Intermediaries as Information Aggregators: An Application to U.S. Treasury Auctions

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Motivation

- Why do investors operate through intermediaries?
- In standard theories, intermediaries ameliorate financial frictions:
  - lower information asymmetries (monitoring and screening borrowers)
  - offer diversification/leverage/maturity transformation
- Rationales do not apply to Treasury auctions
  - Intermediaries observe client order flows and advise them
  - This paper $\Rightarrow$ intermediaries are **information aggregators**
- Study effect of intermediation on auction revenues

Outline

- Start with a simple framework: A menu auction of financial assets, with heterogeneous information about asset value
- New twist: Intermediaries (primary dealers) observe order flow, share average info with clients, and bid on their own account
- Calibrate model to Treasury auction results

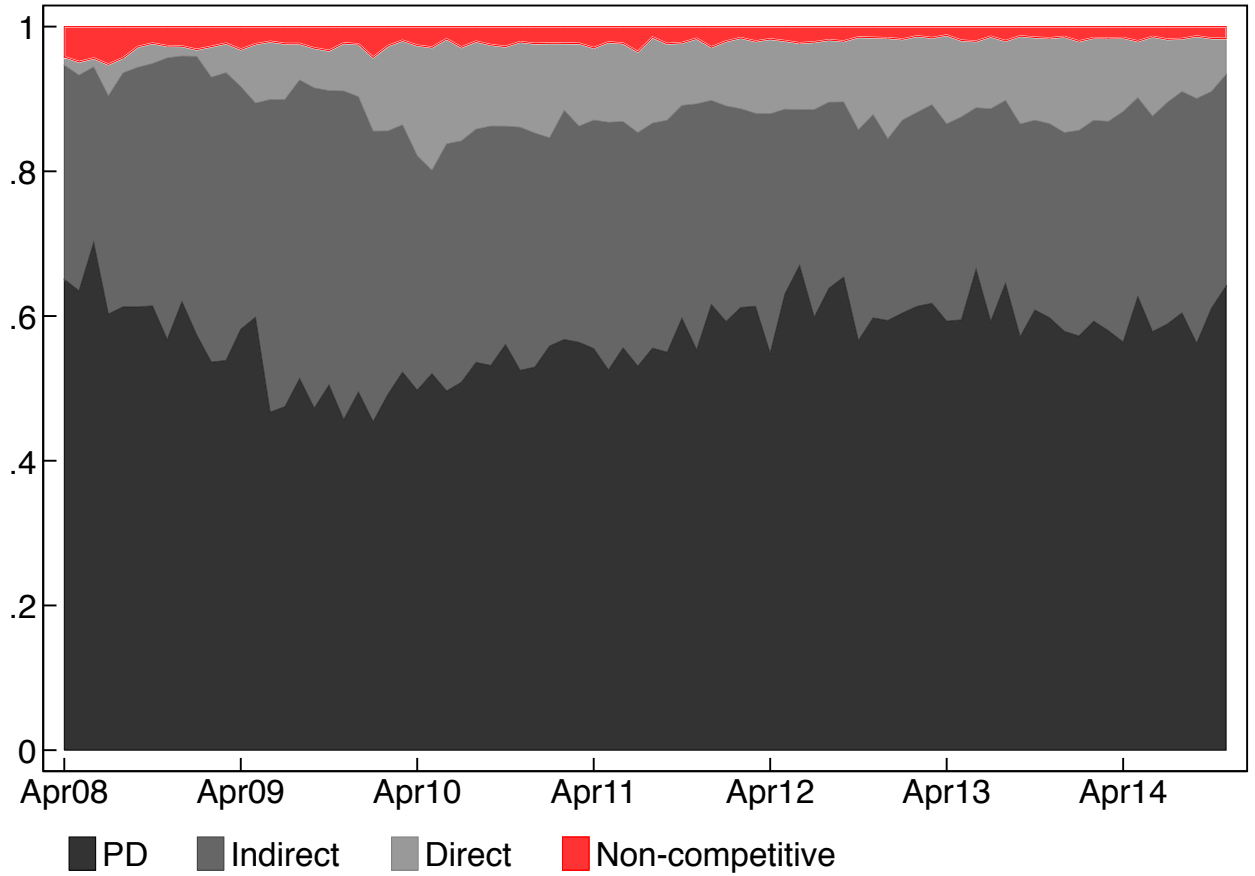
Effect of intermediation

- Gate-keeping intermediaries (e.g. a "full commitment" IPO):
  - Reduce expected auction revenue
  - Reduce revenue variance
- Information intermediaries have the opposite effect:
  - Increase expected auction revenue
  - Increase revenue variance

