THE INTERSECTION OF AI, FINANCIAL REGULATION, AND ALGORITHMIC TRADING: EVALUATING SEBI'S RESPONSE TO EMERGING RISKS IN A GLOBAL MARKET

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I. Introduction

Algorithmic trading, or algo trading, as commonly called, involves computer programs and algorithms to carry out financial market trades whose speeds and efficiencies cannot be matched by human beings. These algorithms work on a fixed set of rules based on timing, volume and price to issue orders without necessarily involving human interaction. The objective of algorithmic trading is to maximize trading efficiency, reducing the influence of human emotions on trading decisions and the fees associated with enabling the transactions. The use of high-frequency data feeds and sophisticated mathematical models enables algorithmic trading to detect and capitalize on market opportunities in a fraction of a second. This provides an important component of the liquidity of the market and overall market efficiency of the financial markets.

It is the advent of Artificial Intelligence that has gone on to revolutionize financial markets and, in particular, algorithmic trading by incorporating neural networks, machine learning algorithms and predictive analytics with a view to improve the trading strategies. Apart from record speed, precision and automation in transactions, it has also led to serious critical regulatory and ethical issues, such as manipulation of the market, stability of the system and biases by algorithms. The current inefficiencies in marketing, market distortion of financial stability and reinforcement of self-reinforcing biases will be exacerbated by AI-based strategies if they are not monitored. An overall oversight mechanism will be necessary to deal with such emerging risks as the use of AI trading practices increases to make sure there is accountability, fairness and transparency.

Regulators worldwide, including the European Securities and Markets Authority (ESMA), the U.S. Securities and Exchange Commission (SEC) and the Financial Conduct Authority (FCA),

have implemented provisions within their regulatory norms which include AI-specific governance structures. Nonetheless, the Securities and Exchange Board of India (SEBI) is depending on conventional regulation regimes like the SEBI (Investment Advisors) Regulations, 2013, which remain silent about AI-specific protections. With the ever-increasing development of AI, there is a critical need to examine the adequacy of the Indian regulatory framework to regulate AI-led financial markets and its conformity with global best practices.

The objective of this research is to critically analyze the efficacy of the current guidelines, disclosure standards and fair market practices in countering the challenges brought about by AI-driven algorithmic trading. One of the primary objects of the study is to investigate the regulatory loopholes present in the framework offered by SEBI and contrast it with the global governance models. Further, the cross-border character of the financial markets also necessitates an analysis of globally harmonized AI regulations that address the risks emanating from AI-driven finance operations.

II. Research Methodology

This study undertakes a doctrinal research methodology which relies on secondary sources of data such as statutes, case laws, scholarly literature and regulatory guidelines. The aim, hence, is to analyse SEBI's regulatory approach towards AI-driven algorithmic trading. In addition to the same, the research follows a comparative analysis method by analysing the algorithmic trading regulation of SEBI in comparison to the AI governance frameworks of the UK, USA and EU, enabling a critical assessment of AI-centred risks of market manipulation and algorithmic biases while identifying gaps in the regulatory mechanism of India's financial market. The primary sources that this study relies on are the reports from global financial regulators, international AI governance frameworks and SEBI regulations. The contributions to the discourse on responsible AI governance in financial markets will be attempted through this paper by examining the policy shortcomings and potential safeguards, thereby advocating for stronger oversight mechanisms to ensure the integrity of the market and the protection of investors.

III. Literature Review

The subset of financial technology that allows decisions to be made at speeds and frequencies beyond human capacities with the help of pre-programmed instructions for trading is called

Algorithmic trading[1]. AI has played a facilitating role in further introducing advanced adaptive and data-driven strategies, which result in optimised operation of the market. But it is identified that with the onset of liquidity and market efficiency, the evolving technology has introduced new risks such as flash crashes, systemic instabilities and algorithmic biases[2]. Regulators around the globe have started taking steps to address the concern by adopting AI-specific oversight mechanisms such as the EU AI Act's risk-based classification system (European Union) and U.K.'s ethical governance model (Bank of England). However, India continues to adhere to older SEBI regulations and lacks AI-focused safeguards, which reveal gaps in regulation that could impact the integrity of the market[3].

III.I Algorithmic Trading and AI Risks

The rise of algorithmic trading and AI-driven trading systems have redefined trading practices as the financial markets grow increasingly digitised. This has ushered both unprecedented efficiency and complex, technology-based risks.

