Informed Trading in Dark Pools

Sugata Ray

joint with Mahendrarajah Nimalendran

IGIDR EMF, Dec 2011

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What are dark pools/crossing networks

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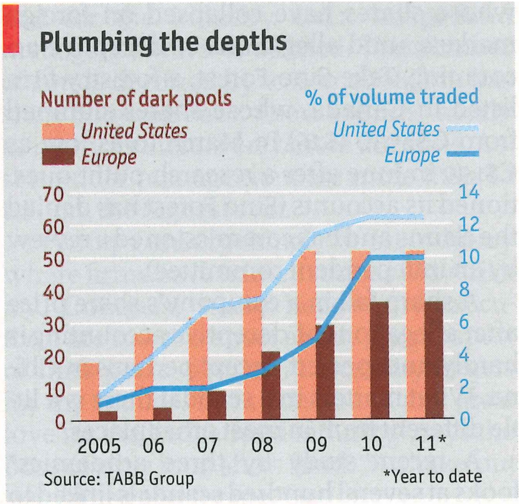
- Relatively new equity market design
- As opposed to limit order books (and other quoting markets)
- Networks look for matches and prices trades relative to quoting exchanges (generally at mid)

Why do we care? Fast growth, regulatory debate



The Economist - July 2011

Asia and India

" Extremely disturbed by the global trend towards dark pools.... [they have] no regulatory responsibility and ... the logical conclusion [to the trend] would be that the biggest chunk of the market would be opaque."

- Ravi Narain, MD, NSE, The Financial Times (2009)

"$4.95 billion in shares were bought and sold from January to March [2011] on [Liquidnet's] dark pools in Australia, Hong Kong, Indonesia, Japan, Malaysia, New Zealand, Singapore and South Korea, compared with $3.75bn a year earlier."

- Bloomberg, April 2011 (Implies 32% YoY growth)

Asia and India - cont'd

"One of the biggest markets we want to be in in Asia is India [but] there is no mechanism in India for off-market crossing."

- Lee Porter, Liquidnet Asia, Bloomberg, April 2011

"The absence of over-the-counter trading platforms for stocks in India prohibits dark pools from operating in the country."

- Sandeep Parekh, founder of Finsec Law Advisers, Bloomberg, April 2011

Crossing network mechanics: Trading $500K of LNKD

Faced with a limit order book that looks like this for LinkedIn:

Bid					Ask				
MM Name	Price	Size	Cum Size	Avg Price	MM Name	Price	Size	Cum Size	Avg Price
ARCA	73.57	1	1	73.570	ISLAND	73.65	1	1	73.650
BATS	73.53	7	8	73.535	DRCTED...	73.67	1	2	73.660
NYSE	73.53	1	9	73.534	PSX	73.68	1	3	73.667
NSX	73.53	11	20	73.532	EDGEA	73.68	1	4	73.670
BYX	73.52	4	24	73.530	BYX	73.68	1	5	73.672
PSX	73.46	1	25	73.527	NYSE	73.68	1	6	73.673
ISLAND	73.46	1	26	73.525	ARCA	73.72	1	7	73.680
CBSX	73.45	11	37	73.502	BATS	73.74	2	9	73.693
EDGEA	73.45	1	38	73.501	NSX	73.79	1	10	73.703
DRCTED...	73.40	1	39	73.498	CBSX	74.10	4	14	73.816

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- Crossing network - negotiated lump cross
- Use both QE and CN?
- What if trader has some private information about LNKD?

This study: Informed trading in dark pools and the effects

- Is there informed trading in dark pools? How do we measure it? Where is it concentrated?
  - Almost all theoretical models suggest including CNs in strategy set helps maximize profits for informed traders
  - However, results critically dependent on parameters of model (shelf life of information, liquidity in CNs, depth of limit order book, how correlated is the information)
  - Other analogous venues without much informed trading: Upstairs markets, regional exchanges.

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  - Other analogous venues without much informed trading: Upstairs markets, regional exchanges.

