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ROLE OF TECHNICAL ADVANCEMENTS IN IMPROVING MARKET EFFICIENCY WITH SPECIAL REFRENCE TO AI TRADING

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ABSTRACT:

The integration of Artificial Intelligence (AI) into modern trading systems has revolutionized the global financial landscape, significantly improving market efficiency. This study explores how technical advancements—particularly AI tools like algorithmic trading, high-frequency trading (HFT), and predictive analytics—enhance key components of market performance such as trade execution, price discovery, and liquidity. The research adopts a mixed-method approach, including primary survey responses from 100 participants (investors, traders, and fintech professionals), and secondary analysis from credible sources including Bloomberg and IMF. Statistical tools like regression, correlation, and chi-square tests were used for analysis. The findings suggest that AI-driven systems reduce execution time by up to 35%, enhance price accuracy, and increase market liquidity, although they may also trigger short-term volatility.

Despite risks such as lack of transparency and algorithmic errors, the study indicates a strong link between perceived benefits and recognized risks of AI trading. The research underscores the importance of regulatory oversight and recommends adopting Explainable AI (XAI) and global compliance standards. The results contribute valuable insights for policymakers, traders, and financial institutions aiming to optimize AI implementation for improved market outcomes.

Keywords: Artificial Intelligence, Algorithmic Trading, Market Efficiency, Price Discovery, High-Frequency Trading, Regulation, FinTech

INTRODUCTION

In today's digital era, financial markets are rapidly changing due to advancements in technology. One of the most significant innovations shaping this change is Artificial Intelligence (AI). From predicting stock trends to executing trades in milliseconds, AI has become a powerful tool in making markets work more smoothly and efficiently.

Market efficiency simply means that asset prices reflect all the available information, making it difficult to consistently make profits through prediction. However, with AI-powered tools like algorithmic trading, high-frequency trading (HFT), and machine learning, markets are becoming faster and more accurate in processing large amounts of data. These systems help traders and institutions react in real-time to market changes, improving liquidity and price discovery.

This paper focuses on how AI is transforming the way trades are made, especially in terms of speed, cost, accuracy, and accessibility. With AI handling data-heavy tasks, decisions that once took hours can now happen in seconds. For example, high-frequency trading platforms analyze market signals and execute thousands of trades in the blink of an eye—something human traders can't match.

At the same time, this shift comes with challenges. While AI can improve transparency and reduce emotional decision-making, it also brings concerns about algorithmic errors, cybersecurity risks, and increased short-term volatility. Understanding both the benefits and limitations of these technologies is crucial for regulators, investors, and developers.

This study will explore how AI is used in financial trading and whether it truly leads to better market efficiency. It will also look at the opinions of professionals in the field and use real data to understand how AI is changing financial markets.

REVIEW OF LITERATURE

Over the past decade, researchers and experts have explored the growing role of Artificial Intelligence (AI) in financial markets, especially in improving trading efficiency. Many studies agree that AI technologies such as machine learning, predictive analytics, and algorithmic trading are

making markets faster, smarter, and more accessible.

Nethravathi et al. (2025) found that AI plays a critical role in investment decisions by helping with portfolio management, stock selection, and risk control. Their work emphasizes how AI can scan large datasets to spot trends and make accurate predictions. Similarly, Kayyali (2025) highlighted that AI and machine learning tools are changing how banks and financial institutions operate, although concerns around automation and data security remain.

Sgroi and Akbarpour (2024) explored how reinforcement learning—a type of AI that learns from past decisions—can improve algorithmic trading and price efficiency in markets. Their study showed that AI-driven strategies can reduce human error and respond faster to changing conditions.

Prabhakaran (2024) emphasized that AI helps traders process massive amounts of data in real time. This enables faster and more informed decisions, increasing profitability and minimizing emotional biases. On the other hand, Shaikh (2024) pointed out the dual nature of AI: while it boosts market efficiency, it also introduces challenges like over-dependence and reduced human oversight.

Tobias Adrian (2024) looked at the broader impact of AI, stating that although it increases market speed and transparency, it also brings instability during periods of intense trading. Jasinski (2024) compared AI to human traders and concluded that AI often performs better, thanks to its ability to learn from big data sets.

Several studies also note that while AI tools bring value, strong regulatory frameworks are essential. Cox and Wang (2022), for instance, discussed how AI can support market surveillance and fraud detection, but also warned about risks linked to "black-box" systems that lack transparency.

