Norges Handelshøyskole

FIN11

Trading and Market Microstructure

The Dark Pool's Effect on Price Discovery

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1 Introduction

In recent years, dark pools have been a topic of interest in the financial world, as well as in the general media. Dark pools are equity trading systems with limited pre-trade transparency. This means that there are no publicly available order books, like there are on the open exchanges.

The usage of dark pools is nothing new as they became prevalent in the late 1980s. It was simply known as "upstairs trading", referring to the trades made on the floors above the trading floor. Dark pools have grown increasingly popular in recent years. Before the financial crisis of 2008, an estimated 5-6% of the total US trading volume was made in dark pools. Norges Bank Investment Management (from now on NBIM) estimates that approximately 30% of the total US trading volume today is made outside traditional venues [NBIM, 2015]. The traditional reasoning behind using dark pools was for institutional traders to execute block orders without impacting the market. Increased market fragmentation has led to a wider variety of traders taking advantage of dark pools. Apart from no market movement, dark venues will usually provide lower transaction costs as most trades are made at so called "mid-prices" - in the middle of the best bid and offer. This saves the traders from paying the full spread. Many dark pools won't charge exchange fees which makes them even more attractive.

However, dark pools are not without limitations. Downsides include a lower probability of execution as there are no market-makers who pick up excess order flows and provide liquidity. Traders may also risk market manipulation from high frequency traders (from now on HFTs). The HFTs use pinging techniques to flush out information from the dark pools to make trades in the lit venues based on this information. NBIM [NBIM, 2012] expresses their concern in 2012 when stating that "the existence of dark pools might impact the price discovery process and hamper market integrity"

We wish discuss the implications dark pools have on the buy-side. The buy-side refers to institutions and traders who buy trade-services from exchanges, regardless of whether the venues are dark or lit [Harris, 2002]. The sell-side is thus providing the trading arena. The quality of dark pools may vary and institutions such as NBIM must be careful of whom they trust their orders with. If they are careless, they may risk HFTs picking up on their trades

and acting opportunistically. The buy-side is incentivized to find good dark pools in order to avoid HFTs and impacting the market. The sell-side is incentivized to have strict policies on who they let into their pools to avoid expensive settlements such as the one exemplified by the Barclays case. Barclays misled their customers on whom they allowed to trade in their pool and the ramifications for institutional traders were severe.

Towards the end of our term paper we will shed light on the ongoing discussion regarding the effect dark pools have on price discovery. Some argue that dark pools provide appropriate venues for the uninformed and informed traders to trade separately because the informed traders will be attracted to the lit markets with better liquidity. This separation will effectively improve price discovery. On the other hand, it is argued that the lack of transparency could be harmful for overall price discovery.

2 Case Description

The discussion surrounding dark pools and lit venues has been heavily debated in recent years. Opponents of dark pools are numerous and their arguments are to a high degree based on the lack of transparency that dark pools provide, in addition to claims that they are harmful for price discovery. Proponents on the other hand, argue that dark pools are effectively improving price discovery by providing appropriate venues for the informed and the uninformed traders to trade uninterrupted.

There are conflicting views on dark pools and their effect on price discovery. We wish to examine what the implications of price discovery are to the buy-side involved in dark pools and lit venues. Further, this paper will discuss whether dark pools have a harmful impact on price discovery, or if the effects are in fact, positive. Thus, our research question becomes:

What are the effects of dark pools on price discovery and what are the buy-side consequences?

3 Theoretical Foundation

In order to answer our research question, it is important to define and elaborate on key terms that will be used throughout the research paper. First, we introduce block trading and the challenges that come with it. Moreover, we will look at dark pools, how they are used and an introduction as to how they are viewed. Furthermore, there is a short introduction to HFTs and their functions. Lastly, we introduce the concepts of price discovery and define buy-side, before we take a closer look at the effects dark pools have on the buy-side.

3.1 Block Trading

Block trading, or trade-orders of significant size, has been a part of equity markets for quite some time. The electronic exchanges and order books have made information about such trades readily available to the trading public. The NYSE rule 72 define block trades as trades that consists of 10.000 shares or more, or with a value of 200.000USD, whichever comes first [Bloomberg, 2016]. This means that both a trade of 10.000 shares of stock X at a price of 1USD is and a trade of 5.000 shares of stock Y at a price of 40USD would be considered block trades. Large trades are a valuable tool for institutional traders to access liquidity [Bloomberg, 2016]. In recent years, as the markets have become increasingly fragmented and specialized, and the electronic trading platforms have found its way to the homes of the layman, the number of block trades have steadily declined.

