Hiding Behind the Veil: Informed Trading and Pre-Trade Opacity

Kiran Kumar, IIM Indore India
Ram Thirumalai, Indian School of Business
Pradeep Yadav, University of Oklahoma

Pre-Trade Opacity

- **Pre-trade opacity arises from restrictions in the ability of market participants to observe all relevant pre-trade information in the trading process.**

- **The recent debate on "dark pools" has focused attention on pre-trade opacity.**

  - **SEC is "taking a serious look at what regulatory actions may be warranted" to "best bring light" to dark pools.**
    - Mary Schapiro, SEC

  - **But dark pools are typically off-exchange trading locations.**

Pre-Trade Opacity

- **Traditional electronic limit-order-book exchanges also often allow pre-trade opacity by enabling traders to use "hidden" orders.**

  - Hidden orders display only part of the order, but execute automatically with the same price priority as displayed orders.

  - However, hidden part of the order loses time priority to displayed orders at the same price.

  - Hidden orders give traders the choice to increase pre-trade opacity in an otherwise transparent environment.

Pre-Trade Transparency

- **Hidden orders constitute a significant proportion of depth and volume in order-book markets.**

- **Information-related transparency is clearly fundamental to the existence of a fair level-playing-field across different market participants.**

- **From an economic perspective as well:**

  - **information-related transparency should generate greater confidence to trade**

  - **lead to more competitive price formation that:**
    - **better reflects extant information**
    - **induces quicker reversal of "pricing errors"**

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Transparency and Informed Traders

- Prices are most efficient and informative as signals of value when private information gets quickly reflected in prices.

- This happens only through trading of informed traders.

- Informed traders may be arguably hesitant to expose their information footprint.

- As liquidity suppliers, they may be less willing to provide free options through their limit prices.

- They may not also want free-riding parasitic traders.

- Informed traders can hence, arguably can prefer a less-transparent market center making that less-transparent center have better price discovery and greater depth.

Is Transparency all Good?

- **Both factors are reflected in mid-1990's debate surrounding the battle for order-flow between London and Paris.**

  - London dealer market: low transparency, more informed traders, and high depth

  - Paris order-book market: high transparency, low informed trading content and low depth.

- **Clear bottom line in the dealer markets literature: Full and complete transparency is <u>not</u> a policy-desirable from the perspective of market design.**

Order Book Markets

- Transparency is much higher in electronic order book markets in at least in two ways
  - One sees the two-dimensional Price-Quantity schedule rather than just best prices.
  - Any public trader can display her trading interests and compete directly.
- New exchanges and trading platforms developing across the world are typically electronic order-matching systems.
  - Most of the liquidity traded in non-US equity markets is now through electronic order-matching systems, and growing rapidly.

- Given the trade-off between the benefits of transparency and the participation of informed traders, it is no surprise that most order-book markets have the ability to post "hidden orders"

Theoretical Models

- The theoretical models of informed traders and on-exchange hidden liquidity that are most directly relevant to this paper are Boulatov and George (RFS 2013) (hereafter "BG") and Moinas (2010).

  - There are some other theoretical models involving on-exchange hidden liquidity, but these assume at the outset that informed traders do not supply liquidity, and are hence not relevant in the context of this paper. For example, Baruch (2005); Madhavan, Porter, and Weaver (1999); and Buti and Rindi (2012).

  - There are theory papers – for example, Zhu (2014) – that model off-exchange hidden liquidity in dark pools that are not relevant to this paper, since they introduce and analyze execution risk within a dark pool that is segregated from the exchange, an issue that does not apply to on-exchange hidden liquidity.

Boulatov and George (RFS 2014)

- BG allow informed traders to coexist as both liquidity demanders and liquidity providers, and model settings in which traders can hide or display their orders.

- Their key reasoning is that informed traders want to capture the extra rents from providing liquidity, but if they have to display their liquidity-providing orders, they lose some of their informational advantage to uninformed traders, and this causes the informed traders to back away from liquidity provision in displayed markets, which weakens competition among liquidity providers.

Boulatov and George (RFS 2014)

- The important conclusions are that:

    - If liquidity can be hidden, informed traders will *all* choose to be liquidity providers.

    - Uninformed liquidity providers will have to compete with informed liquidity providers and earn lower rents or exit liquidity provision;

    - Information will be more effectively incorporated into *quoted* prices, because of which *midquotes* (as distinct from traded prices) will more closely approximate the security's true value. Hence, pricing errors, as measured by deviation from fundamental value, will decline.

