# Implications of Fintech and High Frequency Trading (HFT) Developments on Capital Market Efficiency: A Systematic Literature Review

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| Article Info | ABSTRACT |
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| | With the rapid development of digital technology, global capital markets are undergoing a major transformation through the emergence of Financial Technology (FinTech) and High-Frequency Trading (HFT). This study aims to examine how these two technologies affect capital market efficiency in various countries. The method used was a Systematic Literature Review (SLR), examining 27 scientific articles published between 2021 and 2025 relevant to the topics of FinTech, HFT, and market efficiency. The results show that the implementation of FinTech and HFT can increase liquidity, transaction speed, and price efficiency through the use of technologies such as trading algorithms, blockchain, and automated trading systems. However, in developing markets, their impact remains limited due to limited digital infrastructure, immature regulations, and low financial literacy. Therefore, technological readiness, adaptive governance, and strong regulations are critical factors in ensuring stable and sustainable market efficiency. The implications of this study provide new insights into the role of financial technology in strengthening market efficiency and serve as a basis for policymakers and researchers in developing future digital capital markets. |

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## 1. INTRODUCTION

Capital markets play a crucial role in the modern economy. They are not only a place for buying and selling stocks and bonds, but also channel funds from those with excess capital (investors) to those needing funds for growth (companies). In this way, capital markets help drive long-term economic growth [1]. Confidence in capital markets rests on Fama's (1970) Efficient Market Hypothesis (EMH), which states that stock prices should reflect all available information quickly and accurately. This theory has three forms: weak, semi-strong, and strong, depending on the type of information reflected in prices [2], [3].

Over the past twenty years, technological advancements have dramatically transformed the way capital markets operate. Two key drivers of this change are Financial Technology (FinTech) and High Frequency Trading (HFT). These innovations have made markets faster, more automated, and more data-driven [4], [5]. FinTech plays a role in expanding public access to financial services through digital

technologies such as blockchain, robo-advisories, and online investment applications [6]. Meanwhile, HFT uses high-speed algorithms and computer systems to execute transactions in microseconds, increasing trading efficiency and narrowing the gap between buying and selling prices [7].

FinTech is no longer seen as a disruptor of the old system, but rather as a key enabler of modern financial efficiency. This technology makes financial information more accessible, lowers transaction costs, and increases investor participation. This helps improve semi-strong market efficiency because public information can be disseminated more quickly and equitably [8]. Research shows that the use of financial technology also improves the effectiveness of credit distribution and capital market efficiency, particularly in developing countries like China [9], [10].

Meanwhile, HFT is a specialized subset of algorithmic trading that is highly automated and fast. HFT helps increase market liquidity and accelerate price formation [4]. However, some research also suggests that HFT can introduce new risks such as increased price volatility and the potential for flash crashes [5], [11]. Because transactions are executed so quickly, market participants with more advanced technology can have an unfair advantage over ordinary investors. This raises concerns about market fairness and balance [12].

To date, the impact of FinTech and HFT on capital market efficiency remains a matter of debate among academics. Some researchers have found that their synergy can improve information efficiency and market stability [8], [13]. However, others argue that the high speed and reliance on technology can actually increase market uncertainty and risk [9]. Therefore, systematic research is needed to more deeply understand how these two technologies actually affect capital market efficiency.

This study uses the Systematic Literature Review (SLR) method to comprehensively analyze the relationship between FinTech and HFT developments and capital market efficiency. This method was chosen because it allows researchers to assess and combine existing research findings in a more objective, transparent, and reproducible manner. Through this approach, the study seeks to understand how FinTech and HFT affect operational, allocative, and informational efficiency in modern capital markets.

This research is expected to provide two main benefits. First, academically, the results of this review will help explain the differences in previous research findings and identify unanswered research gaps. Second, practically, the results of this research can serve as a basis for regulators in formulating policies that support technological innovation without sacrificing market stability. Thus, this research contributes to efforts to maintain capital markets that remain efficient, fair, and stable amidst the rapid development of financial technology [4], [12].

## 2. LITERATURE REVIEW

### 2.1 Capital Market Efficiency (EMH)

The Efficient Market Hypothesis (EMH), proposed by Fama (1970), is a key framework in finance for assessing the extent to which stock or security prices accurately and quickly reflect all available information. This theory divides market efficiency into three main forms. The first form, weak efficiency, states that prices fully reflect all historical data, such as price and transaction volume, preventing technical analysis from consistently generating excess returns. The second form, semi-strong efficiency, explains that all public information, such as financial reports, company announcements, and economic data, is already reflected in prices. The third form, strong efficiency, assumes that prices also reflect private or insider information [2].

In the context of emerging markets, recent research suggests that semi-strong efficiency is often not fully achieved. This is due to the time lag between the arrival of new information and market price adjustment [9], [13]. Therefore, studying the speed of information dissemination and price response is crucial, especially in today's digital era, when financial technology (FinTech) and high-frequency trading (HFT) increasingly dominate capital market activity. There are three key forms of market efficiency:

1. Weak-Form Efficiency

Weak-form efficiency is the basic concept of the EMH. This form states that all past price and trading volume data are already reflected in current prices. This means that historical patterns cannot be used to predict future prices or generate unfair profits. If markets were only efficient in this form, price movements would be random and influenced only by new information. Research in several emerging markets still finds weak-form inefficiency, where prices sometimes follow certain patterns that can be exploited for short-term profits [1], [11].

2. Semi-Strong Form Efficiency

At this level, a market is considered efficient if security prices can quickly adjust to all available public information. Public information includes financial reports, economic news, and company announcements. In this research, FinTech plays a crucial role in improving semi-strong form efficiency by accelerating the dissemination of information to the public through digital platforms and artificial intelligence-based analysis [6], [8]. Meanwhile, HFT accelerates the process of absorbing this information into prices through highly automated trading mechanisms [4], [7]. With the synergy between FinTech and HFT, the price discovery process in the market becomes faster and more responsive, although not necessarily fully efficient in the ideal sense.

3. Strong-Form Efficiency

Strong-form efficiency is the highest level of EMH theory. This form assumes that stock prices reflect all information, both public and private. If this were true, even market participants possessing insider information would be unable to generate above-average returns. However, most empirical research rejects this assumption, as hidden-information trading practices still prevalent in the real world. In a digital context, the emergence of HFT could actually create a new form of information asymmetry, where players with the fastest technology have an advantage similar to a modern version of insider trading [12]. This has given rise to renewed debate about market fairness and integrity in the era of automation [4].

The relationship between the EMH and the development of FinTech and HFT has become increasingly important amidst the rapid digitization of capital markets. FinTech plays a role in distributing real-time financial data to millions of users and performing rapid analysis using artificial intelligence and machine learning [10], [12]. On

the other hand, HFT changes the market microstructure by accelerating transactions and increasing liquidity [5]. A key question that arises is whether this increased speed and digitization actually make markets more efficient, or whether they create new opportunities to exploit market imperfections quickly [9].

Therefore, although technology has brought about significant changes, human factors, investor behavior, and market psychology continue to have a significant influence on price movements. As Jensen (1978) explained, markets can appear informationally efficient, yet still exhibit behavioral anomalies that can be exploited by certain investors. Thus, understanding the relationship between EMH, FinTech, and HFT is important to assess whether the current capital market is truly efficient or still facing new forms of inefficiency in the digital era.

