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HIDDEN AND FAST LIQUIDITY - HIDDEN ORDERS AND HIGH-FREQUENCY TRADING

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Abstract

This work focuses on two of the more frequent practices in financial (especially capital) markets - the use of hidden orders and High-Frequency Trading (HFT). Although the use of each of them may reach 40% of the market turnover - even 60% for HFT, the actual knowledge on how they affect liquidity, prices, and market structure is still limited - especially if they are combined. The presence of both of these practices may look controversial, as it seems to be going in the opposite direction to what some of the goals that market regulators try to reach - transparency and increase of market liquidity. Additionally, their use suggests first, to give a clear advantage to some traders while not knowing the exact consequences to others. The aim of this paper is, by performing a literature study, to structure the current knowledge on a very specific topic in the area of market microstructure - the use of hidden orders and High-Frequency Trading. This paper tries to show the motivations, strategies, and eventual price effects behind hidden orders and High-Frequency Trading. It is also important to mention that this paper is based on scarce empirical research available (mainly for the US market) and as such, it is intended to encourage further analysis and research on this important topic.

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Introduction

Both partial and fully hidden orders together with High Frequency Trading (HFT), despite their rather wide implementation, are still considered somewhat controversial as their market impact is not fully understood - especially when combined. The use of these type of orders can be considered conflicting with the aim of achieving market transparency, and together with HFT may also discourage other participants from engaging in financial instrument transactions - something that finally may induce lack of liquidity. This could result from the possibility that hidden orders may increase uncertainty among market participants and therefore could lead to an increase in transaction costs (eg. spreads). This uncertainty may also be a consequence from the assumption that behind hidden orders and HFTs are informed traders which try to increase their trading advantage against less informed traders - something known as *adverse selection*. It is worth noting that empirical studies are not able to confirm this thesis. Those that somehow test this hypothesis show that there should be rather no informational advantage in hidden orders, and HFTs have a goal other than *predatory* trading. Additionally, it doesn't seem logical to use hidden orders by informed traders, since these orders have the lowest priority of execution and may be not executed at all - in the case of any informational advantage it seems more rational to want to execute orders as fast as possible.

As to what liquidity is concerned, conclusions resulting from empirical studies (especially in the United States) show on one hand, that the use of hidden orders is not the source of a decrease in liquidity nor of an increase in price volatility. On the other hand, it has been observed that market participants have become more aggressive - traders increase order submissions, when hidden liquidity becomes visible, i.e. when hidden orders are executed. Going further, at times when electronic trading is performed faster, either by general technological improvement or specialised algorithmic HFT, hidden orders may also, in fact, become a defence mechanism for slower market participants. By using hidden orders these traders do not need to fear, to a great extent, adverse selection and they may even reduce transaction costs since hidden orders may be submitted at any desired price – similar to limit orders. HFT traders, on the other hand, take advantage of speed to avoid adverse selection.

High-Frequency Trading in the capital markets

High-Frequency Trading (HFT), just as the use of hidden orders, is by many considered to be controversial. Even so, currently in the US, HFT share on the total volume of equity markets is estimated to be around 50% (Breckenfelder, 2019) - down from an estimated 61% in 2009 (Gomber et al., 2011).

The presence of HFT in the financial markets has been the outcome of the development of processes in electronic trading that have occurred especially in the US capital markets. Not mentioning all the significant milestones in electronic trading, one of the most important steps for HFT was probably in 1976 when the NYSE gave the possibility of electronic purchase and selling of equities (Agarwal, 2012). The actual dynamic expansion of the HFT occurred in the 2000's when technology was sufficiently advanced. Studies show that HFT market share in the US grew from 20% in 2005 (in the EU nearly 0%), to 60% in the US and 40% in the EU - in just 4 years (Kaya, 2016). Currently, it has stabilised at a level of close to 50%.

Although HFT, being a type of Algorithmic Trading (AT) - the latter rather easy to define, the precise definition of HFT has become quite difficult to produce. This is because, in many cases there is no differentiation, apart from speed, between HFT traders and typical Low-Frequency Trading (LFT), as for example: *„[...] the use of high-speed computer algorithms to automatically generate and execute trading decisions for the specific purpose of making returns on proprietary capital*" (Jarnecic & Snape, 2010). Because HFT do not rely only on speed (Narang, 2010), instead of a hard definition, it seems more adequate to present HFT properties like: proprietary trading, high number or orders, short holding periods, frequent order cancellation, liquid instruments, low latency requirements, and HFT traders will not have open positions by the end of the day (Lenczewski Martins, 2018).

