

# Determinants of volume in dark pools

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# What are dark pools?

- Institutional orders (Pools of liquidity)
- No quotes to show trading interest (Dark)
- No brokers and No dealers (cheap)
- No guarantee of execution (must be another institution there at the same time)
- Execution prices are based on quotes from other market centers (no price discovery)
- Try to keep the sharks out (some hedge funds are excluded)
- Buy side only? In my sample yes.

# Three specific dark pools

- Liquidnet
  - Tied into buy-side trader order management systems.
  - Alerts you if another trader has an order in the other direction, then you negotiate
- POSIT
  - POSIT Match: periodic crosses at the midpoint of the quote
  - POSIT Alert: (similar to Liquidnet) launched in August 2005
- Pipeline – (mostly) hidden limit orders

# Why do we care?

- Institutional trades are important drivers of market prices
- Regulation of markets – requires understanding of how they evolve and compete
- Regulation of institutions – are they acting in the best interest of investors?

# Outline of my talk

- Overview of the sample
  - Nasdaq Stocks
  - Dark Pool and other market center volumes
  - Institutional trading demands (13F filings)
- A puzzle and hypotheses for determinants of trader decisions
- A model for thinking about routing and resulting volumes
- Panel data regression results
- SMM approach and results
- ECN results (panel data regressions)

# Nasdaq Stocks

(My volume data for dark pools only covers Nasdaq stocks)

To be in the sample for a particular month the following must be true for the 7-month window centered on the current month:

- No changes in ticker symbol, CUSIP, or CRSP share code
- No stock splits
- Non-zero volume each month
- Minimum month-end share price of \$2
- Minimum month-end market capitalization of \$100 million
- No other class of common stock issued by the firm

About 1600 stocks each month. Statistical tests look at top 500 by quarterly consolidated volume

# Nasdaq Volumes

(monthly by security for each market center)

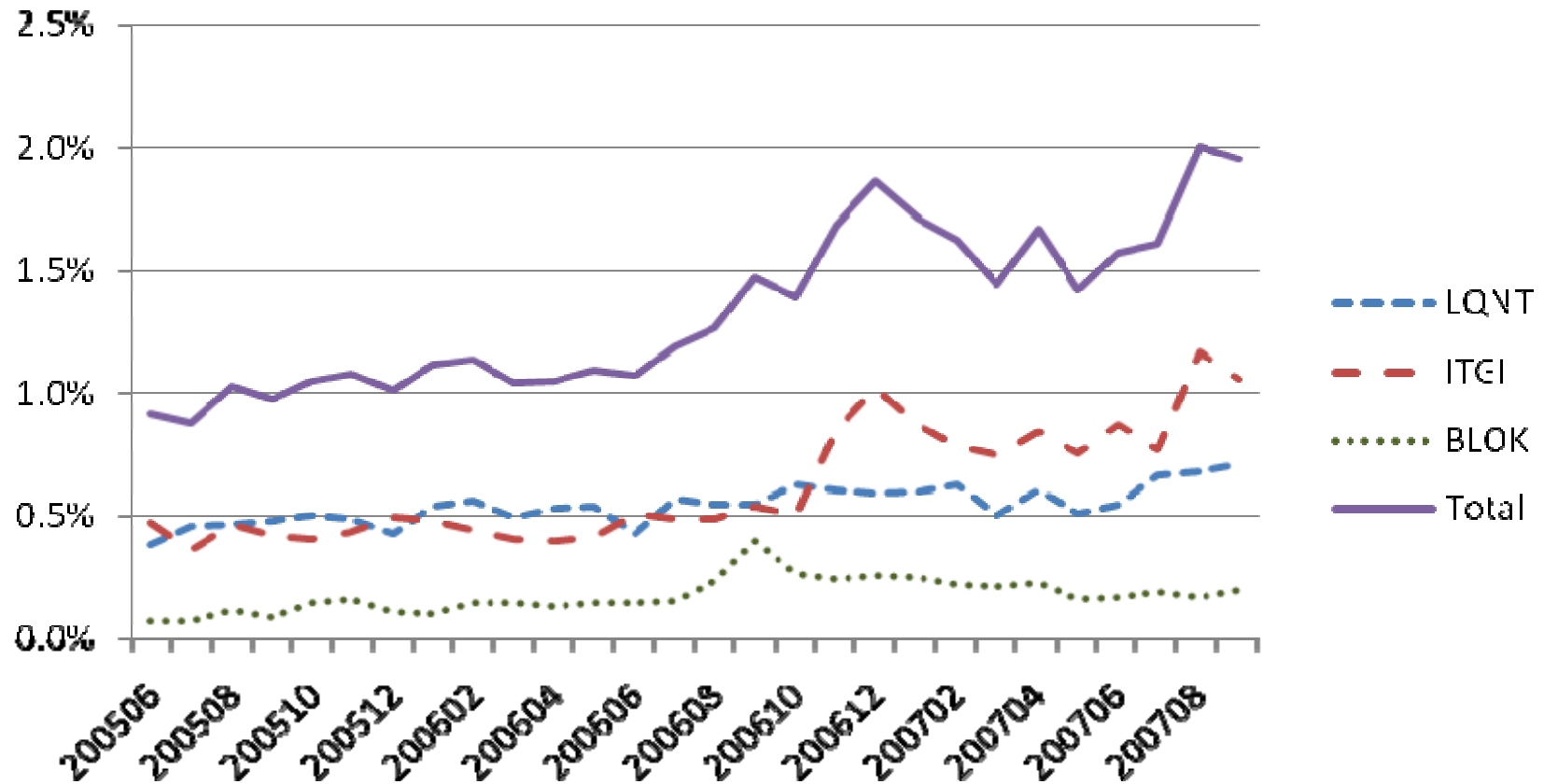
2005							2006							2007													
J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
FTP site: All market Centers (Single counted)																											
							Old web-based reports: Dark Pools (Single counted)																				
							New web-based reports: No Dark Pools (mostly sell-side brokers) (Double counted)																				