There are challenges involved in dealing with block trading. Trading in large volumes may have unwanted effects on the market if there is a publicly available order book [NBIM, 2012]. When a trader places a large buy or sell order the trader is effectively signaling the market to either buy or sell a given security. Other traders in the market will likely react to these signals and thus move the price away from the block trader, making the trades more expensive to execute. Institutional traders and other block traders thus need to take certain measures to avoid negatively impacting the market. Traditionally, reducing a position over time by a percentage of the daily trading volume in a given security has been an effective way of reducing market impact. However, there are downsides to this as only a relatively small number of shares can

be sold daily before HFTs and other traders pick up on the trading pattern. This time-consuming execution increases the risk of price movements against the traders. Alternatively, block traders use the non-public exchanges known as dark pools.

3.2 Dark Pools

Dark pools are alternative trading systems, or ATSs, with striking resemblances to the public stock exchanges. The key difference is that the prices and quantities are unknown, and there is thus no public order book. The order book is an electronic display of different price points and quantities of stocks that different traders are willing to buy and sell at. These price points are known as bids and asks. Without the knowledge of order sizes and prices, interaction comes with a higher level of risk since they do not know when to move their prices up or down to find a match in the contra side. This is part of the reason why dark pools are mostly used by professional traders.

Dark pools are generally used by institutional traders to avoid moving the market, which would likely increase their transaction costs. Dark pools enable the buyer and seller to connect through an intermediary without going through the "lit" market with open order books. Once the trades are executed, the information is sent to an electronic program that contains continuous data from all trades made in the exchange or pool, known as the consolidated tape. The information about the trade is then released after the execution.

There are still negative connotations to the term dark pools as if they were a part of the black market. The fact of the matter is, that dark pools have been around for as long as there has been exchanges and trading floors. In the early days of the stock market, it was simply known as "upstairs trading", referring to trades being made on the floors above the trading floor. What these dark pools in fact are, are private stock trading platforms that are mostly operated by brokerages [CNBC, 2016].

There are several positive aspects of dark pools. This is made clear by the increasing percentage of overall trading volume in these exchanges. One of the advantages, is the dark pools' ability to reduce trading costs as well

as enabling traders to reduce positions in low-volume stocks. Furthermore, the possibility of trading large volumes without triggering unfavorable price movements are an enticing trait to institutional traders. However, there are also disadvantages to dark pools, with the most prominent one being the supposed effects on the process of price discovery. This issue is especially prevalent in securities where a large portion of the total volume is traded in dark pools [PWC, 2015]. Moreover, there is a lack of transparency and publicly available information. One could argue that this is damaging to the overall confidence in the current market and public quote system.