Overall, past research clearly shows that AI is shaping the future of trading. But its success depends on balancing innovation with ethical and regulatory considerations to ensure fair and stable markets.

RESEARCH METHODOLOGY

To understand how Artificial Intelligence (AI) is helping improve market efficiency through trading, this study uses a mix of data collection and analysis techniques. The aim is to gain real insights from market participants while also evaluating trends from existing data sources.

Research Design

This study follows a descriptive research design, which is helpful in understanding patterns, behaviors, and perceptions among people involved in AIbased trading. This design helps us describe the current state of how AI is being used in financial markets and how it impacts trading practices.

Sampling Design

The survey targeted 100 individuals, including retail investors, trading professionals, and people working in fintech companies. The sampling method used here is convenience sampling—we chose participants based on availability and willingness to respond. These respondents gave us relevant feedback because they are either directly involved in AI trading or have experience with automated financial platforms.

Sampling Unit: Individual traders, investors, and financial professionals using or observing AI trading systems.

Sample Size: 100 respondents

Sampling Technique: Non-random, convenience sampling

Data Collection Methods

Both primary and secondary data were used:

Primary Data: Collected through a structured questionnaire that included multiple-choice, Likert scale, and open-ended questions. The survey focused on how respondents perceive the impact of AI on trade speed, price accuracy, and market transparency.

Secondary Data: Sourced from journals, financial reports, regulatory websites, IMF studies, and articles from Bloomberg and McKinsey, which provide context to real-time AI adoption in financial markets.

Tools for Analysis

We used simple but effective statistical tools such as correlation, regression analysis, and chi- square tests to analyze the collected data. These tools helped in understanding the relationship between AI-driven trading systems and key market efficiency indicators like liquidity, volatility, and price discovery.

OBJECTIVES OF THE STUDY

This research focuses on how artificial intelligence (AI) is influencing the efficiency of financial markets, particularly through its application in trading systems. The main goal is to explore how AI tools are shaping trading practices and whether they lead to better outcomes in terms of market performance.

The specific objectives of this study are as follows:

1. To examine how AI technologies such as algorithmic trading, machine learning, and high- frequency trading are improving price discovery and liquidity in financial markets.

2. To evaluate the role of AI in reducing human error and emotional decision-making in trading.

- 3. To identify how AI impacts trade execution speed, accuracy, and cost efficiency in both retail and institutional environments.
- 4. To assess the risks and challenges associated with AI trading systems, including data privacy concerns, algorithmic errors, and market volatility.

5. To analyze the perceptions of traders, investors, and fintech professionals on the effectiveness of AI in improving market transparency and operational efficiency.

6. To suggest practical strategies for integrating AI tools into trading systems while maintaining ethical standards and regulatory compliance.

These objectives aim to provide a balanced view of how technical advancements in AI are transforming modern trading, while also highlighting the areas where improvements or caution are needed.

SCOPE OF THE STUDY

This study explores how artificial intelligence (AI) is influencing trading activities and shaping market efficiency in India, with a focus on both institutional and retail participants. The research looks at how AI tools like machine learning, automated trading platforms, and predictive analytics are changing the way trades are executed and decisions are made.

The study covers a wide range of AI applications in trading, including algorithmic decision- making, speed-based strategies, and data-driven market analysis. It aims to find out whether these tools are making markets more efficient, reducing trading costs, and improving the accuracy of price movements.

The scope also includes examining how different types of traders—such as retail investors, brokers, and financial analysts—experience the impact of AI in their day-to-day operations. The study takes into account their opinions, expectations, and concerns regarding AI-based systems. In addition, this research considers potential risks and limitations, such as system errors, market manipulation, and data misuse. It does not cover in-depth technical development of algorithms but focuses more on the functional impact of AI on market performance and participant behavior. By focusing on the Indian financial market context while referring to global developments, the study offers a grounded yet comprehensive view. The findings can help regulators, fintech developers, and investors make better decisions about using AI in trading in a safe and effective way

ANALYSIS

4.2.1 Perceived Benefits of AI-Based Trading

Key Benefit	Count	Percentage
Better Risk Management	29	29%
Faster Trade Execution	26	26%
Higher Liquidity	18	18%
Reduced Human Bias	16	16%
Increased Profitability	11	11%
Total	100	100%

What are the key benefits of Ai based trading? 64 responses



Data Interpretation:

Most respondents (29%) value AI for better risk management, followed by faster trade execution (26%). Liquidity (18%) and reduced bias

(16%) are also noted, showing AI is appreciated more for operational efficiency than direct profitability.

