



Introduction to HFT Scalping Strategies

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This paper summarizes the intentions, key properties and observable effects of the particular class of high frequency trading known as HFT scalping. By using market structure advantages that have in effect circumvented the regulatory framework of Regulation NMS, HFT firms employing these strategies dominate US equity market volumes. This class of HFT trading leads to observable market phenomena such as high frequency price fluctuations, low fill-to-cancel ratios and liquidity gaps. Traditional electronic execution services and execution strategies commonly utilized by buy side equity traders often operate in a manner that is exploited by HFT scalping strategies.

HFT scalping strategies use market structure advantages to the detriment of counterparties unversed in the often undocumented nuances of exchange special order types and order matching engine logic. This paper does not directly address closely related high frequency strategies such as latency arbitrage and rebate arbitrage, though these strategies often use concepts and techniques from HFT scalping. While this paper's focus is on the US equity markets, the basic concepts of HFT scalping are applicable to financial markets in general.

1 HFT Scalping Strategies

High frequency trading accounts for over half of all trades and messages on the US equity exchanges.^{1, 2} Many high frequency strategies, including rebate arbitrage, latency arbitrage, order anticipation, and high frequency statistical arbitrage, have origins in and/or borrow techniques from HFT scalping, which is characterized by:

- High Frequency Turnover – passive scalping of a micro-spread
- Queue Position – a dependence on order rank and order book depth
- Low Latency – precise and timely reaction to market microstructure events
- Exchange Microstructure – usage of special order types and order matching engine features
- Rebate Capture – subsidized costs through “post only” orders and tiered rebates
- Low Risk Tolerance – avoidance of risk and usage of market book depth to reduce risk

¹ Financial Stability Oversight Council. “2012 Annual Report.” 18 Jul 2012. p 88.

<http://www.treasury.gov/initiatives/fsoc/Documents/2012%20Annual%20Report.pdf>

² Zhang, X. F. “High-Frequency Trading, Stock Volatility, and Price Discovery.” Dec 2010. p 41.

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1691679



Basic HFT scalping originated as a simple spread capture strategy – lean on order book depth, post on the best bid/offer and flip to the other side – from the Chicago futures markets, spreading to the equities markets in the early 2000’s.³ Over time, it evolved from a straightforward flipping strategy to the HFT scalping that dominates today’s US equity exchanges, where profitable rebate capture when making a “zero width” market by buying and selling at same price is possible. Its core intent is, on every round trip trade, to step ahead of supply-and-demand imbalances evident in market depth, and to capture a micro-spread by closing on the other side for a tick or to scratch out by closing on the same side, both of which are favorably subsidized by rebate in the maker-taker market model that is currently prevalent in US equities. A prerequisite is favorable queue position: the scalper must have a high probability of entering the trade as well as a high probability of either exiting for spread (winner) or, if the winner cannot be obtained, of exiting for scratch to avoid losses. Absent a reliable prediction on what the next tick will be, this simple win-or-scratch strategy should not be profitable in a competitive, fair and orderly market, where competition for queue position and favorable execution would presumably be saturated.

To make it profitable, there must be some structural advantage (alpha) in addition to the basic order book depth asymmetry signals and execution tactics. The HFT scalpers’ alpha is not a traditional prediction of market movement; it is an “effective alpha” obtained through the exploitation of market technologies (i.e. exchange “plumbing”) and market microstructure. HFT scalping methods that leveraged the precursor to spam-and-cancel⁴ strategies, using post only orders (order types that discriminate against order flow by trading only against marketable orders willing to pay taker fees), gradually gained market share before the adaptation of Regulation NMS in 2007. Upon the technological and microstructure changes that were introduced to the exchanges after the adaptation of Regulation NMS in the US equities markets, HFT scalping’s growth exploded.

Low latency order placement, originally a stand-alone alpha that enabled HFTs to race to the top-of-queue in a “winner-take-all” competition, is now simply a prerequisite for conducting any variant of HFT scalping strategies. Delay results in unfavorable queue position and poor execution. Colocation reduces latency, allowing HFTs to identify favorable market microstructure conditions and to respond ahead of other traders.

The sophisticated usage of special order types and order matching engines in today’s US equity exchanges is now a primary alpha. The existence of undocumented features of special order types,^{5, 6, 7, 8}

³ Patterson, S. “Dark Pools.” New York: Random House, Inc., 2012. p 52.