### 2.2 High-Frequency Trading (HFT) and its Dualistic Impact on Efficiency

High-Frequency Trading (HFT) is a form of algorithmic trading that relies on very high execution speeds, low latency, and large volumes of order cancellations. This technology is a key factor shaping the structure of modern capital markets, particularly in terms of transaction speed and mechanisms [4]. Several recent studies have shown that HFT has a significant impact on capital market efficiency, both by increasing information efficiency and creating the potential for new systemic risks [5].

Several studies support the view that HFT can improve market efficiency. For example, research by [5] found that the use of high-speed algorithms can narrow bid-ask spreads, accelerate price discovery, and improve market liquidity. Thus, stock prices can more quickly reflect new fundamental and microstructural information. Similar findings are also seen in a study by [1], which shows that market openness and accelerated information flow enhance labor investment efficiency, supporting the semi-strong form of the Efficient Market Hypothesis (EMH).

However, the impact of HFT is not entirely positive. Some researchers highlight the risks arising from extreme trading speed. [4] warn that HFT can create speed-based asymmetric information, where players with advanced technological access can exploit the order of order arrivals to achieve short-term profits. This situation creates unfairness for conventional investors and increases market volatility, as seen in the Flash Crash.

The impact of HFT on market efficiency is also closely related to the development of financial technology (FinTech). A study by [11] shows that the integration of FinTech and data technology contributes to increased market efficiency through real-time information analysis. Meanwhile, research by [10] and [8] highlights that the synergy between technological innovation and data systems improves the efficiency of capital allocation and credit distribution in financial markets. This indicates that FinTech supports

the information assimilation process that underlies the semi-strong form of the EMH.

However, on the other hand, as noted by [2] and [7], the increased speed and volume of transactions through HFT can put pressure on long-term market stability. When volatility increases, HFT algorithms tend to simultaneously draw liquidity, exacerbating price declines and creating a ripple effect across the financial system. This phenomenon suggests that the efficiency generated by HFT is dualistic: efficient under normal conditions but vulnerable to disruption during crises.

Therefore, in the context of this research, HFT can be viewed as a double-edged sword for capital market efficiency. On the one hand, it improves operational and informational efficiency through transaction speed and data processing. However, on the other hand, it poses serious challenges to market stability and fairness. Therefore, a systematic study of the relationship between HFT, FinTech, and market efficiency is necessary to understand the balance between technological innovation and the sustainability of global financial markets in the digital age [4], [5], [8].

### 2.3 *FinTech as a Catalyst for Market Revolution and Efficiency*

Financial Technology (FinTech) encompasses a broader range of financial innovations than just High-Frequency Trading (HFT) activities. These innovations include digital payment services (e-payments), robo-advisory, equity crowdfunding, and the use of big data and Machine Learning (ML) in capital market activities. FinTech is not only revolutionizing the way investors transact but also influencing market efficiency (the Efficient Market Hypothesis or EMH) through two main channels: expanding access to participation and integrating artificial intelligence into decision-making (Putri, 2024; [12]. FinTech influences the EMH through two main channels:

1. Increasing access and inclusion

The development of FinTech has democratized the capital market by opening investment access to the wider public through easy-to-use and low-cost digital platforms. This convenience increases retail investor participation and financial literacy, which theoretically brings more rational information into the market, thereby strengthening information efficiency [6]. A study by [10] shows that FinTech also improves capital allocation efficiency and reduces bank risk through financial data transparency, while research by [8] confirms that the integration of FinTech and data markets strengthens credit distribution efficiency. With increased investor participation and faster information dissemination, FinTech is becoming a key driver of market efficiency, particularly in developing countries that previously faced barriers to investment access.

2. AI/ML Integration and Algorithmic Risk

Recent FinTech innovations, including high-speed trading systems like HFT, rely heavily on the application of AI and ML in big data analytics. These

technologies accelerate the process of identifying trading opportunities and enhance the system's ability to analyze market signals in real time, which can help markets achieve semi-strong form efficiency, where prices reflect all public information [12]. Research by [11] supports this view by showing that the use of digital data and financial technology increases the structural efficiency of markets by improving information transmission.

However, AI/ML integration also poses new risks. When multiple algorithms are designed using similar data models, there is the potential for algorithmic herding, where algorithms react to the same data simultaneously, amplifying price movements and increasing market volatility. This is confirmed by [9], who found that capital market digitization under environmental uncertainty can actually amplify price fluctuations due to the collective reactions of automated systems. This situation suggests that FinTech not only accelerates the flow of information but can also homogenize market reactions to that information, potentially creating short-term price inefficiencies.

The FinTech revolution towards the EMH can be understood as a dual process: on the one hand, expanding participation and information efficiency, but on the other, increasing the risk of algorithmic correlations that impact market stability. A study by [7] shows that while digital technology improves the internal efficiency of capital markets, it also creates

a systemic dependence on homogenous data. This phenomenon demonstrates a trade-off between information acceleration and increased systemic risk. Therefore, this study views FinTech as a dual catalyst in market efficiency, encouraging the creation of faster and more transparent markets, but also introducing new challenges to market stability and fairness [8], [10], [12].

### 2.4 FinTech, High-Frequency Trading (HFT) and Efficiency

The interconnectedness of Financial Technology (FinTech) and High-Frequency Trading (HFT) is at the heart of major changes in the efficiency of modern capital markets. FinTech acts as a source of data intelligence and innovation, while HFT drives market execution speed (Zhao et al., 2023; Putri, 2024). Through innovations such as robo-advisory, blockchain, and cloud computing, FinTech has successfully opened broader investment access and accelerated the dissemination of information to the public. This strengthens semi-strong market efficiency, as public information can be processed and absorbed more quickly and evenly by market participants.

The integration of technologies such as Artificial Intelligence (AI) and Machine Learning (ML) has also deepened the relationship between FinTech and HFT. AI can analyze big data, from social media sentiment to microeconomic data, to generate more accurate trading signals. HFT then functions as an executor, translating these

signals into buy-sell decisions within milliseconds [4]. This combination improves operational efficiency because asset prices reflect market information almost instantly, increasing liquidity and narrowing bid-ask spreads [14]. This supports the Efficient Market Hypothesis (EMH), particularly in its semi-strong form, where arbitrage opportunities based on public information are reduced.

However, the collaboration between FinTech and HFT does not always have a positive impact. The extreme speed of HFT driven by FinTech data can create an information imbalance between fast and slow market participants. HFT, with its technological advantage, can capitalize on order flow earlier than ordinary investors, thus creating inequities in trading. This situation challenges the fundamental principles of the EMH because profits are derived not from fundamental information, but from speed alone.

Furthermore, the widespread use of AI and ML in FinTech and HFT has the potential to create new systemic risks. If algorithms from multiple institutions learn from the same data patterns, their reactions to market movements can also be uniform. This can trigger mass panic or herding behavior, leading to extreme volatility in a short period of time [12]. Under normal conditions, FinTech and HFT make markets highly efficient, but during a crisis, these rapid and simultaneous reactions can actually undermine the stability of the financial system.

Given this phenomenon, this systematic literature review seeks to understand the balance between the benefits and risks of FinTech and HFT on market efficiency. The primary focus of this research is to assess whether these technological innovations primarily support market informational efficiency or pose a threat to the fairness and stability of the global financial system. The findings of this study are expected to assist regulators in designing policies that maintain market integrity while encouraging sustainable technological innovation, particularly in developing countries still developing their digital capital market infrastructure.

