



The Rise of Algorithmic Trading in Indian Stock Markets: Opportunities and Challenges

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Abstract:

Algorithmic trading (AT) has revolutionized the financial markets all over the world, including in India, by leveraging technology for faster and more efficient trade execution. This paper examines the evolution of algorithmic trading (AT) in Indian stock markets, supported by statistical data and regulatory developments. It explores the opportunities algorithmic trading (AT) presents for market participants and the economy while also addressing challenges such as regulatory concerns, market manipulation and cybersecurity risks. The paper concludes with policy recommendations for fostering a balanced ecosystem.

Keywords: Algorithmic Trading (AT), Indian Stock Markets, High-Frequency Trading (HFT), Trading Algorithms, Market Volatility, Price Discovery, Automated Trading Systems, Financial Technology

Introduction:

Algorithmic trading is also known as algo trading. It is the use of computer algorithms to automate trading decisions in financial markets. Instead of manual trading which relies on human judgment, algo trading uses pre-programmed instructions to execute trades based on specific criteria, such as price, volume, or other market indicators. Algo trading systems can be used for a variety of purposes, such as executing trades at high speeds, identifying market trends and managing risk. These systems can be designed to trade a wide range of financial instruments such as stocks, futures, options and currencies.

Algo strategies use computer-defined rules and mathematical logic to automate the process of trading in financial markets. They collect data from different

sources like market data and historical prices. This data is then processed and analyzed to identify potential trading opportunities. Once the data has been collected, a set of rules or instructions are developed based on specific criteria like price movements, market indicators etc. These algorithms are then back tested on historical data to see how they would have performed in different market conditions. When the algo strategy identifies a trading opportunity based on the defined logic, it automatically executes order in the market. This can be done using various order types, such as market orders, limit orders and stop orders.

With technological advancements and regulatory facilitation, the Indian stock markets have seen rapid increase in the adoption of Algorithmic Trading (AT).

The concept of AT gained prominence in India after the Securities and Exchange Board of India (SEBI) allowed direct market access (DMA) in 2008. Since then, its adoption has grown significantly, contributing to increased market efficiency and liquidity while raising concerns about market fairness and stability.

Beginnings of Algorithmic Trading in India:

In 2008, a historical circular, issued by Securities and Exchange Board of India (SEBI) stated that India was opening its markets to algorithmic trading. Direct market Access (DMA) was introduced. Algorithmic trading in India, for the very first time, was undertaken with no intervention from human beings. Gradually, models based on the mechanism of arbitrage were built for Equities, Options and Futures on the National Stock Exchange (NSE) as well as the Bombay Stock Exchange (BSE). Since 2011, the turnover percentage, based on algorithmic trading, has increased by more than fifty percent on the segment of BSE's Equities.

Smart Order Routing: In 2010, SEBI introduced something known as 'Smart Order Routing' (SOR). It enabled investors to place orders for trades without bothering which exchange was facilitating better prices of securities. Traders now knew that they'd get the best price execution. Across the BSE and the NSE, the volume of transactions went up and so did liquidity.

Co-Location Services: Soon, the NSE began to launch services that based on algorithms offering convenient trading tools to investors. Co-location was introduced to provide members the

facility of placing their own servers in the premises of the exchange. This was offered for a fee. These were offered by the BSE by 2013. After this, both the BSE and NSE provided retail trading the opportunity of using algorithms in placing orders. From this time, the Indian stock market has seen a steady rise of algorithmic trading.

Literature Review:

Several global studies highlight the transformative impact of AT. Research in developed markets such as the U.S. and Europe, shows that AT improves liquidity and reduces transaction costs.

Hendershott, T., Jones, C. M. and Menkveld (2011) were the first to examine the impact of algorithmic trading in an equity market context. They examine the causal effect of Algorithmic Trading on liquidity. They suggest that algorithmic trading has grown rapidly since the mid-1990s and liquidity in the world equity market have also dramatically improved. Brogaard, Hendershott and Riordan (2014) studied the High-Frequency Trading (HFT) and its impact on market quality for the US equity market. The study illustrates the High Frequency Trading aspect of a trade, which is also a common phenomenon for Algorithmic Trading. Kelejian and Mukerjee (2016) suggest that "the period since the introduction of algorithmic trading (AT) has seen increases in both the variance and covariance of return volatility in most industries". They find that in certain cases with the arrival of information pertaining to the fundamentals, HFT (a subset of AT) increases volatility.

