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Examining FinTech Indicators on the Performance of Equity Investment Funds

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Abstract

This research examines FinTech indicators on the performance of equity investment funds. With the development of FinTech, new tools have emerged to enhance the efficiency, transparency, and performance management of funds. In this study, the Principal Component Analysis (PCA) method was used to identify key FinTech components, followed by the Markov Switching model to analyze the variable performance patterns of the funds. The results revealed that components of FinTech infrastructure and performance management had the greatest contribution to the improvement of the composite FinTech index. The findings indicated that the FinTech infrastructure component had the most significant impact on the composite FinTech index, followed by performance management and FinTech evaluation in the institutional environment. To analyze different performance states, the Markov Switching model was applied, revealing two main performance states in the funds: a stable state with high returns and a volatile state with lower returns. Practical recommendations for fund managers include strengthening FinTech infrastructure to enhance security and reduce costs, utilizing data mining and behavioral analytics to better identify customer needs, and employing blockchain and automation technologies to improve efficiency and transparency. This study also highlights limitations, such as data restrictions and the generalizability of findings to all institutional environments. These results can assist fund managers in leveraging financial technologies to not only improve fund performance but also increase attractiveness to investors and better manage risks.

Keywords: *Financial Technology (FinTech), Performance, Equity Investment Funds.*

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1. Introduction

With the remarkable growth of technology in recent decades, various economic sectors, including the capital market, have been significantly impacted. One of the prominent areas in this transformation is financial technology, or FinTech, which, through technological innovations in financial processes, has led to increased efficiency, reduced costs, and improved services. Equity investment funds, as one of the popular investment tools, are increasingly reliant on modern tools to maintain and enhance their performance due to their close connection with developments in financial markets. FinTech has played a crucial role in structural changes in the capital market by offering solutions such as electronic payments, online trading platforms, and advanced data analytics. These innovations not only enable investors to access information and conduct transactions faster and more easily but also increase transparency and trust in the market [1, 2].

These indicators are vital for funds as they help them leverage FinTech capabilities to improve services, enhance operational efficiency, and elevate the customer experience. Generally, these indicators can be divided into six main categories: transaction security, payment system efficiency, accessibility and usability, service innovation, data quality and analytics, and regulatory and standards compliance [3]. One of the most critical indicators in the institutional environment of funds is transaction security. With the increasing use of financial technologies, ensuring the security of information transfer and transactions has become a primary priority for funds [4]. This indicator includes assessing data protection levels, preventing unauthorized access, and using advanced encryption protocols to ensure transaction security. Funds should constantly strive to reduce potential risks and gain customer trust by utilizing modern security technologies such as blockchain and two-factor authentication [5].

Indicators related to the efficiency of payment systems and the accessibility of investment fund services are also of great importance. These indicators measure the speed, accuracy, and ease of performing transactions in a digital environment. Fast and reliable payment systems enable customers to complete their transactions quickly and smoothly, which is particularly crucial in today's world, where e-commerce and online shopping are rapidly expanding [6]. Additionally, access to investment fund services through various platforms, such as fund mobile applications, fund internet services, and ATMs, is part of these indicators that should be improved to ensure customers can easily benefit from financial services. Funds can provide more personalized services to their clients and better meet their specific needs using big data analytics and artificial intelligence [7].

Furthermore, new innovations such as open banking and the use of APIs allow funds to integrate their services with other platforms and software, creating a seamless user experience. Finally, regulatory and standards compliance is another key indicator [8]. Funds must ensure that their financial technologies comply with financial regulations and international standards to prevent legal issues and uphold ethical principles. By assessing and improving these indicators, funds can enhance their productivity, increase customer satisfaction, and solidify their position in today's competitive market [9].

The extensive developments in financial technology (FinTech) over the past decade have created unique opportunities to improve performance and efficiency in various sectors of financial markets, including equity investment funds. With the advent of technologies such as blockchain, artificial intelligence, data mining, and digital platforms in the financial field, investment trends in stock markets have significantly changed. These technologies have provided innovative solutions that help improve investment decision-making, reduce costs, and increase transparency, thus enhancing the efficiency and performance of investment funds [10].

FinTech, leveraging emerging technologies like blockchain, artificial intelligence, and machine learning, offers greater security and speed in financial transactions [11]. In recent years, FinTech has brought significant changes to the financial sector [12]. These changes have impacted not only large financial institutions and funds but also small businesses and individual customers [13]. For instance, the emergence of mobile payment platforms and digital wallets has simplified financial transactions for users [14]. Moreover, FinTech enables individuals and companies to obtain loans under better conditions or access diverse investment opportunities without intermediaries [15].

