Asymmetric Information and Inventory Concerns in Over-the-Counter Markets

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Context

Over-the-counter (OTC) markets

- Decentralized trading
- Trade details negotiated in bilateral meetings
- Trading risks: timing, quantity, price

Research question

How does information about the trading needs of your counterparties affect an OTC market?

- Costs of trading
- Market participation
- Allocative efficiency and welfare

Relevance

Regulators introduce post-trade transparency

- TRACE, Dodd-Frank Act, MiFID II

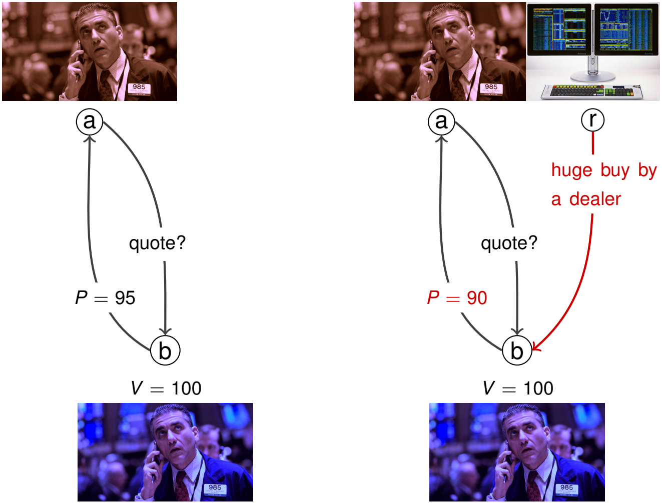
Benefits: Better valuation of asset

- Bessembinder, Maxwell, and Venkataraman (2006) Goldstein, Hotchkiss, and Sirri (2007) Edwards, Harris, and Piwowar (2007)

Costs: Reduced liquidity provision

- Lobbying material by SIFMA, surveys
- Duffie (2012)
- Asquith, Covert, and Pathak (2013)

Reduced liquidity provision?



Main findings

Transparency affects

- allocative efficiency ($\nearrow$)
- inventory costs ($\nearrow$)
- dispersion of transaction prices ($\nearrow$)

- market participation (ambiguous and fragile)
- welfare (ambiguous and fragile)

- OTC markets
  Duffie, Gârleanu, and Pedersen (2005, 2007)
  Lagos and Rocheteau (2007, 2009)
- OTC markets and asymmetric information
  Blouin and Serrano (2001)
  Duffie and Manso (2007), Duffie, Malamud, and Manso (2009, 2010, 2014)
- Inventories
  Ho and Stoll (1980, 1981)
  Grossman and Miller (1988)
  Naik, Neuberger, and Viswanathan (1999)
- Formalism
  Diamond (1982)
  Huang, Malhamé, and Caines (2006), Lasry and Lions (2007)

Outline

Model

Market equilibrium

Market participation

Assets

1. Risk-free rate $r > 0$
2. Risky asset paying dividends at the rate

$$\mathrm{d}D_d = m_d \,\mathrm{d}t + \sigma_d \,\mathrm{d}B_t$$

Investors

- Continuum of CARA agents
- Endowment at the rate

$$\mathrm{d}\eta_t^a = Z_t^a \,\mathrm{d}D_t$$

- Time-varying exposures

$$\mathrm{d}Z_t^a = \sigma_a \,\mathrm{d}B_t^a$$

see Lo, Mamaysky, and Wang (2004)

Trading I/II

Risky asset traded on an illiquid over-the-counter (OTC) market

- Entry costs κ
- Expected search time is $\dfrac{1}{\Lambda \cdot (\# \text{ market participants})}$
- Bargaining over the transaction details

see Duffie, Gârleanu, and Pedersen (2005, 2007)