## Q2 2006 volumes (000's)

MPID	Name	Microsoft		Am. Comm. Lines		Full Sample	
		Volume	Pct	Volume	Pct	Volume	Pct
ITGI	ITG Inc.	3,753	0.1%	948	3.2%	480,162	0.5%
LQNT	Liquidnet	7,968	0.1	596	2.0	424,300	0.4
BLOK	Pipeline	3,700	0.1	72	0.2	136,600	0.1
	Dark Pools	15,421	0.3%	1,616	5.5%	1,041,062	1.0%
	4 Large ECNs	2,599,002	44.5	8,260	28.3	40,254,520	39.8
	10 Large sell-side	1,191,650	20.4	7,193	24.5	21,834,401	21.7
NITE	Knight	59,451	1.0	556	1.9	2,439,568	2.4
	2 internalizers	106,440	1.8	2	0.0	2,531,780	2.5
	Other Nasdaq	649,347	11.1	4,344	14.9	10,586,148	10.5
	Other Exch.	1,210,882	20.8	7,274	24.9	22,394,952	22.2
	Cons. Volume	5,832,192	100.0%	29,246	100.0%	101,082,433	100.0%



# Dark Pool Shares



# Institutional Trading

- 13F filings:
  - required quarterly from all institutions (>\$100 million) that hold US stocks (>10,000 shares or \$200,000).
  - Fidelity files one report for all funds
  - Includes “investment advisors” (like mutual funds but have separate accounts for each investor)
- Use change in quarterly holdings as a proxy for that institution’s trade
  - Trading decisions are at the fund level and the same fund may buy and sell over the quarter, so net change in position understates volume
  - Some 13F institutions (some hedge funds) not allowed in the dark pools
  - Orders in opposite directions must arrive at the same time to have a dark pool trade (simulation approach to handle this)

# Mutual Funds and 13F Filers

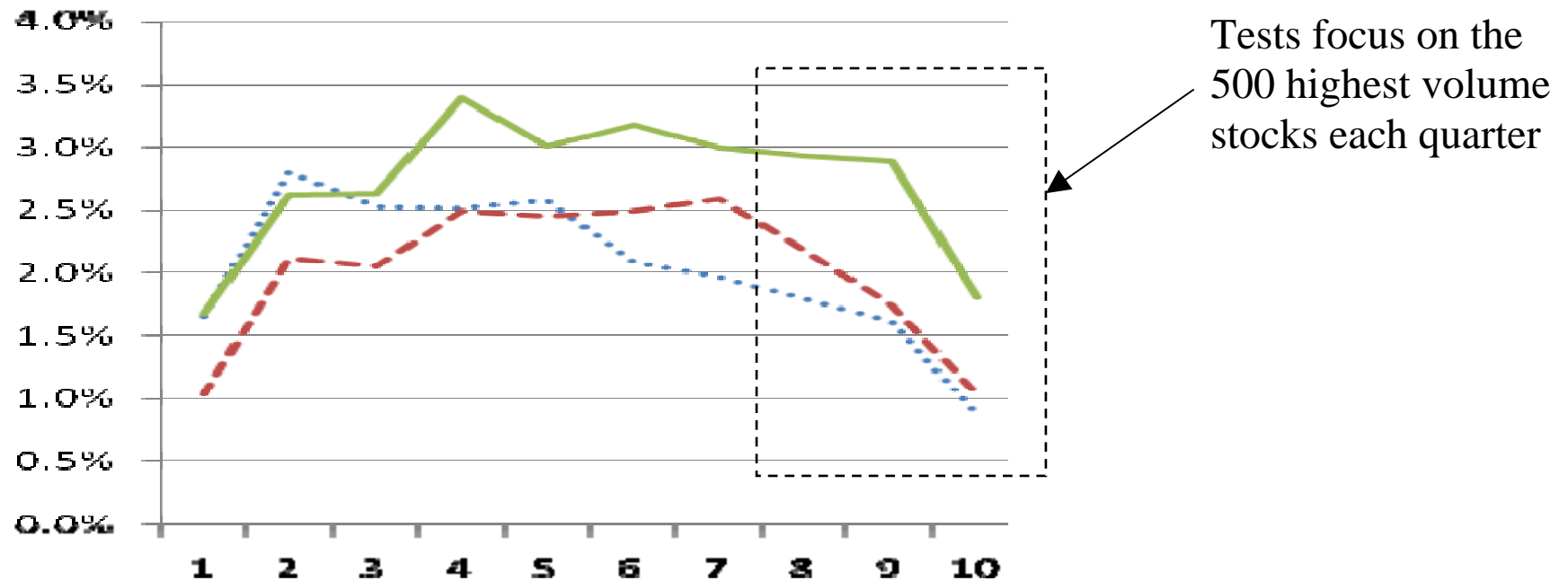
(Microsoft data in billions of shares, June 30, 2006)