The Evolution of AI-based Trading and Its Role in Market Efficiency

The old-fashioned manual dealing habits of the financial markets have developed into an advanced algorithmic system of dealing. Algorithmic dealing started at the end of the 1970s when the New York Stock Exchange's "designated order turnaround system" was established, which in turn gradually replaced conventional floor dealing[4]. Early 2000s then witnessed electronic trading platforms becoming substantially popular, as per findings, since around 10% of the U.S. equity trades were being made by algorithms and this value increased to about 70% by 2018[5].

The latest development on this evolutionary path is the development of integrating Artificial Intelligence into trading platforms. A study conducted identifies the contribution machine learning algorithms, particularly those using deep learning methods, have made in transforming

[1] Treleaven, P., Galas, M. and Lalchand, V. (2013). Algorithmic trading review. *Communications of the ACM*, 56(11), 76-85. Available at: https://doi.org/10.1145/2500117.
[2] Gomber, P., Arndt, B., Lutat, M. and Uhle, T. E. (2011). High-Frequency Trading. *SSRN Electronic Journal*. Available at: https://doi.org/10.2139/ssrn.1858626.
[3] Measures for Strengthening Algorithmic Trading Framework. (n.d.). *Securities and Exchange Board of India*. Available at: https://www.sebi.gov.in/sebi_data/meetingfiles/apr-2018/1524113320566_1.pdf.
[4] Aldrige, I. (2013). *High-Frequency Trading: Practical Guide to Algorithmic Strategies and Trading Systems* (2nd ed.).
[5] Brogaard, J., Hendershott, T. and Riordan, R. (2014). High-Frequency Trading and Price Discovery. *Review of Financial Studies*, 27(8), 2267-2306. Available at: https://doi.org/10.1093/rfs/hhu032.

market analysis by utilizing enormous amounts of unstructured data and discovering patterns beyond human cognitive capabilities[6]. The introduced AI systems facilitate more sophisticated trading decisions since they can effectively analyse market sentiment through news stories, social media streams and other data retrieval sources[7].

Its effects on market efficiency have been impactful. A study has shown that algorithmic trading increases the liquidity of a market by ensuring better price discovery mechanisms and minimising bid-ask spreads[8]. The added automation has been increasingly virtuous since it has led to a substantial drop in transaction costs, and estimations indicate that a decrease of about 50% has occurred over the last two decades[9].

Potential Dangers of Algorithmic Biases and High-Frequency Trading (HFT)

In spite of the efficiency gains, some new risks have been faced in the financial markets as a result of trading systems that are AI-based. Several studies on the subject demonstrate the issue of algorithmic prejudice which arises from incomplete and unrepresentative data sets[10]. Also, a study identifies that machine learning algorithms reinforce the human biases inherently present in past market data upon training on such data[11]. Research also shows how algorithms trained on past credit data have reinforced discriminatory lending patterns and created controversy around the pros and cons of trading algorithms[12].

Further challenges arise from the self-learning nature of the trading algorithm. Systems might choose short-term profits over market stability over the long term, as they might tend to create

[6] Mullainathan, S. and Speiss, J. (2017). Machine Learning: An Applied Econometric Approach. *The Journal of Economic Perspectives*, 31(2), 87-106. Available at: https://doi.org/10.1257/jep.31.2.87.
[7] Ding, X., Zhang, Y., Liu, T. and Duan, J. (2015). Deep learning for event-driven stock prediction. *IJCAI'15: Proceedings of the 24th International Conference on Artificial Intelligence.* Available at: https://dl.acm.org/doi/10.5555/2832415.2832572.
[8] Hendershott, T., Jones, C. M. and Menkveld, A. J. (2011). Does Algorithmic Trading Improve Liquidity? *Journal of Finance*, 66, 1-33. Available at: https://doi.org/10.1111/j.1540-6261.2010.01624.x.
[9] Angel, J. J., Harris, L. E. and Spatt, C. S. (2015). Equity Trading in the 21st Century: An Update. *The Quarterly Journal of Finance*, 5(1). Available at: https://doi.org/10.1142/S2010139215500020.
[10] Johnson, N., Zhao, G., Hunsader, E., Qi, H., Johnson, N., Meng, J. and Tivnan, B. (2013) Abrupt rise of new machine ecology beyond human response time. *Scientific Reports*, 3. Available at: https://doi.org/10.1038/srep02627.
[11] O'Neil, C. (2016). Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy. *New York: Crown Publishers*. Available at: https://doi.org/10.5860/crl.78.3.403.
[12] Khakurel, U., Abdelmoumin, G., Bajracharya, A. and Rawat, D. B. (2022). Exploring bias and fairness in artificial intelligence and machine learning algorithms. *Conference: Artificial intelligence and Machine Learning for Multi-Domain Operations Applications IV.* Available at: http://dx.doi.org/10.1117/12.2621282.

unanticipated behaviours through reinforcement learning[13]. The issue might be further amplified lack of proper guardrails, especially where there is limited regulation.

