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Are Markets Rigged? A Look at High-Frequency Trading and Market Microstructure

With the recent release of author Michael Lewis' book *Flash Boys: A Wall Street Revolt* and its' assertion that *markets are rigged*, there has been a huge wave of interest in high-frequency trading (HFT) and its effect on stock markets. Along with members of the financial media, interested parties include market participants, both retail and institutional, and even politicians and regulators. Unsurprisingly, many of those most vehement regarding the issue have their agendas, be they pro or con. This article will briefly explain the mechanics of HFT, while attempting to cut through the rhetoric and adding some insight on this somewhat arcane (and certainly controversial) topic.

Before jumping into the legal and ethical debate surrounding HFT, it is important to understand what exactly is being described. The phrase *market microstructure* describes the mechanics of exchange in financial markets, of which HFT is a critical feature. High-frequency trading as generally used describes algorithmic trading strategies using computers that rapidly trade securities on public markets. These strategies have execution times that are nearly instantaneous, often a matter of microseconds (one millionth of a second). These algorithms use mathematics to codify rules according to when the programs will execute a buy or sell order. And they are fast. As a point of reference, the average human eye blink takes around 350,000¹ microseconds, or 0.35 seconds. In order to achieve these amazing speeds, HFT firms must invest large sums on computer processing power, as well as on state-of-the-art cables to transfer information. To achieve that last amazing bit of speed, HFT firms in the competition build their physical computer offices as close as possible to the stock exchanges, a process known as co-location. In an industry where performance depends on microseconds, locating 100 miles closer to the source of trading information can be critical, even with information traveling at nearly the speed of light.

¹ <http://en.wikipedia.org/wiki/Microsecond>



High-Frequency Trading Strategies

Simply having a speed advantage over most market participants does not necessarily guarantee a successful business. HFT firms must have a business model as well, and this model must be profitable enough to justify the large investment costs. The majority of HFT profits come from *market making*, which is a critical component of a well-functioning public market. When a person (or institution) makes a trade on a public exchange, that trade is generally handled by either a broker or a market maker. A broker connects two parties (one on each side of the trade) to facilitate a trade, but never actually takes possession of the security being traded. A market maker provides a similar service, but instead of connecting a buyer and a seller, they take the security onto their own book with the intention of selling it themselves within a short time period. Thus the market maker is participating directly in the market, not simply facilitating the transaction. When a security is listed on an exchange it will have two listed prices, known as a “bid” and an “ask” price. The bid price is the price at which market makers are willing to buy the security, and the ask price is the price at which they are willing to sell the asset. The ask price will always be higher than the bid, and the difference is known as the bid-ask spread (or sometimes just “the spread”). Brokers and market makers make money by earning the spread on each trade they make. For example, if ABC stock is listed at \$10.00 - \$10.01, this means that the stock can be sold for \$10.00 per share, or purchased for \$10.01 per share. The brokers or market makers will earn the \$0.01 per share on each trade of ABC.

Since HFT firms acting as market makers often earn only a fraction of a cent per share, the only way to make money as a market maker is to trade as often as possible. These companies facilitate millions² of trades per day, using powerful computer algorithms to identify buyers and sellers on each trade. The existence of market makers willing to execute trades for a fraction of a cent per share has provided a massive boost to market liquidity. In order for HFT firms to get the volume of business they need away from their competitors, they must move faster and be willing to act for a smaller spread, thus driving the spread to a lower and lower amount.

² For example, on March 31, 2014, nearly 1.2 billion shares of stock were traded on the New York Stock Exchange, resulting in \$46 billion worth of stock changing hands (source: www.nyxdata.com).

These spreads which used to be no smaller than 1/8th of a dollar (12.5 cents) are now 1 cent on widely traded securities. This increase in market liquidity has been hugely beneficial to market participants, greatly reducing trading costs. Brokers, who used to benefit from the width of the spread, and who cannot generally match these speeds, are now earning significantly smaller amounts per trade.

The reduced spreads resulting from high-frequency trading are an overwhelmingly positive outcome for the efficiency of the market. However, there are other areas of HFT that are less beneficial for markets and investors. The most serious complaint leveled against high-frequency firms is that they are frontrunners, meaning that they step in front of other traders to earn profits on market movement, to the detriment of buyers and sellers. To understand how this works, it is instructive to look at how trade orders are processed. When an investor decides to buy or sell a security, there are two primary methods for placing a trade. The first (and most common) is to place a market order, where the trade will be made at the best available price. The second is a limit order, where the buyer or seller designates a specific price at which they are willing to trade. These orders will only be filled at that price or better. When a large market order is made, it can affect the price of the security through the mechanics of supply and demand. It is this price movement that creates the potential for frontrunning. Suppose a large institutional investor put in a 10,000 share market order for ABC stock. Through their superior speed advantage, HFT firms are able to identify large block orders like this, and purchase the stock before the large investor is able to fill the order, and sell it to them at a slightly higher price. For example, if ABC was still trading at \$10.00 - \$10.01 (as in our earlier example), the HFT firm might purchase all the available shares of ABC at \$10.01 and \$10.02, and then sell those shares to the large investor at \$10.03, pocketing the profit on each share sold. This behavior will increase trading costs for those investors making trades large enough to move market prices.



