



ASSESSING THE IMPACT OF FINTECH ADOPTION ON BANKING STABILITY IN INDONESIA: A VECM-BASED EMPIRICAL ANALYSIS (2018-2024)

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Abstract

This study examines the impact of financial technology (fintech) adoption on banking sector stability in Indonesia over the period 2018–2024. The research aims to investigate both short-run and long-run relationships between fintech development and key banking stability indicators, namely the Capital Adequacy Ratio (CAR), Non-Performing Loans (NPL), and Gross Domestic Product (GDP). A Vector Error Correction Model (VECM) is employed to capture short-term dynamics and long-term equilibrium relationships among variables. Johansen cointegration tests confirm the existence of significant long-run relationships. The VECM results indicate that fintech adoption has a positive and significant effect on CAR and GDP in both the short and long run, while its impact on NPL remains statistically insignificant. These findings suggest that fintech expansion contributes to strengthening bank capitalization and supporting economic growth without directly increasing credit risk. The study highlights the importance of adaptive regulatory frameworks to harness fintech benefits while preserving financial system stability.

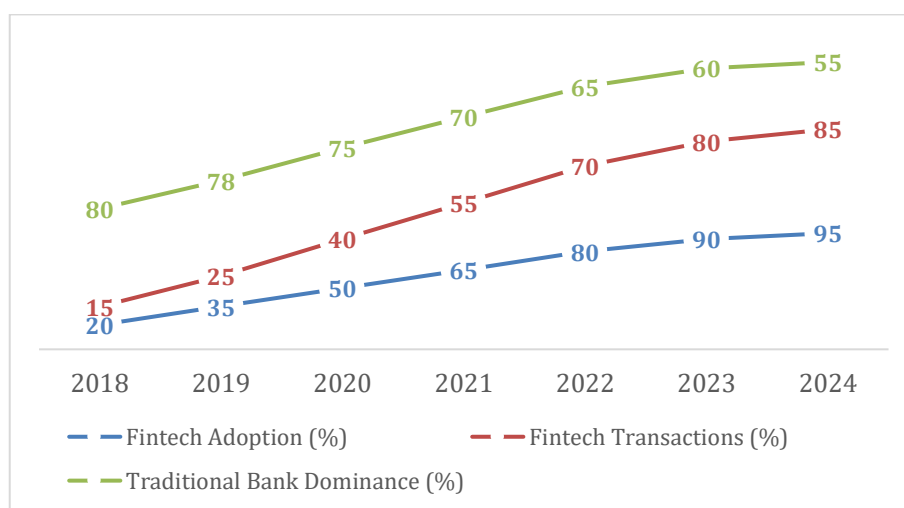
Keywords: banking stability; fintech adoption; financial technology; Indonesia; VECM

INTRODUCTION

Since 2018, Indonesia's financial landscape has undergone a substantial structural transformation driven by the rapid expansion of financial technology (FinTech). Innovations such as digital payment systems, technology-based financing platforms (peer-to-peer lending), and electronic wallets have significantly broadened access to financial services, particularly for segments previously underserved by conventional banking institutions, including micro, small, and medium enterprises (MSMEs) and the unbanked population. While this development reflects meaningful progress in financial inclusion, concerns have emerged regarding the potential implications of large-scale and, in some cases, insufficiently regulated FinTech expansion for the stability of the national banking sector. FinTech adoption may influence key indicators of banking soundness, such as non-performing loan (NPL) ratios and capital adequacy ratios (CAR), as well as broader macroeconomic conditions, including gross domestic product (GDP). Consequently, examining the linkage between FinTech development and banking sector health has become increasingly relevant, particularly over the period 2018–2024.

The urgency of this investigation is further reinforced by evidence suggesting that banking resilience is shaped not only by internal institutional factors but also by rapidly evolving external dynamics, notably financial digitalization. For instance, Rahman and Putri (2023) demonstrate that capital adequacy and GDP growth contribute significantly to long-run banking stability. However, much of the existing literature has yet to incorporate FinTech as a structural factor capable of altering these relationships. This gap highlights the need for an econometric framework that can simultaneously capture short-run dynamics and long-run equilibrium relationships. In this regard, the Vector Error Correction Model (VECM) provides a robust analytical approach to assess the dynamic interactions between FinTech adoption, banking stability indicators, and macroeconomic variables. In this study, gross domestic product (GDP) is employed not merely as a measure of aggregate economic output but also as an indicator of national capacity to support financial intermediation and the expansion of the financial sector. Yulianto and Sari (2022) document that GDP growth is