Some of the controversies negatively affected by the speeds generated by HFT are the increase in volatility, adverse selection, or price discovery, but research results are at least not conclusive. Many studies show for example that there is no direct correlation between HFT and an increase of price volatility - see (Furse et al., 2012), (Brogaard et al., 2013; Chaboud et al., 2009). This last study goes even further by claiming that HFT may even decrease volatility. Contrastingly, another study shows that HFT may significantly increase adverse selection because

HFT due to speed, may process information, submit and execute orders more quickly than other traders (Biais et al., 2011). Of course, this last result seems to arise under the assumption that HFTs and LFTs have access to the same information at the same time, and they have the same price impact.

HFTs continuously invest large amounts of capital in the technology allowing them to increase the speeds around submission and execution, even from microseconds to nanoseconds (Stafford, 2016). The improvements resulting from speed on spreads or volume seem very limited (Gai et al., 2012) and it may suggest that any changes are a result from competition between HFT rather than a general market „improvement". One of the fears regarding HFT is that by using algorithms while at the same time taking advantage of speed, these traders may lead to significant market instability. One of these fears are flash-crashes as the one from 2010. On the 10th May 2010, the Dow Jones Industrial Average dropped almost 9% from the open, about 998.5 points - of which, a 900 point drop occurred in 5 minutes (Golub et al., 2012). It is essential to underline that while an algorithm had an important or even the most important share in this Flash-Crash, it was not an HFT algorithm, but rather an LFT algorithm triggered by a mutual fund (SEC, 2010). Deeper analysis even shows that HFT were initially the only market participants to provide liquidity to the market (SEC, 2010). Going further, studies not even related to Flash-Crashes show that HFTs may actually increase market liquidity (Hendershott et al., 2011; Malinova et al., 2013) - similarly as they provided liquidity in the Flash-Crash on the 10th of May 2010. At the moment, the (negative) market impact of HFT is considered to be limited and far less than it could be expected (Finansinpektionen, 2012).

Hidden orders in the capital markets

It is clear that the turnover generated by hidden orders, just as by HFT, has increased and both have become more popular among different exchanges. They are more commonly used in such exchanges as EURONEXT, ASX, NASDAQ, NYSE, Frankfurt Stock Exchange, Toronto Stock Exchange, and the National Stock Exchange of India - the difference relies on certain mechanisms of how these orders are executed or in the types of hidden orders. In the last several years, when comparing typical visible market or limit orders, there has been an increase in importance of hidden orders - both fully hidden and *Iceberg* orders. The participation rate of hidden orders in the exchanges total volume is quite different depending on the financial markets, their location, or even if they are traditional public trading venues or alternative trading systems (*Dark Pools*). Data from 2009 shows that the volume of hidden orders reached 40% of total volume of the EURONEXT, 28% of ASE (Australian Stock Exchange), or 16% of XETRA (Buti & Rindi, 2009). Other studies confirm these values and show how the interest in these orders has risen throughout the years. For example, for the NASDAQ in the period 2008-2013 the average volume for hidden orders was 13% - with the highest value of 17% in 2008 and the lowest (11%) in 2009-2011 (Gao, 2015). Since 2013, when the volume of hidden orders was around 15% of total volume, these numbers have only risen. Date from the SEC shows an increase in the volume of executed orders from 15% in 2012 to 30% in 2017 (Chakrabarty et al., 2017). The highest volume resulting from hidden orders in the US is estimated to be 45% reached in 2014 in the NYSE MKT (SEC, 2019). It is also necessary to underline that research studies show mainly the volume of executed hidden (fully or partial) orders, but not necessarily submitted and/or cancelled orders, implying that the actual interest of market participants in hidden orders may be significantly higher than what these numbers show.

Together with hidden orders and of similar importance are *Dark Pools,* where participants do not see the bids and the offers available (Bunge, 2013) - i.e. order books are not visible. The primary aim of these special purpose private trading venues is to allow institutional traders to carry out large trades without affecting prices significantly and not to pay an exchange's trading fees (Bunge, 2013). Dark Pools share in the total number of transactions in the US is estimated to have reached 32% in 2012 (Carmona, 2013). This is without a doubt a rising trend in the US, when taking into account 2010 values of 16%, and those of 2017 at 40% (CFA, 2019). As to the volume generated by Dark Pools, data from 2014 shows it reached 15% of all market volume in the US (CFA, 2019), while only a year later, this volume reached 18% (Aguilar, 2015). In the European countries, Dark Pools generated less than 1% of the market volume in 2009, but over 8% in 2016 (Petrescu & Wedow, 2017), or as some data show, even close to 9.6% (Aquilina, 2017). Although market transparency is in general considered to have a positive effect on the financial market, studies also show that hidden orders and hidden liquidity are very important elements to many