Groth (2011) argues that algorithmic trading does not increase

volatility and certainly not more than human traders. AT's behave in a similar manner as human traders do and when compared they don't lead to unexpected volatility surge.

Hendershott, T., Jones, C. M. and Menkveld (2011) investigate if AT changes the nature of price discovery. They use Hasbrouck (1991 a, b) framework, which is based on Vector Auto Regression (VAR) model. They suggest that algorithmic trading decreases the amount of price discovery that is correlated with trading.

In the Indian context, several studies reveal that AT accounts for over 50% of total trading volumes on the NSE. However, concerns over systemic risks and market manipulation persist.

Objectives of the Study:

1. To analyze the growth and adoption trends of algorithmic trading (AT) in the Indian stock markets.
2. To examine the opportunities created by algorithmic trading like improved market efficiency, liquidity and cost-effectiveness for market participants.
3. To identify the challenges and risks associated with algorithmic trading (AT) including regulatory concerns, market manipulation and infrastructure inequalities.
4. To evaluate the impact of algorithmic trading on market volatility, price discovery and retail investor participation in the Indian context.
5. To compare the Indian regulatory framework for AT with global best practices.
6. To provide actionable recommendations for fostering a balanced ecosystem for algorithmic trading in India.

Hypotheses:

1. H1: Algorithmic trading has significantly improved market liquidity and reduced transaction costs in the Indian stock markets.
2. H2: The adoption of algorithmic trading has a positive impact on price discovery and market efficiency in India.
3. H3: Regulatory interventions by SEBI have mitigated some risks of algorithmic trading.
4. H4: Retail investors face significant barriers to adopting algorithmic trading, limiting their ability to compete with institutional players.
5. H5: Cybersecurity risks associated with algorithmic trading systems pose a growing challenge to the stability of Indian stock markets.

Scope of the Study:

The study explores the transformative role of algorithmic trading (AT) in the Indian stock markets, focusing on its opportunities and challenges. The study primarily examines developments in algorithmic trading from 2008 to the present day. This period captures the rapid growth and evolution of AT in India. The research focuses on the Indian stock markets, specifically the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE). The findings aim to provide actionable insights for policymakers, market participants and technology providers to foster a sustainable and equitable ecosystem for algorithmic trading in India.

Methodology:

The study is descriptive and exploratory, aiming to analyze the growth, impact, opportunities and

challenges of AT. The descriptive aspect focuses on statistical trends and market data, while the exploratory component addresses emerging challenges and regulatory dynamics. The study extensively relies on secondary data from various sources including SEBI Reports such as circulars, guidelines and policy updates related to algorithmic trading. Stock Exchange Data related to trading volume, market share and liquidity statistics from the NSE and BSE. Industry Reports including publications by financial institutions, brokerage firms and consulting agencies such as PwC, EY, and KPMG. Academic Journals like peer-reviewed articles and research papers on algorithmic trading and its impact on market efficiency and volatility. Studies from developed markets (e.g., the U.S., Europe) for benchmarking and regulatory insights.

Statistical Insights and Trends:

- **Growth of Algorithmic Trading:** AT has seen exponential growth in India. According to SEBI, algorithmic trading accounted for approximately 51% of the total trading volume on the NSE by 2023, up from 17% in 2011. The average daily volume of AT increased from INR 10,000 crores in 2015 to over INR 25,000 crores by 2023. The data highlights the significant growth potential of the global algorithmic trading market. Valued at USD 15.55 billion in 2021, the market is expected to grow at a compound annual growth rate (CAGR) of 12.2% from 2022 to 2030. This signals increasing adoption of algorithmic trading technologies, reflecting a shift toward more automated, efficient,

and data-driven trading practices in the financial industry.

- **Market Share of Participants:** Institutional investors dominate the AT landscape, with over 70% of algorithmic trades attributed to mutual funds, foreign portfolio investors (FPIs), and hedge funds. On the other hand retail participation also gradually increasing due to the availability of user-friendly algorithmic platforms and trading bots. Zerodha and Upstox have introduced algorithmic trading tools for retail investors which is democratizing access to technology.
- **Performance Metrics:** AT has significantly reduced bid-ask spreads, enhancing market depth. Mixed evidence suggests that while AT smoothens volatility during normal conditions, it may exacerbate it during market disruptions.

