HIGH FREQUENCY TRADING AND ITS IMPACT ON MARKET LIQUIDITY.

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Abstract: This research explores the complex world of High-Frequency Trading (HFT), which is a fancy type of automated trading that has really changed how financial markets work. HFT involves quick buying and selling using advanced technology and complicated computer programs to take advantage of tiny price differences and inefficiencies in the market, all happening in a very short time. Even though HFT has made markets work better and has increased how much trading happens, it has also caused some problems and has been closely looked at by regulators. People worry that it could manipulate the market or give unfair advantages to certain investors. The study looks back at how HFT has changed over time, considering changes in rules, improvements in technology, and big events in the market. The research also looks at how HFT and market dynamics interact, trying to understand how they affect the quality of the market and how much it goes up and down. The study uses information from investigations into the Italian and Swedish stock markets to show how HFT can affect the quality of a market in different ways. Even though there are different findings in the research, it highlights that automated trading, like HFT, has both good and challenging sides. The study stresses the need for rules that can change as automated trading evolves, making sure the financial system stays strong, works efficiently, and is friendly to investors. The knowledge gained from this study can help policymakers, people involved in the market, and investors as they deal with the changing world influenced by HFT.

Index Terms – Component, formatting, style, styling, insert.

I. INTRODUCTION

High-Frequency Trading (HFT) is like a really advanced way of using computer programs to trade stocks super quickly, and it's changed how money moves in financial markets a lot. Basically, HFT involves making a bunch of trades in a super short amount of time, using fancy technology and complex computer algorithms. The big deal about it is that it can make money by taking advantage of tiny differences in prices or when the market isn't working perfectly, all within a fraction of a second. The systems used for HFT are designed to be incredibly fast, making trades happen in just milliseconds or even microseconds. They do this by setting up their computers really close to the stock exchange's computers, using things like direct market access and co-location to make sure there's almost no delay. One common strategy in HFT is called market making. This is where these firms put a ton of buy and sell orders into the market to make it easier for others to trade. They do this by narrowing the difference between what someone is willing to pay for a stock (bid) and what someone is willing to sell it for (ask). It's important to note that this support they give to the market can be taken away quickly if things start changing. Another strategy is arbitrage, where HFT firms make money by taking advantage of price differences in different markets. For example, they might buy a stock in one place where it's cheaper and sell it somewhere else where it's more expensive, making a profit from the difference in prices. What makes HFT different from traditional investing is that it's all about making money from really

quick, small changes in prices. They hold onto their positions for a very short time, from a tiny fraction of a second to just a few seconds. This speed allows them to adapt to what's happening in the market and make lots of trades in a short amount of time. Even though HFT has made trading work better and added more activity to the markets, it has also been in the middle of debates and regulatory scrutiny. Some people say it helps the market by making it easier to trade and find the right prices. Others worry about things like market manipulation, risks to the whole system, and the advantages these firms might have over regular investors.

II. Review of Literature

According to Ritesh Kumar Dubey, (2018), there might be a potential correlation between Algorithmic Trading (AlgoTrading) and three pivotal facets of any financial market: liquidity, volatility, and price discovery. However, the existing body of literature on AlgoTrading is somewhat constrained by the limited availability of datasets. Though, the existing literature on AlgoTrading is limited due to non-availability of dataset, the overall findings suggest a significant impact of AlgoTrading on Volatility, price discovery and liquidity. AlgoTrading exhibits a capacity to narrow the Bid-Ask spreads, mitigate order imbalances, and enhance the overall depth of market orders. These findings have been tested on the NIFTY 50 stocks. The effects of High Frequency Trading (HFT) on the U.S. equity market have been investigated by Jonathan A. Brogaard, (2010). Algorithmic traders have totally taken over the role of traditional human traders. The researcher further claims that HFTs typically use a price reversal strategy that is fueled by order imbalances and that even during the most volatile periods, their trading activity fluctuates relatively slightly. Furthermore, compared to non-HFTs, HFTs' strategies are more correlated. Mandes, Alexandru (2016) offers valuable insights into the transformation of traditional traders and other market participants, who have adapted by embracing algorithmic trading strategies to enhance their competitive advantages. Furthermore, the study presents a comparative analysis between low-frequency trading and High-Frequency Trading (HFT), revealing that HFT strategies excel in swiftly generating entry and exit signals within very short timeframes, resulting in relatively smaller returns. One of the research questions by Marli Damião Abade Nunes, (2021) was to make a comparison between human trading and robot trading, to find out what is more profitable. The conclusion drawn from the research carried out was that it is worth investing in Automated or Algorithmic Trading as it reaps more profit. The research work carried out by Yesol Huh, (2011) shows the intraday liquidity co-movement among the components of the Dow 30 Index and the role of Algorithmic trading. In the past decade, a connection is found between how different assets move together in terms of liquidity has grown stronger. Financial markets are becoming more electronic and faster, with algorithms making decisions in milliseconds. This indicates that liquidity commonality might now even exist on even shorter timescales, like seconds. The study by Terrence Hendershott, Charles M. Jones, Albert J. (2011) states that it is highly probable that algorithms promptly react to incoming order flow and price data by constantly adapting their limit orders, thereby preventing them from becoming outdated and vulnerable to being exploited. Two specific types of information hold primary significance in this context, although the inherent secrecy surrounding algorithm creators and providers makes it challenging to ascertain with absolute certainty. First and foremost, algorithms possess the capacity to readily incorporate widely observed price-related data, subsequently fine-tuning their trading strategies and quoting practices accordingly. Second, some algorithms are designed to sniff out other algorithms or otherwise identify order flow and other information patterns in the data.