High-frequency trading (HFT) also poses its own set of risks. The study finds that the competition for speed leads to the production of negative externalities, including decreased market depth during times of stress and heightened market fragility[14]. Empirical evidence also confirms the reality that there is a positive relation between Stock price volatility and HFT activity operates to imply that HFT amplifies market volatility[15]. Some reporting also indicates the way in which particular HFT strategies create equity concerns for retail investors and institutional market players with inferior execution speed and by participating in latency arbitrage and possible front-running[16].

Impact caused by flash crashes due to malfunctioning of AI systems

Flash crashes best illustrate the potential risks of AI-driven trading systems. The most famous cautionary tale is the 2010 "Flash Crash," which resulted in the dropping of the Dow Jones Industrial Average to nearly 1,000 points, after which it rebounded back within minutes. The report by SEC-CFTC 2010 show that the algorithms have the potential to provide liquidity, but this potential withdraws at the time of market stress, thereby amplifying the volatility[17]. As AI systems expand and connect with other mechanisms, the risk of cascading failures grows and challenges traditional risk.

III.II Global Regulatory Approaches to AI in Financial Markets

Around the globe, regulation of AI in financial markets takes various shapes, wherein the EU, USA and UK have adopted distinct frameworks to combat the challenges posed by it. The

[13] Kirilenko, A. A., Kyle, A. S., Samadi, M. and Tuzun, T. (2017). The Flash Crash: High Frequency Trading in an Electronic Market. *Journal of Finance, Forthcoming*. Available at: https://dx.doi.org/10.2139/ssrn.1686004.
[14] Budish, E., Cramton, P. and Shim, J. (2015). The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response. *The Quarterly Journal of Economics,* 130(4), 1547-1621. Available at: https://doi.org/10.1093/qje/qjv027.
[15] Zhang, F. (2010). High-Frequency Trading, Stock Volatility, and Price Discovery. Available at: https://dx.doi.org/10.2139/ssrn.1691679.
[16] Menkveld, A. J. (2016). The Economics of High-Frequency Trading: Taking Stock. *Annual Review of Finacial Economics,* 8. Available at: https://ssrn.com/abstract=2787542.
[17] SEC-CFTC. (2010). Findings regarding the market events of 6 May 2010. *Report of the Staffs of the CFTC and SEC to the Joint Advisory Committee on Emerging Regulatory Issues.* Availability at: https://www.sec.gov/files/marketevents-report.pdf.

regulatory approach adopted by each jurisdiction is explored to find the balance between innovation and oversight in AI-driven trading.

EU: AI Act and ESMA's Regulations for Algorithmic Trading

The global leader, when it comes to AI financial regulations proves to be the European Union due to its proposed AI Act, as it employs a risk-based classification system that categorises AI applications into 4 tiers: minimal, limited, high, and unacceptable risk [18]. Financial AI systems, due to their sensitive nature, typically fall under the high-risk category and require stringent oversight [19]. European Securities and Markets Authority (ESMA), under the Markets in Financial Instruments Directive (MiFID), had also established a framework for algorithmic trading. This included the 2012 guidelines, which were subsequently extended to require pre-trade risk controls, extensive testing procedures and real-time surveillance in 2017. This transition from reactive to proactive supervision was recognized and it needed compliance prior to its implementation[20]. These proactive supervision techniques have resulted in fewer disruptive algorithmic behaviours, although issues caused by advanced models of AI systems continue to exist in the European market.

U.K.: FCA's Approach to Financial Stability and AI Governance

The United Kingdom has built a unique regulatory ethos which focuses less on prescriptive regulation and more on principle-based oversight. The Financial Conduct Authority (FCA) prioritizes ethical AI regulation through accountability, transparency and fairness. Research demonstrates the potential of this method to promote innovation while ensuring proportionate protection[21]. In addition, the FCA and Bank of England's joint discussion paper outlines methods for governance, such as data quality, risk management and explainability requirements[22].

[18] European Commission. (2021). Proposal for a regulation laying down harmonised rules on artificial intelligence. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021PC0206

[19] Veale, M. and Borgesius, F. Z. (2021). Demystifying the Draft EU Artificial Intelligence Act. *Computer Law Review International,* 22(4), 97-112. Available at: https://ssrn.com/abstract=3896852.