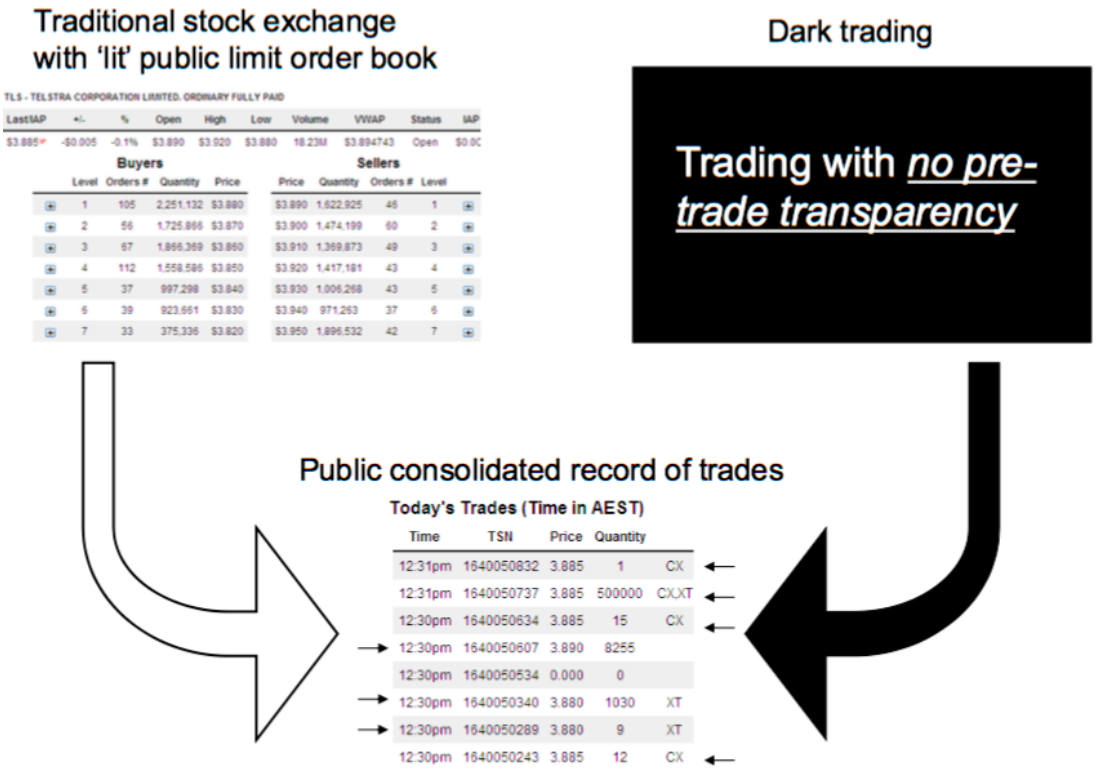


Figure 1: Lit vs Dark Trading [Comerton-Forde and Putniņš, 2014a]

Figure 1 provides an accurate explanation of the connection between a dark and a lit venue. The lit order book displays information on the current bids and asks of a given asset. If a trader analyzed the lit market in the time period between 12:30 and 12:31, the trader would expect to have a good in-

dication of the amount of trades and the current trading volume of the asset as he continuously observes orders getting picked off from the order book. If the trader checked the record of trades (Today's Trades), however, he would quickly realize that there were several additional trades on the same asset in the applicable time period. The black arrows on the Today's Trades matrix illustrates which trades were executed through both the lit- and dark venues.

Since electronic trading was introduced, dark pools were marketed as safe havens for block traders from predatory high frequency traders [SEC, 2016]. However, the perceived safety has proven to be illusory in many dark pools.

3.3 High Frequency Trading

"High-frequency traders use computer algorithms - a.k.a., algobots - to arbitrage away the most infinitesimal price discrepancies that only exist over the most infinitesimal time horizons"[TheAtlantic, 2016]. Whilst it was previously humans who acted on information, it is today computers using advanced algorithms that act on information in an instant. The "HFTs try to profit from price movements caused by large institutional trades, or block trades" [Forbes, 2016]. The programs the computers are equipped with evaluate the stock market trades, and make transactions based on this.

In the theory of Trading and Market Microstructure, high frequency traders can often be looked upon as informed traders [Schenk-Hoppé, 2016]. Using several techniques, HFTs are able to gather information regarding the underlying value of the traded asset faster than others. To maximize profits, HFTs thereby compete with each other in order to match trades with uninformed traders. According to Øyvind Schanke [Schanke, 2016], HFTs are the new liquidity suppliers.

Although the HFTs only account for a small portion of all traders, they are responsible for almost two thirds of all stock market transactions. Their strategy is to trade as much and as quickly as possible in order to profit on the margin. Although the profit margin might be small, the total value is large because of the volume. The best HFTs are the ones that react quicker, perhaps a millisecond before the others. Having said that, we can move into the terminology of co-location. A computer which is located close to the

source of the information will receive the information quicker, and thus be able to react faster than its competition. Consequently, it will be more profitable than other HFTs.

In addition to co-location, the HFTs can outcompete its competitors by pinging. This is a "This involves HFT firms placing buy and sell offers in 100-share lots for every listed stock" [CRS, 2014]. When large trades are made companies will use algorithms to break the large orders into smaller ones and thus feed them quietly into the market. The HFTs might discover this through a "ping", or several "pings", and thus manage to achieve a nearly risk-free profit at the expense of the buy-sider/company executing the large transaction.

3.4 Price Discovery

Price discovery is the process of determining the prices of assets in the marketplace through the interaction of buyers and sellers [Harris, 2002]. In other words, if the equity was only traded in one market, i.e. a stock exchange, and all information was known, there would be perfect price discovery, and the prices would be informative.