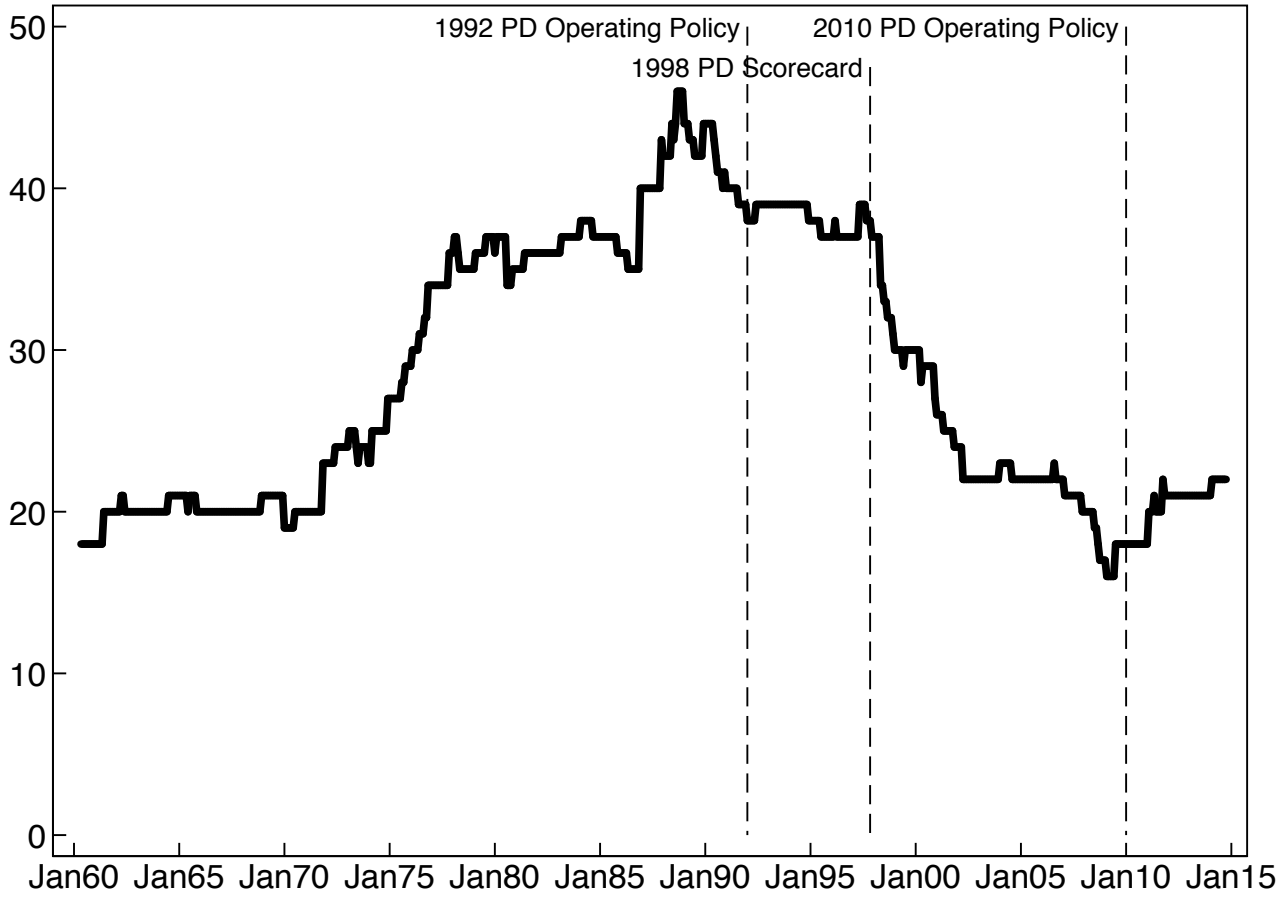
Institutional detail

- Competitive (price-contingent) and non-competitive bids (retail and FIMA)
- Clearing rate set by first accepting non-comp bids, then comp bids in ascending rate order up to offered amount
- PDs account for large shares of allotted amounts
  - Explicit/implicit minimum bidding requirements
- Other institutional investors can bid directly or indirectly
  - Most investors' bids are placed indirectly