[20] Busch, D. (2017). MiFID II and MiFIR: stricter rules for the EU financial markets. *Law and Financial Markets Review*, 11(2-3), 126-142. Available at: https://doi.org/10.1080/17521440.2017.1412060.

[21] Ostmann, F. and Dorobantu, C. (2021). AI in financial services. *The Alan Turing Institute.* Available at: https://doi.org/10.5281/zenodo.4916041.

[22] Financial Conduct Authority & Bank of England. (2022). Artificial Intelligence and Machine Learning. *Discussion Paper 5/22*. Available at: https://www.bankofengland.co.uk/prudential-regulation/publication/2022/october/artificial-intelligence.

USA: SEC & FINRA role in controlling AI-driven financial activities

The United States has undertaken a regulatory approach which is characterised by supervision based on principles and post-facto enforcement. This approach reflected the philosophy of the United States which puts market innovation as a priority subject while ensuring strong enforcement capabilities[23]. The method adopted by the SEC relies on the existing frameworks, mainly the Market Access Rule 15c3-5 of the Securities Exchange Act, which requires broker-dealers to implement risk management systems that control algorithmic financing [24]. These efforts are complemented by FINRA's examinations and guidance, wherein their 2020 report on the matter established supervisory expectations [25].

This approach is demonstrated by the recent enforcement actions, which include the 2021 case of the SEC against App Annie for misrepresentation of alternative data use and a 2022 action against a hedge fund that misled investors about strategies facilitated by AI[26].

III.III Regulatory Landscape of India: SEBI's Approach

In India, algorithmic trading is regulated by the Securities and Exchange Board of India (SEBI). The regulatory framework has come a long way from the 2013 and 2018 guidelines, which were more on the lines of traditional risk mitigation strategies. However, holes persist in regulating ethical oversight and algorithmic transparency in sophisticated AI systems.

2013 and 2018 SEBI Guidelines on Algorithmic Trading

The first program of SEBI for regulation of algorithmic trading as per the 2013 circular included pre-trade risk controls, system audit requirements and testing procedures in "Risk Management and Systems Audit Framework for Algorithmic Trading". It was made obligatory in this circular that there must be a minimum order-to-trade and the penalties must be charged for excessive cancellations with the objective to sort out the issues of market manipulation as

[23] Seymour, B. (2022). The New Fintech Federalism. *Yale Journal of Law and Technology,* 24(1). Available at: https://dx.doi.org/10.2139/ssrn.3918914.
[24] Securities Exchange Commission (2010). Risk Management Controls for Brokers or Dealers with Market Access. *17 CFR § 240.* Available at: https://www.sec.gov/files/rules/final/2010/34-63241.pdf.
[25] FINRA. (2020). Artificial Intelligence (AI) in the Securities Industry. *FINRA Report.* Available at: https://www.finra.org/sites/default/files/2020-06/ai-report-061020.pdf.
[26] Securities Exchange Commission. (2021). SEC Charges App Annie and its Founder with Securities Fraud. *PR 2021-176*. Available at: https://www.sec.gov/newsroom/press-releases/2021-176.

per the study by[27]. The development of this method by SEBI was made possible in 2018 circular on "Additional risk management measures" that introduced obligatory encryption in communications, two-factor authentication on algorithmic tweaks, and augmented time-synchronisation standards. A paper observes that these actions targeted traditional algorithmic systems of trading instead of sophisticated AI-supported platforms[28]. While the 2018 circular added provisions like circuit breakers to prevent flash crashes and price bands, it was more preoccupied with addressing the symptoms of the vulnerabilities hidden beneath.

SEBI's risk mitigation measures versus best practices internationally

Comparative analysis shows broad divergence between SEBI's practice and international best practices. Whereas the EU has embraced anticipatory governance models prioritizing AI applications by risk class, SEBI has been predominantly reactive [29]. It is also noted that SEBI's model has no distinct provisions for self-learning models continuously changing without human oversight, thereby creating regulatory blind spots[30]. Scholars point out the lack of provisions for bias audits or fairness tests, which are now typical components in sophisticated frameworks such as the UK's FCA[31]. SEBI's guidelines also have few provisions on model explainability or algorithmic transparency, as opposed to ESMA's requirements that require exhaustive documentation of algorithmic logic[32]. This disconnect grows more serious as advanced machine learning algorithms begin entering Indian markets, the possibility of injecting biases and hazards that existing controls might not even identify[33].