4 The Dark Pool Effect on the Buy-Side

In recent years the debate on dark pools' impact on price discovery has been a widely debated topic in the financial world. In a survey conducted by the CFA Institute (2009), 71% of the respondents considered dark pools to be"somewhat" or "very" problematic for price discovery. Furthermore, The European Commission (2010) stated that "a[n] increased use of dark pools ... raise[s] regulatory concerns as it may ultimately affect the quality of the price discovery mechanism on the lit markets". In this part of the paper, we wish to shed light on the effects dark pools have on the buy-side of the market.

4.1 Dark Venues and the Buy-Side

There are different perspectives on the future use of over the counter trading, which include all off-exchange trades, and especially dark pools. Some argue that dark pools are essential to secure efficiency in the market as well as to protect investors. However, others argue that dark pools are harmful for price discovery and that they do more evil than good.

The traditional reasoning behind using dark pools from a buy-side perspective has been the need to reduce market impact and to save on transaction costs. This is done by trading at the midpoint of the best bid and offer, thus saving the spread. However, the order sizes have diminished over the years as dark pools become more accessible to the public. This is reflected in the drop of the average size of executed orders in dark pools, which in 2014 were 200 shares. This is equal to the average order size on the European lit exchanges.

Market fragmentation has swept over the financial world along with the proliferation of "slicing and dicing" algorithms. These algorithms aim to cut big orders into smaller pieces and spread them out over time and on different venues. With the rise of market fragmentation, the concentrated markets with great order depth are few and far in between. Concentrated markets can generally provide higher certainty of execution and greater transparency related to pricing, along with greater order depth. However, downsides include monopolistic exchanges where operators aren't incentivized to reduce trading cost, but rather the opposite. [Lexicon, 2016].

On the other hand, fragmented markets provide competition for the order flow and provide incentives for the trading venues to reduce transaction costs. However, they are often limited by their lack of order depth and thus their inability to provide liquidity to the buy-side. In the developed financial markets there is a definitive trend towards more fragmented markets. This is illustrated by the decline in Nasdaq's and NYSE's market shares, caused by new market operators entering the market.

4.2 The Quality of Dark Pools

The quality of dark pools varies. The graph below shows the percentage amount of illiquid trades in some of the most significant dark pools in Europe. We define an illiquid trade as a trade that, due to its order size, could not have been executed on a lit venue.

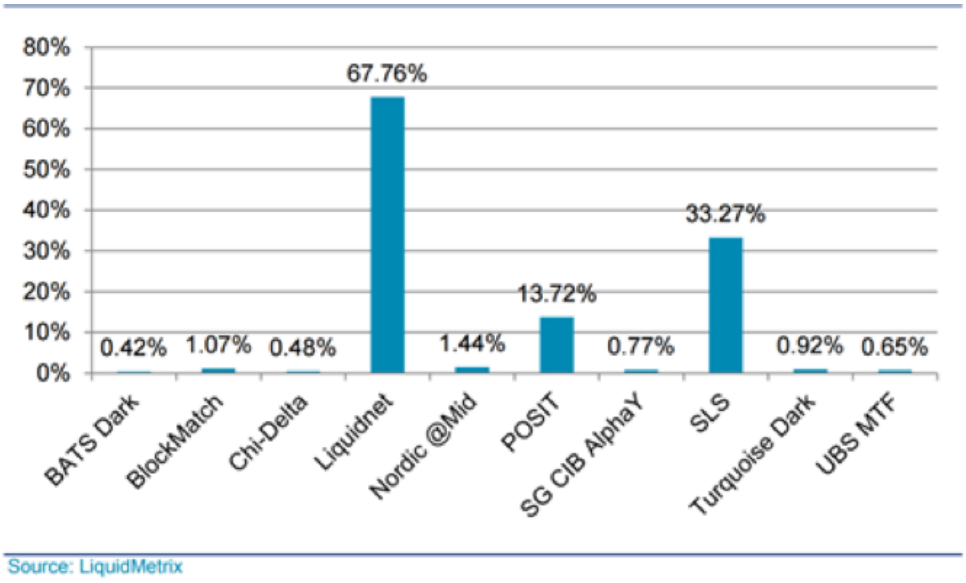


Figure 2: Percentage of Illiquid Trading on European Dark Pools [TredeTech, 2014]

The amount of illiquid trades can provide us with information about the quality of a given dark pool. All the transactions from the HTFs will show

up as liquid trades in figure 2. Although we cannot tell whether the liquid trades are from HTFs or not, we can conclude that an illiquid trade does not come from an HFT. Thus, it is possible to assume that a higher amount of illiquid trades in a dark pool reflects a lower amount of HFTs in the pool. With this in mind, it is evident that dark pools have different policies on which traders are allowed to access their venue, and there is therefore a difference in the amount of HFTs in the different venues. Based on figure 2, it is reasonable to believe that Liquidnet, has a stricter HFT-policy than BATS Dark, and is thus a safer market place for institutional traders.