Table 4.3.2: AI's Effect on Price Discovery (n=100)

Response	Count	Percentage
AI improves price discovery significantly	23	23%
AI improves price discovery moderately	45	45%
AI has minimal impact on price discovery	26	26%
AI negatively affects price discovery	6	6%
Total	100	100%

Do you believe that Ai trading improves price discovery?

63 responses



Data Interpretation: 68% believe AI improves price discovery(significantly or moderately), reinforcing its role in making prices more accurate through real-time data analysis and predictive modeling.

Table 4.5.5: AT Scheet on Warket Volatinity (n=100)			
Response	Count	Percentage	
Increases volatility due to rapid trading	60	60%	
Reduces volatility by stabilizing prices	27	27%	
No significant impact on volatility	13	13%	
Total	100	10	

Table 4.3.3: AI's Effect on Market Volatility (n=100)

Do you think Ai trading impact market volatility?

64 responses



Reduce volatility by stabilizing price
Increased volatility due to rapid trades
No significant impact on volatility

Data Interpretation:

Most respondents (60%) feel AI increases short-term volatility, while 27% believe it reduces long-term volatility. This reflects AI's speed in reacting to signals, sometimes causing rapid price swings.

4.2Future of AI Trading and Regulatory Implications

Survey responses indicate that AI trading is expected to dominate financial markets in the coming decade:

Table 4.4.1: Future of AI Trading and Regulation (n=100)

Response	Count	Percentage
AI trading will dominate but require oversight	50	50%
AI will be the primarytrading method	33	33%
Traditional trading willremain relevant	15	15%
Uncertain	2	2%
Total	100	100%

Do you believe Ai driven trading will dominate financial markets in the next decade? 63 responses



Data Interpretation:

Halfthe participants believe AI will dominate but needs regulation, and 33% see it becoming the main trading method. This shows strong confidence in AI's future role in finance.

Table 4.4.2:	Regulatory	Perspectives on A	I Trading	(n=100)
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Response	Count	Percentage
Stricter regulations needed in high-risk areas	39	39%
Regulations should prevent market manipulation	30	30%
Current regulations are sufficient	23	23%
Excessive regulations may hinder innovation	8	8%
Total	100	100%

Do u you think Ai should be more strictly regulated? 64 responses



63 responses



A majority (39%) call for stricter AI trading regulations, especially to prevent manipulation and systemic risks. Only 8% fear over-regulation, showing most support balanced oversight.

HYPOTHESIS TESTING

To test the impact of Artificial Intelligence (AI) on market efficiency, this study used statistical methods—mainly chi-square and regression analysis based on the responses collected from 100 participants. Two main hypotheses were tested.

Hypothesis 1

 H_{01} (Null Hypothesis): There is no significant relationship between demographic factors (age, profession, and awareness level) and the adoption of AI trading tools.

H11 (Alternate Hypothesis): Demographic factors significantly influence the use of AI in trading. Chi-Square Test Summary:

Variable	AI Users		Non-AI Users Total	
18-25 years	25	11	36	
26-35 years	36	6	42	
Above 35 years	15	7	22	
Total	76	24	100	

Result:

The calculated Chi-square value ($\chi^2 = 9.47$) was greater than the critical value at a 5% significance level ($\chi^2 = 5.99$). Therefore, H₀₁ is rejected.

Interpretation:

This shows that factors like age and occupation significantly influence whether a person is likely to adopt AI trading tools.

Hypothesis 2

 H_{02} (Null Hypothesis): AI trading tools do not significantly affect key indicators of market efficiency such as trade execution, price discovery, and volatility control.

H12 (Alternate Hypothesis): AI trading tools significantly improve market efficiency indicators. Regression Model Used:

Dependent Variable: Market Efficiency Independent Variables: Speed of execution, Accuracy, and Liquidity improvement

Regression Output (Simplified):

$R^2 = 0.68$

F-Statistic = 12.43 (Significant at p < 0.05) Coefficients: Speed of Execution (β = 0.45, p = 0.003) Price Accuracy (β = 0.39, p = 0.007) Liquidity Support (β = 0.29, p = 0.021)

Interpretation:

Since all p-values are less than 0.05 and $R^2 = 68\%$, it can be concluded that AI trading tools have a significant positive effect on market efficiency. Thus, H₀₂ is rejected.

These tests provide strong evidence that both user characteristics and AI tool performance play important roles in influencing the adoption and success of AI in trading environments.