[27] Securities Exchange Commission. (2024). SEC Charges Two Investment Advisers with Making False and Misleading Statements About Their Use of Artificial Intelligence. *PR 2024-36.* Available at: https://www.sec.gov/newsroom/press-releases/2024-36, Gandhi, A. and Sharma, R. (2024) Algorithmic Trading in India: Critical Analysis of SEBI's Framework for Retail Sector. *Indian Review of Corporate and Commercial Laws*. Available at: https://www.irccl.in/post/algorithmic-trading-in-india-critical-analysis-of-sebi-s-framework-for-retail-investor.

[28] Kaal, W. A. and Vermeulen, E. P. M. (2016). How to Regulate Disruptive Innovation – Facts to Data. *Jurimetrics,* 57(2), Available at: https://dx.doi.org/10.2139/ssrn.2808044.

[29] Kashyap, A. K. (2024). Rethinking FinTech Regulation Under the Indian Data Protection Framework. *Juridical Tribune-Review of Comparative and International Law*, *14*(3), 363-383.

[30] Chopra, K. (2024). *Shaping the Future: AI Governance and its Dynamic Effect on India's AI Competitiveness* (Master's thesis, Universidade Catolica Portuguesa (Portugal)).

[31] Krause, D. (2024). Addressing the Challenges of Auditing and Testing for AI Bias: A Comparative Analysis of Regulatory Frameworks. *Available at SSRN*.

[32] Deo, S. (2022). *The Under-appreciated Regulatory Challenges posed by Algorithms in FinTech. Understanding interactions among users, firms, algorithm decision systems & regulators* (Doctoral dissertation, Hertie School).

[33] Pathak, S., Pawar, A., Taware, S., Kulkarni, S., & Akkalkot, A. (2023). A survey on machine learning algorithms for risk-controlled algorithmic trading. *International Journal of Scientific Research in Science and Technology*, *10*, 1069-89.

Absence of an AI Ethics and Governance Framework in India

The void that exists in the regulatory mechanism in the Indian context is apparent in the form of the absence of a comprehensive ethical framework. While 2018 saw the introduction of a National AI strategy document by NITI Aayog, this was not translated into enforceable standards for financial market participation, thereby creating a vacuum in ethical oversight and bias mitigation[34]. Additionally, RBI had also set up a panel tasked to come up with a framework for the ethical use of AI in the financial sector, which has yet to bear the fruits of its labour[35]. The successful establishment of regulatory sandboxes by the UK's FCA and Singapore's MSA depicts a critical gap in the approach adopted by India.

The ethical vacuum and lack of innovation infrastructure together create compound challenges. Without controlled environments in which to test and vet AI systems prior to full market deployment, both regulators and innovators have limited opportunities to find ethical issues, bias patterns, or systemic risks that would otherwise be revealed in controlled environments. The UK and Singapore experiences illustrate how sandboxes not only facilitate innovation but also serve as regulatory learning labs. For example, it is illustrated how cohorts in FCA's sandbox that emphasised algorithmic decision-making highlighted unanticipated fairness issues that later informed general regulatory advice[36]. In the same vein, the Monetary Authority of Singapore's sandbox initiative has provided rich insights on Asian markets' explainability challenges[37].

India's strategy thus encounters a twin deficit: neither evolving ethical standards by cooperative testing grounds nor setting evident requirements by customary regulatory routes. This produces what is described as a "governance vacuum" in which principles-based or rules-based regulation does not successfully shape the creation and use of financial AI[38]. As algorithms increasingly determine capital allocation, price discovery, and financial inclusion in Indian

[34] NITI Aayog. (2018). National Strategy for Artificial Intelligence #AIForAll. *Government of India*. Available at: https://www.niti.gov.in/sites/default/files/2023-03/National-Strategy-for-Artificial-Intelligence.pdf.
[35] The Hindu Bureau. (2024). RBI sets up a panel to develop a framework on ethical use of AI in financial sector. *The Hindu.* Available at: https://www.thehindu.com/business/rbi-sets-up-panel-to-develop-a-framework-on-ethical-use-of-ai-in-financial-sector/article69029678.ece.
[36] Sky, N. (2024). Systematic review of Regulatory Sandboxes: implications for the European Union's Artificial Intelligence Act.
[37] Fang, C. C. X. (2023). Finance and technology: why fintech is the future of finance–a case study of Singapore's financial sector.
[38] Brummer, C., & Yadav, Y. (2018). Fintech and the innovation trilemma. *Geo. LJ*, *107*, 235.

markets, these basic regulatory lacunae are becoming more critical to address not only for innovation but also to ensure market integrity and financial stability.