Allotted shares by bidders



Number of primary dealers



Basic model

- N investors are evenly assigned to 1 of D dealers
- All have exponential utility $-\exp(\rho_j W_j)$
  ρ_j is ρ_D for dealers ρ for investors and

$$W_j = W_0 - q_j p + q_j f$$

- Future value of security $f \sim N(\mu, \tau_f^{-1})$

Model structure

Type	Information	Decisions	Strategic	Demand
Market orders			Non-competitive	$x \sim N\left(0, \tau_x^{-1}\right)$
Investors (N)	$s_i, \bar{s}, p$	Bidding	Price-takers	$q_i\left(p \mid s_i, \bar{s}\right)$
Dealers (D)	$\bar{s}, p$	Bidding	Strategic	$q_d\left(p \mid \bar{s}\right)$
Large invest. (1)	$s_L, \bar{s}, p$	Bidding; intermediation	Strategic	$q_L\left(p \mid s_L, \bar{s}\right)$

- Each investor has a signal

$$s_i = \underbrace{f}_{\text{“fundamental”}} + \underbrace{\varepsilon_i}_{\text{“noise”}}; \quad \varepsilon_i \sim N(0, \tau_\varepsilon^{-1})$$

- Dealers disseminate average $\bar{s}_j$ to their clients

$$\bar{s}_j = f + \bar{\varepsilon}_j; \quad \bar{\varepsilon}_j \sim N\left(0, D/N\tau_\varepsilon^{-1}\right)$$

$\Rightarrow$ Dealers aggregate information (reduce uncertainty)

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- Large, strategic investor chooses between bidding directly or through a dealer

  Trade-off: gain access to $\bar{s}$ but disclose s_L to dealer

Model intuitions

- Optimal bids $q(p)$ condition on information in realized price p
- Equilibrium price:

$$p = A + B \underbrace{(f + \bar{\varepsilon})}_{\bar{s}} + Cx \tag{1}$$

- Investors use p to learn about f but
  - Not perfectly revealing of $\bar{s}$ because of market orders x
  - More dealers $\Rightarrow$ less precise $\bar{s}$ $\Rightarrow$ price less informative about f

Basic model solution

- Investors bid

$$q_i(p) = \frac{\mathbb{E}[f|s_i, \bar{s}, p] - p}{\rho \mathbb{V}[f|s_i, \bar{s}, p]}$$

Basic model solution

- Dealers bid

$$q_d(p) = \frac{\mathbb{E}[f|\bar{s}, p] - p}{\rho_D \mathbb{V}[f|\bar{s}, p] + dp/dq_d}$$

- Having a dealer lowers payoff uncertainty:

$$\mathbb{V}[f|s_i, \bar{s}, p] < \mathbb{V}[f|s_i, p]$$

- Increasing the number of dealers
  - Makes dealers less strategic: lowers dp/dq_d
    - $\Rightarrow$ Dealers less sensitive to information.
  - Inhibits information aggregation: precision of $\bar{s}_j$ falls, $\mathbb{V}[f|s_i, \bar{s}, p]$ rises

