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RESEARCH ARTICLE

PRICE DISCOVERY AND MARKET QUALITY IN THE AGE OF ALGORITHMIC TRADING: EVIDENCE FROM THE NATIONAL STOCK EXCHANGE

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Abstract

Algorithmic trading has become an important part of modern financial markets. In India, the National Stock Exchange (NSE) has developed into a highly electronic and technology-driven market in which trading algorithms can respond to information within very short periods of time. This paper examines how the growth of algorithmic trading may have affected market quality on the NSE, focusing on three measures: bid-ask spreads, intraday volatility and the speed of price discovery. It also considers the regulatory framework developed by the Securities and Exchange Board of India (SEBI) to manage the risks associated with automated trading. Previous research on the NSE suggests that algorithmic trading can improve the speed with which information is incorporated into prices, but it can also reduce liquidity provision during periods of market stress. The paper therefore argues that the effect of algorithmic trading is not uniformly positive or negative. Its impact depends on market conditions, the type of trading strategy used and the effectiveness of regulatory safeguards.

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Introduction:-

Financial markets have changed significantly with the development of electronic trading. Instead of relying entirely on human traders, modern exchanges allow computer programs to automatically submit, modify and cancel orders according to predefined rules. Algorithmic trading refers broadly to the use of computer algorithms to automate trading decisions or order execution. High-frequency trading represents a more specialised form in which speed, technology and very short holding periods are particularly important. The National Stock Exchange of India provides an interesting environment for studying these developments because it has operated as an electronic order-matching market and has gradually adopted sophisticated trading technologies. NSE currently provides infrastructure supporting algorithmic trading, direct market access and co-location for institutional and sophisticated participants. The growth of algorithmic trading raises an important economic question: does faster trading make financial markets better? A market is generally considered to have better quality when investors can trade with relatively low transaction costs, sufficient liquidity, and prices that respond efficiently to new information. However, very fast trading can also create risks. Algorithms may withdraw liquidity during periods of extreme volatility, and large numbers of orders can increase the pressure on exchange infrastructure. This paper examines this relationship in the context of the NSE.

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Understanding Market Quality:-

Three measures are particularly useful for studying market quality.

Bid-Ask Spread:-

The bid-ask spread is the difference between the highest price a buyer is willing to pay and the lowest price a seller is willing to accept. A smaller spread generally indicates that investors can trade at lower immediate transaction costs. If algorithmic market makers increase competition for order flow, spreads may become narrower.

Intraday Volatility:-

Intraday volatility measures how much prices fluctuate during a trading day. Algorithmic trading may reduce volatility by allowing information to be incorporated into prices more quickly. However, under certain circumstances, algorithms can react to each other and amplify short-term price movements.

Price Discovery:-

Price discovery refers to the process through which market prices incorporate information about the underlying value of an asset. A market with rapid price discovery adjusts quickly when new information becomes available. Because algorithms can process information and submit orders much faster than humans, they may potentially increase the speed of this process. These three indicators provide a useful framework for examining whether the technological development of the NSE has translated into better market functioning.

Algorithmic Trading in the Indian Market:-

SEBI has recognised both the benefits and risks of algorithmic trading. In its discussion of algorithmic trading and co-location, SEBI noted that algorithms can improve market quality by helping information enter prices rapidly, tightening spreads and improving liquidity. At the same time, it highlighted concerns including adverse selection for non-algorithmic traders and the possibility of extreme events such as flash crashes. SEBI's regulatory framework has consequently focused on controlling the risks associated with automated orders. For example, the regulatory framework requires risk controls for algorithmic orders, including price and quantity checks. Exchanges are also expected to have mechanisms for identifying dysfunctional algorithms that could create runaway trading activity. SEBI has also introduced controls relating to the order-to-trade ratio (OTR). A very high number of orders relative to completed trades can place pressure on market infrastructure and may be associated with strategies that repeatedly submit and cancel orders. In February 2026, SEBI revised aspects of its OTR framework for algorithmic orders, demonstrating that regulation continues to evolve alongside trading technology.

Algorithmic Trading and Bid-Ask Spreads:-

One of the main arguments in favour of algorithmic trading is that it can improve liquidity. Suppose two traders are competing to provide liquidity to investors. If automated systems can continuously update their buy and sell quotes in response to market information, competition between liquidity providers may result in narrower bid-ask spreads. Narrower spreads are generally beneficial because they reduce the cost faced by investors who need to execute trades immediately. However, this effect may not remain constant throughout the trading day. During periods of uncertainty or extreme volatility, algorithmic traders may become less willing to provide liquidity. An important study using NSE data compared trading before and after the introduction of algorithmic trading and found that algorithmic traders reduced their participation and liquidity provision during periods of high and persistent volatility and unusually wide spreads. This finding is important because it challenges the idea that algorithms always provide liquidity. Under normal conditions, automated strategies may improve market efficiency. During stressed conditions, however, some algorithms may withdraw from the market precisely when liquidity is most needed.