- How does this affect market quality for participants in quoting exchanges?
  - Predictions are more mixed
  - We examine profitability of CN trades as well as whether QEs factor in information that may be available to CN traders

Academic literature and our contribution

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  - Counterparty detail: Where is the information

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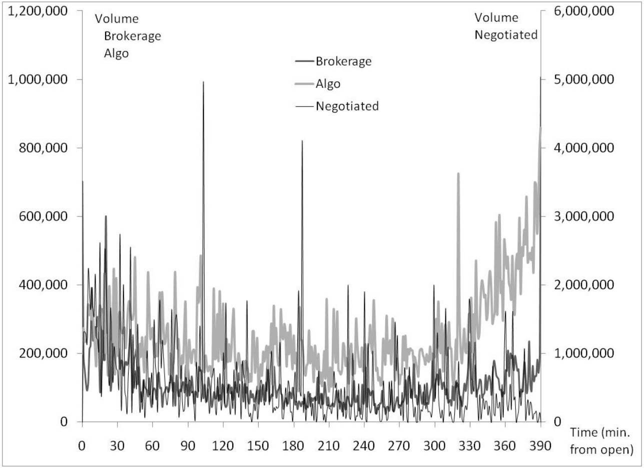
- CN space is quite fragmented (40-50 CNs, the biggest has 10-15% market share, a few have 5-10% market share)

Transactions on the CN over the course of the day



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Member algo Trades between members or between a member and external liquidity supplied from another dark venue. These trades are generally small and numerous. They are most likely generated by an algorithm that is designed either to minimize transactions costs or to trade for a profit.

Summary Statistics: Counterparties

Volume (Total =355MM shares)

	External	Member	Total
Desk	11.7	0.6	12.3
Member Algo	25.6	2.8	28.4
Member Negotiated	2.4	56.9	59.3
Total	39.6	60.4	100.0

No of trades (Total = 490K)

	External	Member	Total
Desk	35.8	0.0	35.8
Member Algo	63.4	0.1	63.5
Member Negotiated	0.1	0.6	0.7
Total	99.3	0.7	100.0

Summary Statistics: Signed trades

Volume (Total =355MM shares)

	Sell	Unsigned	Buy	Total
Desk	3.80	6.10	2.50	12.30
Member Algo	7.70	17.00	3.80	28.40
Member Negotiated	2.90	53.50	2.90	59.30
Total	14.30	76.50	9.10	100.00

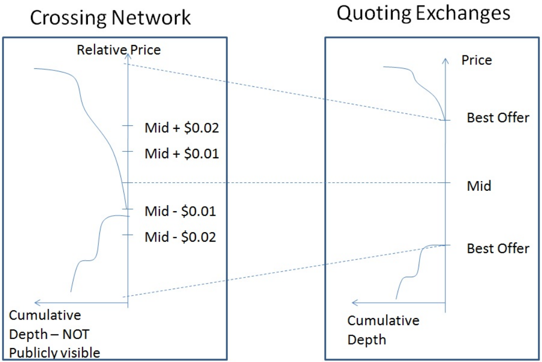
No of trades (Total = 490K)

	Sell	Unsigned	Buy	Total
Desk	15.50	11.60	8.60	35.80
Member Algo	27.20	24.10	12.20	63.50
Member Negotiated	-	0.60	-	0.70
Total	42.70	36.30	20.90	100.00

Summary Statistics: Pricing deviations from mid (DFM) of NBBO

DFM (dollars)	Fraction of transactions (%)
-0.02 or less	3.48
-0.02 to -0.01	3.69
-0.01	10.59
-0.01 to 0	24.99
0.00	36.35
0.00 to 0.01	12.89
0.01	1.96
0.01 to 0.02	0.70
0.02 or more	5.37

A limit order book within a limit order book



Zhu (2009): “Some dark pools passively match buyers and sellers at prices derived from transparent exchange; many others are essentially invisible limit order books that execute orders by price and time priority.”

Empirical tests for informed trading

- How do transactions on dark pools affect spreads (and other measures of quoting market liquidity)

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- Are signed trades in dark pools profitable?

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- Effect: If there is informed trading in CNs, we would expect spreads to rise following CN transactions

Average change in percentage spreads following a CN transaction - 10 min before vs. 10 min after

Liquidity	Desk	Negotiated	Member Algo	Total	Base (median)
Liquid	0.006	0.004(NS)	0.016	0.012	0.061
2nd quint.	-0.008	-0.020	0.005	0.001	0.151
3rd quint.	-0.027	-0.043	-0.005	-0.010	0.447
4th quint.	0.014	0.014(NS)	0.033	0.026	1.048
Illiquid	0.220	0.057(NS)	0.315	0.294	5.185
Total	0.001	-0.012	0.013	0.009	0.103