    - Uninformed liquidity demanders will face lower effective spreads. Hence, average spreads should decline with more hidden orders.

Other Theoretical Models

- Moinas (2010) models informed traders and hidden liquidity, and concludes that the probability with which an informed liquidity supplier submits a hidden order is always greater than or equal to the probability with which a large uninformed liquidity supplier submits a hidden order.

  - Conclusion is consistent with BG: informed traders should be dominant liquidity suppliers in a market with hidden orders.

- Consistent also is the Harris (1997) argument that traders posting potentially informed orders would prefer pre-trade opacity to reduce parasitic "front-running" and *signaling*-related adverse "footprint" of an order.

- Also consistent is the conjecture that informed traders may not want to provide free options by posting fully displayed orders, and hence may choose to use hidden orders.

Experimental Study

- Bloomfield, O'Hara, and Saar (2013) address, in an experimental laboratory setting, how endogenous opacity arising through hidden orders affects trader behavior.

- BOS find that, while both informed and liquidity traders use hidden orders, the behavior of informed traders is more sensitive to changes in opacity.

- Consistent with BG, when opacity is high, BOS informed traders use SLOs to execute more of their trades to keep their informational advantage longer; and liquidity traders trade more aggressively by demanding liquidity.

- As transparency increases, liquidity traders are better able to assess depth in the book, become less aggressive, and increase their liquidity provision.

Extant Research

- On the basis of theory and experimental evidence, in a market with on-exchange hidden orders, informed traders should dominate in the placement of hidden SLOs, and uninformed or liquidity traders should dominate the placement of MLOs, but with no clear implications for the hiding of MLOs by them.

- While extant empirical research has not directly addressed this specific issue, the overwhelming inference on this issue that appears to follow tangentially from current empirical evidence would be exactly the opposite – that it is the uninformed not the informed traders who use liquidity supplying hidden orders.

Extant Research

- Aitken, et al (2001) and Pardo and Pascual (2012) find that the permanent price impact of hidden orders are no different from that of fully-displayed orders.

- Bessembinder, et al (JFE 2009) show that the opportunity cost of unexecuted hidden orders are lower than that of unexecuted fully-displayed orders. Given the lower adverse price movement after the submission of hidden orders when compared to fully-displayed orders, they conclude that hidden orders are more likely uninformed.

- That said, De Winne and D'Hondt (2007) observe that traders on the Euronext submit more aggressive orders when they detect hidden depth, which is consistent with BG; and Anand and Weaver (2004) document that informed traders use hidden limit orders to minimize price impact of aggressive orders, again consistent with the spirit of BG.

Research Questions

- Our primary focus is to examine how the information level of market participants interfaces with their preference to use hidden orders when they supply and demand liquidity.

  - Do informed traders prefer to use hidden orders when they are supplying liquidity by placing limit orders, or when they are demanding liquidity through marketable limit orders?

  - Is the presence of more hidden order submissions and associated trades related to more efficient price-discovery?

  - Is the presence of more hidden order submissions and associated trades related to greater liquidity?

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Data

- Extremely rich proprietary data on all orders and trades from the *National Stock Exchange of India* for 18 months January 2005 to June 2006.

- This exchange had the highest number of trades among electronic order markets in the world both in 2005 and 2006, and third highest among all exchanges, just behind NYSE and NASDAQ.

  - About 7 times more trades than London/Euronext.

  - Average number of orders per day : 5.6 million

 - Average number of trades per day : 2.5 million

Data

- Most importantly, this dataset includes the coded identities of each and every trader, whether an order is hidden or not, and trader categories.

- We investigate a random sample of 100 stocks, which account for about 18% of the market capitalization of all stocks on the NSE.

- We find that 11 percent of all incoming SLOs and 30 percent of the total value of incoming SLOs have a hidden component. The corresponding numbers for MLOs are 5 percent and 32 percent, respectively.

- Numbers are consistent with larger orders being more likely to be hidden as these traders want reduce their "footprint".