- Total Shares Outstanding 10.0
- Total of 1,418 13F filers as of June 30, 2006 5.4
- Total of 4,838 mutual funds as of May 15-August 15, 2006 2.3
- Total of 3,826 mutual funds that filed exactly on June 30, 2006 1.8
- Total of 554 mutual funds identified\* with a 13F filer 1.2

\* Some of the 13F identifiers in the Thompson database are incorrect.

# A Puzzle

Why isn't dark pool volume higher, especially for high volume stocks?



NASDAQ quarterly dark pool/consolidated volume; solid=3Q07, dash=2Q06,dots=3Q05. Shown by deciles of consolidated volume for full sample—top 500 is deciles 8,9,10

# Hypotheses and Predictions

Hypothesis 1: (soft dollars)  $\Rightarrow$  Traders sort stocks by *spread per share* (note that agreements are for a fixed number of shares) and then route shares with the lowest spreads to soft-dollar venues, and NOT to dark pools. (***spread rank measure***)

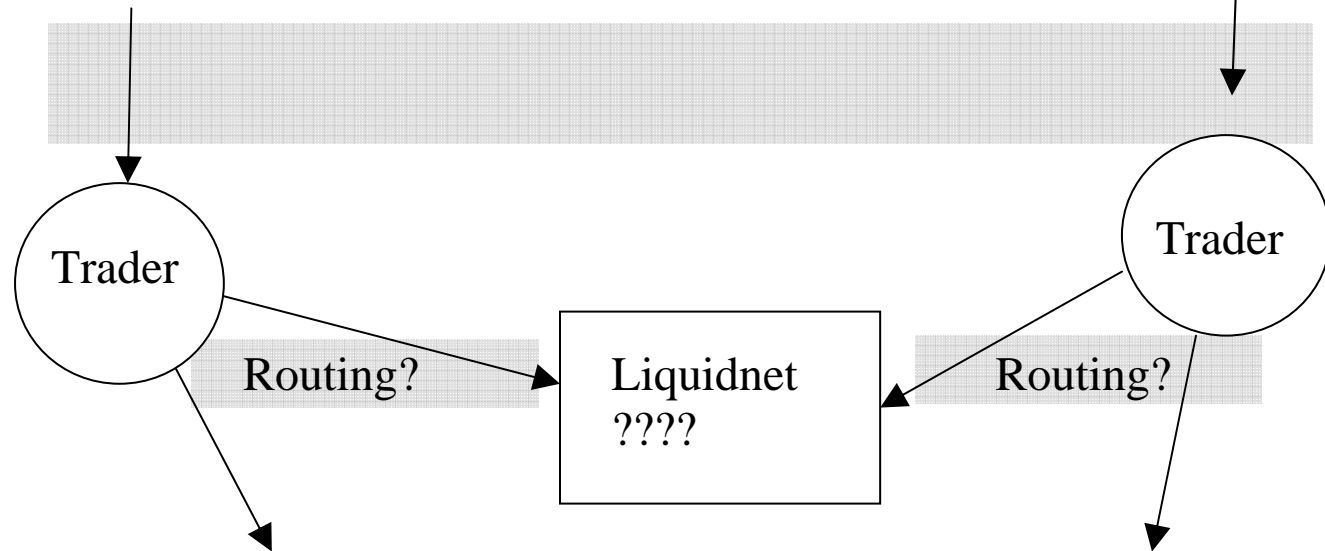
Hypothesis 2: (busy traders)  $\Rightarrow$  Traders sort orders by *dollar spread per order* (=shares times spread per share) and route highest value orders to dark pools (***dollar value rank measure***)

Hypothesis 3: (want price certainty)  $\Rightarrow$  trade off *proportional spread* against *proportional volatility*.

