

Algorithmic Justice in Financial Markets: A Normative Framework for Fair Trading in the Age of Artificial Intelligence

Yetong An

Santa Monica College, Santa Monica, USA
an_yetong01@student.smc.edu

Abstract. This study explores the issue of fairness in AI-driven algorithmic trading through an ethical lens that synthesizes Rawlsian justice theory, utilitarianism, and virtue ethics. By analyzing key events such as the 2010 Flash Crash and the GameStop incident, this study reveals how algorithmic trading helps professional institutions disadvantage retail investors. We will begin by reviewing the use of trading algorithms such as HFT in today's markets, as well as traditional theories and principles of market ethics. This paper will then articulate the theoretical framework, discuss the fairness challenges posed by algorithmic trading, and incorporate case studies. The article will conclude with recommendations, including mandatory transparency protocols for trading algorithms, latency standardization for achieving equal access, AI-driven real-time market monitoring, and independent certification systems that enforce the principle of "algorithmic justice." By redefining fairness as a necessary consideration during algorithm design rather than an afterthought to avoid market regulation, this study argues for integrating ethical responsibility into code architectures and regulatory infrastructures, balancing technological innovation with fair market participation.

Keywords: Algorithmic Trading, Algorithmic Justice, Ethical Framework.

1. Introduction

In today's AI era, examples of using AI derivatives in life are commonplace. Since the birth of computers in the 1970s and 1980s, attempts have been made to use this latest tool in the markets - simple programs to automate the submission and execution of orders - and then came the concept of algorithmic trading: algorithmic trading refers to the use of algorithms or computer programs to automatically and quickly under specific predefined conditions execution of trading strategies under specific predefined conditions. Over the next few decades, high-frequency trading, Statistical Arbitrage, Trend Following, and even AI-driven Predictive Trading emerged. Algorithmic trading has greatly improved trading efficiency and reduced transaction costs. However, brand-new technologies have led to brand-new questions: can fairness in the market be guaranteed? Can the symmetry of information be guaranteed? And how to ensure the effectiveness of market regulation? When these concerns are realized, they can lead to market volatility or manipulation, as in the case

of the US stock market flash crash in 2010. Such events resulted in ordinary investors facing huge losses and undermined investor trust in the markets.

This thesis hopes to combine theoretical foundations and case studies with the fairness issues brought about by the application of algorithmic trading in the market, so as to propose operable fair trading standards and attempt to give concrete policy recommendations to safeguard investors' rights and interests as well as the stability of the market.

2. Literature review

Algorithmic trading, as a product of the information age, is gradually trusted and relied upon by the financial market, and at the same time, algorithmic trading brings many fairness issues to the market. Traditional market ethics theories emphasize information symmetry, equal opportunity, and market transparency to ensure a level playing field. However, the rapid development of algorithmic trading, represented by high-frequency trading (HFT), has triggered market volatility and fairness controversies [1]. For example, HFT has raised public questions about market ethics by utilizing millisecond information advantages, resulting in a significant information disadvantage for the average investor [2].

Angel and McCabe point out that while high-frequency trading has greatly enhanced market liquidity and efficiency, it has also created an "information gap" that undermines traditional standards of market fairness [3]. Further, with the development of AI-driven Predictive Trading, algorithmic transparency and interpretability have become the new focus of fairness research, as Pasquale points out in his classic book [4]. The Black Box Society, that algorithmic opacity exacerbates information asymmetry by making it difficult for investors to be held accountable and difficult to regulate.

O'Hara also emphasized in his study that the changes in micro-market structure brought about by algorithmic trading, such as ultra-high-speed execution of trading orders and complex trading signal processing, have led to the gradual failure of the existing regulatory system [5]. In summary, the fairness issue in the context of algorithmic trading has gone far beyond the scope of traditional ethical theories, and there is an urgent need to establish a theoretical and regulatory framework suitable for the new era.

3. Theoretical framework and methodology

3.1. Unified theoretical framework

To address fairness comprehensively in algorithmic trading, this research constructs a unified theoretical framework based on John Rawls' Theory of Justice and key ethical principles. Rawls' veil of ignorance encourages rule-making that protects the least advantaged, such as retail investors who may lack access to the technological infrastructure used by institutional traders [6]. From this lens, fairness in algorithmic trading must center on equal opportunity and mitigating systemic imbalance.