Opportunities In Algorithmic Trading:

The algo strategy continuously monitors the market for any changes and adjusts the trades accordingly. This process helps to optimize the trading strategy and improve its performance over time. Algo trading platforms also incorporate risk management strategies to minimize the potential losses from any adverse market movements. This can be done by setting stop-loss orders, using hedging strategies and monitoring overall portfolio risk.

- **Improved Market Efficiency:** AT enables faster execution and reduces human errors, leading to more efficient price discovery. It has minimized arbitrage opportunities across markets, ensuring fairer pricing mechanisms.

- **Enhanced Liquidity:** The presence of algorithmic market makers improves liquidity, as evidenced by the NSE's increasing trade volumes. Studies show a 30% reduction in average bid-ask spreads due to AT. A study of NSE trading data reveals a 40% increase in liquidity metrics, attributed to AT. Analysis of intraday data also shows that AT reduces volatility under normal conditions but may amplify it during market stress.
 - **Cost Reduction:** AT minimizes transaction costs by optimizing order execution. For institutional investors, this translates to better fund performance.
 - **Technological Advancements:** Machine learning and AI-driven trading strategies are enhancing predictive accuracy, enabling traders to capitalize on intricate market patterns.
 - **Global Competitiveness:** The rise of AT has positioned Indian markets as competitive global players, attracting FPIs and enhancing capital flows.
- location facilities and guidelines on order-to-trade ratios. However, balancing innovation and fairness remains a challenge.
- **Market Manipulation:** AT is susceptible to manipulation tactics such as spoofing and layering, which can distort market integrity. For instance, the infamous 2012 "Flash Crash" in the U.S. underscored the risks of high-frequency trading (HFT).
 - **Infrastructure Costs:** Implementing AT requires significant investment in technology and infrastructure, including collocation services. This creates an uneven playing field for retail investors.
 - **Retail Disadvantage:** Retail investors often lack access to the sophisticated tools and data analytics used in AT, raising concerns about market equity.
 - **Cybersecurity Risks:** Automated trading systems are vulnerable to cyberattacks, which can disrupt market operations and compromise sensitive data.

Challenges and Risks:

Despite its benefits, reliance on AI brings certain risks. Over-dependence on AI could destabilize markets, amplifying risks such as herd behaviour and flash crashes. Furthermore, AI-generated misinformation and fake content pose new challenges, necessitating proactive measures and verification tools. Indian regulators, including SEBI, are preparing for stricter rules to manage these risks, ensuring the financial ecosystem remains balanced and secure.

- **Regulatory Concerns:** SEBI has issued several circulars to regulate AT, including restrictions on co-

Regulatory Landscape:

- I. The U.S. enforces stringent measures under the Dodd-Frank Act and has dedicated systems to monitor HFT activities. Europe's MiFID II mandates transparency and imposes limits on algorithmic and HFT practices. SEBI has been proactive in regulating AT to ensure market stability. For this purpose SEBI uses following different approaches.
- II. **Mandatory Registration of Algorithmic Traders:** SEBI makes it mandatorily that all algorithmic trade brokers should register with SEBI and seek prior approval for

their trading systems. This limits only the regulated trade to high-frequency and algorithmic trading and prevents unregulated activities that can be seriously harmful.

- III. **Risk Management Systems:** Algorithmic trading has been mandated with the implementation of strict risk management systems by SEBI to avoid any unwanted consequences. These systems include kill switches that automatically halt the trading if the algorithms begin to behave erratically, safeguards from algorithms touching pre-defined limits, and mechanisms to help minimize liquidity risks.
- IV. **Latency and Co-location Restrictions:** Until 2018, SEBI did not allow co-location facilities unless there was fair access from the exchanges. The main idea is to make the level playing field for all traders, with no particular group sporting an unfair technological advantage over the others.
- V. **Algo Flagging and Auditing:** To enhance transparency, SEBI mandates every order arising out of an algorithm to be specifically so indicated as an algorithmic trade. This will enable regulators to track the level of algorithmic trade and identify any consistent pattern of manipulation or abuse of any kind. Other than flagging, SEBI has also made mandatory audit trails of algorithmic trading systems. The brokerage firm must maintain log records of all algorithmic transactions involving parameters of the various algorithms used. It is to ensure that trading activities may be checked and audited as and when required.