market participants. Otherwise, other mechanisms could be used to hide trading intentions, such as dividing orders into many markets, submitting and executing orders inside a brokerage (*Upstairs Markets*) or sending orders to *Dark Pools* (Bessembinder & Venkataraman, 2004). *Dark Pools* may be considered an alternative to hidden orders available in typical exchanges which institutional traders use when wanting to execute orders without a significant price impact, or to simply search for better prices than available on the market (Aquilina, 2017). Also, when taking into account their current share in the UK's capital market, studies performed by the FCA don't show *Dark Pools* to significantly affect either market quality or stability (Aquilina, 2017).

Hidden orders give traders the ability to define an amount (size) that will not remain visible in the order book - orders which can be fully or only partially hidden. Both of these types of hidden orders, are described as „*Hidden Orders*" although partially hidden orders are more often described as „*Iceberg orders*" as their visibility resembles the visibility of an iceberg over the water. In a partially hidden order, the trader defines a size smaller than the actual order size, which will be visible in the order book. For example, if the total size of the order is 10,000 and the partially visible size is 1000 then the order book will show each time 1000 until the order is fully executed, not presenting the actual size of the order that remains to be filled. EURONEXT for example, records the total size of the orders in the order book but only shows the size specified by the trader. On the EURONEXT, *Iceberg orders* are only available for instruments denominated in EUR, and for those orders with a size of at least 10000 EUR (which eliminates many retail traders) (Euronext, 2019). It is important to mention that execution of each of the predefined amounts of the partially visible order will have a worse time priority than the previous one. If the trader assigns 1000 as the visible size for an order with a total size of 10000, then for each partial execution it will resemble the submission of 10 visible limit orders of 1000 at different moments. Similar is the submission of a *synthetic Iceberg* (Gould et al., 2013), where the trader must follow the market very closely as he is submitting a new limit order of the similar size as of the one that would be visible in the *Iceberg* order. At the same time, each new order will need to be submitted at the closest moment of when the previous limit order was executed. But as Gould et al. underline there is a crucial difference between Iceberg orders and synthetic ones, when a considerable market order arrives (Gould et al., 2013). Market orders take all the visible liquidity and in the end all the hidden liquidity at the specified price - up to the size of the market order. This means that in an *Iceberg order*, the remaining hidden sizes will sequentially be filled at the specified price. In the case of a *synthetic Iceberg*, each new limit order may be executed at a new price level simply because the market order will deplete the liquidity (visible and hidden) that was available at a price level. Since the new order will not be at the same price level, due to time priority rules, it may be executed at a worse price level than previously planned.

Traders taking into account hidden orders need to build an appropriate strategy involving decisions related to order size and price according to potential order execution. In contrast to visible limit orders, it will also be necessary to decide to what extent an order will not be visible. If most of the order size is visible, then the hidden order may stop its function as a hidden one and become a typical limit order, but increasing the visibility of the hidden order may increase the chance that the order will be filled due to the visibility priority rule. A study by Buti & Rindi, shows that the optimal visible vs. hidden order size to be 3 to 7 (Buti & Rindi, 2009). Traders will also probably avoid using hidden orders when the spread is tight as there is little room for price improvement. This is a similar observation to the one when traders prefer using hidden orders in small market cap stocks, and in these cases, will prefer to submit hidden orders at prices further away from the market prices in order to increase potential profits (Buti & Rindi, 2009). When spreads are tight, traders prefer to increase order aggressiveness through market or limit orders. It is interesting that studies regarding HFT show a quite different behaviour of hidden order book placement, in comparison to non-HFT. The results of such a study in the National Stock Exchange of India (NSE), shows that close to 46% of the hidden orders are placed *at* or *better than* market prices in comparison to the 1.5% of visible orders (Chakrabarty et al., 2017). Going further, 97% of hidden orders submitted by HFTs are submitted within 5 ticks of the market prices, while traders not using algorithms place 39.12% of hidden orders away from 5 ticks of the market prices (Chakrabarty et al., 2017). This behaviour may be explained by the liquidity providing competition between HFTs by placing hidden orders at gradually higher/lower prices.

