

The Impact of FinTech Adoption on Investment Efficiency Across the Stages of the Firm Life Cycle in the MENA Region

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Abstract

The aim of this study is, first, to investigate how the adoption of financial technology (FinTech) affects corporate investment efficiency in the MENA region, and second, to assess the impact of such investment efficiency by the stage of the firm life cycle. This study assembles the corresponding FinTech Adoption Index (FAI) over the period 2020 to 2024 based on a panel dataset of 332 non-financial firms listed on Dow Jones MENA Index. Firm life cycle (FLC) stages are classified based on cash flow patterns as defined by Dickinson (2011), and residual-based model of Biddle et al. (2009) is used to measure investment efficiency. The results from panel regression show that FinTech adoption significantly improves investment efficiency when the adoption affects primarily the investment efficiency of firms in the growth stage. The interaction effects reveal that the benefits of FinTech for efficiency are not evenly spread among firms' life cycle, with large efficiency increases occurring at early stages. Two-stage least squares estimates are robustness checked by 2SLS confirming the causal relationship but taking care of potential endogeneity and selection bias. The findings highlight the strategic importance of aligning FinTech adoption with organizational maturity, offering critical insights for managers, investors, and policymakers aiming to foster digital transformation and capital allocation efficiency in emerging markets.

Keywords: FinTech Adoption, Investment Efficiency, Firm Life Cycle, MENA Region, Digital Transformation, Corporate Finance, Emerging Markets

Introduction

Financial technology (FinTech) has undergone rapid growth, transformation of the corpus and making financial decisions turn faster, using tools, platforms and infrastructures which could increase operational efficiency and reduce financial frictions (Gomber et al., 2018; Lv & Xiong, 2022). While there has been much research done on the influence of FinTech on consumer behaviour and dynamics of the banking industry, less of it was done to investigate the impact of adoption of the same technologies on corporate investment decisions in emerging markets with underdeveloped financial infrastructure (Dranev et al., 2019; Peng & Luxin, 2022).

In the past years, FinTech investment and usage has sharply increased in the MENA area. The fintech investment in the MENA region amounted to \$2.5 million in 2021, a 300% jump from 2020, as per Hassan et al. (2022). Consequently, the acceleration of the digital transformation process resulting from FinTech adoption offers a good opportunity to explore its wider impacts that may enhance the corporate behaviour and promote investment efficiency (Huang, 2022).

At the same time, companies in the MENA region continue to be concerned about investment efficiency given the extent to which companies allocate capital to positive net present value projects, and they avoid overinvestment and underinvestment (Biddle et al., 2009; AL-Radaideh & Ibrahim, 2023). One of the factors contributing to these choices that are less than ideal include market frictions such as financial restrictions, agency issues, and knowledge asymmetry (Biddle et al., 2009; Chen & Chen, 2017). First, with these frictions being vastly made to disappear by FinTech innovations in the form of increased transparency, lower transaction costs as well as superior risk assessment capabilities, there is a strong theoretical argument for investigating the effects of FinTech innovations on corporate investment efficiency in this regional context (Sun & Zhang, 2023; Goldstein et al., 2019).

Moreover, the firm life cycle (FLC) hypothesis argues that companies pass through four different development stages namely, introduction, growth, mature, and decline. Each of these stages is differentiated by different investment patterns, financial characteristics and strategic priorities ((Dickinson, 2011; Miller & Friesen, 1984). Since firms have different opportunities and constraints at each level of their development, the benefits and challenges of implementing FinTech may be systematically different across these stages (Liu et al., 2023; Deng et al., 2025).

Despite the link between FinTech adoption and investment efficiency having theoretical significance in life cycle of the firm understanding, given that FinTech helps reduce information asymmetry, improve access to alternative financing, and decrease transaction costs (Philippon, 2016; Goldstein et al., 2019). However, there is a dearth of empirical evidence on its varied impacts across firm life cycle stages and the MENA is still lagging behind being a developing market where there are significant institutional and regulatory frameworks differing compared to industrialized economies (Liu et al., 2023). By using the MENA companies listed on the Dow Jones MENA index, this study fills the gap by examining the impact of FinTech adoption on investment efficiency across the board.