Trading II/II: Bargaining

(i) *a* asks *b* for a quote.
(ii) If *b* finds it optimal

- *b* receives a signal

$$s_a = Xz_a + (1 - X)\zeta,$$

  with $X \sim B(1, \tau)$, $\zeta \sim \mu$

- *b* quotes a price *p*
- *a* chooses a quantity *q*

τ is the transparency of the market

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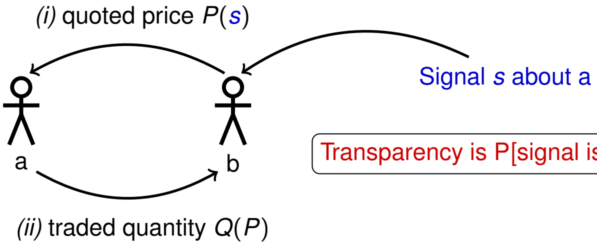

Transparency is P[signal is correct]

Preferences

- Investors maximize expected CARA utility from consumption

$$V_t \triangleq \sup_{(c_s)_{s\geq t}} \mathrm{E}_t \left[- \int_t^{\infty} e^{-\rho\,(s-t)}\, e^{-\gamma\, c_s}\, \mathrm{d}s \right]$$

- Budget constraint

$$\mathrm{d}w_t = r\; w_t\,\mathrm{d}t - c_t\,\mathrm{d}t + \mathrm{d}\eta_t^a + \theta_t\,\mathrm{d}D_t - P_d\,\mathrm{d}\theta_t$$

- Transversality condition

$$\lim_{T\to\infty} \mathrm{E}\left[e^{-r\gamma \tilde{w}_T} \right] = 0$$

Twisting the Preferences

- Risk-aversion focused on dividend risk
- BIAIS (1993), DUFFIE, GÂRLEANU, AND PEDERSEN (2007), VAYANOS AND WEILL (2008), GÂRLEANU (2009)
- $\gamma \to 0$, $\sigma_a = \frac{1}{\sqrt{\gamma}} \bar{\sigma}_a$
- SKIADAS (2008, 2013A, 2013B)
  HUGONNIER, PELGRIN, AND ST-AMOUR (2012)

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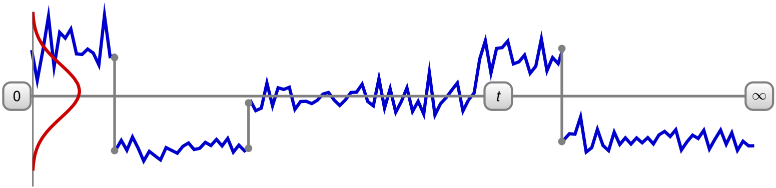
Timeline

Entry Decision

- initial exposures
- entry costs κ

- Trading
- Endowment shocks



Outline

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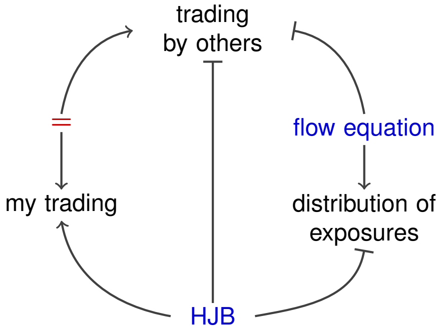
Take as given the investors in the market



HJB Equation

$$
\begin{aligned}
\rho V(w,z) = & \sup_{\tilde{c}} \left\{ U(\tilde{c}_s) - V_w(w,z)\tilde{c} \right\} \\
& + V_w(w,z)\left(rw + zm_d\right) \\
& + \frac{1}{2}\left(V_{ww}(w,z) z^2 \sigma^2 + V_{zz}(w,z)\sigma_z^2 \right) \\
& + \lambda \, \mathrm{E}^{\mathcal{L}(z_q,s_z)} \left[\mathbf{1}_{\{z_q \in A\}} \left(\begin{array}{c} \sup_{\tilde{q}} V\left(w - \tilde{q} P\left(z_q, s_z\right), z + \tilde{q}\right) \\ - V\left(w,z\right) \end{array} \right) \right] \\
& + \lambda \left[\begin{array}{c} \mathrm{E}^{\mathcal{L}(z_a,s_a)} \left[\sup_{\tilde{p}} \mathrm{E}^{\mathcal{L}(z_a,s_a)} \left[V\left(w + Q\left(z_a, \tilde{p}\right)\tilde{p}, z - Q\left(z_a, \tilde{p}\right)\right) \middle| \, s_a \right] \right] \\ - V\left(w,z\right) \end{array} \right]^{+}
\end{aligned}
$$

