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# Exploring Weak-Form Market Efficiency in the Evolving World of Digital Finance

**Vinu Ashok**

**Research Scholar,**

**Department of Commerce,**

**University of Kerala, Thiruvananthapuram**

***Abstract:*** The financial markets have been transformed from a traditional market ecosystem to digital market systems. Traditional market systems were characterised by manual trading, delayed information dissemination, and higher transaction costs. The evolution of digital finance transformed the ecosystem through electronic real-time trading, smartphone trading apps, and speedy information transfer. Digital finance paves the way for increased retail participation. The digital finance ecosystem enables transaction transparency through depositories, thereby reducing settlement cycles and speeding up information processing. Since information is an integral part of the financial market, the persistence of information asymmetry creates an imbalance, as some investors who possess it can earn abnormal returns. These imbalances can lead to potential mispricing in financial markets. Weak-form market efficiency asserts that there is no information asymmetry regarding past prices, since they are publicly available and already reflected in current security prices. The paper examines how digital finance systems influence weak-form market efficiency by speeding up information dissemination and eliminating abnormal gains driven by predictability.

***Keywords:*** Digital finance, information asymmetry, information dissemination, weak-form market efficiency.

## 1. INTRODUCTION

According to Fama (1970), a market is considered efficient when prices reflect all available information wholly and instantaneously. The efficient market hypothesis explores how closely stock prices track the information available. Fama (1970) classified the efficient market hypothesis into strong, semi-strong and weak-form efficiency. The weak-form efficiency states that the current stock prices fully reflect available information. Technical and fundamental analysis are irrelevant if the available information is reflected in the current price. Information is an integral part of decision-making. The introduction of digital finance in India was in the mid-2010s. The digital finance systems rely on the processing and dissemination of

information. The systematic dissemination of information is essential to deliver the financial services efficiently. Digital finance enhances transparency, accessibility, and the speed of information flow, thereby reducing information asymmetry. The evolution of digital finance transformed the ecosystem through electronic real-time trading, smartphone trading apps, and speedy information transfer. The rapid spread of digital information often leads to information overload, highlighting the dynamic relationship between information and digital finance. Digital payments via Unified Payments Interface (UPI), Paytm, Phone Pe, Google Pay, QR code payments, contactless transactions, and mobile and internet banking are the outcomes of digital finance in India. Despite these advancements, the extent to which digitalisation enhances weak-form efficiency remains an empirical question. This paper explores how digital finance systems accelerate the flow of information, making markets even more efficient and reducing the likelihood of abnormal profits driven by predictable patterns.

## 2. REVIEW OF LITERATURE

Fama (1970) introduced the efficient market hypothesis, which says that prices quickly reflect all available information. Fama (1970) categorised the efficient market hypothesis as strong, semi-strong, and weak-form efficiency. Weak-form efficiency holds that current stock prices fully reflect all available information. However, others found autocorrelation in returns (Lo & MacKinlay, 1988). Many emerging markets do not meet the weak-form efficiency hypothesis, mainly because of structural constraints, lower liquidity, and higher transaction costs (Borges, 2010). Narayan et al. (2017) found that market efficiency in emerging Asian markets changes over time, suggesting that it develops with institutional and technological progress. Jain et al. (2013) examined whether the weak-form Efficient Market Hypothesis (EMH) holds in the Indian stock market, particularly during periods affected by the global financial crisis. The study finds that the Indian stock market is becoming more informationally efficient, but external shocks and investor behaviour can still lead to some predictable trends. This research adds to the literature on market efficiency and shows that developing markets like India are moving toward weak-form efficiency, though the process is not yet complete. Ryaly et al. (2014) found varying levels of efficiency, which suggests that advances in technology and digital financial infrastructure could help reduce information gaps and improve price discovery in emerging markets. Goel and Sahay (2023) studied the weak-form efficiency of socially responsible investment indices in India using unit root and autocorrelation tests. They found significant return predictability, which rejects the random walk hypothesis and shows that even sustainability-focused indices in India display weak-form inefficiency. Gill, Kumar, and Singh (2023) examined weak-form market efficiency in cryptocurrency markets by analysing calendar anomalies, including day-of-the-week and month-of-the-year effects. Using statistical techniques such as autocorrelation tests and regression-based models, the authors identified significant seasonal patterns in cryptocurrency returns, suggesting that returns are predictable. These anomalies resulted in the rejection of the random walk hypothesis and suggest that cryptocurrency markets do not meet the weak-form efficiency criterion.

