Diving into Dark Pools

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Research Proposal

Preliminary Note

Please notice that this piece of research is well advanced and that a preliminary draft of Phase I is expected to be completed by the end of March 2010.

Introduction

There are several reasons for why institutional traders may want to avoid displaying their orders in the continuous limit order market. Order display invites imitation, potentially reducing the alpha of the underlying investment strategy. Displayed orders also invite front running and quote matching by broker-dealers as well as by opportunistic traders, resulting in higher trading costs. Further, traditional order display is associated with direct broker involvement, generating significant commission costs. Institutional sized orders also face another problem; average trade and order sizes have fallen dramatically in recent years, making it virtually impossible to trade in size in the continuous limit order market. It is therefore not surprising that there is a growing demand for trading venues that make it possible for institutions to keep their orders secret, offer low commission rates, maximizes the chances of trading with other institutions (as naturals), and allow institutions to trade in size at the mid-quote. Such non-displayed pools of liquidity have been present in US equity markets for a very long time. Examples include reserve and iceberg orders within exchanges’ and ECNs’ trading systems, floor broker orders and specialist capital on floor-based exchanges, working orders handled by agency brokers or broker-dealers, dealer capital and stand-alone as well as broker and exchange/ECN operated crossing networks.\(^1\) More recently, non-displayed liquidity pools such as Internalization Pools and Ping Destinations have been added to the list. Nowadays opaque sources of liquidity are often grouped under a single label (with unfortunate nefarious connotations): **Dark Pools.** In broad brush terms, Dark Pools are characterized by limited or no pre-trade transparency, anonymity, and derivative (almost exclusively mid-quote) pricing. However, they differ in terms of whether or not they attract order flow through IOIs/advertising and whether or not they allow interaction with proprietary and black box order flow.\(^2\) It is difficult to accurately measure the amount of volume that is actually matched through Dark Pools but estimates range from 8-10% of share volume.\(^3\)

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2. See Mittal (2009) for a discussion of Dark Pool characteristics.
3. Rosenblatt Securities, Inc. started tabulating monthly share volume for Dark Pools of Liquidity in its Trading Talk publication in March 2008 and TABB Group started its Liquidity Matrix publication in April 2007. Efforts to track volume in these venues are problematic due to a lack of uniform Dark Pool reporting standards.
Given this growth in market share, it is perhaps not surprising that Dark Pools have recently attracted the attention of media and regulators. Google Search Volume Index (SVI) illustrates this quite well:

Scale is based on the average traffic of dark pools from United States in all years.

The SEC has recently openly criticized the impact of dark pools on the price discovery process. In May, James Brigagliano, SEC’s Division of Trading and Markets, said dark pools could impair price discovery by drawing valuable order flow away from the public quoting markets. “To the extent that desirable order flow is diverted from the public markets, it potentially could adversely affect the execution quality of those market participants who display their orders in the public markets,” he said. He added that anything that “significantly detracts from the incentives to display liquidity in the public markets could decrease that liquidity and, in turn, harm price discovery and worsen short-term volatility.”

Moreover, SEC Chairman Mary Schapiro announced on June 19th, 2009, that the SEC is “taking a serious look at what regulatory actions may be warranted” and that she has asked SEC staff to review ways to “best

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bring light” to dark pools. In testimony before the House Committee on Financial Services’ Subcommittee on Capital Markets, Insurance and Government-Sponsored Enterprises, on July 14, 2009, Chairman Schapiro further stated: “We have heard concerns that dark pools may lead to lack of transparency, may result in the development of significant private markets that exclude public investors (through the use of ‘indications-of-interest’ that function similar to public quotes except with implicit pricing), and may potentially impair the public price discovery function if they divert a significant amount of marketable order flow away from the more traditional and transparent markets.” Finally on October 21, the SEC proposed lowering the threshold at which quotes must be publicly disseminated to 0.25 percent of the average daily volume in a stock, from the current 5 percent.