Type Dynamics

$$
\begin{aligned}
\mathrm{d}z_t = \sigma_z \,\mathrm{d}B_t & \\
& + \begin{pmatrix} X_{r,t} & Q(z_{t-}, P(z_q, z_{t-})) \\ +(1 - X_{r,t}) & Q(z_{t-}, P(z_q, \zeta)) \end{pmatrix} \mathrm{d}N_t^r \\
& + \begin{pmatrix} X_{q,t} & -Q(z_{t-}, P(z_{t-}, z_r)) \\ +(1 - X_{q,t}) & -Q(z_{t-}, P(z_{t-}, \zeta)) \end{pmatrix} \mathrm{d}N_t^q,
\end{aligned}
$$

Market Equilibrium

Proposition

There exists an equilibrium for which the value functions has the form

$$V(t, w, z) = -\exp\left(-r\gamma\left(v_0(t) + v_1 z + v_2 z^2\right)\right).$$

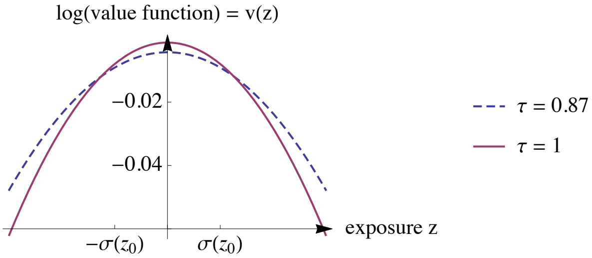
The distribution of types is characterized by

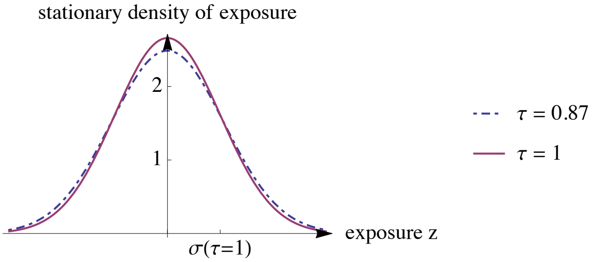
$$\hat{\mu}_t(w) + \left(1 + \frac{\frac{1}{2}\sigma_z^2}{2\lambda} w^2\right)\hat{\mu}(w) = \left(\begin{array}{ll} \frac{\tau}{2} & e^{i\frac{2}{3}(1-\tau)\mathcal{M}w}\,\hat{\pi}\left(\frac{1}{3}w\right)\hat{\pi}\left(\frac{2}{3}tw\right) \\ +\frac{1-\tau}{2} & e^{i\frac{2}{3}(1-\tau)\mathcal{M}w}\,\hat{\pi}\left(\frac{1}{3}w\right)\hat{\pi}\left(\frac{2}{3}tw\right) \\ \frac{\tau}{2} & e^{-i\frac{2}{3}(1-\tau)\mathcal{M}w}\,\hat{\pi}\left(\frac{2}{3}w\right)\hat{\pi}\left(\left(1-\frac{2}{3}t\right)w\right) \\ +\frac{1-\tau}{2} & e^{-i\frac{2}{3}(1-\tau)\mathcal{M}w}\,\hat{\pi}\left(\frac{2}{3}w\right)\hat{\pi}(w)\,\hat{\pi}\left(-\frac{2}{3}tw\right) \end{array}\right)$$

- Exponential convergence at rate $\frac{4}{9}\lambda(1+\tau^2)$
- Steady-state variance of exposures

$$\text{Var}\left[\tilde{z}_\infty\right] = \frac{\sigma_a^2}{\frac{4}{9}\lambda(1+\tau^2)}$$

Transparency Makes Inventories Costly





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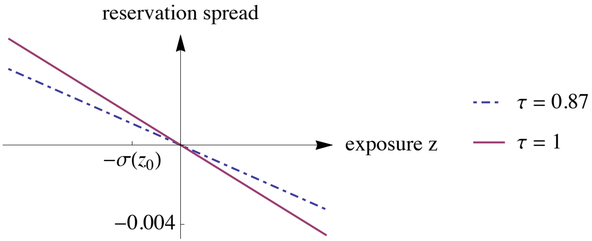