Study Objectives:

• Examine the influence of High Frequency Trading (HFT) on market liquidity.

• Investigate the effects of High-Frequency Trading (HFT) on market volatility.

Market Liquidity

Market liquidity is characterized by the ease and speed with which buyers and sellers within a market can execute transactions, incurring minimal impact costs. Market liquidity is like how easy and quick it is for people to buy or sell stuff in a market without it causing a big fuss. It's all about how smoothly things can happen, making sure that everyone can trade without too much trouble or losing a lot of money. The main idea is to make sure that you can buy or sell something quickly at a fair price without any big problems.
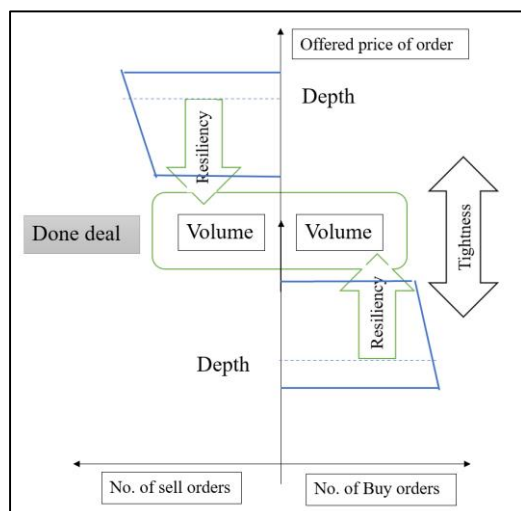
Liquidity Indicators:

A- Volume:

Volume is like a way to see how much trading is happening in a market. It helps us understand how many people are buying and selling things. We can measure this using something called turnover, which shows the total number of shares traded in the whole market over a certain time. When there's a lot of trading going on, it means many orders are being placed quickly, making the whole process work better. So, the more trading there is, the better the liquidity, which means things are moving smoothly in the market.

B- Tightness:

Tightness is all about how much it costs to do a trade, specifically how close the prices are when you want to sell or buy something. We can figure this out by looking at the gap between the highest price someone is willing to pay for something (the best bid) and the lowest price someone is asking for it (the best ask). If the gap is small, it means it's not costing much to trade, and that's a sign of good liquidity. So, the closer these prices are, the better it is for trading because it keeps the costs down.

C- Resiliency:

Resiliency is like a market's ability to quickly handle new orders, fixing any imbalances and preventing prices from straying too far from what's expected based on basic principles.

To measure resiliency, we look at the daily ratio of the price range to turnover. This means we calculate the difference between the highest and lowest transaction costs in a day and divide it by the total turnover for that day. A market with high resiliency usually has a lower value for this ratio, making it a good place for traders because it helps transactions happen smoothly.

D- Depth:

Depth is all about the number of orders you see at the highest price someone is willing to buy or the lowest price someone is willing to sell. It's like counting how many people are ready to buy or sell at those prices, either right away or have already done so. If there are lots of orders visible or completed below or above the current trading price, we say there's more depth. Researchers use different ways to measure this, like looking at the ratio of orders, the total number of orders at buying and selling prices, the average depth of these

orders, or the total amount of money involved. More depth usually means there's higher liquidity, making it easier for people to trade in the market.