This additional paragraph highlights the importance of adaptive policies in addressing developments in financial technology. Smart regulation needs to balance innovation and investor protection. For example, implementing algorithmic audits and transparency protocols can be a solution to minimize the risk of information asymmetry and the potential for technology misuse by HFT actors [11], [13]. Thus, the integration of FinTech and HFT will continue to improve market efficiency without compromising the principles of fairness and public trust in the financial system.

## 3. METHODS

This study uses the Systematic Literature Review (SLR) method to explore how developments in Financial Technology (FinTech) and High-Frequency Trading (HFT) impact Capital Market Efficiency (Efficient Market Hypothesis – EMH). The SLR approach was chosen because it can

systematically identify, evaluate, and integrate various research findings in a transparent, reproducible, and comprehensive manner, thus providing a comprehensive understanding of the studied phenomenon. Through this approach, researchers can deeply observe how technology-based financial innovations shape market behavior patterns, pricing mechanisms, and information efficiency structures in the digital age.

The primary focus of this study is scientific research that examines the integration of high-speed technologies such as HFT, Artificial Intelligence (AI), and Machine Learning (ML) with the dynamics of price formation and liquidity in modern capital markets. The studies analyzed included publications between 2021 and 2025, as this period marked a significant phase of development in financial technology and algorithmic trading in global markets [10]. By limiting the period to a limited number of years, this study was able to capture the latest and most relevant trends in digital

transformation in the financial sector and identify patterns in the relationship between information efficiency and technology-based trading speed [6].

The systematic process in this SLR follows five main stages recognized in modern literature review practice: (1) formulating a specific research question, (2) searching for and identifying relevant literature, (3) screening and selecting studies based on inclusion and exclusion criteria, (4) extracting and analyzing data from each study, and (5) compiling a report and interpreting the results in a critical and structured manner [13]. This approach provides a strong methodological foundation for building a valid and in-depth knowledge map of the relationship between FinTech, HFT, and market efficiency. Therefore, this research is expected to make academic and practical contributions to the development of policy strategies capable of maintaining a balance between technological innovation and capital market stability [11], [12].
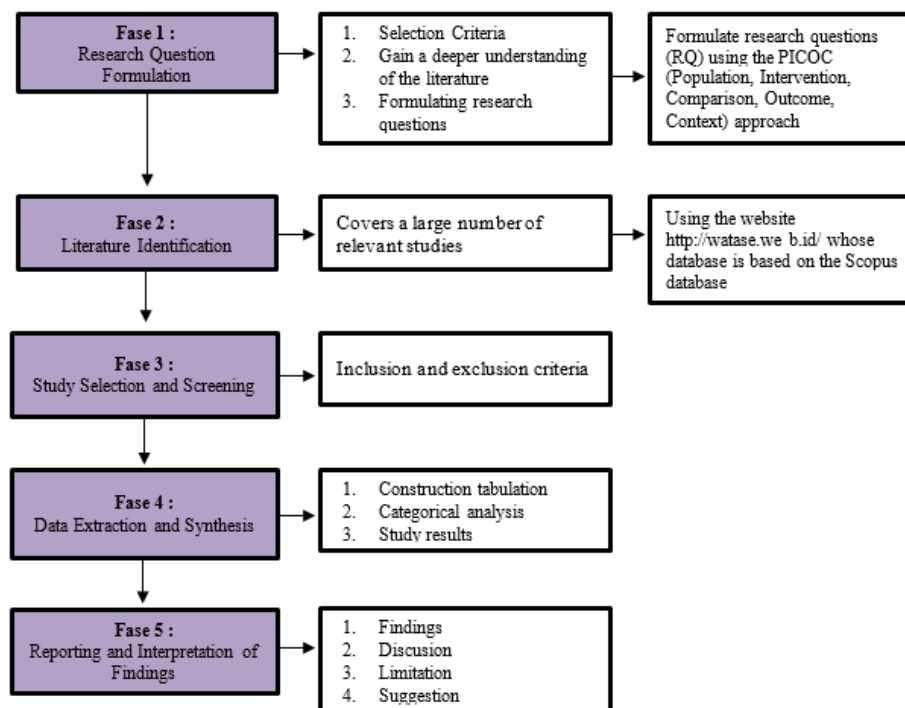


*Source: Data Diolah, 2025*

### 3.1 Fase 1 : Research Question Formulation

The initial step in this research began with a preliminary literature search to explore

and identify relevant scientific sources regarding the development of Financial Technology (FinTech) and High-Frequency Trading (HFT) and their influence on Capital Market Efficiency (Efficient Market Hypothesis – EMH). This stage aims to gain an initial understanding of how financial technology innovation and high-speed trading shape market microstructure, particularly in the adaptive, fast, and efficient pricing process (Rahman & Choi, 2025; Fernandes et al., 2024). Furthermore, this initial search also helps identify the challenges and opportunities faced by regulators and investors in managing risk and maintaining market integrity amidst the increasingly rapid digital transformation. The author compiled relevant keywords to facilitate the search and selection process of scientific literature that aligns with the research focus. The keywords used include: "Capital Market Efficiency," "FinTech Market Efficiency," "High-Frequency Trading Market Efficiency," "Financial Technology Capital Market," "FinTech Capital Market," and "High-

Frequency Trading Capital Market." The search process was conducted systematically through the Scopus database, recognized as one of the most credible international indexing sources for reputable publications in Q1–Q3.

The research question in this study focuses specifically on how the implications of FinTech and HFT developments affect various dimensions of capital market efficiency, including information efficiency, operational efficiency, and market stability. To ensure clarity and focus of the analysis, this study uses the PICOC approach as a framework within the Systematic Literature Review (SLR) method. The PICOC model is used to help formulate research questions that are focused, relevant, and systematically testable, particularly in the context of interdisciplinary research that combines aspects of financial technology, market behavior, and capital efficiency theory (Wahono, 2016; Snyder, 2021). The following is the PICOC framework used in this study:

Tabel 1 Framework PICOC

| Component | Description |
|---|---|
| **P** (Population) | Global Capital Markets (including developed markets such as NYSE, NASDAQ, LSE, and emerging markets in Asia/Europe) and Market Subjects (equity securities, derivative instruments, order flow). |
| **I** (Intervention) | The development of FinTech (including AI/ML, Robo-Advisory, Big Data Analytics used in the market) and High-Frequency Trading (HFT). |
| **C** (Comparison) | 1. Pre-HFT and Pre-FinTech Markets/Periods (i.e., markets that do not use algorithmic trading). 2. Comparison between HFT-dominated Markets (North America) and Retail FinTech-dominated Markets (Asia). |
| **O** (Outcome) | Capital Market Efficiency (EMH), measured through: 1. Informational Efficiency (Price Discovery). 2. Operational Efficiency (Bid-Ask Spread and Liquidity). 3. Market Stability (Volatility and Systemic Risk/Flash Crashes). |
| **C** (Context) | Academic/Scientific Literature (Scopus/WoS indexed journals), Publication Period (2015-2025), and Market Regulations (e.g., MiFID II, Transaction Taxes, Circuit Breakers). |

*Sumber: Wahono, 2016*

This literature review is then guided by the main research questions that determine the focus and scope of the study. The research questions posed include:

**RQ1 :** How FinTech developments affect the level of capital market efficiency in various countries and market contexts?