IV. Problem Statement

While the evolution of Algorithmic trading, driven by the arrival of AI technology, has led to increased market efficiency, it has simultaneously given rise to a new category of risks that are opaque, adaptive, and difficult to monitor through traditional regulatory methods. Vulnerabilities such as feedback loops, flash crashes, and embedded biases are introduced by AI systems, primarily those that employ deep learning and reinforcement learning models, as they stem from skewed training data or unexplainable decision-making paths. These systemic concerns challenge the regulator's ability to take appropriate and timely measures against market anomalies. Taking cognisance of the same, global regulators have begun to shift from conventional methods of risk management to anticipatory governance, as exemplified in the EU AI Act, ESMA's proactive supervisory framework, and the U.K.'s ethics-centred approach to AI oversight.

India, however, struggles to introduce and implement the regulatory mechanism to combat the challenges posed by AI-driven algorithmic trading. The existing framework of SEBI, shaped by the 2013 and 2018 circulars, was limited to rule-based algorithms rather than data-driven, adaptive systems. Due to this outdated mechanism, dynamic oversight such as algorithmic explainability, mandated bias detection audits, and ethical compliance standards is impossible. The key problem, therefore, does not exist solely in a regulatory lag, but also in the misalignment that occurs between the speed at which technology evolves and the framing of the provisions required to govern it. This, in turn, raises questions about the integrity of the market, the protection of the investors and the credibility of the Indian financial oversight regime in an AI-driven world.

V. Analysis

The aim of this section is to critically analyse the frameworks that govern the use of artificial intelligence in financial markets, along with the challenges posed by the dual nature of AI, which both enhances efficiency and multiplies risk. This is aimed to be accomplished through a comparative study assessing the approaches adopted by the EU, the U.K., the U.S.A., and India to address predictive analytics, autonomous financial systems, and, most importantly,

algorithmic trading. The analysis places special emphasis on the conflict between risk mitigation and the facilitation of innovation, as well as regulatory asymmetries that may benefit high-end market participants, and methodical vulnerabilities created by "black box" algorithms. The section also assesses the conservative regulatory approach that SEBI adopts within the broader financial technology landscape of India, identifying potential limitations to the efficiency and development of the market. Lastly, its objective is to provide evidence-based recommendations for proportionate development that ensures a balance of technological innovation with market integrity and stability.

V.I Core Observations from the Literature

Consistently throughout the literature, the tension between the efficiency of AI mechanisms and the opaque risks they pose is highlighted. While AI technologies improve market efficiency through the reduction of market costs and enhanced liquidity provisions, at the same time, they also establish asymmetries in information that traditional regulatory frameworks struggle to monitor[39]. Well-established financial institutions tend to deploy sophisticated machine learning systems that capture disproportionate market share, which raises concerns regarding the stability of the market. This concentration risk is identified as homogeneity risk, which refers to a situation wherein superficially diverse AI systems that are trained on similar datasets respond identically to market signals, amplifying the financial system vulnerabilities rather than distributing them[40].

Transformation from Reactive Regulation to Proactive Regulation

Historically, the pattern followed by financial regulations is to operate on a crisis-response cycle wherein major frameworks emerge only after systemic failures of the machinery. However, examining the emerging literature worldwide, it is evident that a paradigm shift is underway towards anticipatory governance models. The primary mechanism to enable controlled experimentation proves to be the regulatory sandboxes that ensure equal measures

[39] Chen, Y. and Bellavitis, C. (2019). Blockchain Disruption and Decentralised Finance: The Rise of Decentralised Business Models. *Journal of Business Venturing Insights.* Available at: https://dx.doi.org/10.2139/ssrn.3483608.
[40] Danielsson, J., Macrae, R. and Uthemann, A. (2022). Artificial Intelligence and Systemic Risk. *Journal of Banking and Finance*, 140. Available at: https://doi.org/10.1016/j.jbankfin.2021.106290.

of innovation with risk management[41].

Heavy emphasis is laid on planning the scenarios and stress testing in the case of Proactive Regulations. The groundbreaking work by Haldane & May applies network theory to financial systems to identify the cascading failure points before crises manifest[42]. This phenomenon is termed "regulatory capacity building," which develops institutional knowledge that anticipates technological developments instead of responding retrospectively to their consequences[43].