Market Volatility

Volatility is like a measure that shows how much the value of a specific investment or market goes up and down. If the value changes a lot, we say there's high volatility, which means there's more risk involved. This measure is usually calculated by looking at how much the returns (profits or losses) for that investment or market vary from their average. In financial terms, volatility is often connected to big changes in either a positive or negative direction. For example, if the stock market keeps moving more than one percent up and down regularly, we call it a volatile market.

$$vol = \sigma\sqrt{T}$$

where:

- *v = volatility over some interval of time*
- *σ = standard deviation of returns*
- *T = number of periods in the time horizon*

CBOE Volatility Index (VIX): The CBOE Volatility Index (VIX) is like a real-time indicator that shows what the market thinks about how much the prices of stocks in the S&P 500 Index might change soon. It's based on options for the SPX index that have short expiration dates, and it gives an estimate for how much things might go up or down in the next 30 days. Volatility, which means how quickly prices change, is often seen as a way to figure out how worried people in the market are.
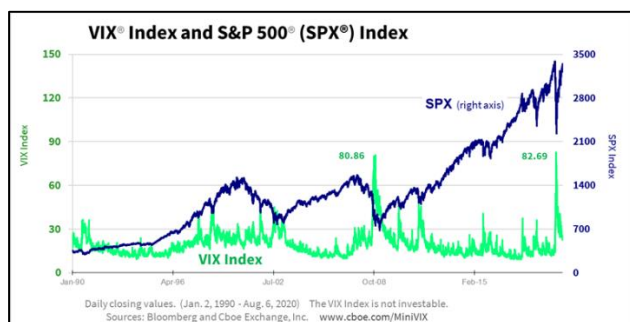
Price Discovery

Price discovery is like the way the market figures out how much something is worth. It happens when people who want to buy and sell stuff interact and decide on the current fair price. In financial markets, lots of things play a part in this process, such as how much people want to buy or sell, economic news, and how investors feel. Traders and investors look at all these things to make smart choices, and their decisions affect the prices in the market. Having a good price discovery process is important because it keeps things fair and clear in the market, helping resources and money get distributed effectively. Stock exchanges, auctions, and online trading platforms are key players in this ongoing process, making sure that prices accurately show the latest information and what everyone in the market expects.

Figure 1: Bid-Offer Prices and Spread
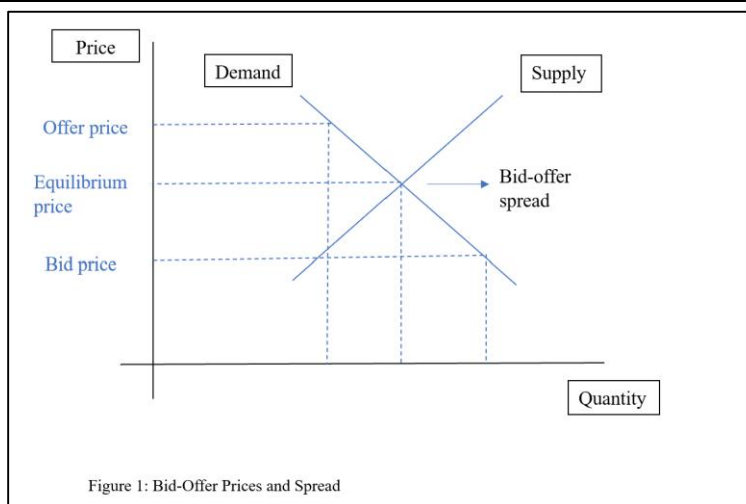
HFT and its implications on Market Liquidity:

According to Panagiotis Anagnostidis in 2020, his study found that High-Frequency Traders (HFTs) show a higher level of co-variation in how they provide liquidity compared to non-HFTs. This means that HFTs, which use advanced algorithms, tend to have more coordinated actions in supplying liquidity. However, part of this increased co-variation in HFT liquidity may be because of activities by Designated Market Makers (DMMs) who use common inventory handling strategies. The study also highlighted that the size of orders and the timing of trades play a significant role in how liquidity moves. For investors, this could mean higher costs when making large trades, and securities traded heavily by HFTs may have more systematic risks during stressful market times. Policymakers may need to consider new rules to enhance liquidity, especially during uncertain market periods. Benjamin Clapham's study in 2020 showed that while High-Frequency Traders (HFTs) can make profits from their quick trading strategies, their activity actually improves the overall quality of the market for everyone involved. This includes institutional and individual investors who benefit from better liquidity, leading to lower costs when making trades. The study found that when HFT technology is not available, there's an increase in spreads and a decrease in the depth of order books. Despite these improvements, there is a need for protective measures, like circuit breakers, to prevent potential negative outcomes such as flash crashes. Dorian Abreau's study in 2022 focused on the impact of High-Frequency Trading (HFT) on market liquidity using data from the NASDAQ OMX and 26 HFT firms. The analysis showed that HFTs contribute to increased liquidity in the equity market they examined. When HFTs provide liquidity to non-HFTs, effective spreads contract, but when non-HFTs provide liquidity to HFTs, effective spreads widen. This indicates that HFTs benefit from providing liquidity, while non-HFTs may not have the same advantage. The study also found that during the 2008 crisis week, effective spreads widened even more when HFTs provided liquidity. Oguz Ersan's review in 2021 looked at the extensive literature on High-Frequency Trading (HFT) and its effects on financial markets. It highlighted the positive role of HFT in providing liquidity, improving market quality. However, discussions also covered potential negative consequences, especially during extreme market conditions. The study aimed to organize and synthesize existing findings to reconcile conflicting perspectives and enhance understanding.