Corollary

When the transparency increases,

- Trades become smaller
- Cross-sectional dispersion of prices increases

Outline

Model

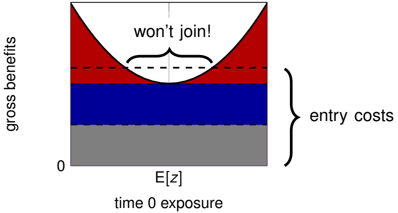
Market equilibrium

Market participation

Endogenous market participation

Net benefits to joining the OTC market

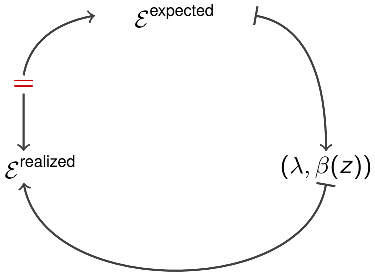
$$\beta(z) = a\,(z - \mathrm{E}[\tilde{z}_0])^2 + b\,\mathrm{Var}[\tilde{z}_0] + c\,\sigma_a^2 - \kappa$$



Liquidation	a is $\nearrow$ in λ	$\searrow$ in τ	
Intermediation	b is ($\searrow$ 0) in λ	$\nearrow$ in τ	entrants are substitutes
Anticipated risk-sharing	c is $\nearrow$ in λ	$\nearrow$ in τ	entrants are complements

Rational market participation

$\mathcal{E} = \{$investors who enter the OTC market$\}$



Solution Methods

1. Homogeneous initial exposure
2. Cases for which most investors enter the market
3. Numerics

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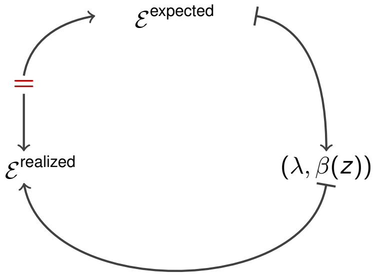

Solution Methods

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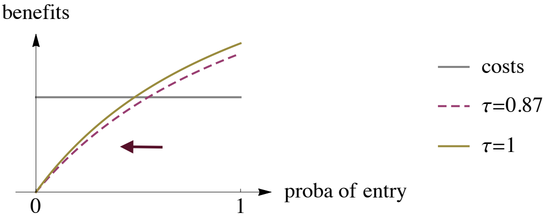
Market Participation: Method 1

Homogeneous initial exposure

Proposition

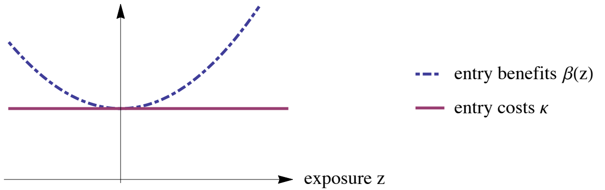
If $\text{Var}[\tilde{z}_0] = 0$

- No participation is an equilibrium
- Full participation is an equilibrium if $\beta(1) \geq \kappa$
- Partial participation is an equilibrium if $\beta(p) = \kappa$, $p \in (0, 1)$

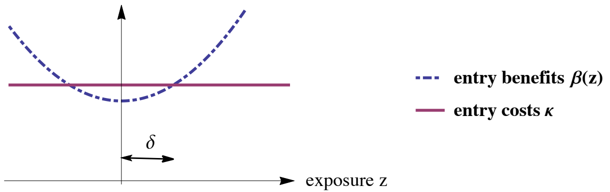


Participation weakly decreasing in transparency.
Ambiguous effect on welfare.