⁴ Bodek, H. “Locked Markets, Priority and Why HFTs Have an Advantage: Part I: Spam and Cancel.” Decimus Capital Markets, LLC. Tabb Forum, 11 Oct 2012.

<http://haimbodek.com/research/The%20Problem%20of%20Locked%20Markets%20-%20Part%20I%20-%20whitepaper.pdf>

⁵ BATS. “Display-Price Sliding.” http://batstrading.com/resources/features/bats_exchange_pricesliding.pdf

⁶ Direct Edge. “Direct Edge Guide to Order Types.”

<http://www.directedge.com/Portals/0/docs/NextGen%20Guide%20to%20Order%20Types.pdf>



including those that “hide and light,” have become an important topic of debate and controversy in the press.^{9, 10, 11} When used appropriately, these order types ensure favorable queue position, providing HFT with better execution as well as protection against losses. HFTs use special order types to gain favorable queue position on entry, ahead of customers and other traders. On exit, knowledge and manipulation of queue position allow HFTs to flip out for outright winners or for scratch instead of 1 tick losers. The particular mechanisms for achieving superior queue position tend to be quite different per exchange, with a variety of specific microstructure features (e.g. price-time priority corruption and conditions where internally self-locked markets are permitted) essential to getting ahead of the electronic crowd. A simple example of a “hide and light” trade is given in the Appendix.

HFT scalps micro-edges and rebates. Tiered rebates subsidize opportunity costs and realized losses, turning scratch trades into winners. Large losses due to sweeps (adverse price movements against their transient and/or potential positions) can overwhelm any profitability, so management of sweep risk is paramount. HFTs use the market microstructure to detect and avoid sweep risk, which is the risk associated with trading against large informed toxic orders (e.g. large institutional orders) that take out multiple levels of the order book. For example, HFTs are able to identify critical conditions where they are potentially exposed to toxic order flow by monitoring microstructure phenomena associated with Intermarket Sweep Orders (ISOs). By comparing the slow Stock Information Provider (SIP) feed with the faster trade and quote data from direct co-located exchange price feeds, HFTs can identify dislocations (e.g. trades printing through the SIP feed quotes) associated with sweep events. Upon detection of a possible sweep event, HFTs rapidly withdraw their liquidity to avoid interacting with the adverse flows.

Thus superior cancellation latency is key for avoiding “negative alphas” from sweeps that would otherwise result in large losses that would overwhelm any naive flipping strategy. This cancellation latency to avoid sweeps is a primary competitive dimension of HFT scalping that is not commonly discussed in academic research.

HFT scalping is predatory in its aim of stepping ahead of institutional order flows. It can be characterized as an opportunistic and discriminatory mimic of traditional market making – where HFT uses opaque advantages, including special order types, instead of explicit market making privileges – without the market making obligations. It is not a traditional spread-scalping strategy that posts on each side of the spread, relying on speed to jump ahead of the rest of the market. It is not a traditional strategy based on low latency – speed is simply a prerequisite for effective utilization of special order

⁷ NASDAQ. “Protocol Quick Reference.”

http://www.nasdaqtrader.com/content/ProductsServices/TRADING/Protocols_quickref.pdf

⁸ NYSE Arca. “NYSE Arca Equities Order Types.” <http://usequities.nyx.com/markets/nyse-arca-equities/order-types>

⁹ Patterson, S. and Strasburg, J. “For Superfast Stock Traders, a Way to Jump Ahead in Line.” Wall Street Journal, 19 Sept 2012. A1. <http://online.wsj.com/article/SB10000872396390443989204577599243693561670.html>

¹⁰ Patterson, S. and Strasburg, J. “How ‘Hide Not Slide’ Orders Work.” Wall Street Journal, 19 Sept 2012. A12. <http://online.wsj.com/article/SB10000872396390444812704577605840263150860.html>

¹¹ Chapman, P. “Trading Official Says Fewer Order Types Will Help Simplify Marketplace.” Traders Magazine, 9 Oct 2012. <http://www.tradersmagazine.com/news/locked-markets-rule-change-110389-1.html?pg=1>



types and market microstructure. Unlike traditional quantitative strategies whose alphas are valuation oriented, HFT scalping is market structure oriented, tracking liquidity and exploiting exchange features to attain preferential order treatment.