Another segment of studies argues that FinTech has a negative impact on the banking business. Due to strict regulations, traditional funds often cannot meet loan demand. The increase in online lending directly affects the business involved in loan issuance by investment funds [16]. For example, Buchak et al. (2018) found that FinTech accounted for 30% of shadow banking growth in the United States, with FinTech lenders, as part of the shadow banking

system, growing in the residential mortgage market and reducing the market share of traditional funds [17]. Qiu et al. (2018) also stated that FinTech development increases debt costs, which, in turn, raises the risk of investment fund assets [18].

One of FinTech's crucial aspects is its impact on improving transparency and reducing costs in financial systems. By using blockchain, transactions are conducted transparently and at lower costs, increasing trust between parties [19]. Equity investment funds, as one of the significant financial tools, require the use of modern technologies for optimal data analysis, risk management, and performance enhancement. These funds can obtain more accurate information about market behavior and associated risks through FinTech. Additionally, financial technology, by establishing better communication platforms, enables faster interaction with investors and financial partners, thereby increasing responsiveness to market fluctuations and sudden changes.

A major issue in investment fund performance is risk management and sustainable returns. Technologies like artificial intelligence and machine learning enable fund managers to analyze and predict complex market patterns. On the other hand, blockchain provides a secure and transparent platform for transactions, reducing operational errors and execution costs, thereby increasing investor trust. These technologies, offering advanced analytical capabilities, can play a crucial role in optimizing fund performance and attracting new investors [20, 21]. However, there is a lack of comprehensive empirical analysis on identifying and evaluating financial technology (FinTech) indicators within the institutional environment of funds, and this topic has largely been overlooked in research conducted within the country.

This article examines the impact of financial technology (FinTech) on the performance of equity investment funds. With rapid advancements in financial technologies, new opportunities have emerged to improve investment management processes, reduce costs, and enhance transparency in the capital market. This study focuses on key FinTech indicators such as data analysis platforms, artificial intelligence, blockchain, and risk management, analyzing how these technologies influence the performance of investment funds. Therefore, examining the role and impact of financial technology indicators on the performance of equity investment funds is essential to determine how these technologies can improve returns and reduce risk. This article will analyze the relationship between financial technology indicators and the performance of equity investment funds using empirical data and statistical analysis and provide recommendations for enhancing fund performance.

2. Methodology

In the first stage, financial technology indicators affecting the performance of equity investment funds are calculated using Principal Component Analysis (PCA). An important issue in aggregating indicators is the application of an appropriate weighting method. In various studies, such as those by Stoni et al. (2018), Abura and Van Roy (2017), and Semler and Chen (2018), the regression method of cyclical elements has generally been used. In this method, the cyclical component of each variable contributing to the composite index is regressed against the cyclical component of a reference variable (FinTech infrastructure) for which the composite index is constructed. The correlation coefficient obtained is then used as the weighting criterion for the financial technology composite index based on the following equation.

$$W\_k = (r\_k\text{^}2)/(\sum\_(k = 1)\text{^}n\text{▒}r\_k\text{^}2 \quad)$$

Thus, after calculating the financial technology index, its effects on the performance of equity investment funds will be analyzed using the Markov Switching regime-shifting model estimation.

$$\boldsymbol{SD_{i,t}} = \begin{cases} \boldsymbol{\alpha_0 + \beta_1 SD_{i,t} + \beta_2 GreenGDP_{i,t} + \beta_3 FINTECH_{i,t} + \beta_4 L_{i,t} + \beta_5 EDU_{i,t} + \beta_6 CAP_{i,t} + u_t} & \boldsymbol{S_i = 1} \\ \boldsymbol{\gamma_0 + \theta_1 SD_{i,t} + \theta_2 GreenGDP_{i,t} + \theta_3 FINTECH_{i,t} + \theta_4 L_{i,t} + \theta_5 EDU_{i,t} + \theta_6 CAP_{i,t} + u_t} & \boldsymbol{S_I = 2} \end{cases}$$

In this research, we estimate the selected model using the Markov Switching (MS) model in the OxMetrics software.

The Markov Switching model was first introduced by Quandt (1972) and Quandt and Goldfeld (1973), and later Hamilton (1987) applied and developed it for analyzing business cycles. The main idea behind Markov Switching Vector Autoregressive (VAR) models is that the parameters of the VAR model depend on the regime variable St. However, St is unobservable, and only the probability associated with it can be determined. Unlike nonlinear methods such as STAR and ANN, where regime transitions occur gradually (Gradual Switching), in the Markov Switching model, regime transitions happen suddenly (Sudden Switching). In this model, it is assumed that the

regime at time t is unobservable and depends on an unobserved process (st). If we consider a model with two regimes, it is assumed that st can take values of 1 and 2. An AR(1) model with two regimes can be imagined as follows:

$$y_t = \begin{cases} \varphi_{0,1} + \varphi_{1,1} y_{t-1} + \varepsilon_t & if \quad s_t = 1 \\ \varphi_{0,2} + \varphi_{1,2} y_{t-1} + \varepsilon_t & if \quad s_t = 2 \end{cases}$$

or in a simplified form:

$$y_t = \varphi_{0,s_t} + \varphi_{1,s_t} y_{t-1} + \varepsilon_t$$

To complete the model, the characteristics of st must be specified. In the Markov Switching model, st is considered a first-order process. This assumption indicates that st depends only on the regime of the previous period, st-1. The transition probabilities from one state to another are introduced as follows:

$$p(s_t = 1/s_{t-1} = 1) = p_{11}$$

$$\mathbf{p(s_t = 2/s_{t-1} = 1) = p_{12}}$$

$$\mathbf{p(s_t = 1/s_{t-1} = 2) = p_{21}}$$

$$\mathbf{p(s_t = 2/s_{t-1} = 2) = p_{22}}$$

In the above relationships, p(i,j) represents the probability of the Markov chain moving from state i at time t-1 to state j at time t, which is always non-negative, and the following conditions are applied to them.

$$\mathbf{p_{11} + p_{12} = 1}$$

$$\mathbf{p_{21} + p_{22} = 1}$$

3. Findings

The first step in estimating the model is calculating the financial technology index. As discussed, this index consists of five sub-sections. After separating the trend from the cycle in each variable using the Hodrick-Prescott method, the weight of each sub-index in the composite financial technology index must be determined.

Table 1. Relative Importance of Variables in the Composite Financial Technology (FinTech) Index

Variable Name	Relative Importance of Variables
Evaluation of Financial Technologies (FinTech) in the Institutional Environment of Investment Funds	21
Performance Management	24
FinTech Efficiency in Investment Funds	11
Customer Identification	17
FinTech Infrastructure	27
Total	100

Table 1 shows the relative importance of the components of the overall index, broken down by the selected variables using the cyclical element regression method. Based on the obtained weights, FinTech infrastructure has the greatest impact on the composite financial technology index, followed by performance management and the evaluation of financial technologies (FinTech) in the institutional environment of investment funds. The financial technology index is calculated as the weighted sum of the five variables.

Table 2. LR Test Results

	Probability Value	Degrees of Freedom	Test Statistic
Investment Fund Performance	0.0000	11	485.96

According to the results in Table 2, the probability level is below 5%, leading to the rejection of the null hypothesis and acceptance of the alternative hypothesis. Therefore, the Markov Switching nonlinear method is used for model estimation.

The next step in estimating Markov models is to determine the optimal number of regimes. Initially, the model is estimated with different regimes, and the regime with the lowest Akaike and Schwarz criteria values and the highest maximum likelihood function value is chosen as the optimal regime. The model is then estimated and interpreted based on these optimal regime results. Table 3 presents the values of the Akaike and Schwarz criteria and the maximum likelihood function.

Table 3. Determining the Optimal Number of Regimes

Model	ML Statistic	ACI Statistic	SC Statistic	Number of Regimes
Investment Fund Performance	*-785.36	*23.96	*29.52	2
Source: Research Findings, *: Indicates the lowest criterion value				

Based on the estimation results, the two-regime state consistently has the highest maximum likelihood function value and the lowest Akaike and Schwarz criteria.

In Markov Switching models, all variables must be stationary, and the appropriate tests for the model include the LR test for determining the suitability of the nonlinear model. Once the optimal lags and regimes are identified, the Markov model estimation results show the significance of most coefficients at a 95% confidence level. It should be noted that the intercept captures the average impact of other variables on the performance of equity investment funds (the dependent variable) that are not explicitly mentioned in the model.

Table 4. Markov Regime-Switching Model Estimation Results

Variable Name	Coefficient	Standard Deviation	t-Statistic	Probability Level
Security	0.116408	0.023637	4.924808	0.0001
Performance Evaluation	-0.822679	0.047883	-17.18086	0.0000
Risk Management	0.089278	0.027937	3.195642	0.0015
Cost Management	0.742134	0.193535	3.834616	0.0001
Regulations	0.029212	0.010482	2.786775	0.0055
Digital Payments	0.210418	0.095113	2.212287	0.0274
Online Credit Facilities	0.077424	0.013421	5.769035	0.0000
Blockchain-Based Financial Services	0.072578	0.030158	2.406622	0.0164
Validation and Authentication	0.026711	0.012321	2.167938	0.0306
Customer Characteristics	0.173019	0.072536	2.385275	0.0174
Individual Characteristics	0.053752	0.022425	2.396934	0.0165
Customer Banking Experience	0.197885	0.085146	2.324058	0.0201
FinTech Infrastructure	0.077384	0.010161	7.615773	0.0000
Cultural and Social Conditions	0.144886	0.021574	6.715828	0.0000
Political and Regulatory Conditions	0.107799	0.020271	5.317791	0.0000

As mentioned in the model introduction section, the error terms of the Markov Switching model must be normal and free from autocorrelation and heteroscedasticity. The results of the diagnostic tests for these characteristics are presented below.