All significant to at least a 5% level except those marked (NS)

Change on change regression I

$\Delta s_{10} = \alpha + \sum_i \beta_i g_{i,t} + \epsilon$ where Δs_{10} is the change in the average quoted percentage spread from 10 min before transaction to 10 minutes after

	All	Desk	Member Neg.	Member Algo
α	0.010*	-0.000	-0.007	0.014*
	(2.036)	(-0.115)	(-1.055)	(2.228)
R-squared	0.118	0.086	0.125	0.131
N	225003	78388	1332	145268

Controls: Change in volume, change in volatility, market cap

Interpretation: On average, after any trade on a CN, the spread increases by 1.0bp. After a trade by a member using algorithms, the spread increases by 1.4bp.

Change on change regression II

$\Delta s_{10} = \alpha + \sum_i \beta_i g_{i,t} + \epsilon$ where Δs_{10} is the change in the average quoted percentage spread from 10 min before transaction to 10 minutes after

	Liq. desk	Illiq. desk	Liq. Neg	Illiq. Neg	Liq. Algo	Illiq. Algo
α	-0.001	0.048+	-0.008+	0.048	0.008+	0.133*
	(-0.451)	(1.889)	(-1.902)	(0.887)	(1.966)	(2.238)
R2	0.070	0.212	0.037	0.287	0.092	0.231
N	66203	4201	906	154	109072	9495

Controls: Change in volume, change in volatility, market cap

Interpretation: On average, after a trade by a member using algorithms for an illiquid stock, the spread increases by 13.3bps

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- Prices in the QE move and short term returns are realized (could also be the result of news release)

Long buys and short sells - Returns over next hour I

	Ret(bp)	T-stat	N
Sell	-2.0	-4.05	73,204
Unsigned	-1.5	-3.17	67,292
Buy	11.9	10.11	35,684
Buy - Sell	13.9	10.89	

Signed trades make money - portfolio makes 13.9bps over the hour (955% per year if annualizable!)

Long buys and short sells - Returns over next hour II

Sample	Buy - Sell	T-stat
All trades	13.9	10.89
Most Liquid	-5.5	-11.65
Least liquid	520.2	6.70
Least liquid - member algo	749.5	7.60
Least liquid - CN desk	-73.1	-1.01

Be wary of trading an illiquid ticker on a CN against a motivated trader. Trade loses 5.2% in the next hour! At least the CN brokerage desk is not involved in this.

Regression: Returns on pricing mechanism

$r_{60} = \alpha + \sum_i \beta_i g_{i,t} + \epsilon$ where r_{60} is the return over the next 60 minutes and g_i are the explanatory variables

	Liq. desk	Illiq. desk	Liq. Neg	Illiq. Neg	Liq. Algo	Illiq. Algo
DFM (%)	6.652	-8.617	349.240	-49.801	-24.824	36.779*
	(0.230)	(-0.500)	(1.241)	(-0.747)	(-0.398)	(2.065)
R2	0.004	0.064	0.003	0.009	0.008	0.092
N	40170	2509	575	71	65572	5080

Control variables includes historical returns
Interpretation: when motivated members trade illiquid tickers they make 36 times the additional payment back in returns over 60 minutes!

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CN pricing arbitrage Order imbalance leads to mid being off - affects returns but not spreads

Earnings days - Spread analysis

	Desk	Negotiated	Member Algo	Total
Most Liquid	0.006	-0.002(NS)	-0.003	-0.001(NS)
2nd Liquid	-0.005(NS)	0.013(NS)	0.128	0.054
3rd Liquidi	0.019(NS)	-0.063	-0.016	-0.013
4th Liquid	0.209	-0.091(NS)	-0.024	-0.002(NS)
Least Liquid	No Observations			
Total	0.004(NS)	-0.021(NS)	0.012	0.010

Overall, spreads still increase. Spreads do not increase for illiquid tickers.

Earnings days - ST Return Analysis

Sample	Buy - Sell	T-stat
All trades	-42.5	-11.24
Most Liquid	12.6	3.57
Least liquid	-82.8	-9.33
Least liquid - member algo	-62.4	-8.73
Least liquid - CN desk	-123.9	-2.03

Signed trades underperform on earnings days - suggests motivated traders on CN do not have ST fundamental information.

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- The Economist: "require dark pools to publish their operating and membership criteria, so that investors can make a better [decision]"