Here, this paper integrates three core ethical perspectives to flesh out our theoretical framework:

At the heart of utilitarianism, as developed by Jeremy Bentham and John Stuart Mill, is an emphasis on 'outcomes', i.e. a decision is morally justified if it maximizes collective happiness or utility [7]. Applying this to algorithmic trading is tantamount to asking us to assess whether such algorithmic trading improves market efficiency, liquidity, and accessibility. However, some critics have argued that high-frequency trading (HFT), while potentially benefiting the market broadly,

marginalizes retail investors and that this, too, is a utilitarian paradox that, while profitable overall, can be costly for a few.

Justice ethics, and Rawlsian theory in particular, shifts its focus from "outcomes" to "equitable structure". Those who hold these views tend to believe that fairness is not limited to market access but also includes the protection of vulnerable participants (retail investors). This view is particularly important in the case of GameStop, where platform restrictions appear to have favored institutional interests over those of individual traders, and Justice Ethics requires that rules be transparent and consistent regardless of an individual's position in the market.

Virtue Ethics can be traced back to Aristotle, and Alasdair MacIntyre reinterpreted it better [8]. Virtue Ethics differs from the first two Ethics in that it does not focus on equitable structure or outcomes but rather emphasizes the moral character of the decision-maker. Projecting this concept onto the financial sector means that it should value the integrity and responsibility of algorithm developers, platform designers, and institutional leaders. Virtuous behavior means not only compliance with the most basic relevant laws but also their willingness to promote transparency and respect for users at all transaction levels.

These ethical models provide a multidimensional structure for understanding fairness, the central keyword referred to in our study, which informs the case interpretations and policy recommendations in this study.

3.2. Methodology

To translate theory into actionable insights, this paper employs a multi-method qualitative strategy that enables a more in-depth analysis of algorithmic fairness in the real world.

3.2.1. Case study methodology

This paper next applies the ethical framework just presented to three landmark cases. This approach allows us to assess the ethical dynamics in the context of the intentions of algorithm designers, the responses of regulators, and the lived experiences of market participants. The case studies provide a concrete basis for theoretical testing, not only highlighting abstract fairness issues but also simultaneously revealing the practical limitations of existing frameworks.

Each case is analyzed from three perspectives:

Ethical perspectives: how utilitarian, justice and virtue-oriented ethics explain or challenge the fairness of the actions taken.

Systemic Consequences: The wider implications of the incident for trust, access, and market structure.

Corrective potential: What lessons does the case offer for redesigning trading systems and regulatory regimes?

3.2.2. Stakeholder analysis

The article will also integrate stakeholder analysis to examine and analyze the perspectives and power asymmetries of key market participants:

Retail investors: This group is often at a disadvantage due to limited access and speed of information.

Institutional traders: This group has the dual advantage of technology and information, which to some extent raises equity issues.

Regulators: This group is responsible for neutrality, but due to technological backwardness is often unable to achieve true neutrality in real-life situations.

Algorithm developers: this group is in a place where it cannot directly observe them, they usually operate behind the scenes, but their moral agency is central.

The above analysis reveals not only conflicting interests but also the ethical interdependence of different groups, suggesting that more inclusive and empathetic policy recommendations should be made. The paper views stakeholder dialogue not only as a mapping tool but also as a normative process - one in which equity is shaped by whoever's voice is heard and respected.

It combines ethical theory, in-depth case studies, and stakeholder reflection to ensure a rich, context-sensitive understanding of equity that is both principled and practical.

3.3. Philosophical reflections

It already knows about the rapid rise of AI-driven financial systems (algorithmic trading) and has challenged traditional economic assumptions about rational actors and free markets. Philosophically, it raises several questions: Are technologies such as trading algorithms morally neutral? Can systems built for speed and profit embody public values such as justice or trust?

This study argues that algorithms can never be neutral; they are embedded in the moral assumptions of their designers, which include which metrics can be optimized and which risks can be tolerated. Inspired by Langdon Winner, it argues that technological artifacts like trading algorithms can embody political and ethical choices that invisibly shape power structures [9].

This paper therefore proposes here the principle of "algorithmic justice": a design ethic based on Rawls' "veil of ignorance." Developers should design trading systems as if they could be used by any trader, regardless of the capital, access, or affiliation of the counterparty. This philosophical stance redefines fairness as an obligation of the algorithmic designer at the time of design, rather than just an add-on carried to fulfill market regulatory requirements.