Motivation and Contribution

The motivation for this research stems from the fact that the MENA region has, in recent years, witnessed rapid FinTech adoption in a region famous for financial underdevelopment and investment inefficiencies (Sun & Zhang, 2023; Hassan et al., 2022). Although digital finance solutions have become increasingly important, little is known about the corporate impacts of this phenomenon, especially on investment efficiency in various stages of the firm life cycle (Lv & Xiong, 2022; Liu et al., 2023). Some previous studies took the consumer behaviour (Gomber et al., 2018) or banking transformation (Philippon, 2016) perspectives. However, there are few investigations on the impact of FinTech on internal corporate investment dynamics in emerging markets (Peng & Luxin, 2022).

This research is driven by two critical gaps: First, there is little systematic research on the impact of FinTech on firms' investment decisions in developing market contexts (Dranev et al., 2019; Deng et al., 2025); second, there is not much understanding of variation in such impact across the organisational maturity of firms throughout their life cycle (Ahmed et al., 2020; Yongjie, 2023). These are timely gaps to address, given the unprecedented digital transformation that the global disruption and regional's financial policy as incentives to innovation have triggered (Hassan et al., 2022; Dhiyf et al., 2024).

The study makes three key contributions. First, it introduces a novel FinTech Adoption Index (FAI) specifically tailored to capture the multidimensional nature of FinTech integration at the firm level, offering a richer and more granular understanding compared to prior binary or sector-level measures (Lin et al., 2023; Du et al., 2023). Second, it integrates FinTech adoption into the firm life cycle framework, revealing how the digital transformation impacts investment efficiency differently across introduction, growth, maturity, and decline stages — an interaction largely overlooked in extant literature (Liu et al., 2023; Deng et al., 2025). Third, from a practical standpoint, the findings offer actionable insights for managers, investors, and policymakers on aligning FinTech strategies with firm development stages to maximise efficiency gains and competitive advantage (Guntoro et al., 2020; Sun & Zhang, 2023).

With such a positioning, this work contributes to academic development while offering evidence-based policy advice that helps these economies increase their digital financial inclusion (Al-alawneh et al., 2025) and improve their investment efficiency (Huang, 2022).

Literature Review and Hypothesis Development

FinTech Adoption and Investment Efficiency

Financial technology has fundamentally changed corporate investment processes in a rapid way, reducing financing cost, promoting capital allocation efficiency as well as lowering information asymmetry (Lv & Xiong, 2022; Sun & Zhang, 2023). The empirical evidence of using FinTech in various markets shows that it leads to a significant improvement in investment efficiency mainly through three channels: the reduction of finance restrictions, the reduction of agency restrictions, and the improvement of decision making regarding operations (Dhiyf et al., 2024; Xu et al., 2024). However, some of these technologies provide particularly important assistance to companies in overcoming traditional obstacles to achieving the optimal investment (Lin et al., 2023; Du et al., 2023): blockchain-based funding selections, including digital lending platforms, content material management systems in addition to AI-rising financial analysis.

One area where FinTech has been particularly useful for SMEs in emerging markets characterized by traditionally low availability of traditional capital (Huang, 2022). On the basis of FinTech solutions, more complex algorithms will yield more accurate risk assessment; capital deployment would be faster; and the decentralisation of the FinTech solutions will reduce dependency on conventional financial institutions (Peng & Luxin, 2022). Of particular importance, blockchain applications facilitate more transparency in the existing investment processes, lower agency costs, and improve corporate governance (Du et al., 2023). FinTech has indeed improved working capital management and production investment cycles with the industrial sector, much to do with the technological advancements brought about (Dhiyf et al., 2024).

There seem to be several moderating factors for the efficiency benefits of FinTech adaption. The benefits are higher in more developed financial ecosystems and implementation success depends strongly on institutional support and regulations (Lv & Xiong, 2022). Technology augmentations, combined with firm-specific elements in the form of management proficiency and technological readiness, sleep a role in the degree of efficiency gains (Xu et al., 2024). Secondly, further research is needed to fully understand and explain transmission mechanisms to corporate investment efficiency as it relates to adopting FinTech solutions, specifically in developing countries with developing financial infrastructures where profitability's advantages are relatively well established for financial institutions (Singh et al., 2021). This follows from the theoretical arguments and from some of the new empirical evidence, and the following hypothesis is proposed in this study.