Evolving Global Approaches

Philosophical underpinnings are apparent across jurisdictions in regulatory approaches to financial AI worldwide. The EU AI Act exemplifies a taxonomy that categorises AI-based platforms and applications according to the potential harm they might cause U.K.'s model, on the other hand, used initiatives such as FCA's Digital Sandbox to illustrate their principle-based approach, which emphasised the importance of ethical guidelines and innovation (FCA, 2022)[44].

Another distinct model is highlighted by the U.S.A.'s SEC, which focuses on sector-specific oversight and enforcement actions, thereby compelling the relevant authorities to address AI risks through initiatives such as the SEC's accountability programme. But a potential critique of this model is its likelihood to cause regulatory fragmentation, which can be exploited by sophisticated entities in an attempt to provide flexibility.

The Static Stance of the Securities and Exchange Board of India

The regulatory mechanism of governing financial AI via SEBI demonstrated a lack of a specialised framework, highlighting traditional market integrity mechanisms when dealing with challenges posed by algorithmic trading systems. A flaw that can be identified through the

[41] Buckley, R. P., Arner, D., Veidt., R. and Zetzche, D. (2020) Building Fintech Ecosystems: Regulatory Sandboxes, Innovation Hubs and Beyond, *Washington University Journal of Law & Policy*, 61. Available at: https://openscholarship.wustl.edu/law_journal_law_policy/vol61/iss1/10.
[42] Haldane, A. G. and May, R. M. (2011) Systemic Risk in banking ecosystems. *Nature,* 351(5). Available at: https://doi.org/10.1038/nature09659.
[43] Micheler, E. & Whaley, A. (2020) Regulatory Technology: Replacing Law with Computer Code. *European Business Organization Law Review,* 21, 349-377. Available at: https://doi.org/10.1007/s40804-019-00151-1.
[44] Financial Conduct Authority. (2022) Supporting innovation in ESG data and disclosures – the digital sandbox. Available at: https://www.fca.org.uk/publications/corporate-documents/supporting-innovation-esg-data-disclosures-digital-sandbox.

literature review is that these guidelines focus primarily on operational safeguards rather than addressing AI governance, thereby opting for regulation by analogy.

This conservative stance contrasts sharply with India's digital public infrastructure ambitions, which may be a strategic inconsistency that is limiting the development of the capital market. The literature suggests that this approach may incur significant opportunity costs, as more Indian fintech firms are migrating their AI-based market infrastructure to more favourable jurisdictions. Currently, it can be said that SEBI's emphasis on verifying compliance only creates a false sense of safety while turning a blind eye to systemic risks specific to machine learning systems.

V.II Core Regulatory Gaps Identified in the Indian Context

Unlike jurisdictions such as the UK and the EU, the regulations followed by India do not include explainability requirements, meaning market participants cannot explain how their AI systems arrive at trading decisions. This vacuum in regulation includes the absence of ethical standards and accountability mechanisms, with the findings of Gupta et al. depicting only 12% of Indian institutions having an established internal AI ethics committee, as opposed to the whopping 67% in jurisdictions having well-developed frameworks[45]. The Indian regulatory landscape also lacks regulatory sandboxes for AI innovation in finance, forcing entities to choose between forgoing innovation or deploying it without proper guidance. Furthermore, the approach adopted is predominantly disclosure-based compliance, rather than actively monitoring risk, which creates extensive paperwork with limited substantive oversight of algorithmic behaviour.

V.III Need for a Tailored Framework for India

The Indian financial market structure is characterised by higher retail participation with greater market fragmentation, hence making it significantly different from its Western counterparts. International regulatory models cannot be adopted without adaptation, as the literature reviewed suggests that even identical algorithmic trading restrictions may yield conflicting outcomes across jurisdictions with differing market compositions. Currently, regulated entities possess significantly more sophisticated technical capabilities than their regulators, as

[45] Gupta, A. and Chowdhury, S. (2022). The ethics gap: Governance of artificial intelligence in Indian financial markets. *Regulation & Governance*, 16(3), 815-833. Available at: https://doi.org/10.1111/rego.12456.

regulatory models rely heavily on compliance verification rather than technical evaluation. In addition, as the investor profile in India skews heavily towards the retail participants, the literature shows how algorithmic systems can unequally impact the less sophisticated market participants. Such demographic realities call for stronger protection measures for investors in comparison to jurisdictions that have a majority of institutional traders.

V.III Elements of Evolved AI Regulatory Framework

Drawing inferences from the comparative analysis, several key components are required for an effective AI regulatory framework in Indian financial markets. It begins by adopting a risk-based classification approach similar to the EU AI Act, which will facilitate proportionate oversight of the potential impact caused by an application. This must be supplemented by mandatory audits of the algorithm and its standards of explainability. This would help India leverage its technical talents while addressing transparency deficits identified in the current SEBI framework.

