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Statistical Evaluation of Algorithmic Trading and Financial Ethics

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Abstract

Artificial intelligence integration has ushered in a new era of efficiency and complexity in the world of modern finance. One of the most notable examples of AI in the financial markets is algorithmic trading, which has fundamentally altered how traders operate and how markets behave. The ethical implications of algorithmic trading must be examined as financial systems adopt new technology, posing concerns about accountability, equity, and transparency. This study delved into the complex interplay between ethical considerations in financial markets and algorithmic trading practices. The growing impact of AI on consumer behavior and the pressing need to consider its ethical implications which spurred me to conduct this investigation. The purpose of this study was to investigate the following question: How does algorithmic trading impact stock returns, and how does this impact pertain to ethical principles in finance? The following sections offer a comprehensive literature review that puts my investigation into context and sheds light on previous studies on algorithmic trading, financial ethics, and their relationship. I used statistical methods to give the investigation a quantitative component and enable me to determine the degree of uncertainty surrounding our conclusions thanks to the supporting confidence interval. In the conclusion, the paper provided an overview of the main findings, explored their implications for financial ethics, and offered recommendations for further research in this rapidly developing area. As I continue to examine the broader implications of technology, finance, and ethics, this research contributed to a detailed understanding of how algorithmic trading shapes financial markets and the ethical considerations that accompany these changes.

Keywords: Identity, Gender, Socioeconomic class, Education, Politics

1. Introduction

The existing literature on algorithmic trading reveals a complex system characterized by rapid technological advancements. Many emphasize the transformative impact of algorithmic trading on market efficiency, stock returns, and cost determination. Notably, the ethical concerns of algorithmic trading have drawn a lot of attention. In order to fully appreciate algorithmic trading's potential to improve the market, research highlights the need for a balanced investigation into the advantages and hazards of this practice. It also warns against unforeseen consequences and barriers placed in place to limit its influence, such as circuit breakers that can momentarily stop trading on an exchange. This literature review provides background for my investigation, offering insight into the current state of algorithmic trading and paves the way for a complete analysis of algorithmic trading's ethical dimensions.

Algorithmic trading is a revolutionary force in the constantly evolving financial industry, revolutionizing the execution of monetary matters. The fundamental idea behind algorithmic trading is to utilize computer algorithms to effectively evaluate market data, make wise trade selections, and sensibly manage risk. Algorithmic trading, which combines expertise with technological innovation, has not only redefined but also reshaped traditional stock trading techniques. As Hope (2017) mentions, "In the 1970s, 1980s and early 1990s, it could have made a trader millions." Since many of the technological trading processes started to emerge in the 1970s, algorithmic trading has evolved.

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Driven by the proliferation of market data and advances in processing power, algorithmic trading has reached unprecedented heights of sophistication. A key component to its function is the utilization of predefined rules and mathematical models, facilitating split-second trading decisions that optimize execution and capitalize on market inefficiencies. Algorithmic trading employs a diverse amount of strategies, each conditioned to exploit specific market conditions. Strategies such as "trend-following" capitalize on identifying and riding market trends, while "scalping" seeks to profit from short and quick misalignments in asset prices. At its peak, high- frequency trading (HFT), a form of algorithmic trading that uses computer programs to transact, executes trades in fractions of a second, utilizing intricate algorithms to identify and exploit many market opportunities. The applications of algorithmic trading are very broad as they can be implemented for many things including stocks, bonds, and currencies. In equity markets, algorithmic trading is prominent, constituting a substantial portion of total trading volume. According to recent market data, algorithmic trading accounts for approximately 60% of the total trading volume in major stock exchanges worldwide. Its influence extends to fixed-income markets, as it optimizes bond trading strategies, and asserts a significant presence in the foreign exchange market. While algorithmic trading facilitates efficiency and liquidity upon financial markets, it can also raise ethical concerns. At the heart of these concerns lies the matter of transparency, given that the decision- making processes of algorithms might lack clarity. This could lead to disproportion in information, potentially disadvantaging specific market participants. According to a recent survey of market participants, 75% expressed concerns about the lack of transparency in algorithmic trading. The fairness of trading becomes a crucial point of discussion as algorithms work through many aspects of the market, potentially contributing to market fluctuation and impacting other participants. As algorithmic trading continues to shape financial markets, the challenge of finding a balance between embracing technological advancements and ethical concerns is difficult. Regulatory frameworks are crafted to enhance transparency, ensure fair and orderly markets, and address potential risks associated with algorithmic trading. Monitoring and supervisory mechanisms can also be beneficial as they can detect and prevent market abuses, creating an environment where algorithmic trading and ethical standards can coexist.