Proposed Project

There is to date very limited academic research on the topic of Dark Pools. Moreover, the existing models have focused on the comparison between a dealer market and a crossing network, thus overlooking the relevant features that drive the strategic interaction of Dark Pools with limit order books.

Project Phase I

We aim to extend this literature by building on our own past research (Rindi (2008), Buti and Rindi (2008)) to develop a theoretical model of a dynamic limit order market where traders may select to submit orders either to the fully transparent limit order book or to a less transparent venue (Dark Pool). The model will be used to generate predictions regarding the mapping between stock characteristics, market conditions, and the market share of Dark Pools. We also intend to use the model to illustrate the dynamic interaction between the transparent public market and the Dark Pool and how this affects overall market quality and price discovery.

Provided we will find data on dark trading, our goal is to then use data on Dark Pool trading to test the predictions from the model (Phase II).

Project Phase II: Research Questions

1. What are the determinants of volume (market share) in Dark Pools?
2. What are the effects of Dark Pools on market quality?
3. What are the effects of Dark Pools on price discovery?

Data [SOURCE]

Daily share volume in Dark Pools by stock, 1/1/2005-6/30/2009 [Dark Pools/FINRA]

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6 See Literature Review below.
Daily share volume by stock [TAQ/CRSP]

Daily market quality statistics (e.g., quoted spreads, effective spreads, depth, volume, volatility) [TAQ]

Quarterly stock characteristics (e.g., Size, Book-to-Market, Momentum, Industry) [CRSP/Compustat]

Quarterly institutional ownership [13 F filings, Thompson]

Research Team

We believe that our research team is uniquely suited to shed light on Dark Pools. Sabrina Buti and Barbara Rindi have written theoretical and empirical research papers on limit orders books, transparency, and anonymity. Ingrid Werner has published empirical papers on market microstructure topics ranging from London interdealer trading, NYSE floor brokers, to short sales. Our resumes are attached.

Academic Literature Review

We will discuss the different strands of the academic literature that are relevant for understanding the role of Dark Pools in today’s markets. Dark Pools are characterized by limited or no pre-trade transparency, so we will start by discussing anonymity and transparency. Dark Pools also co-exist with more transparent venues, which suggest a review of the literature on multimarket trading and on hidden orders in limit order books is appropriate. Finally, we review the literature that addresses Dark Pools (including crossing networks) directly.

Anonymity and Transparency

Dark Pools allow traders to choose between venues with different degrees of pre-trade transparency. The standard theory shows that transparency can enhance liquidity by reducing adverse selection costs and most theoretical models of the effects of anonymity and transparency predict that anonymous trading systems will attract more informed trades [e.g., Madhavan (1995), Pagano and Röell (1996), Röell (1991), Fishman and Longstaff (1992), Forster and George (1992), Theissen (2001), Baruch (2005)]. Several empirical papers have recently explored the significance of anonymity and transparency in experimental settings [Bloomfield and O’Hara (1999, 2000), Flood et al. (1997, 1999)] and in real data [e.g., Boehmer, Saar, and Yu (2005)]. These studies provide mixed evidence about the importance of anonymity and liquidity. Some studies find that anonymity and/or a lack of transparency can enhance liquidity at the expense of the informativeness of prices. Other studies conclude that anonymity and/or a lack of transparency can reduce liquidity but improve the informativeness of prices.
However, more recent theoretical work on limit order books suggest that lack of transparency can instead enhance liquidity due to higher participation of liquidity suppliers.\(^7\) Support for this prediction is found by Foucault, Moinas and Thiessen (2007), who show that liquidity increased on the Paris Bourse when anonymity was introduced. Analogously, Comerton-Forde, Frino and Mollica (2005) find that liquidity increased on the Tokyo Stock Exchange after the removal of brokers’ identification codes.