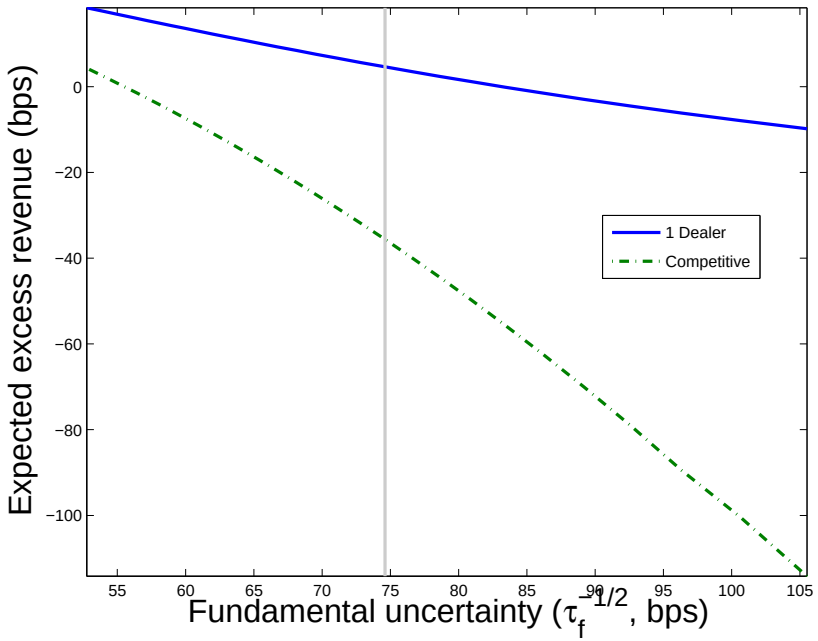
Calibration

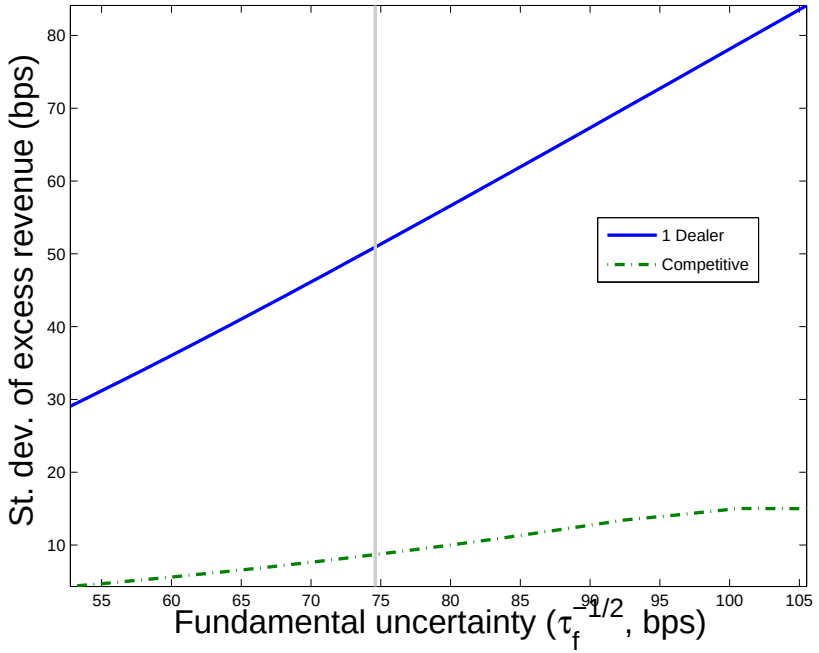
- Assume investors hedge interest rate risk by shorting a replicating portfolio of off-the-runs (from a 1pm estimated yield curve)
- Net revenue measure is the price of the on-the-run minus off-the-run portfolio
- Match target parameters:
  - Coefficient of the estimated equilibrium pricing equation:

$$p = -17_{[4.7]} + .97_{[.03]}f + 124_{[34]}x$$

  - Other parameters: mean allotted shares by direct, indirect, dealer and non-competes (including "imputed" FIMA), mean and standard deviation of auction/issue price