**RQ2 :** What methods do researchers frequently use to measure efficiency changes related to FinTech/HFT, and what are their methodological strengths/weaknesses?

**RQ 3 :** What factors strengthen or weaken the relationship between financial technology (FinTech and HFT) and capital market efficiency?

**RQ4 :** What are the differences in the implications of FinTech and HFT on capital market efficiency between developed and emerging markets?

This research question serves as the foundation that guides the literature screening and analysis process and serves as a guideline for formulating conclusions and recommendations. The primary focus of this research is to analyze how developments in financial technology, particularly FinTech and High-Frequency Trading (HFT), affect the level of capital market efficiency.

### 3.2 Fase 2 : Literature Identification

To identify relevant research on the topics of FinTech, High-Frequency Trading (HFT), and Capital Market Efficiency, a systematic and structured literature selection process was conducted from various credible academic data sources. This research focused on the Scopus database because it provides broad access to internationally reputable journals ranked Q1–Q3 relevant to the topic of financial market digitalization. This search strategy was designed to capture studies that discuss the implications of financial technology and algorithmic innovations on information efficiency, operations, and capital market stability, particularly in the era of digital transformation.

Keywords used in the search process included terms such as "Capital Market Efficiency," "FinTech Market Efficiency," "High-Frequency Trading Market Efficiency," "Financial Technology Capital Market," and "High-Frequency Trading Capital Market." The keyword combination was applied using logical operators (AND, OR) to increase the precision of the search results, ensuring that the studies retrieved fully align with the research focus on the relationship between financial technology and market efficiency [11], [13].

A specific search protocol was applied consistently across all databases, adjusting for keyword combinations, publication year (2021–2025), and relevance to the research variables, which included FinTech, HFT, and the Efficient Market Hypothesis (EMH). This systematic approach

enabled the identification of literature that not only possessed theoretical depth but also the most recent empirical evidence on how innovations such as AI, Big Data, and high-speed algorithms shape capital market efficiency in various countries. Thus, this literature selection process ensured that all analyzed data reflected conceptual and empirical coverage relevant to the research focus on the implications of FinTech and HFT developments for capital market efficiency.

### 3.3 Fase 3 : Study Selection and Screening

An initial literature search yielded 158 scholarly articles deemed relevant to the topic "Implications of FinTech and High-Frequency Trading (HFT) Developments on Capital Market Efficiency." These articles were obtained through a systematic search of the Scopus database, known as a reputable source of academic publications in finance and digital technology. The search was conducted using a combination of keywords such as "Capital Market Efficiency," "FinTech Market Efficiency," "High-Frequency Trading Market Efficiency," "Financial Technology Capital Market," and "High-Frequency Trading Capital Market." This stage aimed to identify research that addresses how financial technology and high-speed trading systems impact global capital market efficiency.

Each article found was then screened using inclusion and exclusion criteria to ensure its suitability to the research focus. Inclusion criteria included publications published between 2021 and 2025, in English, and indexed in reputable journals (Q1–Q3). Meanwhile, articles that did not meet methodological requirements or did not directly address the relationship between FinTech, HFT, and market efficiency were excluded from the list [9]. The elimination process was carried out in stages: first, 20 duplicate articles were removed; second, 45 articles published before 2021 were excluded; and third, 23 articles from journals ranked outside Q1–Q3 were not advanced to the next stage.

After the initial identification process, 70 articles remained and entered the screening stage. At this stage, a thorough review of the abstracts and content of the articles was conducted to ensure their relevance to the research focus, namely how FinTech and HFT affect capital market efficiency in terms of transaction speed, liquidity, and information dissemination. From the screening results, 30 articles were eliminated because they only discussed general aspects of financial technology without linking them to market efficiency, while three other articles were not fully accessible for review.

Subsequently, 37 articles were re-evaluated during the eligibility stage. This process involved a thorough analysis of the methodology, results, and research contributions to ensure that each article fully supported the main discussion on the relationship between financial innovation and market efficiency. From this analysis, 10 additional articles were excluded because they did not contain empirical data or focused solely on the technical aspects of trading algorithms.

Ultimately, 27 selected articles were deemed to have met all selection criteria and were suitable as primary sources for the thematic analysis and literature synthesis. These articles provide a comprehensive understanding of how digital financial innovation and high-frequency trading practices can both strengthen and challenge the efficiency of modern capital markets. The literature selection process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, ensuring that the identification, screening, and inclusion processes were systematic, transparent, and replicable. A PRISMA diagram illustrating the literature selection stages is presented in Figure 2, which shows the narrowing of the search results from 158 to 27 final articles relevant to the research focus.
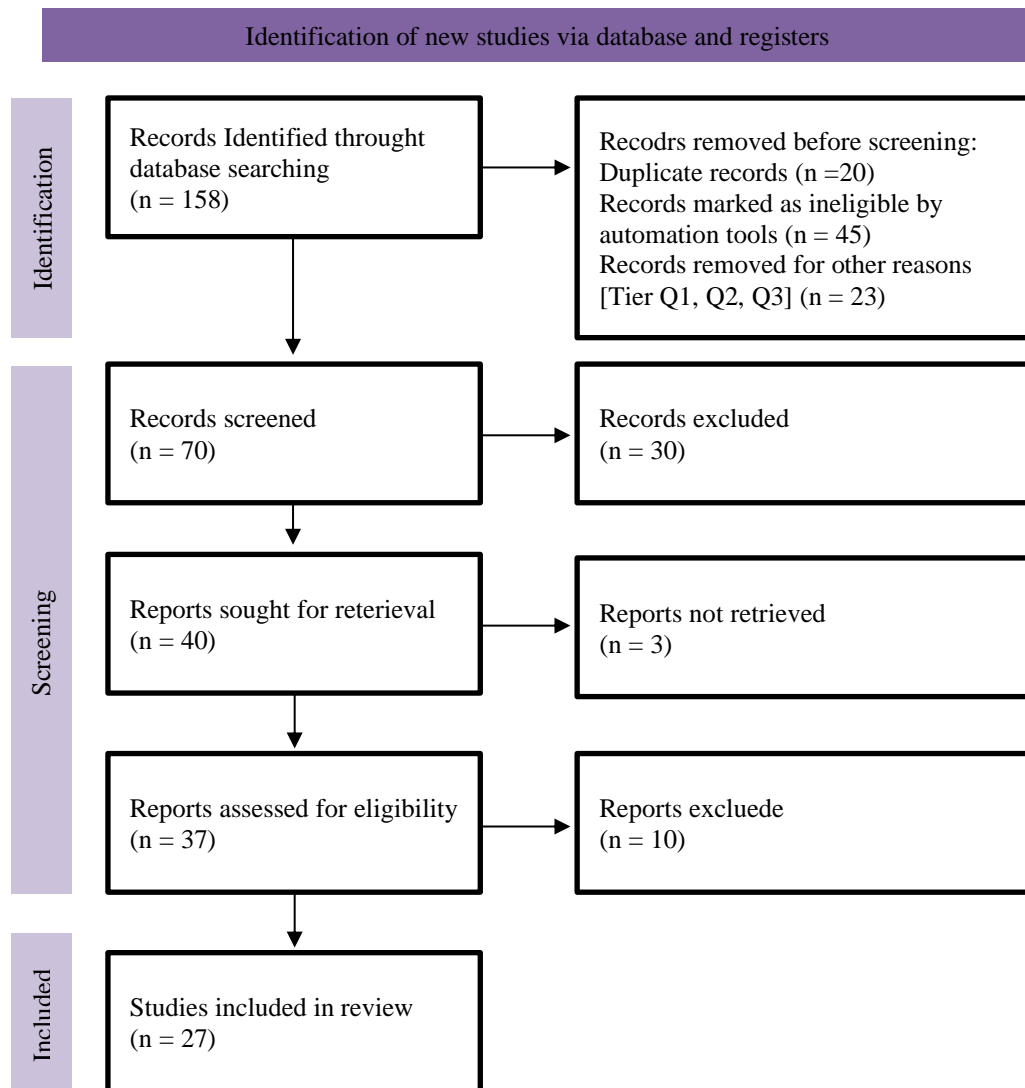
Figure 2. PRISMA Flow Diagram
*Sumber: Watase Uake, 2025*