With the exception of Bloomfield and O'Hara's (2000) study of trade reporting, all these studies compare different market designs, either transparent or opaque trading. That is, they do not examine what happens when traders have simultaneous access to different trading venues with different levels of transparency. Thus, the lessons that can be drawn from them for today's fragmented markets are limited.

**Multimarket trading**

From the basic premise that “liquidity begets liquidity,” it is surprising that multiple venues actively trade the same stock. Indeed, early theoretical works predicted that only under very special circumstances and in the presence of sufficient frictions would multimarket trading be sustainable [e.g., Pagano (1989), Chowdhry and Nanda (1991)]. Yet, most markets are clearly characterized by multimarket trading so the theoretical work is not all that helpful.\(^8\)

Empirical work on multimarket trading has primarily focused on whether regional exchanges are able to cream-skim uniformed orders, leaving a disproportionate amount of informed orders – and thus wider spreads - on the NYSE [e.g., Lee (1993), Easley, Kiefer, and O’Hara (1996), Bessembinder and Kaufman (1997), Subrahmanyam (1997), Bennett and Wei (2006)]. More recently researchers have been exploring the implications of fragmentation for market quality also for Nasdaq stocks [Goldstein, Shkilk, Van Ness and Van Ness (2008)] and ETFs [e.g, Boehmer and Boehmer (2003), Nguyen, Van Ness, and Van Ness (2007)].

More directly related to our current project, a few papers have explicitly compared parallel trading systems with differing degrees of opaqueness. Reiss and Werner (2005) study interdealer trading and find that adverse selection is less prevalent in anonymous brokered markets (IDBs) than in the nonanonymouse public market. By contrast, Barclay, Hendershott, and McCormick (2003) find that informed traders tend to migrate to anonymous trading systems (ECNs).

**Hidden orders**

Finally, there are theoretical models that analyze how undisclosed pools of liquidity are embedded into limit order books by those Exchanges that allow traders to submit iceberg (partially disclosed) and/or hidden orders (totally undisclosed). The introduction of these order types can be seen as a competitive reaction of regulated markets to the growing demand for opaqueness.

\(^7\) Foucault et al. (2006) and Rindi (2008).

\(^8\) We are not discussing a parallel literature that discusses multimarket trading in the context of cross-listed stocks. See, e.g., Karolyi (2006) for a survey.
Buti and Rindi (2008) show that hidden pools of liquidity on the limit order book increase market depth and traders’ participation, and have stabilizing effects when the market is under stress. Moinas (2006) finds that when iceberg orders are used by insiders to trade large volumes, they improve efficiency, but their impact on liquidity and on the agent’s welfare is ambiguous. In addition, Esser and Mönch (2007) evaluate the time priority advantage and the adverse informational impact of a large visible part of an iceberg order to determine the optimal limit price and peak size.

Empirical research on US data has shown that hidden orders within traditional exchanges and ECNs represent a significant fraction of liquidity provision in today’s financial markets. Hasbrouck and Saar (2004) find that executed hidden orders on the Island ECN during 2001 only constitute about 3 percent of submitted limit orders but account for almost 12 percent of order executions. Tuttle (2006) finds that reserve depth in Nasdaq’s SuperSOES is as high as 25 percent of dollar-depth at the NBBO for Nasdaq 100 firms in 2001. She also finds that reserve size is used more for firms with high idiosyncratic risk and high volatility. While the presence of reserve orders at the inside has no effect on effective half-spreads, the price impact of a trade is significantly lower when reserve size is quoted.