generally positively associated with banking stability. Nevertheless, as FinTech becomes increasingly dominant in providing credit access and alternative financing channels, the influence of GDP on the financial sector may deviate from traditional patterns. At the same time, the capital adequacy ratio (CAR), as a key measure of banks' capital resilience, may also be affected, particularly when intensified competition from FinTech firms constrains banks' lending activities. Such competitive pressures may ultimately elevate credit risk and non-performing loans (NPLs), even in cases where banks are not directly involved in FinTech operations. The selection of explanatory variables namely NPL, CAR, and GDP is grounded in their role as representative indicators of banking stability and performance. By applying the Vector Error Correction Model (VECM), the interrelationships among these variables can be examined simultaneously, capturing both short-run dynamics through contemporaneous adjustments and long-run equilibrium relationships through the error correction mechanism. A key strength of the VECM framework lies in its ability to model complex and realistic dynamic interactions that are often overlooked by conventional linear econometric models.



The uploaded figure illustrates the trends in FinTech adoption, FinTech transaction activity, and the relative dominance of traditional banks over the period 2018–2024. FinTech adoption (blue line) exhibits a sharp upward trajectory, rising from approximately 20% in 2018 to nearly 95% in 2024, indicating a substantial shift of users toward FinTech-based financial services. Similarly, FinTech transactions (orange line) increase markedly, from around 15% in 2018 to about 85% in 2024, reflecting the growing reliance on FinTech platforms for financial transactions. In contrast, the dominance of traditional banks (grey line) declines steadily, from roughly 80% in 2018 to 55% in 2024, suggesting a gradual erosion of market share as users increasingly migrate to FinTech platforms. In addition, this study engages with a broad body of literature examining the influence of FinTech on the banking sector, with particular emphasis on its implications for financial stability and the evolution of banks' business models. By synthesizing these insights, the research aims to provide practical guidance for policymakers and industry stakeholders in formulating strategies to address the challenges arising from rapid FinTech adoption (Hendriyanto & Widodo, 2024). Ultimately, the findings are expected to offer deeper insights into policy and strategic measures that can help safeguard the stability of Indonesia's banking sector amid ongoing digital transformation.

LITERATURE REVIEW

A. Financial Technology (FinTech) Adoption

Financial technology, commonly referred to as FinTech, denotes the application of digital technologies to deliver financial services in a more efficient, accessible, and cost-effective manner. In the Indonesian context, FinTech adoption has expanded rapidly since 2018, driven by increasing internet penetration, widespread smartphone usage, and shifts in consumer behavior toward digital

financial services. FinTech encompasses a wide range of activities, including digital payments, peer-to-peer (P2P) lending, as well as technology-based investment and insurance services. The growing presence of FinTech is widely recognized as a transformative force in the traditional banking sector, introducing new forms of competition while simultaneously fostering innovation and efficiency improvements (Samsudin & Rahman, 2022). From an analytical perspective, FinTech adoption can be systematically measured using a FinTech adoption index. This index is typically constructed through a regression-based framework that captures key determinants of FinTech diffusion, such as internet penetration (PI), accessibility and ease of use (A), and consumer trust (C). These factors are commonly modeled as a function of time (t), reflecting the dynamic and evolving nature of technological adoption. Such an approach enables researchers to quantify the pace and intensity of FinTech adoption while accounting for structural changes in the digital financial ecosystem.

$$FAt = \beta_0 + \beta_1 PI_t + \beta_2 A_t + \beta_3 C_t + \epsilon_t$$

B. Non-Performing Loan (NPL)

Rahman and Putri (2023) highlight that rising non-performing loans (NPLs) have the potential to intensify systemic risk within Indonesia's banking system. Their findings indicate that, although FinTech plays a significant role in expanding access to credit, the associated increase in exposure to default risk requires careful monitoring. The study further demonstrates that NPLs are not solely determined by banks' internal risk management practices but are also shaped by external dynamics, such as FinTech-bank partnerships. In this context, elevated default risks originating from FinTech-related lending activities may transmit to traditional banking institutions, thereby amplifying vulnerabilities across the broader financial system.

C. Capital Adequacy Ratio (CAR)

In the same study, Rahman and Putri (2023) emphasize that the capital adequacy ratio (CAR) serves as a critical buffer against external shocks. Their analysis shows that banks with higher CAR levels tend to exhibit greater resilience to disruptions arising from increased FinTech activity. However, as credit intermediation through FinTech platforms continues to expand, pressures on capital adequacy have become more pronounced. This dynamic necessitates that banks maintain CAR at relatively higher and safer levels, particularly when engaging in partnerships or strategic integration with FinTech firms, in order to preserve financial soundness and mitigate emerging risks.