Digital finance fuses traditional financial systems with cutting-edge tools such as mobile payments, fintech apps, and AI, enabling access to financial services anytime, anywhere, without ever stepping into a bank. Digital finance through Fintech providers improves financial inclusion in both emerging and advanced economies (Ozili, 2018). For individuals with low or variable income, the value of these services is often

greater than the higher cost they will pay to obtain them from conventional regulated banks. Gomber et al. (2018) shed light on the dynamic interplay between financial technology and market efficiency. The study reveals how fintech breakthroughs like digital payments, big data analytics, artificial intelligence, and blockchain turbocharge information processing and slash transaction costs. These advances breathe new life into the Efficient Market Hypothesis by enabling rapid information flow and sharper price discovery, ultimately boosting weak-form efficiency. (Saini & Saha, 2024) examined how digital finance promotes financial inclusion in India. They found that fintech tools like mobile wallets, online banking, and digital payments have made formal financial services more accessible to underserved groups. The study also highlighted that digital finance helps close institutional gaps and supports economic empowerment for people from different socio-economic backgrounds. (Ojha, 2024) The study suggests that stronger technology and good policy support can help digital financial services boost financial inclusion. These findings may offer useful guidance for other emerging economies with similar goals. (Jana, 2024) While there has been progress, challenges like limited internet access, low digital literacy, regulatory issues, and funding shortages are slowing growth. This study looks at trends, challenges, and future possibilities using reliable secondary data. (Devi & Kishan, 2025) Digital transformation has changed India's financial sector, affecting payments, banking, and financial inclusion. From 2019 to 2024, more people used mobile platforms, fintech grew, and government programs such as Jan Dhan, Aadhaar, and UPI accelerated the shift from cash to digital payments. In 2023–24, UPI handled over 13,000 crores in transactions, underscoring its importance as a global example of real-time payments. Financial inclusion improved, with almost 78% of adults having bank accounts by 2021 and more direct benefit transfers going digital. Fintech investment and new ideas changed credit, insurance, and savings, while traditional banks started using both digital and traditional models. The study by Kushwaha and Malpani (2025) shows that using fintech reduces the gender gap in financial access by 23% and increases formal credit access by 31% among previously unbanked individuals. These findings offer important insights for policymakers and financial institutions aiming to use technology to support inclusive growth.

A few studies in the literature examine weak-form efficiency in the context of digital finance. Weak-form efficiency asserts that information is reflected in current prices, while digital finance reduces information asymmetry. There is scope to study how digital finance enables transparent, efficient information flows to support decision-making in stock market investments. The aim of this study is to assess how implementing digital finance affects weak-form efficiency in an emerging economy such as India.

## 3. THEORETICAL BACKGROUND

### 3.1. Weak-form market efficiency

A market is said to be weak-form market-efficient when the current price has already been reflected in past prices, and past price-sensitive details are of no use for predicting future prices. (Fama, 1970). Here, technical and fundamental analysis are irrelevant for prediction, and investors cannot earn super profits. One form of the efficient market hypothesis is that the stock market is efficient at quickly absorbing new information. Those who possess the latest, up-to-date information play a fair game, but this creates information asymmetry. Now, with technological advancements, information dissemination is available to all investors, thereby reducing information asymmetry.

### 3.2. Information Asymmetry

Information asymmetry occurs when one investor has information that others do not, leading to an imbalance in decision-making. This typically happens when company insiders possess more information. Few traders will receive more information than the rest. The outcomes are inefficiencies, mispricing and unfair returns. Digital finance reduces asymmetry by disseminating real-time information.

### 3.3. Digital Finance

Digital finance is the delivery and use of financial services through digital platforms. Digital finance integrates financial systems with innovations such as mobile payments, fintech applications, and AI. In other words, transacting financial services without physical interaction with traditional channels.

#### 3.3.1. Components of digital finance in India

- Digital payments include Unified Payments Interface (UPI), Paytm, PhonePe, Google Pay, QR code payments, Mobile banking, internet banking, and Paperless KYC using Aadhaar.
- Digital lending includes Instant personal loans through apps, and Alternative credit scoring using AI and transaction data.
- Digital investments include Online stock trading and mutual fund platforms.
- Digital insurance includes Online policy purchase and claim automation.