# Simulation of Dark Pool Volumes

Wellington's holdings of ACLI	
3/31/2006	478,640
6/30/2006	3,170,070
Change	+2,691,430

Blackrock's holdings of ACLI	
3/31/2006	1,824,660
6/30/2006	416,682
Change	-1,407,978



# Routing Decisions

- Orders are assumed to be routed to dark pools based on the following value function:

$$V_{i,s,q} = \alpha_q + \beta X_{i,s,q} + \tilde{z}_{i,s,q} + \tilde{e}_s$$

- $X_{i,s,q}$  is a vector containing characteristics of institution  $i$ , stock  $s$ , and the institution's order in that stock in quarter  $q$ .
- The order is routed to the dark pools if  $V_{i,s,q} > 0$ .
- $\sigma_z$  set = 1;  $\sigma_e$  set (= .2) in a calibration exercise (match random effect standard deviation)

# Panel Data Estimation (Table 4)

- Assume dark pool volumes (scaled by total consolidated volume) are approximately linearly related to stock characteristics and total and average institutional order information. Includes random effects by stock.

Coefficient on:	Estimate	T-statistic
Matched small institutional orders	0.164†	27.4†
Extra (imbalance in) small institutional orders	0.038	10.0
Increase in Matched orders if large orders are included	0.099	8.0
Increase in Extra if large orders are included	0.013	1.6
Matched small orders interacted with:		
daily return volatility	0.006	2.5
relative spread	0.009	3.0
indicator: spread rank measure <0.2	-0.054	-7.9
average dollar value rank measure	-0.107	-3.2
average institutional position value	0.011	1.4
average institutional turnover	-0.084	-10.4

†averages of quarterly values



# Interpreting the Regression Coefficients

- With all of the interacted variables set to zero (dollar spread per share is not particularly narrow, and all of the other characteristics are average), 1,000 shares of additional 13F buy and sell volume increases predicted dark pool volume by

$$1,000 \text{ shares} \times 0.164 = 164 \text{ shares}$$

- For a very low dollar spread stock like Microsoft, 1,000 shares of additional 13F buy and sell volume increases predicted dark pool volume by

$$1,000 \text{ shares} \times (0.164 - 0.054) = 110 \text{ shares}$$

# SMM Estimation (Table 5)

- SMM produces estimates for the coefficients in the Probit function that governs each routing decision
- For each stock/quarter we observe: Institutional orders, stock characteristics, and dark pool share of consolidated volume.
- Moment conditions are the GLS coefficients from panel data regressions.

Coefficient on:	Estimate	T-statistic
$\sigma_{s,q}$ (return volatility)	0.084	4.03
$R_{s,q}$ (relative spread)	0.063	1.96
$i20srm_{s,i,q}$ (low spread rank measure indicator)	-0.215	-2.34
$dvr_{s,i,q}$ (dollar value rank measure)	-1.291	-4.56
$dp_{i,q}$ (institution's average position size)	-0.104	-1.30
$to_{i,q}$ (institution's turnover)	-0.724	-6.13

# Test of Hypotheses and Predictions

## Supported by the data

Hypothesis 1: (soft dollars)  $\Rightarrow$  Traders sort stocks by *spread per share* (note that agreements are for a fixed number of shares) and then route shares with the lowest spreads to soft-dollar venues, and NOT to dark pools.

## NOT Supported by the data

Hypothesis 2: (busy traders)  $\Rightarrow$  Traders sort orders by *dollar spread per order* (=shares times spread per share) and route highest value orders to dark pools

Hypothesis 3: (want price certainty)  $\Rightarrow$  trade off *proportional spread* against *proportional volatility*.

# ECNs as an alternative (Table 7)

- Panel data regression using Automated Trading Desk and Bloomberg Tradebook. Regression includes random effects by stock.

Coefficient on:	Estimate	T-statistic
Matched small institutional orders	0.001†	0.1†
Extra (imbalance in) small institutional orders	0.001	0.3
Increase in Matched orders if large orders are included	0.000	0.1
Increase in Extra if large orders are included	0.005	1.1
Matched small orders interacted with:		
daily return volatility	0.009	5.1
relative spread	0.002	0.7
indicator: spread rank measure <0.2	-0.059	-10.0
average dollar value rank measure	0.079	3.3
average institutional position value	-0.012	-2.3
average institutional turnover	0.012	1.8

†averages of quarterly values