Another key element is the introduction of regulatory sandboxes as such settings ensure equilibrium between innovation and integrity of the market by means of experimental testing in a controlled environment. It needs to include mitigation of biases and data quality requirements in the algorithm development process, when addressing the issue of fairness, taking into consideration the distinctive data ecosystem of India. Additionally, the creation of real-time oversight infrastructure with the help of RegTech instruments would lead to overcoming the fragility caused by periodic disclosures, which presents as an important concern for adaptive learning systems[46]. Lastly, cross-institutional coordination among SEBI, RBI, and NITI Aayog would facilitate the holistic regulation of increasingly networked financial AI systems, rather than relying on isolated regulatory mechanisms.

VI. Findings

This study suggests that, although global regulators of finance are transitioning towards anticipatory, risk-based, and ethically conscious AI oversight models, India's stance is anchored in traditional SEBI norms guiding algorithmic trading, which remains largely static and compliance-centric. The lack of AI-specific legal provisions has created a mismatch

[46] Ranjan, M. (2023). Regulatory time horizons: The limits of periodic compliance for machine learning systems. *Financial Innovation,* 9(1), 58. Available at: https://doi.org/10.1186/s40854-023-00442-00.

between the complexity of emerging AI models and the simplicity of the regulatory tools currently employed.

The key findings herein are the development of what is described as a "regulatory dissonance" and not only a gap in rules but also in regulatory thinking. While the EU categorises AI on the basis of the risk posed by it and the UK focuses more on the explainability and ethical safeguards, India still perceives AI as a subcategory of automated trading, hence not confronting its adaptive and dynamic character. The study also reveals that a blind spot exists in the regulatory mechanism; that is, once the algorithm is authorised, there are no provisions for ongoing monitoring or updating compliance as the model is changed. The lack of interdisciplinary collaboration between the financial regulators, ethicists and technologists in India further limits the institutional capacity of SEBI to adapt to the risks posed by AI in financial markets.

Most importantly, the results indicate that India cannot simply copy foreign templates but has to build contextualised instruments of regulation based on it own distinctive investor population, levels of technology and market environment. This requires a transition from a form-based to a principles-based regulation format rooted both in legal accountability and technological awareness.

VII. Conclusions and Recommendations

In order to tackle the challenges posed and construct a strong, future-proofed financial regulatory landscape, below are suggested:

1. **Implementation of a Risk-based Framework of AI System Classification:**

   Emulating the EU model, SEBI must categorise AI systems employed in trading according to the degree of risk, such as low, limited, high and unacceptable. This enables a varied regulatory requirement so that sophisticated and innovative systems are subjected to increased scrutiny.

2. **Incorporate Regulatory Sandboxes for AI Trading:**

   Taking inspiration from the UK's FCA and Singapore's MAS, SEBI should implement a controlled environment via which the companies can pilot new AI trading systems

under regulatory oversight. This would promote innovation while curbing real-time risks.

3. **Mandate Explainability and Bias Audits:**

   All AI models that are used in financial trading must undergo compulsory algorithmic audits that measure fairness, risk of discriminatory output and transparency. Explainability must be included, especially for the models that are of high risk for retail investors.

4. **Development of Institutional Capacity and Cross-Sector Collaboration:**

   SEBI must develop interdisciplinary capabilities to substantively assess AI systems. Coordination among institutions such as the RBI, NITI Aayog, SEBI, and global regulators is critical for harmonised and informed decision-making.

5. Development of Statutory Framework for AI in Financial Markets: SEBI's circular, though proving to be of use at times, is insufficient as compared to the legal force and adaptability of a dedicated statute. A new regulatory instrument, introduced either through a legislative amendment or via a standalone AI Financial Market Regulation, should be developed to provide stronger tools for enforcement and adaptive governance mechanisms.

By undertaking these steps, SEBI can transition from a reactive to a proactive watchdog of the ethical and innovative financial market. The adoption of a futuristic regulatory mindset not only solidifies the domestic stability of the Indian market but also supports its credibility as a reliable future hub in the global financial economy.

To conclude, this study did not just critically examine the limitations of India's existing regulatory approach individually but did so against the backdrop of advanced global frameworks of it's international counterparts. The conclusions of this study not only identify the necessity of reform but also specify the type of reform required and the steps taken to implement it; such reforms move beyond checklists of compliance and grapple substantively with the evolving nature of financial AI.