The arguments behind the decisions for determining which type of orders to choose may be very complex and

dependent on the pursued goals and strategies. They may be related to trader information level, potential price impact, or even order execution priority. Market transparency may increase the market participant's exposure, as information will flow in a more public fashion and more quickly than in a hermetic market. This will also mean that less informed traders may try to build strategies targeted at those informed traders (D'Hondt et al., 2004). One of these mechanisms is *frontrunning* which aims at having profits by achieving and using any type of information that has impact on prices before they are available to other market participants. Going further, this may also mean that other „*parasitical*" or *predatory* traders, by making complex order book analysis, can lead these newly informed traders to have significant exposed orders. Of course, *frontrunning* or *predatory* trading may not always be profitable since the risks or costs may be high, so it requires that potential price changes have a minimal value - taking also into account the capital engaged in the trades. By using hidden orders, traders may avoid exposure to all these (and other) different risks. Traders using hidden orders must also take into account that these orders may not be executed at all as they have the least priority when compared to other orders. This can be treated as an *opportunity cost* in return for the anonymity traders receive. Information asymmetry and thus the share of hidden orders may also be conditional on the types of financial instruments. Stocks with the largest market capitalisation suggest having more information available, for information to flow more rapidly, thus for the information asymmetry to be smaller. The latter means there is a smaller risk of *adverse selection* in comparison to stocks with lower market capitalisation. Empirical studies (between 2012-2015) in the US clearly show the higher share of hidden orders of 27.6% in stocks with lower market capitalisation in comparison to 13% in stocks with the highest market capitalisation (Jain & Jain, 2017). As to what HFTs are concerned, the previously mentioned study performed in the NSE shows a similar behaviour, although the highest share of hidden orders was seen on medium market capitalisation stocks at a 36% level while for the highest market capitalisation stocks, the share of hidden orders submitted by HFT is only at a 10% level - in comparison to the 66% level of hidden orders (*Iceberg*) submitted by non-HFT (Chakrabarty et al., 2017). A similar behaviour as with market capitalisation may be seen with trade volume, i.e. hidden orders will be more often used on stocks with higher volume than those with lower volume - because, among other reasons, there is higher probability that orders will be executed quickly without a significant price impact (higher liquidity). The study by Jain & Jain shows that in the US the share of hidden orders in low volume stocks is greater than 21%, while for high volume stocks it is closer to 15% (Jain & Jain, 2017). Along with volume, there may be questions as to what the share of hidden orders may be in high and low volatility stocks. As mentioned before, if traders rather prefer to submit hidden orders in stocks with wider spreads, then it is logical to expect a similar reaction in stocks with higher volatility. As such, the study by Jain & Jain confirms this assumption showing a higher share of hidden orders in higher volatility stocks - close to 17% in comparison to 11.6% in low volatility stocks (Jain & Jain, 2017).

The role of hidden orders in the price discovery process and market stability

The use of electronic Order Books is an important step in order to increase market transparency because market participants may in real-time observe order values that have been or will be soon executed. While in every market traders may submit both market and limit orders, in others, completely or partial hidden orders may additionally be available. On one hand, permitting the use of hidden orders may increase or encourage increase liquidity by those traders that feared showing their strategy or trading objectives (Pardo & Pascual, 2012). On the other hand, the use of hidden orders may also decrease market transparency - what may in the long-run affect transaction costs, information asymmetry and finally, it may affect price efficiency understood here as the ability for prices to adjust to all available information. A study by D'Hondt et al. performed on the EURONEXT shows that close to 35% of the market depth around the best 5 ticks from the best prices (*Bid/Offer*) of which, 20% at the best prices, are supplied by hidden orders (D'Hondt et al., 2004). This fact brings the attention to an important element resulting from using hidden orders - available liquidity, which is not only the one visible in the order books which is in fact considerably higher - which may give a much different impression of the market, than in reality. The study by L. Tuttle in 2003 for example, shows that 25% of the available liquidity at the best prices in the NASDAQ 100 is delivered by hidden orders - interestingly enough, this is most probably an additional supply of

liquidity and not a shift in liquidity from visible to hidden orders (Tuttle, 2003).