There are, however, several trades in the dark venues that are not connected to block trading. The reasoning behind this is the aforementioned reduction in transaction costs [TredeTech, 2014]. In most of the European dark pools, more than 99% of all trades were made somewhere in between the best-bid-offer (BBO). When trades are made in this range, investors stand to make a profit compared to trading in lit venues. This is shown in the figure below. It is, however, worth noting that this assessment was made in isolation, and may not be representative for a larger population [TredeTech, 2014].

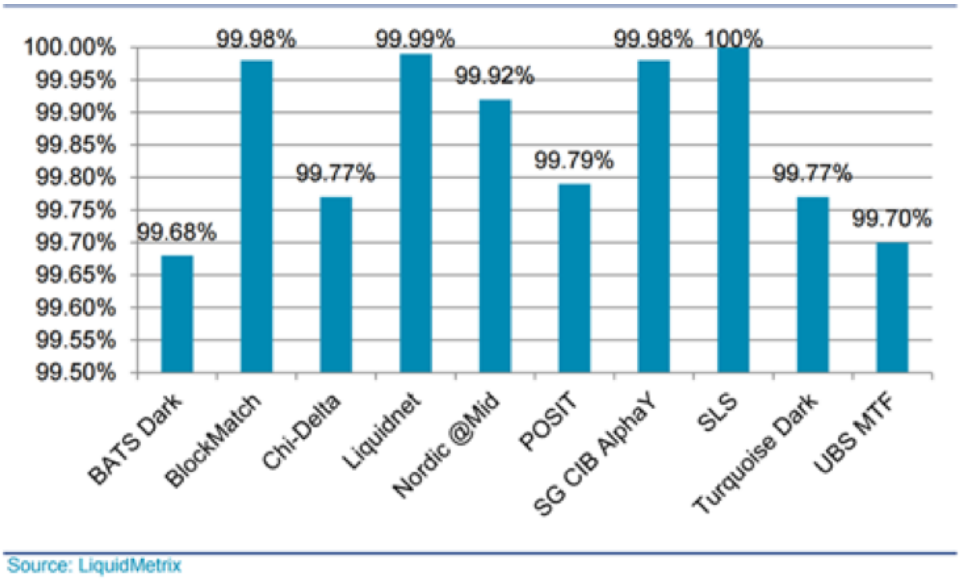


Figure 3: Percentage of Trades Executed Inside the European Best-Bid-Offer on European Dark Pools [TredeTech, 2014]

4.3 Background on the Barclays Case

As previously stated, many traders use dark pools in order to avoid HFTs. Although this creates an incentive for banks to create these types of venues, the banks' have an opportunity to gain more profits by allowing HFTs in to their venues. This creates a conflict of interest which is exemplified by the lawsuit on Barclays by the Securites and Exchange Commission (SEC) in 2014. Barclays, one of the largest banks in the world, owns and operates Barclays LX which is an ATS that operates as a dark pool. The LX "matches, and executes orders from clients and direct subscribers to buy and sell NMS stocks". NMS stock are "exchange-listed equity securities and standardized options" [SEC, 2016]. In May 2014 Barclays LX was the second largest NMS stock alternative trading system. The LX was portrayed as a safe haven for institutional traders clear of predators that would be encountered in the regular market. They would keep the dark pool safe by developing Liquidity Profiling, "run surveillance reports every week to make sure that there is no toxic flow in [LX's] book", and "utilize direct feeds from exchanges to deter latency arbitrage" [SEC, 2016].