Solution available when there is full participation



Most investors enter the market



Market Participation: Method 2

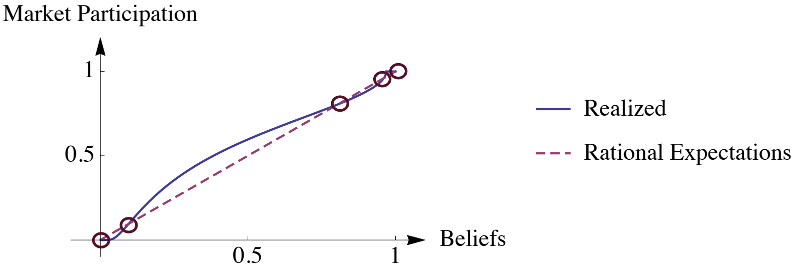
Proposition

Around the full participation case, when σ_a is large enough,

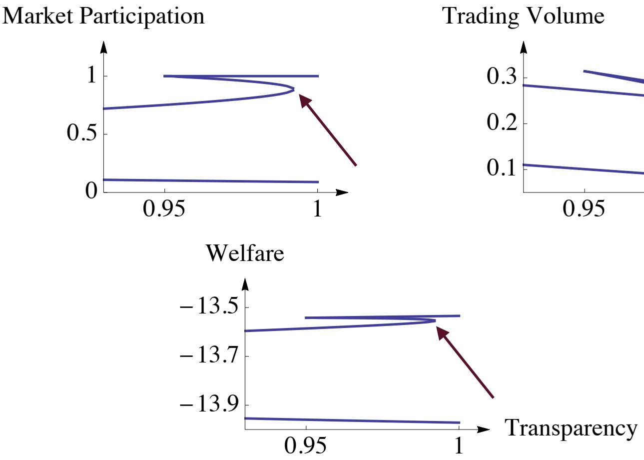
- two equilibrium paths for $\tau > \tau_{\text{full}}$
- market participation and welfare can $\searrow$ in τ
- discontinuous participation drop when $\tau < \tau_{\text{full}}$

- Ambiguous effect of transparency on
  market participation, trading delays, welfare
- Economy is fragile in the transparency τ

Numerical solution: Assume strong enough complementarity



Equilibrium is Fragile



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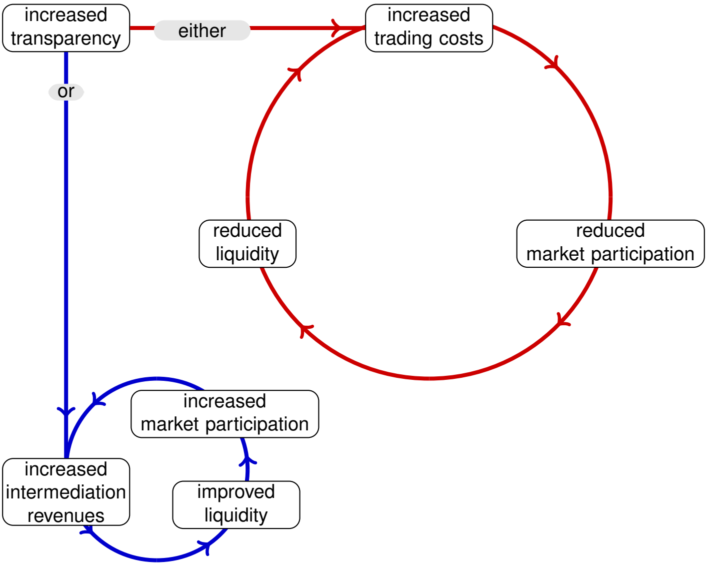
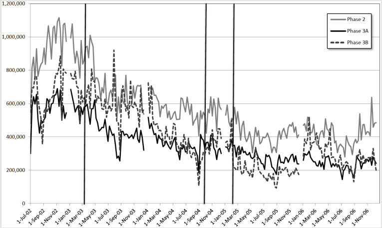


Equilibrium is Fragile

Empirical Evidence

ASQUITH, COVERT, AND PATHAK (2013) document bond trading volumes being reduced by up to 40% after post-trade transparency was introduced.



According to our model, this drop in trading volume was accompanied by a drop in welfare.

Policy Recommendation

Subsidizing liquidity provision eliminates the low participation equilibria.

Wrapping up

- Trading is more costly in a transparent market — but less trading in equilibrium
- Market participation ambiguous and fragile in transparency
- Welfare ambiguous and fragile in transparency

Thank you!

Notation	Parameter	Value
r	interest rate	0.01
σ	volatility of dividends	1
σ_a	volatility of exposure	0.52
Λ	scaling of matching function	1
γ	risk-aversion	1