$$
Results

\[ \bar{q}_{ot}^{13F}(\theta) \text{ is discontinuous at } T \text{ and the jump is} \]

\[ \lim_{\epsilon \downarrow 0} \bar{q}_{oT+\epsilon}^{13F}(\theta) - \bar{q}_{oT-\epsilon}^{13F}(\theta) = \xi_n \mathbb{I} \left\{ (1 - \alpha_n) 1_{\{\Delta_n \geq \Delta_{oT}^{13F} \geq \text{bid}_{13F}^T(\Delta_n)\}} \right\} > 0 \]

The above equation implies that:

1. \(13F\) owners are more likely to sell after the report
2. but not with high \(\alpha_n\) non-owners
Results

\( \bar{q}_{ot}^{13F}(\theta) \) is discontinuous at \( T \) and the jump is

\[
\lim_{\epsilon \downarrow 0} \bar{q}_{oT+\epsilon}(\theta) - \bar{q}_{oT-\epsilon}(\theta) = \xi_n \mathbb{E} \left\{ (1 - \alpha_n) 1_{\left\{ \Delta_n \geq \Delta_{oT} \geq bid_{13F}(\Delta_n) \right\}} \right\} > 0
\]

The above equation implies that:

1. 13F owners are more likely to sell after the report
2. but not with high \( \alpha_n \) non-owners
Results

$\bar{q}_{ot}^{13F}(\theta)$ is discontinuous at $T$ and the jump is

$$\lim_{\epsilon \downarrow 0} \bar{q}_{oT+\epsilon}^{13F}(\theta) - \bar{q}_{oT-\epsilon}^{13F}(\theta) = \xi_n \mathbb{E}\left\{ (1 - \alpha_n) \mathbb{1}_{\{\Delta_n \geq \Delta_{oT}^{13F} \geq bid_{T}^{13F}(\Delta_n)\}} \right\} > 0$$

The above equation implies that:

1. 13F owners are more likely to sell after the report
2. but not with high $\alpha_n$ non-owners
Results

$q_{ot}^{13F}(\theta)$ is discontinuous at $T$ and the jump is

$$
\lim_{\epsilon \downarrow 0} q_{ot}^{13F}(\theta) - q_{ot}^{13F}(\theta) = \xi_n \mathbb{E}\left\{ (1 - \alpha_n) \mathbb{1}_{\{\Delta_n \geq \Delta_{oT}^{13F} \geq bid_{T}^{13F}(\Delta_n)\}} \right\} > 0
$$

The above equation implies that:

1. $13F$ owners are more likely to sell after the report
2. but not with high $\alpha_n$ non-owners

![Diagram of $q_{ot}^{13F}(\theta)$ with discontinuity and jump at $T$.]
Results

$\bar{q}_{nt}^{13F}(\theta)$ is discontinuous at $T$ and the jump is

$$\lim_{\epsilon \downarrow 0} \bar{q}_{nt}^{13F}(\theta) - \bar{q}_{nt}^{13F}(\theta) = \xi_s \mathbb{E}\left\{ (1 - \alpha_o) \mathbb{1}_{\{\text{ask}_{T}^{13F}(\Delta_o) \geq \Delta_{nt}^{13F} \geq \Delta_o\}} \right\} > 0$$

The above equation implies that:

1. $13F$ non-owners are more likely to buy after the report
2. but not with high $\alpha_n$ non-owners