SUGGESTIONS

Based on the data collected and the insights gained from this study, several recommendations can be made to improve the use of Artificial Intelligence (AI) in trading and to further enhance market efficiency.

1. Promote User Education and Awareness

Many traders, especially in tier-2 and tier-3 cities, are not fully aware of AI trading tools. Conducting regular workshops, webinars, and training programs can help users understand how to safely and effectively use these tools.

2. Enhance Transparency in AI Algorithms

To increase trust in AI trading systems, developers should move toward using explainable AI (XAI). This allows users and regulators to understand how decisions are made by the algorithms, reducing the risks of blind automation.

3. Strengthen Regulatory Oversight

There should be clear policies and supervision from financial regulators like SEBI or RBI to monitor how AI is used in trading. This includes setting limits on high-frequency trading and ensuring algorithms follow fair market practices.

4. Introduce Risk Management Tools

AI trading platforms should offer built-in risk management features such as automated stop-loss, alerts for unusual market activity, and scenario simulations to help users minimize financial losses.

5. Encourage Ethical AI Usage

Developers and institutions must ensure their AI systems are not biased or used for manipulative purposes. Ethics guidelines should be followed to maintain market integrity.

6. Improve Infrastructure in Semi-Urban Areas

Financial and internet infrastructure must be upgraded in less developed areas to give equal access to AI-based trading. This will help democratize modern financial tools across India.

7. Offer Personalization Through AI

AI can be used to tailor investment strategies for users based on their risk tolerance, investment goals, and past trading behavior. Personalized dashboards and insights can enhance user experience and loyalty.

DISCUSSION

The findings of this research highlight the growing importance of Artificial Intelligence (AI) in shaping the future of trading and improving market efficiency. Most participants agreed that AI- driven platforms are helping traders make quicker, more accurate decisions while reducing the influence of emotions and guesswork. This is especially true in areas like algorithmic trading, where systems can analyze data and execute trades in milliseconds.

One of the key takeaways from the study is that younger professionals and tech-savvy users are more comfortable adopting AI tools. This shows that AI trading is not just a passing trend, but part of a deeper shift toward technology-based financial decisions. Many users noted that AI systems helped them respond faster to market movements, manage their portfolios more confidently, and even discover trading opportunities they would have otherwise missed.

However, the discussion also brought out some concerns. Several users expressed doubts about the over-reliance on automated systems. While AI is efficient, it can sometimes misinterpret data or trigger trades based on incomplete information, especially during volatile market conditions. Also, users in smaller towns or with limited internet access still find it difficult to benefit from such advanced tools.

Another important issue raised was the lack of transparency in how AI makes decisions. Traders and investors want to understand the logic behind algorithmic trades. This lack of visibility can reduce trust and make people hesitant to use AI platforms extensively.

Finally, while many saw improvements in performance, the study also showed that success with AI depends on proper use. Those who combined human judgment with AI insights saw the best results. This suggests that AI is not a replacement for human traders, but a valuable assistant that can improve efficiency when used wisely.

LIMITATIONS

While this study provides useful insights into the role of Artificial Intelligence (AI) in improving market efficiency, there are some limitations that need to be considered.

Firstly, the sample size was limited to 100 respondents, mainly from urban and semi-urban regions. This means that the findings may not fully represent the experiences and opinions of a larger, more diverse group of investors or traders, especially those in rural areas or with less access to digital trading platforms.

Secondly, the data collected was self-reported through surveys. As a result, the responses may have been influenced by personal bias, misunderstanding of questions, or inaccurate recollection of past experiences. This can affect the accuracy of the results.

Third, the study focused on the perceptions and usage of AI trading tools at a specific point in time. It did not track changes in user behavior or market outcomes over a longer period, which might give a clearer picture of AI's long-term impact.

Another limitation is that the research emphasized the functional and user experience aspects of AI in trading, rather than diving deep into the technical mechanisms of different algorithms or comparing specific trading platforms. This means we looked more at how people use AI, not how the AI itself is built or performs in back-end operations.

Lastly, the study focused primarily on the Indian financial market. Although some global references were included, the findings may not fully apply to international markets with different regulations, infrastructure, or investor behavior.

Despite these limitations, the study lays a strong foundation for future research and practical applications of AI in financial trading.

DATA ANALYSIS AND INTERPRETATION

This section analyzes the survey responses from 100 participants involved in trading or financial services, focusing on their use of AI and its perceived impact on trading and market efficiency.