4.4 The Case Against Barclays

In the beginning LX subscribers could protect themselves from trading with certain types of subscribers based on their classification. For example, if one type of subscriber, an investor, did not want to trade with HFTs, the investor could ask Barclays to impede trades with the electronic liquidity providers, which include HFTs. In order to allow the subscribers to narrow down whom they wanted to avoid trading with, Barclays developed a tool called Liquidity Profiling. This would be a "sophisticated surveillance framework that protect clients from predatory trading". The Liquidity Profiling would determine a subscriber's aggressiveness based on its actions instead of its classification. Each subscriber would be put in a category from 0 to 5, where 0 represented the most aggressive flow, and 5 the least aggressive. This appears to be a clever move to avoid predatory traders, because a subscriber can specifically avoid those who act predatory, instead of the traders the subscriber believes to be predatory. However, Barclays, at several instances overrode these objective evaluations. For example, the Liquidity Profiling recognized their own market making desk as being a type 0 or 2 trader, which ranks it among some of the most aggressive traders. Barclays overrode this and

categorized it as a type 4 trader. In addition to this they also overrode the categories of institutional traders and other subscribers. This caused two problems. Firstly, the subscribers were not made aware of the overriding, and, secondly, traders who believed they were "free" of aggressive traders, were now unconsciously trading with them.

As previously mentioned, many of the traders in a dark pool are large institutional traders, for example hedge funds. At some points these might want to liquidate their positions. They choose to do this in a dark pool to avoid moving the market and reduce their profits. The hedge fund looking to liquidate its position, and has chosen to only trade with type 4 and 5 traders, may end up in financial difficulty if some of the type 4 or 5 traders are actually type 0 and predatory. If and when the predatory trader notices the presence of the institutional trader, through for example pinging, the predatory traders will withdraw liquidity instead of providing it. In the case of the Barclays market making desk, which is supposed to provide liquidity but was moved from type 0 to type 4, this leads to a problem for the institutional traders as it will be negatively impacted from the predatory market making desk acting opportunistically towards the institutional trader [Brunnermeier and Pedersen, 2002]. Although Barclays claim that the institutional traders are experienced and should be aware of the risks of the market, the institutional traders are trading on false premises and might thus be taken off guard.

In addition to reclassifying traders, Barclays made other questionable moves with their dark pool. In their "Pitchbooks", which are "PowerPoint presentations to market LX and Barclays' electronic trading capabilities to current and prospective LX subscribers" [SEC, 2016], they misled their clients by not providing the whole picture. They avoided to show the size of their largest traders, which could have made the customers aware of predatory traders, in order to make the LX look more favorable and "safe". Furthermore, Barclays "failed to establish adequate safeguards and procedures to protect subscribers' confidential trading information" [SEC, 2016], as Barclays employees who knew the "relevant computer language" [SEC, 2016] could see the executions and orders the next day. Lastly, Barclays also claimed to use direct data feeds in order to avoid latency arbitrage. However, it was discovered that the LX did not, for example, use a direct market data feed from the NYSE, which exemplifies the lack of data and speed in the LX.

Although Barclays, in theory, could argue that they in all cases had not done anything wrong, they had misled their subscribers, and perhaps blindsided them into trading with predatory traders. It can be argued that the institutional traders should know the risks they take, and indeed they should, but the institutional traders should at least know the terms of the playing ground. As a result of this misleading, Barclays admitted to "violating securities law in the ways it operated the pool" and will pay a $70m fine [BBC, 2016].

4.5 HFTs Role in Price Discovery

The HFTs can arguably be seen as influencing the level of price discovery. As previously mentioned, the HFTs use "pinging" to detect possible large orders in dark pools. When several minor orders have been filled, the HFTs are likely to have come across a large order. Once the order has been detected in the dark pool, orders will be sent from the HFTs to the lit market in order to profit from the information gathered in the dark pool. Once the HFTs manage to catch a glimpse of the transaction occurring in the dark pool, they will use this knowledge to execute trades on the lit market.

If for example an HFT detects a large buy order of a stock in a dark pool, it goes to the lit venue and buys the exact same stock. The order is large, so the price of the stock will increase gradually until the whole order is fulfilled. Then the HFT goes back to the dark pool and sells the large order to the detected buyer. However, the price is now higher and the HFT will make money. The prices would in this example actually be more informative, because the result is the same as if the buyer would have gone directly to the lit market. Which thus will create a form of price discovery.