The presence of hidden orders in the financial market leads also to the introduction of new mechanisms aimed at searching for this hidden liquidity. Some traders may submit many small orders inside the spread, which are soon after cancelled - a mechanism known as *„pinging"* (Furse et al., 2012). This procedure, or tool, may be very useful for some market participants, especially for HFT traders to considerably quickly close unwanted positions that may already be open (Xu, 2013). *Pinging* can be considered an aggressive mechanism of liquidity taking, as orders are eventually executed at less favourable prices in comparison to market-making but at the same time it is less aggressive than market taking since *pinging* does not *cross the spread* (Xu, 2013). Pinging is most often done using *Immediate-Or-Cancel* (IOC) orders which are either partially or fully executed. If only a portion of the order's value is filled, the unfilled part is immediately cancelled. Without this last feature, there would be a smaller amount of *pings*, and no additional information would derive from the order book and submitted orders. In the end, it could lead to an even smaller market transparency as a result from the increase in hidden order submissions. Another possible problem that could arise from not allowing *pinging* and hidden orders is the possibility of a lower probability of execution of visible limit orders further away from the best prices, which diminishes the available liquidity. Additionally, studies made by Buti & Rindi or those by Anand & Weaver on the TSX (Toronto Stock Exchange) show that market depth inside the spread is significantly higher when hidden orders are allowed (Buti & Rindi, 2009), {Anand and Weaver, 2004, #7324} which is a significant step forward for price improvement. Other studies performed by Bessembinder & Venkataram show that hidden orders even reduce transaction costs for block trades (Bessembinder & Venkataraman, 2004). Bindi & Rindi also highlight two contradictory effects in the order book offsetting the impact of hidden orders, under specific conditions. First, spreads become wider with the use of hidden orders, while soon afterwards these spreads become tight. When the use of hidden orders results from a deliberate action to avoid trader exposure to price wars, this will lead to the widening of spreads, although when the market discovers the presence of hidden orders it will also increase the trader aggressiveness that tightens the spread (Buti & Rindi, 2009). These findings are, of course, not general rules. For example, Foley, Malinova & Park in their studies on the TSX show that the use of hidden orders led to the widening of quoted spreads and therefore transaction costs, while at the same time leaving market depth, volume and volatility unchanged (Foley et al., 2013). Somewhat similar to the studies of Buti & Rindi, the studies of E. Moro et al. show an analogous effect but related to prices - after hidden orders are filled, prices have the tendency to revert to a similar level as the previously one (before hidden orders were executed), and the *„permanent impact is equal to roughly 0.5-0.7 of the temporary impact"* (Moro et al., 2009). A study by A. Lepone & M. Mistry also shows there may be a significant temporary price impact (within 10 min) of hidden orders - if they are submitted aggressively (Lepone & Mistry, 2011). The mechanism affecting prices with the use of hidden orders is not directly related to their use but related to the liquidity that has been increased by them, and also the liquidity supplied by market orders which affect prices in the long-run (Frey & Sandås, 2009).

As HFT has become an important part of the financial market, so have studies regarding the strategies and effects of this trading method, including the eventual use of hidden orders. Non-HFT traders using hidden orders may actually be using a mechanism allowing them to compete with significantly faster traders. As non-HFT act as market makers with a wider spread than HFT, the probability of execution is certainly lower. When orders become hidden, non-HFT have the possibility to submit orders at any price (at tighter spreads), while at the same time not being concerned of the potential exposure to informed traders. Studies performed between 2012 and 2015 on the NASDAQ show that non-HFT are responsible for delivering hidden liquidity at a level of 70% of all hidden orders (Gao, 2015). On the contrary, HFTs may not be interested in hidden orders, as it becomes more difficult to make transactions with less informed traders and prefer using order submission/update/cancelation speed as a method to safeguard against adverse selection. This shows that parallel methods to protect against adverse selection may rely on both the advantage of not having visible orders and the technology (speed) advantage (Gao, 2015).

Summary

High-Frequency Trading and hidden orders, although their effects in the financial markets may not be fully

understood, the steady turnover generated in the capital markets throughout the years suggests a rather mature progress of these mechanisms. The share of HFT volume in the equities market is estimated to be 50% in the US and close to 40% in the EU. The volume generated by executed hidden orders isn't very far behind either with an estimation of 30% in the US (2016) and 40% in the Euronext (2009).

By performing a literature analysis, this paper aims in structuring the current knowledge on HFT and hidden orders - also when both are combined. This paper shows that the goal for using HFT and hidden orders is in great part to reduce adverse selection exposure and so are not necessarily used by the most informed traders. Additionally, it is shown that both of these mechanisms do, in fact, lead to the increase of market liquidity and not the opposite, first because hidden orders encourage institutional traders to become more active not fearing adverse selection, and secondly the main HFT business model is liquidity provision and through speed they reduce adverse selection exposure. Going further, the initial concern related to HFT that they could generate *Flash-Crashes* is unfounded as shown in the case of the 10th of May 2010 *Flash-Crash* they were initially the only liquidity providers. Not only that, the presence of HFT in the capital markets decreases volatility, tightens spreads (just as hidden orders do), and reduces information asymmetry. As a result, from these analyses and generated volume, showing deep interest mainly from institutional traders, these mechanisms do not seem to negatively affect financial markets, but rather the opposite. This conclusion needs of course, to be continuously updated as the market evolves, and hopefully this paper will encourage further studies.

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