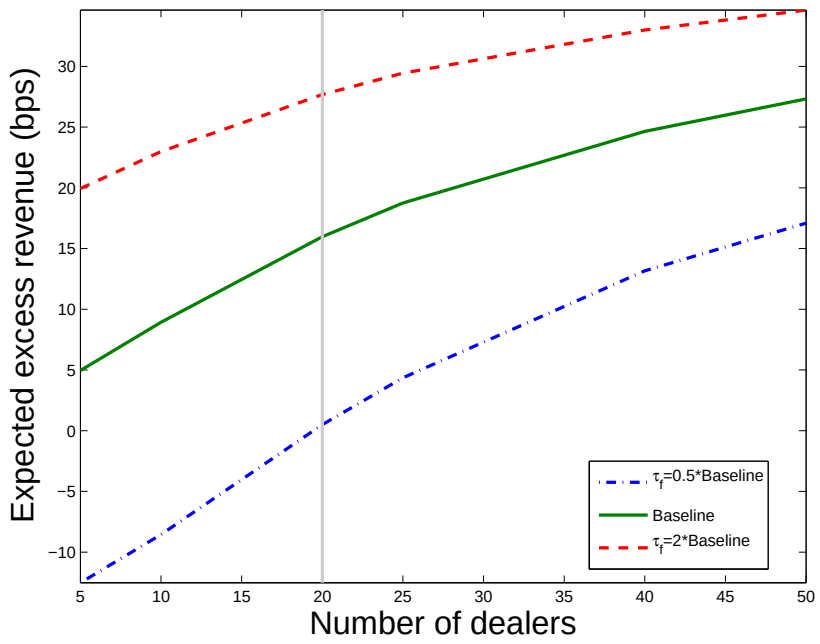
Effect of one vs. no dealer

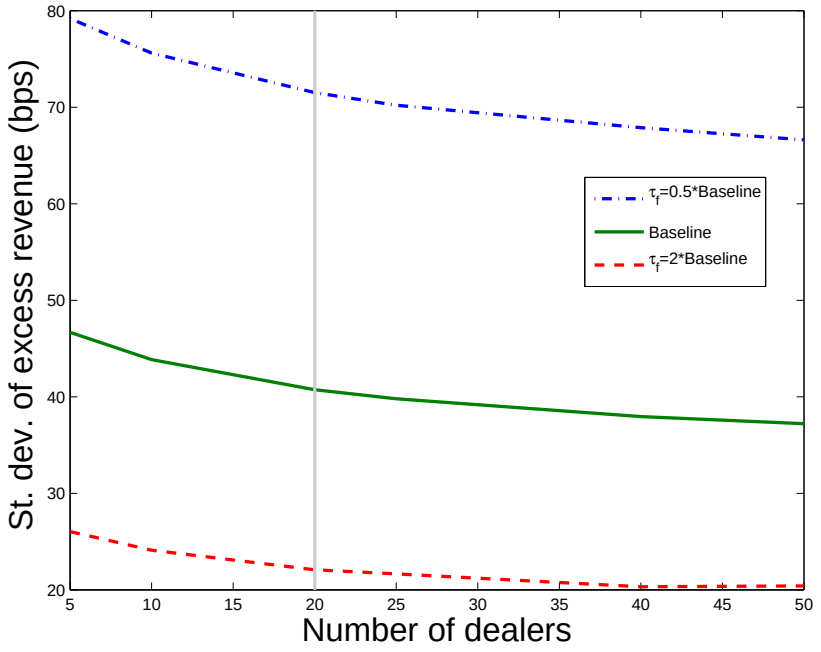




- Less uncertainty with information aggregation
  - $\Rightarrow$ Higher revenues
  - $\Rightarrow$ More sensitivity to information $\Rightarrow$ more volatility
- Effect of information intermediaries is opposite to IPO underwriters

Changing the number of dealers





- Adding dealers: increases competition, total demand but disaggregates information
  - ⇒ Higher revenues because of first two effects
  - ⇒ More uncertainty lowers information sensitivity ⇒ lower volatility
- Work-in-progress on separating effects (only varying information aggregation ⇒ both revenue/volatility decrease)

Intermediation choice

- Large investors bid indirectly for intermediate number of dealers
  - Few dealers: dealer demand very sensitive to information, so optimal for large investor not to disclose signal
  - Many dealers: dealers have less precise information

Minimum bidding requirements

- Primary dealers have minimum bidding requirements:
  - Post 2010 Operating Policies: pro-rata share of offered amount with "reasonable" bids to market
  - A dynamic constraint: high bids in some auctions relax constraint in future auctions

  $\Rightarrow$ Introduce low bidding penalty χ

- Without penalty:

$$q_d(p) = \frac{\mathbb{E}[f|\bar{s}, p] - p}{\rho_D \mathbb{V}[f|\bar{s}, p] + dp/dq_d}$$

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- With penalty

$$q_d(p) = \frac{\mathbb{E}[f|\bar{s},p] - (1-\chi)\,p}{\rho_D \mathbb{V}[f|\bar{s},p] + (1-\chi)\,dp/dq_d}$$

- Higher χ lowers strategic component of demand but also price elasticity

$\Rightarrow$ Higher auction revenue but higher volatility

Conclusions

- Present a theoretical framework to capture key institutional features of Treasury auctions
- Intermediaries aggregate information:
  - $\Rightarrow$ Intermediation results in higher revenues but also higher variance
  - $\Rightarrow$ Increasing the number of intermediaries raises competition but disaggregates information