5 Dark Pools and its Impact on Price Discovery

This part of the paper will discuss the consequences of a dark pool alongside a lit venue. The link between dark pools and price discovery has been a debated area. This is due to the fact that the relationship between order size, execution probability and information seems difficult to measure [Ye, 2012]. However, recent theoretical papers have claimed a breakthrough on the direct price discovery effects when introducing a dark pool.

Haoxiang Zhu, of the MIT Sloan School of Management, and Mao Ye, of the University of Illinois, are amongst the leading academics on the field of price discovery and dark pools. They have published papers with contradictory views. In short, Zhu argues that dark pools improve price discovery, while Ye argues the opposite.

5.1 Zhu: Positive Effect on Price Discovery

Zhu's paper is based on a model of trading behavior. The model includes not only informed traders who act on the basis of detailed knowledge about a stock, but also liquidity investors with different reasons to trade, i.e. rebalancing a portfolio. The informed traders aim to profit from proprietary information from the value of the traded stock. The two types of traders choose between a lit exchange and a dark pool. The lit exchange displays an order book where the bid and ask prices are listed. In the dark pool the orders are matched at the midpoint of the bid and ask prices of the lit market. The dark pool order flow is not supported by any market makers. Sending an order to the dark pool therefore involves a trade-off between potential price improvement and the risk of not executing the trade.

The risk of not executing is the key to Zhu's results. Informed traders are likely to have similar opinions and their orders are therefore positively correlated with each other. This effect causes the informed traders to cluster on the same side of the market, which in turn causes the liquidity orders to have a higher probability of execution in the dark pool. Zhu suggests that

the difference in execution risk pushes relatively more informed traders into the lit venues and relatively more uninformed traders into the dark pool, which in turn improves price discovery.

5.2 Ye: Negative Effect on Price Discovery

Ye (2012) contributes to theory of finance and market microstructure by proposing a model that analyses three types of agents in two periods. The three types of agents are informed traders who know the value of the asset, liquidity traders who, like in Zhu's model trade for exogenous reasons, and a market maker who sets the price on the lit exchange. The essential difference between Zhu and Ye's model is that Ye only allows the informed trader to choose between the lit and the dark venue.

Ye claims that the informed trader has an incentive to both trade less aggressively on the lit exchange and trade more in the dark pool. The effects of trading less aggressively will firstly, lead to a smaller price impact, allowing the trader to augment his profit from the information. Secondly, the informed trader has an incentive to hide his information by trading in the dark pool because it will not affect the price. The incentive is caused by two trading costs the informed trader must consider. The cost of shifting the market price when placing orders on the lit exchange, and the cost of not getting an order executed in the dark pool. Ye's findings conclude that dark pools are harmful for price discovery when informed trades are able to trade in both the lit venues as well as the dark pools simultaneously.

5.3 Discussions on the Findings

Zhu argues that price discovery is improved due to the fact that the dark pools separate the uninformed and informed traders. Microeconomics, where perfect information is assumed, explains how perfect price discovery originate from the equilibrium between supply and demand, thus the proper price. As previously explained, the uninformed traders do not have access to information regarding rapid changes in the fundamental value. Having a larger percentage of the uninformed traders in the dark venue, where trading does

not affect price, therefore reduces the number of trades executed against the fundamental value.

In order to maximize profits, informed traders must attempt to exploit any mispricing in the fundamental value. The lit exchange in Zhu's model will, as previously explained, include a relatively higher percentage of informed traders. This, in turn, causes a greater competition of executing favorable trades when the asset is mispriced. The lit market is where the prices are formed, thus making the price discovery process more efficient. Zhu concludes that the effect of separating the uninformed and informed traders decreases the amount of random noise on the lit market, which improves price discovery.

Ye on the other hand, argues that dark pools harm price discovery because the informed traders will trade in both the dark and the lit venues. According to Ye, price discovery depends on the level of liquidity trading and fundamental value uncertainty. Ye argues that the informed traders reduce their aggressiveness on the lit market in order to avoid a negative externality on their dark trading profits which leads to reduced price discovery.