The moral precepts and ideals of financial ethics serve as a guide for professionals, institutions, and individuals in conducting their business in an honest, open, and equitable manner. These moral considerations are essential in determining how financial activities are conducted and making sure they positively impact market participants' well-being and the stability of financial markets. There is a dedication to openness and transparency in financial ethics. The reason that ethics are so crucial and relevant is because most people have a “moral compass” that plays a role in “guiding the decisions that we make and helping us decide what is right and wrong” (Schur, 2022). Transparent financial practices entail giving all pertinent stakeholders access to information that is understandable, accurate, and readily available. In addition to fostering confidence among market players, this openness makes it easier for informed decisions to be made, which improves the general effectiveness and equity of financial transactions. Fairness for all parties is another key component of financial ethics, guaranteeing that no person or group receives an unfair advantage or disadvantage when it comes to financial matters. Beyond specific transactions, financial ethics are important for the overall stability and well-being of the financial markets. Being ethically responsible aids in the prevention of deception, manipulation of the market, and other actions that might jeopardize the stability of the financial system. Furthermore, the development of fair practices and level playing fields fosters an atmosphere in which market players can compete on the basis of merit rather than dishonest or manipulative tactics. This is made possible by financial ethics and as financial markets continue to evolve and face new challenges, the importance of financial ethics becomes increasingly crucial in maintaining trust, promoting stability, and upholding the integrity of the global financial system. When all things are taken into consideration regarding the ethical dilemmas of algorithmic trading, it is crucial to ask, “What is the true proportion of stock companies in the United States that implement algorithmic trading in their calculations and what does this proportion indicate about the impact that algorithmic trading has on stock returns?”

2. Materials and Methods

2.1 Goal

In the following section I used a statistical model to evaluate and answer the following question: What is the

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impact of algorithmic trading on stock returns, and can I establish a confidence interval for this impact? Algorithmic trading is quite impactful on the interior as it uses a predetermined formula to function, however I used this confidence interval to estimate what the true proportion of stocks companies that use algorithmic trading really is.

2.2 Research Design

In this evaluation I gathered data on stock prices, returns, and other relevant financial indicators. I have noted that the independent variable is the presence of Algorithmic Trading and the dependent variable is stock returns. The confidence level that will be used is 95% which corresponds to a 1.96 critical value. After gathering data and statistics this confidence interval was drawn from the following pieces of information. These pieces of information which are essential to the research is that recent studies state that 68% of stock companies use algorithmic trading, the population size of that sample is about 215 stock companies in the United States, the amount of stock companies in the United States is around 4000, and a random method was used to take a sample of 215 stocks to create a diverse group within the sample.

3 Results

3.1 Confidence Interval

1. We will estimate the true proportion of stock companies in the United states that implement Algorithmic Trading with 95% confidence.
2. It is stated that a random sample was conducted, the true estimated population of about 4000 stocks is 10 times that sample size of 215, and the distribution is approximately normal.

3.2 Equation

$$\hat{p} = .68 \pm 1.96\sqrt{\frac{(.68).32)}{215}} = (.617,.741)$$

The output of this equation is going to give the sample proportion in a range and is calculated by taking the point estimate (which comes from the 68% estimate of the parameter) and adding and subtracting it to/from the critical value of 1.96 (which is used since we are using a confidence level of 95%) times the square root of (point estimate)(1- point estimate) / (sample size). We are 95% confident that the true proportion of stock companies that use Algorithmic Trading is between .617 and .741.

4 Discussion

Given that the survey was conducted in a responsible manner this data suggests that we can be 95% confident that the true proportion is in between these values. To further elaborate on what this means, 95% confidence means that 95% of all samples that are taken will yield an interval that contains the true proportion of stocks that use algorithmic trading (this number is not one that we know and serves as the reason we need to conduct this confidence interval). For example, if I calculated a confidence interval for 100 samples of data on the percentage of stock companies that use Algorithmic Trading, with 95% confidence, I would expect about 95 out of the 100 to yield an interval that contains the true proportion. For the confidence interval above step number 2 ensures that it is reliable and can provide that in repeated samples we are 95% confident that the true proportion of stock companies that use Algorithmic Trading is somewhere between .617 and .741.