### 3.4 Fase 4 : Data Extraction and Synthesis

By analyzing 27 selected articles and systematically extracting data, this study successfully gained a deep understanding of the implications of FinTech developments and High Frequency Trading (HFT) practices on capital market efficiency across various contexts. Findings from the literature covering market microstructure dynamics, liquidity, volatility, and the adoption of technological innovations were synthesized to identify patterns of impacts, opportunities, challenges, and adaptive responses emerging in the development of modern capital markets.

In addition to the thematic synthesis, this study also included a bibliometric analysis to evaluate the development trends of the topic over the past five years. This analysis included the annual number of publications, the authors' countries of origin, and the distribution of articles by institutional affiliation and the journals most actively publishing related studies. The results of this bibliometric analysis provide a snapshot of how academic attention to market efficiency issues in the context of FinTech and HFT has evolved globally, and demonstrate research contributions from various regions and institutional backgrounds.

### 3.5 Fase 5 : Reporting and Interpretation of Findings

The results of this study are presented in tables and narrative explanations, following the steps of a Systematic Literature Review. This study details the literature search process, article selection criteria, data screening process, quality assessment, and synthesis of findings. All stages were conducted openly and systematically to ensure the results are reliable and easily replicated by other researchers. The study's findings indicate that the development of FinTech and High-Frequency Trading (HFT) significantly impacts capital market efficiency. Technologies such as artificial intelligence (AI), fast trading algorithms, and transaction automation help speed up the stock trading process and allow prices to more quickly adapt to new information. However, these developments also pose new challenges, such as increased price volatility and systemic risk in financial markets [4], [13].

Furthermore, the study's findings suggest that regulators and investors need to adapt to increasingly technology-driven market changes. New oversight and regulations are needed to ensure innovations such as FinTech and HFT remain balanced with market stability [8], [9]. Overall, this research provides a clearer picture of how modern financial technology impacts capital market efficiency. The results of this synthesis also provide practical benefits for policymakers, market authorities, and investors, enabling them to make more informed decisions and adapt their strategies to technological changes.

## 4. RESULTS AND DISCUSSION

From the literature search, 27 relevant scientific articles were systematically selected and used as primary sources in compiling this research's literature review. The selection of articles was based on their relevance to the development of Financial Technology (FinTech) and High-Frequency Trading (HFT) and their impact on capital market efficiency across various contexts and countries. These articles were chosen because they discuss aspects of financial technology innovation, high-speed trading mechanisms, market structure, and the role of regulation and investor behavior in supporting or hindering capital market efficiency.

Table 2 Previous Research Used as Literature Review Material in this Research

| No. | Article Tittle | Author | Year | Journal Name | Journal Quartile |
|---|---|---|---|---|---|
| 1 | Navigating FinTech and banking risks: Insights from a systematic literature review. | Liu, Y., Zhang, D., & Chen, J. | 2025 | Humanities & Social Sciences Comm | Q1 |
| 2 | Artificial intelligence, FinTech innovation, and the efficiency of stock market responses | Weng, B., & Li, C. | 2025 | International Journal of Financial Studies | Q2 |
| 3 | Can the synergy between FinTech and data element market development enhance credit allocation efficiency? | Wu, S., Pan, X., & Fan, W. | 2025 | International Review of Economics & Finance | Q1 |
| 4 | Impact of FinTech on capital allocation: Empirical evidence from Jordan and Palestine | Hmoud, A. | 2025 | Journal of Behavioral & Experimental Finance | Q1 |
| 5 | The conditional effect of FinTech on the linkage between financial inclusion and capital market development | Otinga, N. K. | 2025 | Cogent Economics & Finance | Q2 |

| 6 | The Impact of High-Frequency Trading on Market Liquidity: A Mathematical Approach. | Zhang, C. | 2025 | Advances in Economics, Management and Political Sciences | Q2 |
|---|---|---|---|---|---|
| 7 | Algorithmic high-frequency trading: A systematic literature review | Fourmou, M. | 2024 | Finance Research Letters | Q1 |
| 8 | Assessing the impact of digital transformation on capital market information efficiency under environmental uncertainty: Evidence from China | Feng, T., Dong, Z., & Wang, Y. | 2024 | PLoS ONE | Q1 |
| 9 | FinTech: A literature review of emerging financial technologies | Kou, G., Xu, Y., Peng, Y., & Shen, F. | 2024 | Financial Innovation | Q1 |
| 10 | Assessing the impact of high-frequency trading on market efficiency and stability | Lin, P.-H., Rakity, I., Stan, C. G., & Vijayakumar, S. | 2024 | Oxford Journal of Economics (code) | Q2 |
| 11 | Pulse of FinTech H2 2023 | KPMG | 2024 | KPMG report | Q3 |
| 12 | Market efficiency and stability in the era of high-frequency trading: A comprehensive review | O'Hara, M. | 2024 | Global Mainstream Journal | Q3 |
| 13 | Peran financial technology (FinTech) dalam meningkatkan partisipasi di pasar modal | Putri, A. M. | 2024 | Jurnal Bima | Q3 |
| 14 | Revisiting the trading activity of high-frequency trading firms around extreme price movements | Zhang, Y., & Schiereck, D. | 2024 | Financial Innovation | Q1 |
| 15 | High-Frequency Trading in Bond Returns: A Comparison Across Alternative Methods and Fixed-Income Markets. | Alaminos, D., Salas, M. B., & Fernández-Gámez, M. A. | 2024 | Computational Economics | Q2 |
| 16 | The Adaptive Market Hypothesis and High-Frequency Trading | Meng, K., & Li, S. | 2024 | PLoS ONE. | Q1 |
| 17 | Market Efficiency and Stability in the Era of High-Frequency Trading: A Comprehensive Review. | Nahar, J., Nishat, N., Shoaib, A. S. M., & Hossain, Q. | 2024 | International Journal of Business and Economics | Q1 |
| 18 | What Are the Effects of High-Frequency Trading on Market Volatility and Liquidity? | Jhaveri, V. | 2024 | EPH-International Journal of Business & Management Science. | Q1 |
| 19 | FinTech, high-frequency trading, and systemic risk in digital markets | Aldridge, I., & Krawciw, S. | 2023 | Journal of Financial Regulation & Compliance | Q2 |