5.4 Comerton-Forde and Putnins: Depends on the Level of Trading

The research done by Comerton-Forde and Putnins shows that trades executed in the dark market tend to be less informed than trades executed in the lit market [Comerton-Forde and Putniņš, 2014b]. The high level of dark trading in the lit market increases adverse selection risk and the lit market's bid-ask spread, which is consistent with the theoretical predictions of Zhu. As dark trading increases and adverse selection risk on the lit market becomes more severe, the order book quotes take on a more important role in impounding new information compared to prices [Comerton-Forde and Putniņš, 2014b]. When adverse selection risks are high, the informed traders gain a competitive advantage in providing liquidity. Comerton-Forde and Putnins conclude that dark trades play a greater role in price discovery as dark trading increases. However, the dark market's share of price discovery increases at a slower rate than its increase in market share, which provides further evidence that dark trades tend to be less informed than lit trades [Comerton-Forde and Putniņš, 2014b].

The informed traders on the lit market would like to trade with the uninformed traders in the dark market. However, the informed traders tend to cluster at one side of the market[Zhu, 2013], which limits the execution probability.

According to Comerton-Forde and Putnins the overall impact on informational efficiency depends on the level of dark trading. For a typical stock, the level of dark trading is not harmful. However, for stock-days with high level of trading, price discovery is harmed. The article provides evidence that regulatory action should consider the level of dark trading in specific stocks, rather than the aggregate market level of dark trading. Furthermore, Comerton-Forde and Putnins find no evidence that block trades negotiated without pre-trade transparency harm informational efficiency. This is an interesting result, having in mind that dark pools were originally created for this purpose. Block trading would also avoid temporary price distortions that would have occurred if the block was traded in the lit market.

6 The Asset Manager's View on Price Discovery in Dark Pools

Lastly, the view of Norwegian Bank Investment Management should be included in the discussion on dark pools and price discovery. NBIM is a part of Norges Bank and is responsible for managing the Government Pension Fund and thereby the process of its investments in foreign exchange reserves internationally[NBIM, 2016]. NBIM's view on dark pools is explained in the article "Sourcing Liquidity in Fragmented Markets" published in 2015, as well as through a guest lecture in 2016 by the former chief investment officer for asset strategies & head of trading, Øyvind Schanke.

NBIM believes that dark pools play an important role in ensuring well-functioning markets. With NBIM's order sizes, dark pools are essential because they bring together institutional traders with long term investment strategies. Their view on the dark pool price discovery effect is based upon the works of Comerton-Forde and Putnins as earlier reviewed in this paper. NBIM stresses the newfound importance of limit order book depth and the ratio of volatility, as these now serve a greater purpose in the price discovery process. NBIM argues that the trades that occur on the lit exchanges are more informative due to the lit markets being later in the investor's, and NBIM's, preferred list of venues. This coincides with the findings of Zhu with the argumentation that a higher percentage of informed traders on the lit exchange lead to enhanced price discovery.

In order to maintain well-functioning markets, NBIM hopes for more transparent matching mechanisms surrounding both the lit and dark venues. Proper price discovery involves sufficient pre-trade information. More pre-trade information and transparency can be achieved by more available information regarding order types and matching priority for the hidden exchange's systems. Furthermore, a higher transparency about available order types, especially if they differ by client, will empower the price discovery process [NBIM, 2015]. NBIM clarifies that dark pools differ in transparency, and has therefore created a whitelist of permitted trading venues that their brokers are allowed to operate in. They will stay away from venues if the dark pool's transparency and the price discovery processes are not adequate.

7 Conclusion

This term paper has discussed the effects dark pools have on price discovery and the buy-side consequences. Throughout the paper we have attempted to emphasize different factors that will lead to well-functioning markets.

There are many opponents of dark pools due to their lack of transparency. The recent Barclays case serves as a warning that one needs to be selective with which dark pools to use. We have observed that not all dark pools are the same, and that the volume traded at different venues are ranging from blocks to smaller trade volumes.

Our analysis of current price discovery models shows that the view on whether or not dark pools are harmful for price discovery is a much debated area. Due to recent empirical studies, however, asset managers like NBIM now states that dark pools serves an important role in the price discovery process. Comerton-Forde and Putnins supports Zhu's origional idea that dark pools provide a separation between informed and uninformed traders which removes the amount of random noise on the lit exchange, thus improving price discovery.

7.1 In Contemplation

Dark pools and the challenges such venues face in an ever changing financial world has been supplementary to the FIN11 curriculum. The opinions and models of leading academics have direct relations to the terms, facts and challenges we encountered during trading simulations and background research throughout the course. Our analysis may consequently have some restrictions, seeing that our aim and focus might be more embedded in theory, rather than the real financial world. Contrary to these restrictions we believe our conclusions are realistic.

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