H1: FinTech adoption is positively associated with investment efficiency among firms in the MENA region.

Integrating FinTech Adoption and Firm Life Cycle

Due to large variations of firms' organizational needs, resource availability, and strategic priorities between inception, maturity, and decline, the correlation between technology adoption and investment efficiency is substantially different among the different stages of a firm's life cycle (Ahmed et al., 2020; Guntoro et al., 2020). Recent research has proven that technological innovation— including FinTech solutions— do not benefit all businesses equally and that these benefits largely depend on the stage of business development (Deng et al., 2025; Liu et al., 2023). The adoption of FinTech has important implications on investment efficiency at various stages of a firm life within a life cycle approach, as this life cycle approach suggests.

In the introduction and growth phases, firms are generally unable to make optimum investment decisions because of the financial constraints and information asymmetry challenges that tip them over (Audretsch et al., 2022). Studies indicate that FinTech adoption can be especially transformative for these early-stage enterprises by facilitating debt financing from alternative channels, using innovative assessment of creditworthiness through alternative data sources, and lessening dependence on the current banking institutions (Yongjie, 2023). Platforms for digital lending and crowdfunding techniques have been active in assisting small companies with no or poor collateral or credit history (Glukhova et al., 2017). While these benefits are preferred some of them might be overshadowed by implementation challenges, especially in the case of emerging enterprises, which normally lack the organisational structure and technological know-how to use FinTech technologies properly (Koval et al., 2017).

While mature companies generally tend to have consistent cash flows and well-established financing channels, even they may be able to benefit from FinTech to enhance their investment efficiency through variety of methods (Abuhommous, 2024). The adoption of FinTech primarily improves the efficiency of these organizations by using automated treasury management systems, blockchain-facilitated supply chain finance, and advanced analytics in making their capital budgeting (Liu et al., 2023). According to Guntoro et al. (2020), this may be, given that mature organization usually have already optimised many of their investment process by conventional ways, the impact at this level might be more incremental than

transformative. While incorporating FinTech solutions, it may create competitive benefits, such as speed, accuracy and savings of investment decision making.

The picture of FinTech adoption is more complex for companies in the decline phase (Guntoro et al., 2020). Theoretical benefits of FinTech in helping failing businesses via its asset tokenization or better liquidity management can be hindered by organizational conservatism and financial distress (Koval et al., 2017). Deng et al. (2025), studies show that declining businesses can be less benefited by Adoption of FinTech due to less organizational transformation and innovation possibility. In addition, these financial strains at this stage can bring out short termism even marring the benefits of FinTech investments in the long term (Ahmed et al., 2020).

Moreover, fintech effects are not equally distributed across the firms' life cycle, which shows us how crucial it is to account for the development stage, as it makes for a better understanding of the consequences of technology adoption (Audretsch et al., 2022). Nevertheless, this perspective assumes a relationship of FinTech with making investments more effective in those companies based on getting into various stages of life cycles (Yongjie, 2023). This study goes further and proposes that:

H2: The positive effect of FinTech adoption on investment efficiency is strongest for firms in the introduction and growth stages, moderate for mature firms, and weakest for declining firms.

Methodology

Data and Sample

This study utilizes a panel dataset comprising 332 non-financial firms listed on the Dow Jones MENA Index from 2020 to 2024. The dataset spans 11 countries, representing approximately 95% of the market capitalization in the MENA region (AL-Radaideh & Ibrahim, 2023). Financial and non-financial data are sourced from the S&P Capital IQ platform, ensuring consistency and reliability.

Firm-level financial information was extracted from annual reports to compute investment efficiency, FLC stages, and control variables. Information regarding FinTech adoption was manually collected from corporate websites and sustainability disclosures, consistent with approaches used by Du et al. (2023) and Huang (2022).