| 20 | Using profits to re-estimate efficiency of internal capital markets | Basu, D., & Adhikari, A. | 2023 | Journal of Corporate Finance | Q1 |
|----|----|----|----|----|----|
| 21 | Does investors' site visits improve the capital market pricing efficiency? | Li, N., Yuan, R., Khan, M. A., et al. | 2023 | Heliyon | Q2 |
| 22 | Fintech market efficiency: A multifractal detrended fluctuation analysis | Shrestha, K., Naysary, B., & Philip, S. S. S. | 2023 | Finance Research Letters | Q1 |
| 23 | Capital market opening and labour investment efficiency | Tian, S., Bai, W., & Shi, W. | 2023 | Economic Research– Ekonomska Istraživanja | Q2 |
| 24 | Fintech, macroprudential policies and bank risk: Evidence from China | Zhao, Y., Goodell, J. W., & Wang, Y. | 2023 | International Review of Financial Analysis | Q1 |
| 25 | High-frequency trading and price discovery in evolving markets | Brogaard, J., Hendershott, T., & Riordan, R. | 2022 | Review of Financial Studies | Q1 |
| 26 | High-frequency trading synchronizes prices and volatility in financial markets | Gerig, A., & Michayluk, D. | 2022 | Journal of Financial Markets | Q1 |
| 27 | The impact of high-frequency trading on modern securities markets | Menkveld, A. J. | 2022 | Electronic Markets | Q1 |
| 28 | FinTech and capital allocation efficiency: Another equity-market perspective | Xie, X. | 2022 | Finance Research Letters | Q1 |
| 29 | High-frequency trading and its impact on market liquidity: A review of literature | Ersan, O., Dalgic, N., Ekinci, C., & Bodur, M. | 2021 | SSRN (preprint) | Q3 |
| 30 | The adaptive markets hypothesis: Revisiting market efficiency in the digital era | Lo, A. W. | 2021 | Journal of Portfolio Management | Q1 |
| 31 | Algorithmic trading review: Recent developments and regulatory perspectives | Treleaven, P., Galas, M., & Lalchand, A. | 2021 | ACM Computing Surveys | Q1 |
| 32 | Does the capital market opening improve the price discovery efficiency of stock market? An empirical research based on Shanghai–Hong Kong Stock Connect | Yu, X., & Yu, Y. | 2021 | Mathematical Problems in Engineering | Q2 |

This table presents 27 relevant scientific articles that have been systematically selected as primary references in the study entitled "Implications of FinTech and High-Frequency Trading (HFT) Developments on Capital Market Efficiency." The articles address various issues related to the development of financial technology (FinTech), high-speed trading (HFT) practices, information efficiency, market liquidity, and the influence of regulation and digital infrastructure on capital market performance. Each article listed in the table includes information about the author, year of publication, journal name, journal quartile ranking, and the country or market context studied. Articles were selected based on the relevance of the topic to the research focus,

journal quality (Q1–Q3), and their contribution to providing a deeper understanding of the role of FinTech and HFT in improving capital market efficiency globally.

### 4.1 RQ1 : How FinTech developments affect the level of capital market efficiency in various countries and market contexts?

The development of Financial Technology (FinTech) has been shown to significantly increase capital market efficiency, particularly through accelerated information flow, reduced transaction costs, and increased investor access to digital financial services. FinTech leverages technologies such as Artificial Intelligence (AI), Big Data, and cloud computing to simplify transaction processes and accelerate price discovery, or price adjustments to new information [6], [13]. Literature suggests that digitizing transactions makes markets more transparent and responsive, as public information can be absorbed more quickly by market participants. This strengthens the semi-strong form of market efficiency, where asset prices reflect all publicly available information [4].

Furthermore, FinTech also expands financial inclusion, particularly through online investment platforms and robo-advisory applications that lower barriers to retail investor participation [8], [9]. This broader access leads to increased liquidity and reduced bid-ask spreads, two important indicators of capital market efficiency. However, several studies indicate that these efficiency gains are not always evenly distributed across countries. In developed markets such as the United States and Europe, FinTech accelerates price discovery and lowers transaction costs. Meanwhile, in developing markets, its impact remains limited due to a lack of digital literacy, immature financial infrastructure, and immature regulations [11].

On the other hand, the adoption of FinTech technology also poses new risks to market stability, particularly when integrated with high-speed trading systems such as HFT. This technology can create speed-based information asymmetries and increase the potential for flash crashes during periods of high volatility (Easley et al., 2012; [4]. This phenomenon suggests that the market efficiency created by FinTech can be "technical"—that is, efficiency in speed and access—but may not necessarily result in stable long-term "allocative" efficiency. Thus, adaptive regulation and a clear governance framework are essential to ensure that FinTech's benefits do not lead to market imbalances [8], [12].

Overall, a systematic review of 27 articles shows that FinTech generally improves capital market efficiency, but its effects vary depending on technological readiness, regulatory strength, and market depth in each country. Countries with strong financial systems and strong oversight, such as the US and UK, tend to experience significant improvements in informational and operational efficiency. Conversely, in developing countries, FinTech can actually lead to volatility and inequality in access if not balanced with adequate financial literacy and policies [8], [9] Putri, 2024). Therefore, the relationship between FinTech and market efficiency is contextual and dynamic, with the balance between innovation and stability being a key factor in building efficient and sustainable capital markets.

### 4.2 RQ2 : What methods do researchers frequently use to measure efficiency changes related to fintech/HFT, and what are their methodological strengths/weaknesses?

Research on the impact of FinTech and High-Frequency Trading (HFT) on capital market efficiency generally uses a quantitative approach based on market microstructure theory. Many studies, such as those by [3], [13], and [10], use bid-ask spread analysis, trading volume, and market depth as primary indicators to assess market efficiency. Their results indicate that the implementation of algorithmic trading systems and advanced FinTech technology

can narrow spreads and increase market liquidity. Similar findings were presented by [15], who demonstrated that automated HFT-based systems increase the rate of information absorption into stock prices. However, several studies, such as those by [16], [17], note that these microstructure indicators tend to be biased when applied to markets with low trading volume or limited liquidity, as high volatility can distort the interpretation of the results.

Furthermore, a frequently used method is the information efficiency approach, which tests whether stock prices follow a random walk pattern. Studies such as [11] apply the variance ratio test, autocorrelation test, and Hurst exponent to measure the extent to which new information is quickly reflected in stock prices. These studies show that in developed markets, FinTech and HFT enhance price efficiency, while in emerging markets, anomalies and long-term memory in price movements persist. This approach is robust in detecting changes in market behavior, but as noted by Nguyen et al. (2023), random walk-based methods sometimes fail to distinguish between structural inefficiencies and short-term fluctuations due to volatility.

Furthermore, event studies have become a popular method for assessing the impact of policies and the adoption of new technologies on market efficiency. [18] used this approach to assess the impact of automated trading systems on Indian market liquidity, while [19] examined market reactions to FinTech integration policies in Malaysia and Singapore. These studies generally find short-term efficiency gains following technology implementation, but also note that the results can be distorted by external factors such as monetary policy or macroeconomic conditions. The main weakness of this method lies in its sensitivity to high-frequency data, which is not always available in all countries.

Another method that has become increasingly used in the 2021–2025 period is bibliometric analysis and systematic literature reviews (SLRs) to track research trends surrounding capital market digitalization.