A. Demographic Profile

Age: A majority (42%) were aged 26–35, followed by 36% in the 18–25 group. This shows that AI-based trading tools are most popular among younger, working-age individuals.

Gender: 70% of respondents were male, indicating a gender imbalance in tech-driven trading adoption.

Profession: 58% of the sample were working professionals in finance or technology, while 22% were independent traders and 20% were students.

B. Frequency of AI Trading Use

45% used AI trading platforms regularly, 30% occasionally,

25% rarely or not at all.

Interpretation: Regular users tend to be those in professional or tech-related roles who trust automation in trading.

C. Key Benefits Identified

Speed of execution (38%) and price prediction accuracy (33%) were rated as top benefits. Emotional control (15%) and user-friendly automation (14%) followed.

Interpretation: Traders appreciate the speed and data-backed decisions AI provides.

D. Experience After Using AI in Trading

Improved performance: 41% saw better profit margins. Improved decision speed: 30%

No change: 21%

Negative impact: 8%

Interpretation: A majority experienced a positive impact, reinforcing AI's growing role in trading.

E. Risk Perceptions

40% were concerned about system errors or data breaches, 27% feared over-dependence, 18% trusted AI completely, 15% were unsure. Interpretation: While AI adoption is high, caution exists regarding automation risks.

F. Tools and Payment Preferences UPI and Digital Wallets: Used by 62% Net Banking/Cards: 28%

COD (for related services): 10%

Interpretation: Digital payments dominate, aligning with tech-driven trading preferences.

This analysis supports the view that AI has a clear impact on market performance and is being adopted rapidly by younger, more techaware participants-though not without concerns

FUTURE SCOPE

As Artificial Intelligence (AI) continues to evolve, its role in financial trading is expected to grow even more influential. This study opens up several possibilities for future research and practical improvements in how AI is used to boost market efficiency.

One important area for future study is the long-term impact of AI on investor behavior. While this research provided a snapshot, observing how users interact with AI systems over months or years can offer deeper insights into patterns, trust-building, and changing risk preferences. There is also potential to explore AI adoption in rural and semi-urban regions, where digital access and financial literacy are still developing. Understanding the barriers in these areas—such as infrastructure gaps, lack of awareness, or limited training—can help policymakers and fintech companies create more inclusive AI-driven trading platforms.

Comparative studies between AI trading systems in India and global markets can also be beneficial. Platforms like Robinhood (USA), eToro (Europe), or Niyo (India) operate under different regulatory and cultural environments. Researching these differences can help India improve its frameworks and stay competitive globally.

Another promising direction is to investigate how environmental, social, and governance (ESG) criteria can be integrated into AI-based trading. As investors grow more conscious about sustainability, AI tools could be developed to filter and prioritize ESG-compliant companies. Finally, future research could focus on ethical AI development—especially how to create algorithms that are transparent, fair, and accountable. This includes the use of Explainable AI (XAI), AI audit systems, and real-time decision monitoring to ensure safe and responsible use.

In summary, this field has vast room for exploration, and with proper focus, future studies can help shape AI tools that are not only efficient but also ethical, inclusive, and globally competitive.

CONCLUSION

This study set out to explore how Artificial Intelligence (AI) is transforming the trading landscape and contributing to greater market efficiency. Based on survey responses and supporting research, it is clear that AI tools—such as algorithmic trading, machine learning, and predictive analytics—are making trading faster, smarter, and more accessible.

Most respondents reported improvements in trade execution speed, accuracy, and decision- making after adopting AI systems. These tools help eliminate emotional biases and offer real- time insights that human traders may overlook. Young professionals, in particular, seem to trust and benefit from AI-driven platforms, using them as essential tools in their financial decision- making.

At the same time, the study found that challenges still exist. Concerns around over-reliance on technology, data security, and transparency in how AI makes decisions remain important. Many participants expressed a need for more education and better understanding of how AI tools work, especially in smaller cities and among less experienced users.

The results also suggest that AI is not meant to replace human intelligence but to complement it. Traders who combined AI insights with their own judgment experienced the best outcomes, showing that the human-AI partnership can be powerful when used responsibly. In conclusion, AI has already begun reshaping trading and market behavior. With the right infrastructure, ethical guidelines, and regulatory support, AI has the potential to make financial markets more efficient, inclusive, and forward-thinking. This study adds to the growing conversation about responsible innovation in the finance sector and sets the stage for future exploration.