Sample Stocks

Characteristic	Mean	Median	Max	Min
Percentage of Turnover with Hidden Orders	33	33	61	14
Daily Number of Trades per stock	19121	12710	70129	2870
Percentage of Trades with Hidden orders	42	41	65	20
Daily Order Submissions per stock	24907	18334	94355	4210
Percentage of Orders with Hidden component	9	9	17	4

Hidden Orders

Intra-day Variation of Hidden Depth
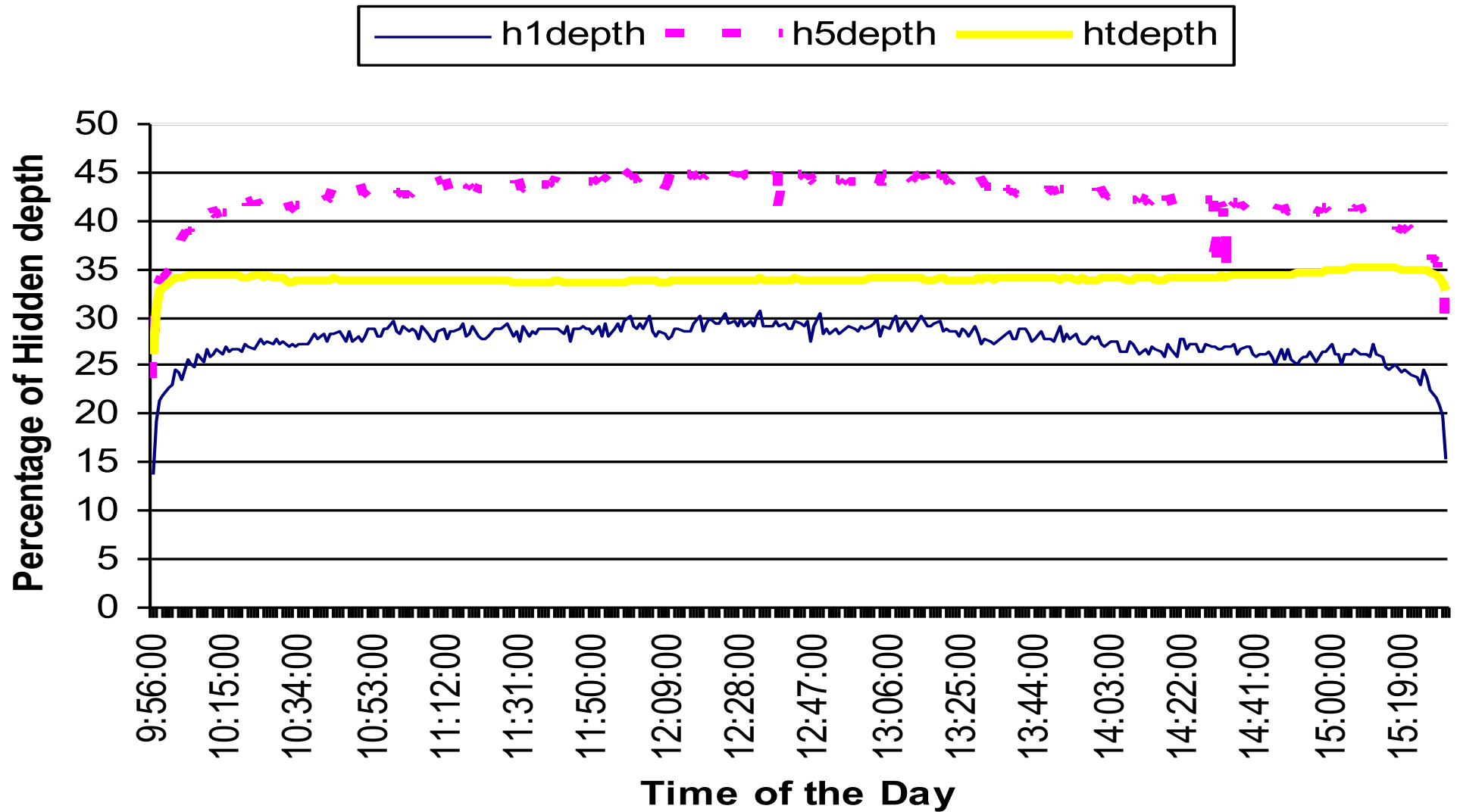
Descriptive Statistics – Stock Characteristics