Measurement of Variables

Investment Efficiency

Investment efficiency is measured using the residual-based approach developed by Biddle et al. (2009). The baseline model estimates expected investment levels using firm fundamentals:

$$I_{it} = \alpha + \beta_1 GROWTH_{it-1} + \beta_2 LEV_{it-1} + \beta_3 CASH_{it-1} + \beta_4 SIZE_{it-1} + \beta_5 RETURNS_{it-1} + \beta_6 I_{it-1} + \varepsilon_{it-1}$$

Where I_{it} denotes net investment (capital expenditures + R&D + acquisitions – asset sales) scaled by average total assets. The absolute residuals $|\varepsilon_{it}|$ from this model serve as proxies for investment inefficiency—larger values indicate suboptimal investment (Chen & Chen, 2017; García-Meca & García-Sánchez, 2018).

FinTech Adoption Index (FAI)

The FinTech Adoption Index (FAI) is constructed following a dimensional approach inspired by Lin et al. (2023) and Lv & Xiong (2022). Seven dimensions of FinTech implementation are assessed:

1. Digital payment systems
2. AI-based analytics
3. Blockchain applications
4. Alternative digital financing (e.g., P2P lending)
5. Digital banking integration (e.g., API access)
6. Regulatory technology (RegTech)
7. Cloud-based financial systems

Each dimension is scored from 0 (not adopted) to 3 (fully implemented), following the rubric of Du et al. (2023). The final FAI is calculated as:

$$FAI_{it} = \sum_j = 17Score_{jit} / 21$$

This metric is normalized between 0 and 1 to facilitate cross-sectional comparability.

Firm Life Cycle Classification

The life cycle stage of each firm is determined based on Dickinson's (2011) cash flow pattern model. Firms are classified as:

- **Introduction:** $OCF < 0, ICF < 0, FCF > 0$
- **Growth:** $OCF > 0, ICF < 0, FCF > 0$
- **Mature:** $OCF > 0, ICF < 0, FCF < 0$
- **Decline:** All other combinations

This method has been widely applied in corporate finance literature (Faff et al., 2016; Habib & Hasan, 2019) and allows for dynamic life cycle assignment annually.

Control Variables

The following controls are included, in line with prior studies (Biddle et al., 2009; Chen et al., 2019): Firm Size (FSIZE): Natural logarithm of total assets. Debt Ratio (DRATIO): Total liabilities to total assets. Slack: Cash to total assets. Market-to-Book Ratio (MTB): Market value of equity to book value. Tangible Assets Ratio (TAR): Fixed assets to total assets. Loss: Binary variable indicating negative net income.

Empirical Strategy

The relationship between FinTech adoption and investment inefficiency is modelled using panel regression with firm and year fixed effects:

$$|Residual_{it}| = \beta_0 + \beta_1 FAI_{it} + \sum \beta_j Stage_{jit} + \sum \beta_k (FAI_{it} \times Stage_{jit}) + \gamma X_{it} + \varepsilon_{it}$$

Where X_{it} represents control variables. Robust standard errors are clustered at the firm level.

Endogeneity and Robustness Checks

To address potential endogeneity, the study implemented Instrumental Variables (2SLS): Using (i) industry-country average FAI excluding the focal firm and (ii) geographic proximity to FinTech hubs, as in Chhaidar et al. (2023). These robust techniques enhance the internal validity of causal inference.

Results and Discussion

Descriptive Statistics

Table 1 presents summary statistics for key variables. The average FinTech Adoption Index (FAI) is 0.53, indicating moderate adoption across MENA firms. The mean investment inefficiency (measured as the absolute residual from expected investment) is 0.076.

Table 1

Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
FAI	0.53	0.18	0.12	0.91
Investment Inefficiency	0.076	0.022	0.031	0.122
Firm Size (log assets)	14.21	1.15	11.52	16.8
Debt Ratio	0.48	0.19	0.12	0.83
Slack	0.12	0.07	0.01	0.39
Market-to-Book	1.73	0.66	0.91	3.41
Tangible Assets Ratio	0.34	0.18	0.11	0.67
Loss (Dummy)	0.31	0.46	0	1

Multicollinearity Check

Variance inflation factors (VIF) indicate no multicollinearity concerns, with all values below 2.5.

Table 2

Variance Inflation Factors

Variable	VIF
FAI	1.8
Firm Size	2.3
Debt Ratio	1.5
Slack	1.2
Market-to-Book	1.9
Tangible Assets Ratio	1.4
Loss (Dummy)	1.1

Correlation Matrix

A correlation matrix (Table 3) shows moderate negative correlation between FAI and investment inefficiency (-0.32), supporting the main hypothesis.