My statistical analysis, including the calculation of a confidence interval, reveals the prevalence of algorithmic trading in the stock market. According to this sample, the estimated proportion of stock companies employing algorithmic trading in the US falls within the range of 61.7% to 71.4%, indicating a substantial majority in the field of stock trading. The quantity of algorithmic trading that is widespread speaks volumes and enhances market liquidity and efficiency. Investors benefit from smoother transactions and generally lower trading costs as a result of the

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widespread adoption of these computer-driven strategies, which enable faster and more precise trade execution. But in this age of algorithmic trading, you have to consider how it might affect stock returns. When looking at this impact, algorithmic trading generally has a positive impact on stock returns due to the rapid processing and optimal timing it acts with. Paired with the high levels of usage by stock companies as found in this study, it can correlate with the increase in stock returns. However, that is not always the case as many other factors must be considered. While the intention is often to capitalize on short-term market inefficiencies, the consequence can be heightened market fluctuation which can force investors and market participants to adapt to sudden price fluctuations triggered by algorithmic trades. The influence of algorithmic trading on stock returns operates from both sides. On one side, it promotes liquidity and enhances market efficiency. Conversely, the quick-fire nature of algorithmic trades may cause price fluctuations that are inconsistent with the underlying value of stocks, casting doubt on the effectiveness and stability of the market. Regulatory frameworks are essential for reducing the risks that could arise from algorithmic trading. For instance, using circuit breakers was one important aspect of the research that was emphasized multiple times. Circuit breakers are mechanisms designed to temporarily halt trading during periods of extreme volatility. They activate when predetermined percentage declines in broad market from around 7 to 20 percent. This pause in trading helps counter the potential negative impacts of algorithmic trading by providing a cooling-off period, preventing panic selling, and allowing investors to reassess information before resuming trading in a more controlled manner. Circuit breakers serve as a crucial tool to maintain market stability and act as those "frameworks" to counter the potential risks of Algorithmic Trading. Altogether, the revealed majority usage of algorithmic trading in stocks signifies a notable technological evolution in the financial field. Understanding and adapting to the evolving system of algorithmic trading is key for investors, regulators, and market participants as they continue to work in this ever-changing sector.

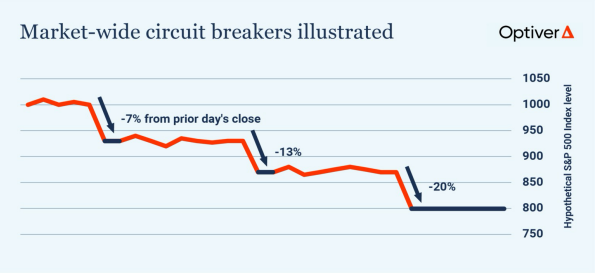

Figure 1. Visual representation of how and when circuit breakers impact the S&P Index Level.

During a trading day, "if the index decreases by 7% from the prior day's close, a Level 1 halt is triggered, pausing trading between 9:30 am and 3:25 pm. If the index drops by 13%, a Level 2 halt occurs under the same time constraints, but no additional halts occur after 3:25 pm for these levels. A 20% decline triggers a Level 3 halt, which can happen at any time during regular trading hours, and it results in the suspension of trading for the rest of the day" (Optiver, 2022).

4.1 Future Implications

The statistical experiment reveals the prevalent usage of algorithmic trading in the stock market and shows the profound implications for the future of finance, particularly as society undergoes a shift toward greater reliance on artificial intelligence and technology. First off, the use of algorithmic trading indicates a continuous trend toward a more automated financial environment. A rise in the creation and application of sophisticated trading strategies can be expected as technologies and algorithms get more complex. The way that the markets are structured and traded may change as a result of this evolution, requiring investors and financial institutions to reevaluate their approach to trading. But as algorithmic trading becomes more popular, it becomes more important to address the moral issues that surround it. The experiment highlights how crucial it is to address the ethical issues surrounding algorithmic trading strategies. It also suggests that in the future, there will probably be a greater emphasis on creating and enforcing ethical frameworks and regulations to guarantee the responsible and fair use of these technologies. In the broader context of society, the prevalence of algorithmic trading aligns with a broader shift towards a technology centered world.

Altogether, the statistical experiment not only captures a picture of the current prevalence of algorithmic trading but also serves as a foreshadow pointing towards a future where the intersection of finance, technology, and ethics will play an increasingly pivotal role in shaping the financial field.

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5 Conclusion

This paper was written about the prevalence of algorithmic trading and the impact that it will have on financial ethics. In the next portion of the paper, this study pulled data to run a statistical experiment that aimed to support my claim on the prevalence and high usage of algorithmic trading in stock companies. The results were then connected that to the impact it will have on stock returns as well as to the future of AI and Ethics in this quickly changing society. In conclusion, as algorithmic trading becomes increasingly complex, future research can further assess its impact in the financial sector and present the heightened need to highlight the importance of ethics when having access to these technological resources. Within my research, the methods of data collection include scholarly website search with the use of extensively critical and proper manners.

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