Juraj Hruska's paper in 2015 examined the relationship between algorithmic trading, specifically high-frequency trading (HFT), and market liquidity in European derivative markets. The study found mixed results but concluded that the overall impact of HFT on market liquidity is positive. The variability in results was attributed to the limited information available about the analyzed market, and future investigations would focus on refining the methodology for measuring liquidity.

HFT and its implications on Market Volitality:

According to a study by V. Caivano in 2015, the impact of High-Frequency Trading (HFT) on financial markets is a topic of extensive research. The study focuses on how an increase in HFT participation affects the volatility of specific stocks in the Italian equity market. The findings suggest that as HFT activity rises, there is a negative impact on market quality, leading to higher intraday volatility in stock prices. This effect is observed across different measures of HFT activity and implies that regulatory measures limiting certain HFT actions may be necessary. Jonas Björkman's study in 2018 reveals that for fifteen out of twenty-four stocks on OMXS30 (Swedish stock market), there is a decrease in volatility, indicating smaller fluctuations in stock prices. This suggests a positive role of High-Frequency Trading (HFT) in improving liquidity and reducing volatility on the Swedish stock market. The study suggests that regulatory measures should avoid hindering HFT strategies that contribute positively to market quality. Ritesh Kumar Dubey's research in 2018 provides compelling evidence on the impact of Algorithmic Trading (AT) on volatility. The study observes a significant influence of AT on the volatility of large-cap stocks, with a notable and beneficial effect in reducing daily volatility overall. This suggests that, on average, AT has a positive impact on market volatility without causing adverse effects on individual stocks or the market as a whole. According to X. Frank Zhang's research in 2010, there is a positive correlation between High-Frequency Trading (HFT) and stock price volatility. This correlation holds even after considering factors like a stock's fundamentals and other influences on volatility. The study suggests that HFT has the potential to increase volatility in the stock market, especially for larger stocks and during periods of heightened market uncertainty.

Conclusion:

In summary, the study of High-Frequency Trading (HFT) shows that it has both positive and challenging impacts on how financial markets work. On the positive side, HFT, using advanced algorithms, makes markets more efficient by reducing spreads and increasing the depth of order books. This is good for both big and small investors as it lowers the costs of making transactions and creates a more effective market. However, challenges arise because HFT can lead to more coordinated actions, raising concerns about market manipulation. Some studies also show that non-HFT participants may face additional costs, emphasizing the need to address differences in trading speed. Overall, the findings highlight that HFT has both positive and potentially risky effects. Striking the right balance is crucial for maintaining a strong and resilient financial market. As HFT continues to evolve, regulations need to adapt to effectively manage risks, ensuring market integrity, and protecting investor interests. Policymakers should approach this task with a careful understanding of the complex dynamics involved. Looking at various studies on HFT, we see a mixed picture. In the Italian equity market, increased HFT participation may lead to more volatility in specific stocks, especially after technological changes. On the other hand, in the Swedish stock market, there is a positive outcome, with a decrease in volatility for most examined stocks, suggesting possible improvements in market quality. While there are different findings, the common theme is recognizing the complex relationship between automated trading and market behavior. The impact of HFT on volatility depends on the situation, with potential negative effects in specific scenarios. The favorable influence of Algorithmic Trading (AT) on overall market volatility indicates the need for tailored regulations that balance innovation and efficiency while being cautious about potential negative effects on market stability and investor interests. Policymakers are encouraged to understand the dual nature of automated trading and design regulations that consider its potential benefits in improving market quality. The key is to have adaptive, nuanced frameworks that fit the specific dynamics of automated trading, ensuring a strong, efficient, and investor-friendly financial system.

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