By incorporating these reflections into the core of our ethical and methodological approach, it argues that the design of algorithmic trading in the marketplace is not only a technical task, but also an ethical one - fairness must be built into the code, not just vetted from the outside.

4. Case studies

4.1. The flash crash of 2010

Applying our theoretical framework, this event is a good example of the paradox of utilitarian existence that the article mentioned - despite temporarily increasing market liquidity, the rapid volatility of the market undermined the overall confidence of investors, leading to a series of subsequent losses. From a Justice Ethics perspective, institutional advantages in speed and information exacerbate inequality, causing disproportionate and very exaggerated harm to retail investors. On a moral-ethical level, on the other hand, it is left to question the moral character and responsibility of the high-frequency traders and platform operators, as it is clear that their prioritization of profits over system stability is what led to the Flash Crash that will be remembered for years to come.

4.2. Robinhood and the gamestop incident

It can analyze this case through Justice ethics, which in fact embodies systemic bias because Robinhood's trading restrictions privilege institutional interests rather than treating them equally with retail investor interests, and this undermines fairness and market integrity. The stakeholder analysis illustrates the difference in priorities between retail investors and platform operators, which is an ethical dimension. Virtue Ethics, on the other hand, illustrates the need for transparency and ethical responsibility of platforms and criticizes Robinhood's ethical lapses in decision-making.

4.3. The virtu financial HFT controversy

From a Utilitarian ethics perspective, it is appropriate to recognize the fact that Virtu Financial improves market efficiency, but at the same time, from a justice ethics perspective, the paper can critically point out the fairness issues that arise from the unequal use of trading technology. The stakeholder perspective, on the other hand, reveals a clear imbalance that favors institutional traders. From the perspective of virtue ethics, this case, on the other hand, is an illustration of how Virtuoso Financial's opaque trading algorithms and lack of transparency are not in line with the moral responsibility that they are supposed to have, and thus it demonstrates the urgency and necessity of regulatory reforms to promote virtuous market behavior.

5. Proposals for a fair trading standard

5.1. Algorithm transparency

Based on the above, the paper recommends mandatory disclosure of trading algorithms by regulators. These trading algorithms should document the logic by which they operate, their decision paths, and those risk parameters that are not visible to the public. This is consistent with the virtue ethic, which promotes integrity and accountability when things go wrong, and the justice ethic, which provides fair access to information for all market participants.

5.2. Equitable market access

To mitigate the systemic imbalances in algorithms mentioned above, trading platforms and exchanges should ensure equitable technical infrastructure that provides retail investors with access comparable to that of institutional investors. This includes standardized latency thresholds, equal access to key market data, and cost parity for trading instruments. This equitable access that actively protects vulnerable participants is consistent with Rawls' ideal of fairness.

5.3. Effective regulation in real time

Given the utilitarian ethic's emphasis on the benefits of the overall market, it should be believed that regulatory platforms should be urged to establish real-time regulation using advanced artificial intelligence monitoring systems. Such systems can protect the integrity of the overall market and investor confidence by detecting and responding to manipulative trading behavior promptly. Such real-time monitoring would safeguard the transparency and fairness of the entire trading ecosystem and would also be in the interest of stakeholders.

5.4. Clarify and enforce penalty standards

Based on the ethics of virtue and justice, severe penalties for ethical violations must be clearly defined and strictly enforced. Penalties should be able to reflect the seriousness and systemic impact of these misbehaviors. Some examples could be fines that escalate in amount with frequency, suspension of trading for varying lengths of time, and the possibility of serious criminal prosecution. A well-developed system of penalties strengthens the integrity of institutional as well as individual investments.

5.5. Ethical algorithmic certification

Inspired by the philosophy of "algorithmic justice," it proposes independent certification of trading algorithms, which can be evaluated against the ethical standards in the Rawlsian principles. Certified algorithms must demonstrate neutrality of user identity, transparency of decision-making, and embedded fairness considerations. Ethical certification urges designers to incorporate fairness into the core of technical design by transferring ethical responsibility to algorithm designers.

6. Conclusions

In conclusion, addressing fairness in algorithmic trading requires a comprehensive integration of ethical theory, philosophical reflection, and practical policy. Our recommendations emphasize transparency, fair access, proactive regulation, strict enforcement, and ethical accountability, embedding fairness deeply in our current financial markets. However, there are still many shortcomings and room for improvement in actual practice, and this is the set of fair rules that it is committed to building up.

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