Panel A. Stock characteristics

Liquidity quintile	Market capitalization (millions of dollars)		Number of order submissions per stock		Percentage of orders with a hidden component		Traded value per stock (millions of dollars)		Percentage of traded value with a hidden component	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
1 (Least)	1,811.98	26.98	97,577	57,132	13.30%	12.37%	22.66	6.95	44.86%	44.38%
2	400.98	112.65	573,484	302,936	9.88%	8.84%	204.41	46.34	50.52%	48.53%
3	200.59	32.26	529,129	264,805	8.90%	8.05%	147.39	46.07	46.59%	40.24%
4	224.10	59.13	1,026,447	953,508	8.29%	8.10%	234.91	159.68	47.44%	51.87%
5 (Most)	4,224.38	1,940.83	4,991,006	5,084,841	8.69%	8.73%	2,610.65	2,374.85	49.18%	49.99%
All	1,372.41	61.69	1,443,529	413,537	9.81%	8.85%	650.28	82.47	47.75%	48.30%

Descriptive Statistics –
Order Characteristics by Liquidity quintiles

Panel B. Order characteristics

	Standing limit orders				Marketable limit orders			
Liquidity quintile	Number of orders	%Hidden	Total order value (millions of dollars)	%Hidden	Number of orders	%Hidden	Total order value (millions of dollars)	%Hidden
1 (Least)	1,308,868	14.19%	1,000.93	38.70%	560,285	6.84%	663.33	32.59%
2	7,272,493	10.22%	9,718.87	30.17%	3,535,939	5.05%	6,344.00	27.18%
3	6,901,168	11.76%	7,173.00	39.27%	3,127,917	6.24%	4,605.15	35.63%
4	13,113,864	10.40%	9,701.77	31.25%	6,282,645	5.19%	7,056.66	31.98%
5 (Most)	61,107,283	10.86%	115,647.46	29.29%	31,604,881	4.25%	78,187.14	32.29%
All	89,703,676	10.86%	143,242.03	30.05%	45,111,667	4.62%	96,856.27	32.10%

Order characteristics by Trader Categories

Panel B. Order characteristics by trader categories

Trader category	Standing limit orders				Marketable limit orders			
	Number of orders	%Hidden	Total order value (millions of dollars)	%Hidden	Number of orders	%Hidden	Total order value (millions of dollars)	%Hidden
Financial Institutions	445,679	62.78%	11,501.28	78.26%	848,981	60.72%	26,490.07	75.47%
Individuals	52,041,682	5.45%	44,828.00	19.12%	27,359,595	2.73%	30,830.86	15.44%
Financial Traders	26,899,132	20.39%	71,424.92	29.53%	11,724,110	4.78%	28,864.62	11.52%
Non- Financial Institutions	10,317,183	11.04%	15,487.82	28.25%	5,178,981	4.98%	10,670.72	28.22%

Information Level

- Following Kaniel and Liu (2006) and Anand, Chakravarty, and Martell (2005), we measure information level of each order by computing the extent to which the quote midpoint moves after order submission in the direction of the order over 60 minutes, 1 trading day, and 5 trading days.

- Following Henderson, Jones, and Menkveld (2011), we also use another measure of information content, namely, the adverse selection half-spread.

- While the earlier information level measure determines the price impact of an order in order submission time, the adverse selection half-spread measures the price impact in trade execution time.

Measure of Information Level

- **Information level of each order**

  - Order size submitted multiplied by (Limit Price – Mid-quote at order submission) divided by Mid-quote H minutes after order submission for sell orders, and reverse for buy orders.

  - Essentially, the scaled price change in the direction of the order.

  - We use this to infer "short-lived" (i.e. intra-day) information, and "long-lived" (i.e. daily or weekly) information.

Information Level of Orders: Hidden vs. Non-Hidden

Panel A. By liquidity quintile

Liquidity quintile	-1min to +60min			-1min to +1day			-1min to +5days		
	Non-hidden	Hidden	t-stat	Non-hidden	Hidden	t-stat	Non-hidden	Hidden	t-stat
1 (Least)	8.70	17.32	-18.99***	9.36	22.25	-13.59***	16.54	33.37	-8.92***
2	1.96	8.49	-26.53***	-2.02	9.36	-20.18***	-13.29	7.51	-17.66***
3	3.99	6.82	-15.20***	2.90	7.57	-11.01***	8.58	18.27	-11.66***
4	2.58	5.47	-20.05***	2.22	7.98	-18.94***	3.30	14.46	-18.37***
5 (Most)	-0.21	2.57	-48.11***	-2.96	3.74	-50.62***	-4.01	3.42	-29.36***