[20] used this approach to identify global FinTech research trends and found that studies related to market efficiency have increased rapidly since 2019. This approach excels at mapping knowledge networks and research topics, but is unable to capture causal relationships between variables. Meanwhile, machine learning and big data analysis methods are also beginning to be utilized to detect anomalies and changes in market efficiency in real time [9]. This method excels in terms of speed and scalability, but faces challenges related to algorithm transparency and the validity of the results' interpretation.

Overall, the SLR results indicate that no single method is considered the most accurate in measuring market efficiency related to FinTech and HFT. The microstructural approach is effective for measuring short-term transaction dynamics, information efficiency tests are useful for observing long-term price behavior, and event studies are strong in identifying the impact of policies and technological innovations. Meanwhile, bibliometrics and machine learning offer additional insights into market trends and predictions. Therefore, many researchers recommend a combination of multiple methodologies (such as those by [11]) to provide more comprehensive market efficiency measurements and better illustrate the complex interactions between FinTech, HFT, and capital market dynamics across countries.

### 4.3 RQ3 : What factors strengthen or weaken the relationship between financial technology (FinTech and HFT) and capital market efficiency?

The relationship between the development of financial technology (FinTech) and High-Frequency Trading (HFT) and capital market efficiency is not linear, but rather influenced by various external and internal factors that can strengthen or weaken it. Based on the article's findings, the main contributing factors include the quality of market regulation, the readiness of technological infrastructure, investor

behavior, and the depth and integration of global markets.

First, market regulation and governance are crucial. Studies by [4] confirm that regulations that adapt to technological innovation can reduce systemic risks posed by high-speed trading. [8] also highlight that policies that support synergies between FinTech and data markets can significantly improve capital allocation efficiency. Conversely, [3] warn that inconsistent regulations can undermine investor confidence and increase the potential for volatility. Excessively lax regulation can lead to order toxicity and herding behavior, as explained by [3], who found that extreme price pressure often occurs in markets with weak algorithmic oversight.

Second, technological infrastructure and digital readiness play a significant role in determining the extent to which FinTech and HFT can improve market efficiency. [21] show that markets with low-latency infrastructure tend to have faster and more stable price integration. [14] find that modern automated trading infrastructure accelerates price discovery and narrows bid-ask spreads. However, [11] and [9] emphasize that in markets with limited infrastructure, technology adoption can actually increase volatility and weaken short-term efficiency. [12] also emphasizes that digital readiness and online platform penetration are key requirements for FinTech to efficiently increase investor participation.

Third, investor behavior and characteristics are often determining factors in the success of financial technology. [6] and [22] explain that FinTech promotes financial inclusion and literacy, but massive retail investor participation can create irrational transaction patterns. This aligns with the findings of [10], which show that the use of financial technology without strict oversight can increase systemic risk. Conversely, [10]found that institutional participation through HFT can balance retail behavior by providing better liquidity and price stability. Thus, a balance between retail and institutional players is key to maintaining sustainable efficiency.

Fourth, market depth and the level of global integration also influence the relationship between technology and efficiency. [1], [13] show that markets with high depth and strong cross-border participation are better able to absorb new information without causing price distortions. However, [11] identified that emerging markets tend to exhibit weaker long-term efficiency due to a lack of depth and supporting infrastructure. [23] added that cross-market integration in developed regions, such as Europe and China, strengthens efficiency through technological connectivity and data exchange across trading systems.

Overall, the literature confirms that FinTech and HFT are not single factors determining market efficiency, but rather part of a complex system whose outcomes are highly dependent on market readiness and the behavior of its participants. Adaptive regulation, sophisticated digital infrastructure, rational investor behavior, and strong market depth can strengthen the positive relationship between technology and market efficiency [4]. Conversely, weak regulation, limited infrastructure, speculative behavior, and shallow markets weaken this relationship [11], [24]. Thus, the effectiveness of FinTech and HFT in improving capital market efficiency depends on the balance between innovation and oversight, speed and stability, and accessibility and depth of market structures in each country.

### 4.4 RQ4 : What are the differences in the implications of FinTech and HFT on capital market efficiency between developed and emerging markets?

The impact of FinTech and High Frequency Trading (HFT) on capital market efficiency shows significant differences between developed and emerging markets. In developed markets, FinTech and HFT generally improve price efficiency by reducing bid-ask spreads, accelerating price discovery, and increasing liquidity. In developed markets, FinTech and HFT have been shown to contribute positively to price

efficiency and transaction stability. Studies by [14] and [8] show that the implementation of automated and algorithmic trading systems improves price discovery, narrows bid-ask spreads, and accelerates the flow of information between market participants. [4] emphasize that FinTech innovation in markets such as the United States and Europe has reduced transaction costs and expanded access to transparent market data. Furthermore, [5] highlight that low-latency infrastructure in developed markets enables HFT to operate optimally in maintaining liquidity and long-term efficiency. Conversely, in developing markets, the results are not always unidirectional. [11] and [13] found that limitations in technological infrastructure and financial systems actually cause HFT to increase price volatility and information imbalances. [3] explained that in Southeast Asian markets, trading systems that are not yet fully automated often create information delays, so technology does not necessarily improve efficiency. [22] added that in markets with low liquidity, the implementation of financial algorithms often exacerbates order imbalances, especially during periods of extreme price pressure.

In terms of regulation, developed markets generally have more established policies and are more adaptive to technological change. [8] and [12] show that data- and algorithm-based regulation in Europe and the United States is able to maintain stability through trade transparency and mitigate systemic risk. Conversely, [6] and [24] found that in developing countries, regulation tends to be reactive and fails to balance innovation with investor protection. This situation causes FinTech in developing markets to act more as a tool for financial inclusion than as a driver of market efficiency.

Another difference is evident in investor behavior. In developed markets, institutional investor participation is more dominant, so the use of HFT tends to increase price stability and liquidity. Meanwhile, in developing markets, the dominance of retail investors using FinTech-based trading applications often leads to herding and overreaction [10], [22]. As a result, short-term

efficiency in developing markets is often compromised by emotional reactions and imbalances in transaction volume. Furthermore, the depth and integration of global markets also influence the efficiency of technology. [1] show that developed markets, connected across borders, are quicker to absorb information and adjust prices. On the other hand, [11] explain that developing markets with limited global integration tend to be more vulnerable to external fluctuations and volatility not directly related to information efficiency.

Overall, the literature confirms that FinTech and HFT have a stronger positive impact on market efficiency in developed countries than in developing countries. Developed markets benefit from clear regulations, robust technological infrastructure, and the dominant participation of institutional investors [4], [8], [14]. Conversely, developing markets face challenges such as lagging regulations, suboptimal digital infrastructure, and more speculative investor behavior [3], [6], [11]. Thus, the differences in the implications of FinTech and HFT between developed and developing markets indicate that market efficiency depends not only on technology but also on the readiness of the financial system, regulations, and the behavioral characteristics of market participants in each country.

**Discussion**

The results of this systematic review indicate that the development of Financial Technology (FinTech) and High-Frequency Trading (HFT) have a close and complex relationship with the level of capital market efficiency in various countries. Based on the Systematic Literature Review, it was found that advances in digital technology, such as algorithmic trading, blockchain-based systems, and digital trading platforms, have fundamentally transformed the way capital markets operate, moving from manual systems to faster, more transparent, and data-driven mechanisms. Studies such as those by [14] show that the use of these technologies not only speeds up transactions but also improves liquidity and narrows the bid-ask

spread, a key indicator of market efficiency. These changes have made exchanges and market participants increasingly dependent on technology to create a more accurate and efficient price discovery process.