Traditional high frequency quantitative strategies rely on well-known valuation-based alphas, including correlated pairs, baskets and futures signals. These traditional strategies generally require significant risk tolerance to scale up, whereas HFT scalping typically does not as it can use the market liquidity itself as insurance against large losses via its superior queue position and execution. However, quantitative strategies, along with traditional cross-product arbitrage strategies, can be and are overlaid on top of the basic HFT scalping framework to produce hybrid strategies.

2 Phenomena of HFT Scalping

Since 2007, adverse effects in the US equities markets have become a growing concern within the financial industry and the general media. Many forms of adverse selection, unexpected slippage and escalating transaction costs can be tied to specific features of HFT scalping practices and exchange order matching engine features. Institutional equity traders are well aware of the adverse impact of predatory HFT strategies. However, the core activity of HFT scalping strategies might be inadvertently attributed to less prevalent abuses such quote stuffing, spoofing, ping-pong, or more discriminatory order anticipation and “statistical front-running” models. Many of the effects are correctly attributed to HFT firms, but are byproducts of large scale HFT scalping strategies rather than primary strategies in of themselves. Examples include fluctuations in quote sizes due “spam and cancel” strategies, the observed disadvantaged fills of traditional orders typically used by smart order routers due to exchange price-sliding practices, and the observed rapid withdrawal of liquidity in today’s markets that can be explained by the low risk tolerance of HFT scalping.

A major change associated with the growth of HFT strategies is the frequent occurrence of visible and dramatic rapid liquidity withdrawal on sweep-like events, commonly associated with a single tick price move. Such phenomena are especially prevalent in low-priced names saturated with HFT scalping activity such as BAC. The observed liquidity withdrawal is a byproduct of HFT’s sensitivity to changes in market sizes and trades, a result of HFT scalping’s dependence on queue depth and position signals. In many cases the price movement will be exasperated through a sub-millisecond withdrawal that, to institutional equity traders, can appear coordinated due to mutually understood signals that have proliferated throughout the HFT industry. Liquidity provided by HFTs is also highly correlated with market impact since the HFTs pull out when potential sweep risk is detected. When triggered, sweep signals initiate a cascade of cancellations by HFT scalpers, resulting in a rapid loss of liquidity. Such events are also commonly associated with aggressive Immediate or Cancel (IOC) Intermarket Sweep Order (ISO) “taking” activity and aggressive Day ISO orders types being posted by the top HFT firms to set the new price.

HFT scalping is predicated on the ability to flip out, i.e. rapid turnover to avoid holding risk. This means HFT scalpers, individually and as a group, are highly risk adverse and will not hold what they perceive as



potentially risky positions, and aim for high frequency turnover to neutralize unanticipated adverse flows. Unwanted risk that they enter into is rapidly flipped from one participant to another in a game of hot potato,¹² ultimately leaving the risk with whoever is too slow to get out of the way, often professional traders who are unfamiliar with HFT scalping strategies.

Because of the extremely rapid responses by HFTs to what they perceive as an unfavorable market condition, there is no time for slower market participants to replenish the market book when size is pulled by the HFTs. HFT pulling can be triggered by microstructure changes, before onset of filled trades due to sweeping activity. In some cases, quote pulling by one large HFT at the top-of-queue top-of-book can create a cascade as other HFTs interpret the rapid reduction in quantity ranked ahead of them as a trigger to pull.

The HFT herd activity of rapidly canceling in these conditions can lead to further market disruption beyond the initial sweep event, a pattern seen all too often in the US equity markets where posted HFT liquidity vaporizes and the hot potato flip-out of toxic flows is triggered among HFTs.¹³ Coincident HFT pulling, whether due to perceived or actual risk, drives the price through multiple levels. This leads to the now common mini-flash crash effect, where rapid liquidity withdrawal leads to a temporary liquidity void with significant disruption of the process of price discovery. In fact, HFT insiders readily admit that mini-flash crashes are an endemic problem without a clear solution:

“the mini-flash crash we do not freely talk about ... happens every day once the best price is pierced”¹⁴

The advantages in queue position and priority offered by the special order types have likely altered the institutional equity traders' overall perception of the equity market. These traders observe apparent market toxicity which in fact is not due to adverse order flow, but due to deep asymmetries between advantaged HFT insiders and disadvantaged institutional traders. The special order types preferred by HFT scalpers and the exploited features make it more difficult for traditional orders to get filled in the expected way. For example, undocumented “queue jumping” features¹⁵ at the exchanges can give the appearance of “statistical front running,” as traditional orders fall to the back of the queue and tend to miss execution at the expected time and/or price.