While this manner of frontrunning is technically legal, what is troubling is the methods through which HFT firms are able to identify and act on large block orders before other market participants. Aside from a tremendous speed advantage through information transferring capabilities, many of these firms have contracts with stock exchanges that allow them to purchase order information before it is released to the public. This informational discrepancy lets HFT firms analyze and act on large orders before the orders are even made available to the

public. Again, none of this behavior is currently illegal, but it is not hard to see how it can be detrimental to investors while providing little or no benefit to markets as a whole.

Investor Alternatives

But, are all investors subject to predation by HFT firms? There are, in fact, other avenues open to concerned participants that allow them to avoid being front-run in open markets. The first is quite simple and obvious; using limit orders. If our large investor above had put in a limit order on ABC stock at \$10.02, they would not have purchased any shares above that price, and thus would have avoided any price movement due to nefarious HFT activity. The clear problem with this method is the possibility that an order would not be fully filled. Suppose, for example, that even if HFT firms were not in the picture, that there were only 3,000 shares of ABC stock available for sale at or below \$10.02. In this case, the investor would not be able to get their order filled without increasing the price that they were willing to pay per share of stock, and thus moving market prices on their own. This price movement is not a malignant market effect, but in fact exactly the behavior that would be expected in a well-functioning market (i.e., an increase in quantity demanded tends to increase the price of any market good).

Another more complicated alternative to standard market trading is the use of *dark pools*. These sinister-sounding venues are private (off-exchange) sources of market liquidity that allow orders to be disguised. The large institutional investor in our example could access a dark pool, where the order would be matched up with sellers on the other side of the trade without making the order information public and thus without creating opportunities for outside firms to profit by placing themselves in the middle of the trade (i.e., frontrunning the transaction). This lack of transparency could theoretically protect the traders from frontrunning, but may not be foolproof either. In Lewis's book, he contends that dark pools sell access to HFT firms, who have methods of identifying large block orders even without public order books, and are thus still able to take advantage of hapless buyers and sellers, though through a slightly less direct process.



Implications for Investors and the Future of High-Frequency Trading

At the beginning of this article, we mentioned the claim of market rigging. After a discussion of high-frequency trading, it seems appropriate to examine that claim in greater depth. For individual traders (i.e., traders not dealing in amounts big enough to move market prices), HFT has proven to be beneficial through compressed bid-ask spreads along with reduced trade execution times. For larger traders, the effects are more ambiguous. They also benefit from smaller spreads, but they can be disadvantaged by the frontrunning by HFT firms. Among these institutional investors are fund providers (such as mutual funds and exchange traded funds). To the extent that frontrunning results in additional trading costs, this activity could cause a drag on fund returns, and thus small retail investors (those investing in those funds) can share in this pain as well. There has not been sufficient research on high-frequency trading to give a definitive answer to whether or not the benefits of smaller spreads outweigh (or are outweighed by) the costs of frontrunning, so it is difficult to identify the net effect³ of HFT. However, calling markets “rigged” seems a bit extreme, perhaps aimed at grabbing headlines and book sales, rather than purely descriptive. Direct market participants are not the only people with an incentive in this debate. Colorful language might help sell copies of *Flash Boys*, but it may unnecessarily distress small investors for whom there are no significant dangers associated with high-frequency traders.

Beyond the immediate HFT debate, it is clear that market microstructure will continue to be a hot topic in the coming months and years. It will be interesting to see how regulators approach an industry that is (at least currently) within the bounds of the law. Among the current suggestions are a transaction tax, mandatory minimum execution times, and restrictions on the ability of exchanges to differentiate their information distribution. Of these ideas, the costs of the first two seem likely to spread among investors. More transparency regarding market data would help level the playing field among traders, but it would not negate the vast speed advantage of the HFT firms, who would still likely be able to move in front of large block trades as they transacted. The high-frequency issue has no easy answers, and appears in certain cases to be misunderstood by those who profess to offer solutions. While HFT only affects our clients indirectly, we will continue to monitor the debate and ensure that our trading and investing policies are always designed to minimize costs to our clients’ accounts. If you have any questions about high-frequency trading, or would like additional clarification on anything discussed in this article, please do not hesitate to contact us.

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³ Aside from the aspects of HFT discussed here, there are certainly other components of the industry, but these are what we view as the most relevant and pervasive.