Information Level of Orders by Trader Category

Panel B. By trader category

Trader category	-1min to +60min			-1min to +1day			-1min to +5days		
	Non-hidden	Hidden	t-stat	Non-hidden	Hidden	t-stat	Non-hidden	Hidden	t-stat
Financial Institutions	5.52	14.77	-35.29***	8.68	25.37	-29.72***	14.86	34.69	-17.36***
Individuals	0.87	5.17	-44.83***	-2.44	5.44	-37.31***	-3.80	7.70	-27.45***
Financial Traders	0.03	1.63	-21.79***	-0.12	2.53	-15.89***	0.23	2.71	-8.15***
Non-Financial Institutions	2.12	4.56	-15.77***	0.20	4.67	-13.37***	-1.14	6.50	-11.74***

Information Level of Orders : Type of Limit Order

Panel C. By type of limit order

Limit order	-1min to +60min			-1min to +1day			-1min to +5days		
	Non-hidden	Hidden	t-stat	Non-hidden	Hidden	t-stat	Non-hidden	Hidden	t-stat
Standing	1.20	2.66	-25.08***	-0.44	3.77	-31.42***	-0.76	5.09	-22.41***
Marketable	0.20	10.34	-88.91***	-3.24	12.79	-64.06***	-5.04	16.90	-44.25***

Probability of Informed Trader Hidden Order Submission

- After controlling for investor type, stock characteristics, and market conditions, we find that a one-standard deviation increase in FIs' information level increases the likelihood of hiding the order by around 2 percent.

  - True for both SLOs as well as MLOs, and buy and sell orders.

- For other traders, a one-standard deviation in increase in information level results in an increase in the likelihood of submitting hidden orders by less than 20 basis points: weaker relationship for Individuals, FTs, and NFIs.

- Our results for FIs and SLOs are consistent with investors trading on long-lived information being more likely to hide their orders in order to protect their private information.

Profitability and Hidden Order Submission

- As our data provides a masked ID for each trader in our sample, we are able to track each trader's usage of hidden orders across stocks and time and the resulting profitability from their trades.

- In this analysis, trader profitability is a proxy for trader information.

- We essentially find that for FIs, Individuals, and FTs larger profits are related to higher usage of hidden orders.

Alternative Trader Characterization

- As robustness check, we use an alternate method of trader categorization based on their daily inventory position.

- We split sample into two sub-periods, one from Jan 2005 through Jun 2005 and another from Jul 2005 through Jun 2006 and examine the relationship between information level and hidden order usage over second sub-period.

- We categorize traders in Fundamental Traders, Day Traders, and Others based on their net inventory position in each stock at the end of each day over the first sub-period.

- Fundamental Traders are longer-term investors whereas Day Traders are short-term investors.

- Our results for Fundamental Traders are consistent with our previous findings for FIs. They are more likely to hide their SLOs and MLOs when informed.

Market Quality: Pricing Errors

- Pricing Error : Not observable directly

  - Following Hasbrouck (1993), we decompose the price into
    - random-walk component - the "true value" series
    - and the residual, i.e. the "pricing error" series.
- Underlying values, F(t), follow random walk with drift,   .

$$F(t) = \mu + F(t-1) + \varepsilon(t) \qquad \varepsilon(t) - N(0, \sigma_\varepsilon^2)$$

- Market prices, S(t), equal underlying values plus pricing errors, Y(t).

$$S(t) = F(t) + Y(t)$$

- We estimate these pricing errors using the Kalman Filter methodology and estimate for each interval the variance of these pricing errors and the speed with which these pricing errors revert to zero.

Pricing Efficiency and Hidden Order Submission

- We examine pricing efficiency to hidden order usage.

- As hiding orders delays order execution, it could result in a delay in the incorporation of information into prices leading to worse pricing efficiency.

- On the other hand, the ability to hide orders may increase the returns to information acquisition costs resulting in more informed trading and better pricing efficiency.

- Using pricing error measures defined in Hasbrouck (1993) and Boehmer and Kelley (2009), we find that pricing errors are lower when FIs use more hidden orders.

- This is true for both their SLOs as well as MLOs.

Pricing Efficiency and Hidden Order Submission

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Summary of Results

- We examine the relation between hidden order usage and trader informativeness and find strong support for Boulatov and George (RFS 2014).

- We find that FIs submit hidden orders when informed. This is true for both SLOs and MLOs and robust to different measures of information. We also find that other types of investors tend to use hidden orders when informed, though the evidence is weaker for other investors.

- We find that pricing errors are lower and effective spreads of uninformed traders are also lower when informed traders use more hidden orders.

- In addition, we find that traders with longer-lived information are more likely to trade patiently using hidden orders.