Mainstream electronic trading services (execution services), including those provided by top tier investment banks, do not effectively counter HFT scalping. In fact, the services quite often inadvertently enhance HFT edge capture to the detriment of the services' institutional clients. Popular techniques to limit market impact, such as order slicing and various weighted averaging strategies, can backfire when

¹² Kirilenko, A., Kyle, A. S., Samadi, M., Tuzun, T. “The Flash Crash: The Impact of High Frequency Trading on an Electronic Market.” 26 May 2011. p 29. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1686004

¹³ Madhavan, A. “Exchange-Traded Funds, Market Structure and the Flash Crash.” 13 Jan 2012. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1932925&http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1932925

¹⁴ Panel on High Frequency Trading. Sandler O’Neill 2011 Global Exchange and Brokerage Conference, 9 Jun 2011.

¹⁵ “For Superfast Stock Traders, a Way to Jump Ahead in Line.” op. cit.



they interact with HFT scalping strategies employing special order types and market microstructure features. For example, traditional strategies are not primarily driven by exchange microstructure conditions, which means passive orders can enter disadvantaged queue positions when submitted by these strategies. These passive orders are commonly exploited for use as “insurance” by HFT scalpers to avoid losses due to sweep events. Until recently, the concepts that drive HFT scalping have for the most part been absent from execution services and research materials provided by investment banks. It is only recently that execution services have started to focus on addressing these issues as a primary impediment to achieving fair and balanced execution performance.¹⁶

3 Summary

HFT scalping relies on superior queue position, avoidance of market sweeps, and rebate capture. Special order types and knowledge of market microstructure make alpha-less micro-spread capture a lucrative trading strategy. HFT scalping’s impact on the equity markets include high frequency price fluctuations, high order cancellation rates and liquidity gaps. Trading algorithms provided by traditional execution services often unnecessarily subsidize HFT scalping profits to the detriment of institutional clients.

Additional articles and in-depth research on this and related topics are available at <http://haimbodek.com/research.html>.

Appendix

The following example illustrates the economics of a potential sequence for a simple HFT scalping trade with an impending sweep event. Note that this example implicitly assumes that the HFT has access to the appropriate fee structure (e.g. most favorable exchange volume tiers, superior clearing rates).

1. Initial conditions:
 - 1.1. NBBO 30.00 X 30.01
 - 1.2. Exchange A 30.00 bid for 1000; Exchange B 30.00 bid for 1000
 - 1.3. HFT resting order at top-of-queue top-of-book 30.00 bid for 100 on Exchange A. One method of achieving this superior queue position is through special order types combined with spamming. Note that such spamming is designed to achieve queue position, not to impact the network or spoof pricing.

¹⁶ e.g. Puaar, A. “SocGen enhances algos to sidestep HFT.” The Trade, 18 Jul 2012.

<http://thetradenews.com/newsarticle.aspx?id=9278&terms=SocGen+enhances+algorithms+to+sidestep+HFT>

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	\$29.98	\$29.99	\$30.00	Inside	\$30.01	\$30.02	\$30.03
NBBO			2,000 shares		2,000 shares		
Exchange A	1,000 shares	1,000 shares	100 shares HFT 900 shares institutional		1,000 shares	1,000 shares	500 shares
Exchange B	500 shares	500 shares	1,000 shares		1,000 shares	500 shares	500 shares

HFT Buy top-of-queue top-of-book

- Incoming sell 1000 at 30.00 order on Exchange A hits bid, clearing Exchange A's book @ 30.00; HFT resting 30.00 bid for 100 is taken out. HFT collects rebate on this first leg of the trade.

	\$29.98	\$29.99	\$30.00	Inside	\$30.01	\$30.02	\$30.03
NBBO			2,000 shares		2,000 shares		
Exchange A	1,000 shares	1,000 shares	100 shares HFT 900 shares institutional		1,000 shares	1,000 shares	500 shares
Exchange B	500 shares	500 shares	1,000 shares		1,000 shares	500 shares	500 shares

takes out top-of-book Exch A

Sell 1000 at 30.00

- HFT detects potential adverse sweep selection – HFT looks to exit risk rather than exiting for edge at midpoint or better.
- HFT submits “hide and light” sell 100 at 30.00 on Exchange A.
 - HFT order locks NBBO (Exchange B still 30.00 bid for 1000); so HFT order is accepted and posted in a hidden state sell 100 at 30.00 on Exchange A.