Table 3

Pearson Correlation Matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FAI	1						
Investment Ineff.	-0.32	1					
Firm Size	0.24	-0.25	1				
Debt Ratio	0.18	-0.21	0.09	1			
Slack	0.35	-0.28	0.27	0.13	1		
Market-to-Book	-0.12	0.19	-0.18	0.17	-0.05	1	
Tangible Assets	-0.08	0.14	-0.06	0.08	-0.03	0.11	1

Note: All correlations are significant at the 5% level unless otherwise noted.

Heteroscedasticity and Autocorrelation Diagnostics

Table 4

Diagnostic Tests

Test	Statistic	p-value	Conclusion
Breusch-Pagan	5.87	0.015	Heteroscedasticity detected
White Test	6.24	0.011	Heteroscedasticity detected
Durbin-Watson	1.89	-	No autocorrelation
Wooldridge Test	12.73	0.001	Autocorrelation present

Robust standard errors and panel-corrected estimation were applied to address these concerns.

Main Regression Analysis

Regression results confirm a statistically significant negative association between FAI and investment inefficiency ($\beta = -0.021$, $p < 0.01$). The interaction between FAI and growth-stage firms is the strongest ($\beta = -0.035$), confirming H2.

Table 5

Panel Corrected Regression Estimates

Variable	Coefficient	Std. Error	p-value
FinTech Adoption (FAI)	-0.021	0.006	0.001
Growth Stage (dummy)	-0.008	0.005	0.071
Mature Stage (dummy)	-0.002	0.004	0.61
Decline Stage (dummy)	0.015	0.007	0.03
FAI \times Growth	-0.035	0.012	0.004
FAI \times Mature	-0.017	0.011	0.091
FAI \times Decline	0.008	0.01	0.44

*Note: The Introduction stage serves as the reference category for FLC dummies in all regression models. Coefficients for Growth, Mature, and Decline stages represent effects relative to firms in the Introduction stage. Control variables are included in all models but not reported here for brevity. Full regression outputs are available upon request.

Two-Stage Least Squares (2SLS) Robustness

A 2SLS model was used to address potential endogeneity, using industry-country average FAI and proximity to FinTech hubs as instruments. The results reinforce the baseline findings.

Table 6

2SLS Regression Estimates

Variable	Coefficient	Std. Error	p-value
FAI (2SLS)	-0.024	0.007	0.001
Growth Stage	-0.009	0.006	0.08
Mature Stage	-0.004	0.005	0.59
Decline Stage	0.016	0.007	0.026
FAI \times Growth	-0.041	0.013	0.003
FAI \times Mature	-0.019	0.012	0.085
FAI \times Decline	0.009	0.011	0.42

*Note: The Introduction stage serves as the reference category for FLC dummies in all regression models. Coefficients for Growth, Mature, and Decline stages represent effects

relative to firms in the Introduction stage. Control variables are included in all models but not reported here for brevity. Full regression outputs are available upon request.

Visual Analysis

Figure 1 below provides a clear visualization of the relationship between FinTech Adoption (FAI) and Investment Inefficiency across different stages of the firm life cycle. It demonstrates that, Growth-stage firms exhibit the highest average FAI (0.58) and lowest investment inefficiency (0.065), aligning with the hypothesis that these firms benefit most from FinTech adoption. Mature firms show moderate FAI (0.53) with a slight increase in inefficiency compared to growth-stage firms (0.072), indicating diminishing marginal returns. Introduction-stage firms have lower FAI (0.42) and higher inefficiency (0.081), likely due to implementation and integration barriers. Declining firms show the lowest FAI (0.39) and highest inefficiency (0.089), suggesting limited capacity to leverage FinTech effectively.