Similarly, research on European data has found a surprisingly large fraction of volume on organized exchanges is the result of executions involving hidden orders. Pardo and Pascual (2006) analyze data on hidden orders from the Spanish Stock Exchange in 2000 and find that on average 26 percent of all trades involve hidden orders and that hidden orders are primarily used in periods of intense trading activity and extremely high liquidity. Their results support the notion that liquidity suppliers use hidden orders to mitigate adverse selection costs. De Winne and D’Hondt (2007) find that iceberg orders represent 14 percent of limit orders and 45 percent of the shares offered or demanded and that more than half the volume available at the best limit during the continuous session is not visible on the market screens of Euronext-Paris in 2002. Bessembinder, Panayides and Venkataraman (2009) find that hidden orders represent 44 percent of sample order volume on Euronext-Paris in 2003. They also show that hidden orders are associated with a decreased probability of full execution and increased average time to completion. Overall, their results indicate that the option to hide order size is valuable in particular to patient traders. Finally, Frey and Sandas (2008) find that the presence of hidden liquidity (iceberg orders) in DBs Xetra in 2004 is associated with greater overall liquidity in the order books, greater trading volume, and smaller price impact. They find that iceberg orders represent 9 percent of all shares submitted, but they represent 16 percent of all shares executed.

Dark Pools

A. Crossing networks

Theoretical models of crossing networks suggest that the interaction between these networks and the continuous market are quite complex [e.g., Hendershott and Mendelson (2000), Donges and Heneman (2004), and Degryse, Van Achter, and Wuyts (2009)]. There is generally a positive liquidity externality that benefits participants in the crossing network when market share grows. However, eventually this positive liquidity externality may be dominated by a negative crowding externality. Essentially, the
traders that should optimally fill their orders in the crossing network (traders with low demand for trading) experience lower fill rates due to an increased participation of traders that are better suited to trade in the continuous market (traders with high demand for trading). Crossing networks also interact with the parallel continuous market in several ways. Introducing a crossing network should result in lower continuous market spreads if the crossing network is used to share inventory risks. However, if participants in crossing networks trade their exhaust in the continuous market, adverse selection increases in this venue and continuous market spreads may widen. Crossing networks should receive more order flow when the continuous market spread is wider, and crossing networks may even result in “order creation” as investors with low demand for trading may submit orders to the crossing network while they would not submit orders to the continuous market.

Empirical work on crossing networks is relatively limited. Gresse (2006) finds that POSIT’s crossing network has a market share of one to two percent of share volume and that the crossing network does not have a detrimental effect on the liquidity of the continuous market (the DM segments of SEAQ), nor is there any significant increase in adverse selection or inventory risk. Instead, spreads decrease due to increased competition and risk sharing. Conrad, Johnson, and Wahal (2003) find that institutional orders (Plexus data) executed in crossing networks have significantly lower realized execution costs, and that most traders use the continuous market to trade their exhaust. Naes and Odegaard (2004) find that institutional orders (from the Norwegian Petroleum Fund) sent first to crossing networks and then to the continuous market obtain lower realized execution costs for the component of the order filled in the crossing network, but not necessarily for the entire order.9 Fong, Madhavan and Swan (2004) find no evidence of a liquidity drain away from the continuous market (Australian Stock Exchange) when traders can trade in a crossing network or in an upstairs market.

B. Analyzing Select Dark Pools

To our knowledge, there is no comprehensive theoretical or empirical analysis of Dark Pools in the academic literature.10 The only paper that comes close is a recent working paper by Ready (2008). He studies monthly volume by stock in three Dark Pools: Liquidnet, POSIT, and Pipeline during the period June 2005 to September 2007. The data suggests that these three Dark Pools execute roughly 2.5 percent of consolidated volume (third quarter 2007) in stocks where they were active during a month, but only 1 percent of market consolidated volume. Moreover, he finds that these three Dark Pools execute roughly 20 percent of “potential institutional volume” defined as the minimum of quarterly buying and selling activity by institutions estimated using 13F filings. While his results are preliminary, he finds that Dark Pools execute most of their volume in liquid stocks (low spreads, high share volume), but they execute the smallest fraction of share of volume in those same stocks.

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9 See also Naes and Skjeltorp (2003).
10 There are several descriptive papers, e.g., Degryse, Van Achter, and Wuyts (2008).
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