	\$29.98	\$29.99	\$30.00	Inside	\$30.01	\$30.02	\$30.03
NBBO			1,000 shares		2,000 shares		
Exchange A	1,000 shares	1,000 shares	Inside	Sell 100 shares HFT hidden	1,000 shares	1,000 shares	500 shares
Exchange B	500 shares	500 shares	1,000 shares		1,000 shares	500 shares	500 shares

HFT Sell hidden; locks NBBO

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Potential outcomes:

- Case 1: Institution joins NBBO on Exchange A with 30.00 bid for 100. This steps on HFT hidden order sell 100 at 30.00, providing HFT with flip out at scratch. HFT collects rebate on both legs of the trade.

	\$29.98	\$29.99	\$30.00	Inside	\$30.01	\$30.02	\$30.03
NBBO			1,000 shares		2,000 shares		
Exchange A	1,000 shares	1,000 shares	Inside	Sell 100 shares HFT hidden	30.00 Bid for 100	1,000 shares	1,000 shares
Exchange B	500 shares	500 shares	1,000 shares		1,000 shares	500 shares	500 shares

Incoming Buy steps on HFT hidden

- Case 2: Incoming marketable order 30.01 bid for 100 on Exchange A. Per exchange rules, incoming order is matched with HFT order at midpoint 30.005. HFT flips out for half tick winner. HFT collects rebate on both legs of the trade.

	\$29.98	\$29.99	\$30.00	Inside	\$30.01	\$30.02	\$30.03
NBBO			1,000 shares		2,000 shares		
Exchange A	1,000 shares	1,000 shares	Inside	Sell 100 shares HFT hidden	30.01 Bid for 100	1,000 shares	1,000 shares
Exchange B	500 shares	500 shares	1,000 shares		1,000 shares	500 shares	500 shares

Incoming Buy matched @ 30.005 to HFT hidden

- Case 3: Away markets begin to fade. HFT flips out for scratch by hitting 30.00 bid on Exchange B while cancelling the hidden sell order on Exchange A. HFT collects one maker rebate but pays one taker fee. The taker fee is the “insurance cost” for this round trip trade.

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	\$29.98	\$29.99	\$30.00	Inside	\$30.01	\$30.02	\$30.03
NBBO			1,000 shares		2,000 shares		
Exchange A	1,000 shares	1,000 shares		Inside	1,000 shares	1,000 shares	500 shares
Exchange B	500 shares	500 shares	1,000 shares		1,000 shares	500 shares	500 shares

HFT Sell hits resting 30.00 Bid
HFT Sell 100 at 30.00

- Case 4: Away markets fade. HFT hidden sell order lights @ 30.00. HFT order is at top-of-queue top-of-book due to “hide and light” properties. HFT potentially flips out at scratch, collecting rebate on both legs of the trade, but holds execution risk (chance of fill < 100%). If order not filled, HFT potentially must flip out for loser.

	\$29.98	\$29.99	Inside	\$30.00	\$30.01	\$30.02	\$30.03
NBBO		1,500 shares		100 shares			
Exchange A	1,000 shares	1,000 shares		Sell 100 shares HFT lit	1,000 shares	1,000 shares	500 shares
Exchange B	500 shares	500 shares			1,000 shares	500 shares	500 shares

HFT Sell order lights at top-of-queue top-of-book

Cases 1 and 2 are clear HFT winners even though this example is for an impending sweep event. Case 3 loses when the taker fee exceeds the maker rebate, but can be a winner if the flip out is done on an inverted “taker-maker” exchange, where the HFT is paid a taker rebate. Case 4 is a clear winner if the sell at 30.00 executes, otherwise is a loser.

In this simple example, it can be argued that losses due to cases 3 and 4 make the expected value of the round trip trade negative. However, given 13 exchanges and approximately 50 dark pools, there are a significant number of exit permutations, special order types and exchange features that serve as alternatives to insurance cost (case 3) or execution risk (case 4). Low latency, a prerequisite of successful HFT scalping, reduces the instances where the HFT is forced to trade on exchanges with less favorable economics in case 3 or into losing trades in case 4.



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