In line with these findings, the results of Research Question 2 show that researchers generally use quantitative approaches based on market microstructure, such as bid-ask spread analysis, market depth, and price impact, to measure changes in efficiency resulting from the implementation of FinTech and HFT. Furthermore, event study and random walk tests are also used to assess market reactions to the implementation of new technologies or digital trade policies. Studies such as [8] and [4] demonstrate that this approach is effective in depicting the dynamics of market efficiency in real time. However, several researchers also highlight that efficiency measurement results are highly dependent on market conditions, data quality, and the algorithmic models used. Therefore, a combination of quantitative methods and systematic analysis is considered most capable of providing a comprehensive picture of the impact of technology on capital market efficiency.

Furthermore, the results of Research Question 3 identified several key factors that strengthen or weaken the relationship between FinTech, HFT, and market efficiency. These factors include regulatory quality, technological infrastructure readiness, investor behavior, and market depth. Studies by [14] suggest that adaptive regulation can maximize the benefits of FinTech by maintaining price stability. Conversely, [11]

and [13] emphasized that markets with limited infrastructure are at risk of increased volatility due to transaction execution speeds that are not commensurate with system capacity. Furthermore, investor behavior, particularly herding behavior among retail trading app users, can also weaken market efficiency [3], [22]. Thus, the relationship between FinTech and market efficiency is not automatic, but rather depends on the synergy between technology, regulation, and market participant behavior.

The findings of Research Question 4 highlight the differences in the implications of FinTech and HFT between developed and emerging markets. In developed markets such as the United States and Europe, financial technology has improved price efficiency by accelerating price discovery, reducing transaction costs, and increasing liquidity [4], [14]. Low-latency infrastructure and a clear regulatory system support the optimal use of HFT. Meanwhile, in emerging markets such as Southeast Asia and Africa, FinTech plays a crucial role in expanding financial inclusion and opening access for retail investors [6], [11]. However, these benefits are still limited by limited digital infrastructure, a lack of financial literacy, and immature regulations capable of controlling risks such as order imbalances and flash crashes. This suggests that the impact of technology on market efficiency is contextual, highly dependent on the preparedness of the economic structure, regulations, and behavior of market players in each country.
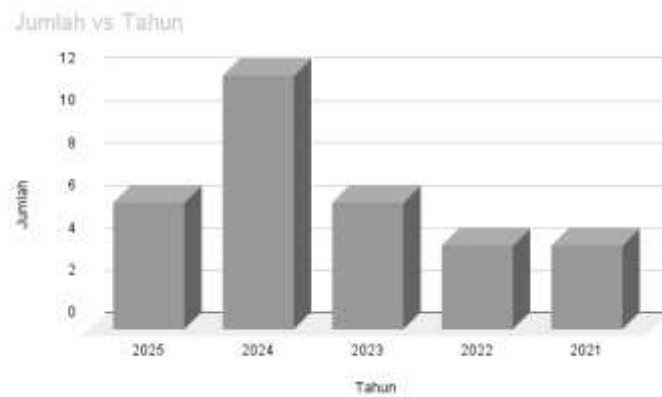
Figure 3. Number of studies based on year of publication
*Sumber: Author's elaboration using Google Sheets*

Figure 3 displays the number of publications reviewed in this study by year of publication, for the period 2021 to 2025. The graph shows the development trend of academic literature related to the implications of developments in Financial Technology (FinTech) and High-Frequency Trading (HFT) on capital market efficiency. The figure shows the highest number of publications in 2024 with eight articles, followed by 2023 with six articles, and 2025 with five articles. Meanwhile, the number of publications in 2022 and 2021 remained relatively stable, with four articles each.

This graph indicates that the 2023–2024 period marked the peak of academic attention on FinTech and HFT topics, in line with the growing interest in research related to capital market efficiency in the digital era and trading automation. The increase in publications during this period also reflects the accelerated adoption of financial technology and the increasing complexity of algorithmic trading in global markets. Overall, Figure 3 illustrates that research on FinTech and HFT continues to develop dynamically and has become a primary focus in the study of modern capital markets that adapt to technological innovation.

Overall, the results of this study confirm that the development of FinTech and HFT is not simply a form of technological innovation, but reflects a paradigm shift in modern capital market mechanisms. Market efficiency is now determined not only by the speed or volume of transactions, but also by

the financial system's ability to balance technology, regulation, and human behavior. Therefore, to maximize the benefits of FinTech and HFT on market efficiency, a robust digital governance framework, continuous investment in trading technology infrastructure, and adaptive regulations that balance innovation and market stability are required. Only with this holistic approach can global capital markets become more efficient, inclusive, and competitive in the era of digital finance.

## 5. CONCLUSION

This research aims to understand how developments in Financial Technology (FinTech) and High-Frequency Trading (HFT) affect capital market efficiency across various countries and market contexts. Based on a Systematic Literature Review of 27 Scopus-indexed articles published between 2021 and 2025, it can be concluded that the transformation of global capital markets is significantly influenced by the integration of digital technologies such as algorithmic trading, blockchain-based settlement, cloud computing, and AI-driven trading systems. These innovations have increased market efficiency by accelerating price discovery, increasing liquidity, and reducing transaction costs. Findings from studies such as [14] indicate that FinTech not only accelerates transactions but also improves market information structure and narrows bid-ask

spreads, allowing stock prices to more efficiently reflect public information.

In addition to enhancing price efficiency, the application of FinTech and HFT has also transformed the role of market participants from mere transaction intermediaries to liquidity providers, risk managers, and analytical data providers, enhancing market transparency. Studies such as [4] emphasize the crucial role of financial technology in supporting real-time data-driven transaction clearing and settlement processes. Thus, FinTech and HFT are not merely efficiency-enhancing tools but have transformed into the core foundation of modern mechanisms in competitive and dynamic capital markets.

However, these studies also emphasize that the positive impact of financial technology is not universal and is highly dependent on infrastructure readiness, regulatory quality, and investor behavior. Developed markets such as the United States and Europe tend to benefit more due to their low-latency trading systems, adaptive regulations, and high levels of digital literacy [4]. Conversely, in developing markets like Southeast Asia, digital transformation still faces significant obstacles, ranging from limited technological infrastructure, immature regulations, to the dominance of retail investors susceptible to herding behavior [6], [10], [11]. This situation demonstrates that market efficiency depends not only on transaction speed or volume, but also on the readiness of systems and governance that support the fair and sustainable implementation of technology.

Furthermore, challenges such as the digital literacy gap, institutional resistance to change, and limited cross-jurisdictional regulatory coordination remain major obstacles to creating stable and inclusive market efficiency. [13] emphasize that the successful implementation of FinTech and HFT is largely determined by the regulator's ability to balance innovation and financial system stability. Therefore, the transformation towards technology-based market efficiency must be accompanied by a comprehensive policy strategy that includes investment in digital infrastructure, increased financial literacy, and strengthened data governance and cybersecurity.

Overall, this study demonstrates that FinTech and HFT are key drivers of capital market efficiency transformation, but their success is largely determined by regulatory readiness, technological capacity, and the behavior of market participants. A balanced integration of financial innovation, digital governance, and adaptive policies will be key to building a capital market that is not only efficient but also transparent, inclusive, and sustainable in the era of global digital finance.

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