Table 5. Diagnostic Test Results for the Model

Test Type	Test Statistic	Statistic Value	Probability Level
Financial Technology Index	Ljung-Box Portmanteau Test for No Autocorrelation	(4) X^2	2.3287
Jarque–Bera Test for Normality	(2) X^2	2.2174	0.6325
ARCH Test for Homoscedasticity	(12,1) F	0.4789	0.4785

According to the results of the tests for no autocorrelation, normality, and homoscedasticity, the error terms have a significance level above 5%. This indicates that the error terms are free from autocorrelation, are normally distributed, and exhibit homoscedasticity, confirming the validity of the Markov model results.

4. Discussion and Conclusion

For this analysis, the data were first examined using the Principal Component Analysis (PCA) model to extract the main indicators related to financial technology in investment funds. Then, the Markov Switching model was applied to analyze the various performance states of the funds and the impact of the identified indicators. Financial technologies (FinTech) in the institutional environment of the fund have identified 17 components across 5 dimensions. The themes include performance management, FinTech efficiency in the banking industry, customer identification, FinTech

infrastructure, and fund goals and planning based on FinTech.

The components identified from the Principal Component Analysis (PCA) in this research include key elements for assessing financial technology and its impact on the performance of investment funds. These components are used as primary indicators in subsequent analyses and are interpreted as follows:

Performance management refers to the fund's ability to efficiently and optimally manage capital. It encompasses the evaluation of indicators such as returns, performance transparency, and the ability to adjust investment plans based on market changes. This component reflects the fund's strength in maintaining desirable performance under various economic conditions.

FinTech efficiency in investment funds evaluates the direct impact of financial technology on the productivity and efficiency of the fund's internal operations. FinTech efficiency relates to aspects such as reducing operational costs, data processing speed, and the quality of data analysis, all of which contribute to improving the fund's financial performance.

Customer identification focuses on the methods used by the fund to identify, analyze, and categorize clients. Accurate customer identification helps funds offer personalized services and increase customer engagement. This component includes the use of technologies such as data mining and behavioral analysis to better understand clients.

FinTech infrastructure pertains to the operational platforms and systems for financial technology within investment funds. These include data management systems, blockchain platforms, and intelligent systems for analysis and decision-making. Robust and sustainable FinTech infrastructure ensures that funds can maintain performance and efficiency in the long term.

Given the results of the analysis and the contribution of each component to the composite financial technology index, the following practical recommendations are proposed for investment fund managers to enhance performance and increase the efficiency of FinTech in their operations:

Focusing on performance management can improve transparency by providing investors with accurate and regular information about fund performance through digital technologies and transparent platforms, thereby increasing their trust. Data analysis tools can assist managers in identifying trends and performance patterns and help in making strategic decisions. Continuous performance monitoring through the creation of key performance indicators (KPIs) ensures optimal fund performance.

Enhancing FinTech efficiency in fund operations involves investing in automation to automate repetitive and time-consuming processes, thereby increasing productivity and data processing speed. The use of blockchain can reduce operational costs and enhance security in the fund's financial processes. Analyzing customer behavior through data mining and behavioral analysis can help managers identify customer needs and preferences, enabling the delivery of better services.

Strengthening FinTech infrastructure requires increasing data security by developing secure and stable infrastructures with encryption technologies to protect client information and sensitive data. Regular updates to software systems and financial technology infrastructures are essential to keep pace with technological advancements and market needs. Developing scalable operational infrastructures allows easy optimization and adaptation in the event of fund growth and an increase in investors.

Focusing on identifying clients and their needs involves creating comprehensive customer profiles by collecting and analyzing detailed information on customer behavior and needs to design more suitable products and services. Personalized services, based on customer data, respond specifically to the needs of each client and increase appeal. Continuous interaction with clients through digital platforms and incorporating their feedback into fund performance and product improvements is crucial.

Strengthening financial technologies in the fund's institutional environment includes improving regulatory compliance using advanced technologies like artificial intelligence to adhere to financial laws and reduce legal and compliance risks. Training staff on new financial technology skills ensures they can make the most of FinTech tools. Using predictive analytics models helps forecast future market changes and investor needs, enabling appropriate actions.

These recommendations can help fund managers succeed and improve the performance of investment funds by leveraging FinTech and enhancing infrastructure and work methods.

Authors' Contributions

Authors equally contributed to this article.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

All procedures performed in this study were under the ethical standards.

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