- VI. **Limits on High-Frequency Trading (HFT):** SEBI has put several restrictions on certain HFT practices. Order-to-trade ratio regulation is in the right direction which requires a broker to ensure that he limits the number of orders that he generates relative to the trades that he executes. That way, strategies that feed off orders for finding prices should not be able to overwhelm the market by the sheer volume of orders. Secondly, SEBI has also introduced a minimum resting period for orders whereby, for example, an order stays in the open order book of an exchange for a certain minimum period before it can be cancelled. This again discourages the rapid-fire entry and deletion of orders, which is common in manipulative trading strategies.

Suggestions:

The following suggestions can help SEBI to strike a balance between fostering innovation and ensuring fair, efficient, and stable financial markets.

- I. **Strengthening Regulatory Framework:** SEBI should implement advanced surveillance systems to monitor algorithmic trades in real time, identifying suspicious patterns that could indicate market manipulation or abusive practices. Pre-approval or certification of algorithmic trading strategies should be mandated by SEBI to ensure their compliance with market rules and prevent disruptive strategies. There is need to enforce strict record-keeping of algorithmic transactions to enable robust audits and post-trade analysis.
- II. **Ensuring Fair Access:** There is need to address infrastructure

- inequalities by regulating co-location services, ensuring equal access to low-latency networks for all participants, including retail investors. Also introduce affordable and simplified algorithmic trading platforms for retail investors, coupled with educational programs on their usage.
- III. **Managing Market Volatility:** Develop better risk controls to prevent algorithm-driven flash crashes or excessive market volatility. Also set dynamic thresholds for order submissions by high-frequency traders to minimize price distortions during volatile periods.
- IV. **Promoting Transparency and Disclosure:** Require participants to disclose the share of algorithmic trades in their total trading volume, ensuring greater transparency in market activity. SEBI should also mandate brokerage firms offering algorithmic services to submit regular reports on algorithm performance, client usage, and compliance status.
- V. **Building Investor Awareness and Trust:** Investor education programs should be launched to demystify algorithmic trading, its benefits and associated risks for retail investors. Also develop redressal mechanisms to address grievances arising from algorithmic trading malfunctions.
- VI. **Cybersecurity and Data Protection:** Establish stringent cybersecurity standards to protect trading platforms and algorithms from cyberattacks. Also enforce measures to ensure that sensitive trading data remains secure and is not misused by brokers or technology providers.
- vii. **Fostering Innovation and Global Competitiveness:** Create a regulatory sandbox for algorithmic trading innovation, allowing firms to test new strategies in a controlled environment without disrupting the broader market. And also collaborate with international regulatory bodies to align with global best practices and foster cross-border investments.
- VII. **Encouraging Research and Development:** Promote the development of India-specific algorithmic trading technologies by offering incentives for R&D in financial technology and encourage the use of AI and big data analytics to generate insights into market behaviour and improve regulatory decision-making.
- By implementing these recommendations, SEBI can leverage the opportunities of algorithmic trading while mitigating associated risks.

Conclusion:

Algo trading platforms have made it very convenient and affordable for traders to use pre-built trading strategies to automate their trades whether it is stocks, currency or commodities. This can help them execute high-volume transactions more frequently and with a greater probability of success. The limitations in algo trading arise from unexpected volatility or black swan events which may require human intervention for more informed decision-making. Once the trader streamlines and backtests a winning strategy, execution becomes very efficient. Given the rapid rate at which the trading community is growing in India, it is a matter of time before a majority of serious traders switch to pre-built trading strategies that align with their risk profile and financial

goals. While it offers unparalleled opportunities for market efficiency, liquidity, and global competitiveness, it also presents challenges such as regulatory hurdles, infrastructure inequality, and cybersecurity risks. A balanced approach that fosters innovation while ensuring fairness and stability is critical for the sustainable growth of AT in India. As AI evolves from an enabler to a

critical component of financial systems, balancing innovation with risk management will be essential. With proactive regulatory measures and a focus on harnessing AI's full potential, the stock market can continue democratizing, empowering investors of all backgrounds to engage in the financial landscape confidently.

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