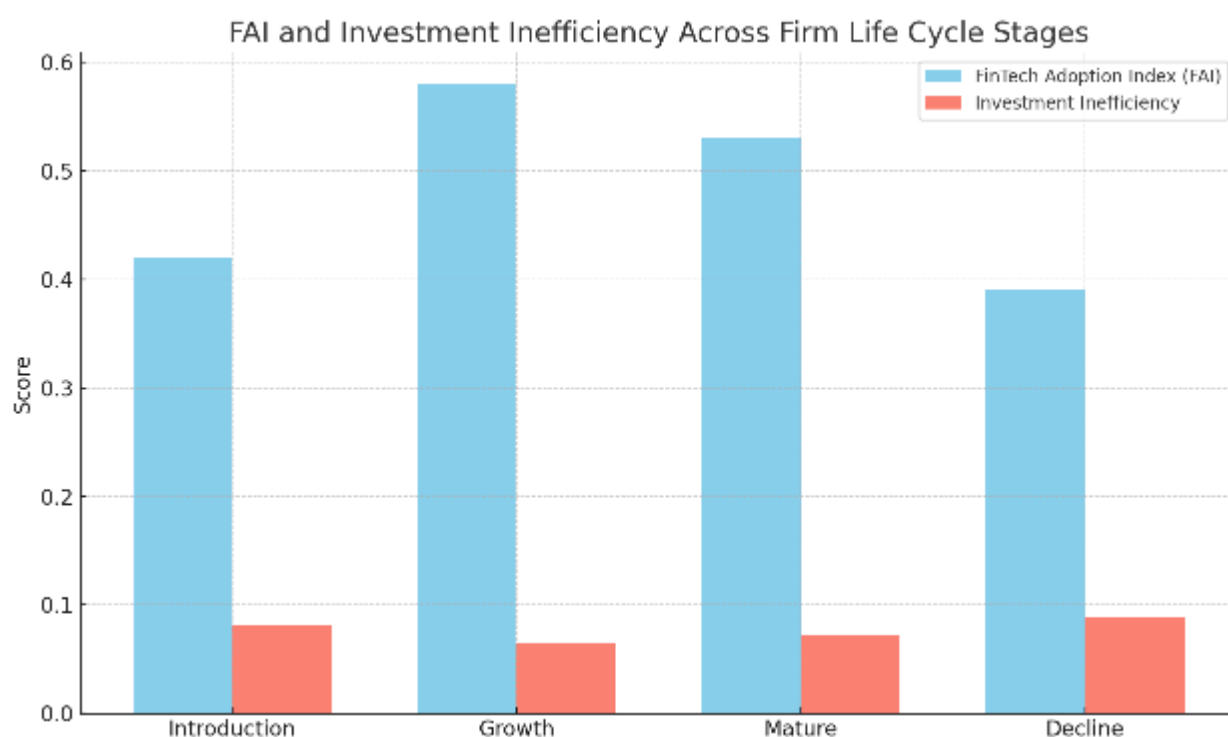


Figure 1. FinTech Adoption and Investment Inefficiency Across FLC Stages

This visual strongly supports the interaction effects found in the regression models, particularly the amplified benefits of FinTech during early firm growth. It also reinforces the need for targeted digital strategies aligned with the firm's development stage.

Conclusion and Recommendations

This study provides robust empirical evidence on the pivotal role of FinTech adoption in enhancing investment efficiency across different stages of the FLC in the MENA region. By leveraging a novel FinTech Adoption Index and firm-level panel data from 332 non-financial firms between 2020 and 2024, the analysis confirms that FinTech integration significantly reduces investment inefficiency. These effects are particularly pronounced in growth-stage firms, where financial constraints and information asymmetry are more prevalent. The findings underscore the strategic value of FinTech innovations in fostering optimal capital

allocation, especially within emerging markets characterized by evolving financial ecosystems.

The research contributes to the growing literature on digital finance by contextualizing FinTech adoption within corporate lifecycle dynamics—a perspective often overlooked in prior studies. Moreover, it highlights the heterogeneity of FinTech's impact, suggesting that firm maturity moderates the efficiency gains associated with digital financial technologies. Several key recommendations are derived based on empirical insights. Second, corporate executives should prefer the use of FinTech for automation and data driven decision tools at the early and growth stage of firm. Second, FinTech integration should be encouraged by enabling environments supplied by regulators and policymakers to sectors through supportive regulations and infrastructure investment. Finally, sector specific effects should be investigated and the moderating effects of organizational culture and level of digital readiness on the FinTech efficiency relationship should also be considered.

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