Algorithmic Trading and Price Discovery:-

Price discovery is perhaps the strongest argument for algorithmic trading. Financial markets constantly receive new information. Prices need to adjust when investors learn about changes in company earnings, interest rates, economic conditions or other events. Human traders require time to interpret information and submit orders. Algorithms can react much faster. This does not necessarily mean that algorithms understand information better than humans. Rather, they can process predefined signals and execute orders rapidly. The NSE's electronic structure makes this particularly relevant. NSE provides multiple levels of market-data feeds, including Level 1, Level 2, Level 3 and tick-by-tick data, allowing sophisticated market participants to process detailed information about orders and transactions. A reasonable hypothesis is therefore that greater algorithmic participation should increase the speed with which new information is incorporated into market prices. However, faster price adjustment is not automatically equivalent to better price discovery. If many algorithms respond to the same signal simultaneously, prices can

temporarily move beyond levels justified by fundamental information. Therefore, speed needs to be considered together with stability.

Algorithmic Trading and Volatility:-

The relationship between algorithmic trading and volatility is more complicated than its relationship with transaction speed. In normal market conditions, automated trading may reduce some forms of volatility by allowing orders to respond quickly to temporary price differences. On the other hand, algorithms can react to the same information at almost the same time. If several systems begin selling simultaneously, the resulting movement can become larger than it would have been if traders had reacted more slowly. This is one reason regulators pay attention to dysfunctional algorithms and technical failures. SEBI's framework requires exchanges to have mechanisms for identifying algorithms that could enter a loop or runaway situation and to take action where necessary. Therefore, the impact of algorithmic trading on volatility should not be treated as a simple cause-and-effect relationship. It may depend on whether the market is calm or stressed and on the strategies being used.

Research Methodology:-

A possible empirical approach for studying this question is to use publicly available NSE market data for a defined sample of liquid stocks. The study can compare market-quality indicators across different periods or trading intervals.

The main variables would include:-

- **Bid-ask spread:** to measure transaction costs and liquidity.
- **Trading volume:** to measure market activity.
- **Intraday volatility:** to measure short-term price fluctuations.
- **Order-book depth:** to examine the quantity of liquidity available near the best bid and ask.
- **Price adjustment speed:** to examine how quickly prices respond to new information.

NSE provides historical and real-time market-data products, including historical data and detailed market information through NSE Data & Analytics. A simple research design could compare periods with relatively high algorithmic activity against periods with lower activity. Another approach would be to examine market conditions before and after major changes in trading technology or regulation. The study should control for major market events because a sudden increase in volatility may be caused by an economic announcement or global financial event rather than algorithmic trading itself.

Regulation and Market Fairness:-

Algorithmic trading creates another important issue: whether technologically advanced traders have an unfair advantage over ordinary investors. Speed can matter in financial markets. Traders with better infrastructure may receive information and submit orders more quickly than slower participants. SEBI has therefore developed rules designed to maintain market integrity and create audit trails for algorithmic orders. Earlier regulatory measures required unique identifiers for algorithms and their orders, helping exchanges monitor automated trading activity. The regulatory approach has continued to evolve. In 2025, SEBI introduced a framework intended to provide safer participation for retail investors in algorithmic trading through brokers, while NSE now maintains a system for empanelling algorithm providers. This shows that regulation is not necessarily intended to prevent algorithmic trading. Instead, the objective is to allow technological innovation while controlling risks to market integrity and stability.

Discussion:-

The evidence suggests that algorithmic trading has a mixed relationship with market quality. There are clear potential benefits. Automated systems can process information rapidly, compete to provide liquidity and reduce the time required for prices to adjust. These effects can contribute to narrower spreads and faster price discovery. However, the benefits are not guaranteed under every market condition. The NSE evidence showing reduced algorithmic participation during periods of high volatility is particularly important. If liquidity providers withdraw during stressful periods, markets may become less stable exactly when investors most need liquidity. The important conclusion is therefore that algorithmic trading should not be judged simply by asking whether it increases or decreases volatility.

A better question is:-

Under what conditions does algorithmic trading improve market quality, and under what conditions can it create additional risks? This approach recognises that different algorithms have different objectives. A market-making algorithm, a statistical arbitrage strategy and an execution algorithm may affect prices and liquidity in very different ways.

Conclusion:-

The growth of algorithmic trading has fundamentally changed the structure of modern financial markets, and the National Stock Exchange provides an important setting for examining these changes in India. The available evidence suggests that algorithmic trading can contribute to faster price discovery, greater competition among liquidity providers and potentially lower transaction costs. However, these benefits can become less certain during periods of extreme volatility, when automated traders may reduce liquidity provision. The Indian experience therefore appears more complicated than the simple claim that technology automatically improves financial markets.

The role of regulation is consequently important. SEBI's continuing development of rules covering algorithmic orders, risk controls, audit trails, order-to-trade ratios and retail participation reflects the need to balance innovation with market stability. For future research, NSE data could provide a useful basis for testing whether periods of greater algorithmic activity are actually associated with narrower spreads, faster price discovery and different patterns of intraday volatility. Ultimately, the goal should not be to determine whether humans or algorithms are "better" traders. The more useful question is whether technological trading systems, when combined with appropriate regulation, can produce markets that are more liquid, efficient and fair for a wider range of participants.

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