#### 3.3.2. Major drivers of digital finance growth

- Government initiatives, such as Digital India, Jan Dhan Yojana
- Aadhaar-based authentication
- Smartphone penetration
- AI, blockchain, and cloud computing

#### 3.3.3. Benefits of digital finance

- Financial inclusion in rural areas
- Faster and low-cost transactions
- Transparency and reduced cash dependence
- Increased market participation
- Improved credit accessibility

#### 3.3.4. Challenges

- Cybersecurity risks
- Digital literacy gaps
- Regulatory concerns in digital lending
- Data privacy issues
- Urban–rural digital divide

### 3.4. Dimensions of the implementation of digital finance

For the study, the researcher divided the entire research into three comparable phases. They are discussed below;

#### 3.4.1. Pre-Digital Phase (2010–2015)

The pre-digital phase occurred from 2010 to 2015. Until this period, cash-based transactions dominated. There were only limited mobile banking services and low adoption of fintech applications. The information asymmetry was greater due to slower information dissemination.

But during these periods, the CORE banking and ATM networks were penetrated. The online translation platforms were at the introduction stage during the period.

#### 3.4.2. Digital disruption phase (2016–2019)

The Indian financial system began to change from this period onward. This period is driven by demonetization and UPI adoption. This period was also characterised by retail participation, low transaction costs, and improved information dissemination. Digital finance improved price discovery and rapid information diffusion.

#### 3.4.3. Digital Boom Phase (2020–2025)

The COVID-19 pandemic characterised this period. During this period, their economy became contactless, paving the way for massive growth in UPI transactions. There was an increased retail participation in stock markets via mobile trading apps. Besides this, social media influence and algorithmic trading led to behavioural distortions.

## 4. RESEARCH METHODOLOGY

This study uses the ProwessIQ database, covering the Nifty 50 index from 2010 to 2025. The analysis is structured into three distinct phases: pre-digital (2010–2015), digital disruption (2016–2019), and digital boom (2020–2025). The Lo and MacKinley (1988) variance-ratio test was employed, and all analyses were conducted in Python.

## 5. RESULTS AND DISCUSSIONS

To clarify the study, statistical tests were applied across three different periods, and the efficiency was compared. The outcome is shown in Table 1

**Table 1: Variance ratio test for each sub-sample**

| Lag | 2010-2015 | 2010-2015 | 2016-2019 | 2016-2019 | 2020-2025 | 2020-2025 |
|---|---|---|---|---|---|---|
| | Test Statistic | P-value | Test Statistic | P-value | Test Statistic | P-value |
| 2 | -12.716 | 0.000 | -10.155 | 0.000 | -4.921 | 0.000 |
| 5 | -10.906 | 0.000 | -8.141 | 0.000 | -4.188 | 0.000 |
| 10 | -8.437 | 0.000 | -6.609 | 0.000 | -3.281 | 0.001 |

***Note.*** **Computed from secondary data**

Table 1 presents the variance-ratio test results for the pre-digital phase (2010-2015), the digital disruption phase (2016-2019), and the digital boom phase (2020-2025). Since the p-value is below 0.05, the test rejects the null hypothesis of a random walk. Here, the stock prices are weak-form inefficient. The investor can

earn an abnormal return because the return series is predictable. Across the three sub-periods, the result was the same: the null of a random walk was rejected. The series for the three sub-periods is weak-form inefficient, indicating that the return series is predictable, which is inconsistent with the weak-form efficiency theory.

## 6. CONCLUSION

This paper examines how digital finance systems affect weak-form market efficiency by spreading information more quickly and reducing abnormal gains arising from predictable patterns. The analysis uses Lo & MacKinley's (1988) variance ratio test. The study period is divided into three parts: before disruption, during disruption, and after the introduction of digital finance in India. The results show that stock returns do not follow a random walk, as indicated by the variance ratio test, which shows significant serial dependence. Because the weak-form efficiency hypothesis is rejected, past price information still helps predict future prices, which means abnormal returns are possible through technical trading. Even though digital finance has improved and information spreads faster, the market still shows mean-reverting behaviour and short-term inefficiencies. The findings suggest that, even with digitalisation, information is not fully reflected in stock prices. Past prices still affect future returns. The study concludes that technology alone cannot ensure efficiency. Instead, investor behaviour and market structure play a larger role in setting prices. This gap shows that more research is needed on behavioural finance factors in digital finance to explain why inefficiency remains.

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