D. Gross Domestic Product (GDP)

Yulianto and Sari (2022) document that GDP growth has historically been positively associated with long-run banking stability. However, they argue that in the era of FinTech-driven financial digitalization, the role of GDP warrants re-evaluation. The proliferation of digital financial platforms may alter the traditional transmission mechanisms through which economic growth influences the banking sector, particularly when FinTech reshapes credit structures without being matched by adequate regulatory frameworks and supporting economic infrastructure. As a result, the stabilizing effect of GDP growth on the banking system may become less predictable in the absence of coordinated institutional and policy responses.

METHOD

This study adopts a quantitative research design and employs the Vector Error Correction Model (VECM) to examine both short-run and long-run relationships between FinTech adoption and the stability of Indonesia's banking sector over the period 2018–2024. The variables included in the analysis comprise non-performing loans (NPLs), the capital adequacy ratio (CAR), gross domestic product (GDP), and a proxy for FinTech adoption, measured by outstanding FinTech lending. Quarterly time-series data are utilized, sourced from the Financial Services Authority (OJK), Bank Indonesia (BI), Statistics Indonesia (BPS), and the Indonesian FinTech Association (AFPI). Prior to model estimation, unit root tests are conducted using the Augmented Dickey–Fuller (ADF) procedure to ensure that all variables are stationary at first differences. The presence of long-run relationships among the variables is then assessed using the Johansen cointegration test. When cointegration is confirmed, the VECM framework is applied to capture both short-run dynamics and long-run

equilibrium adjustments through the error correction term (ECT). Following model estimation, a series of diagnostic tests including tests for autocorrelation, heteroskedasticity, residual normality, and overall model stability are performed to ensure the robustness and reliability of the results. Additional analyses, such as Granger causality tests, impulse response functions (IRF), and forecast error variance decomposition (FEVD), are employed to further investigate the direction, magnitude, and dynamic impact of FinTech adoption on banking sector stability.

A. Cointegration Test

After confirming the stationarity of the data, the next step is to examine whether a long-run relationship exists between FinTech adoption and the stability of the banking sector. To this end, the Johansen cointegration test is employed. This test is designed to identify the presence of cointegration, which indicates a stable long-term equilibrium relationship among the variables included in the model.

B. VECM (Vector Error Correction Model)

The VECM is employed to capture both long-run and short-run relationships between FinTech adoption and banking sector stability. Within this framework, the model assesses whether FinTech adoption exerts a significant impact on banking stability in the long term, while simultaneously analyzing the short-term dynamics and adjustments that occur in response to deviations from the long-run equilibrium.

$$\Delta Y_t = \alpha + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \dots + \beta ECT_{t-1} + \epsilon_t$$

After constructing the VECM, the next step involves examining the direction of causality among the variables using the Granger causality test. This test aims to determine whether FinTech adoption influences banking sector stability or, conversely, whether banking stability affects the level of FinTech adoption. Once all models are estimated, the results from the VECM, cointegration test, and Granger causality analysis will be interpreted to elucidate the relationships between FinTech adoption and banking sector stability. The interpretation of these findings provides a comprehensive understanding of the impact of FinTech adoption on the stability of Indonesia's banking sector over the period 2018–2024.

RESULTS AND DISCUSSION

A. Stationary Test

Variabel	ADF t-Stat (Level)	Prob.	ADF t-Stat (First Diff)	Prob.	Kesimpulan
Outstanding Fintech	- 1.812	0.211	- 4.926	0.001	I(1) (Stasioner setelah diferensiasi)
NPL	- 2.142	0.134	- 3.988	0.014	I(1)
CAR	- 1.673	0.246	- 4.105	0.008	I(1)
PDB	- 1.321	0.300	- 5.345	0.000	I(1)

The results of the Augmented Dickey–Fuller (ADF) test indicate that all study variables Outstanding FinTech lending, NPL, CAR, and GDP are non-stationary at levels, as evidenced by t-statistics higher than the critical values and p-values greater than 0.05. For instance, Outstanding FinTech exhibits an ADF t-statistic of -1.812 with a p-value of 0.211, confirming non-stationarity at level. However, after first differencing, all variables become stationary, as indicated by ADF t-

statistics lower than the critical values and p-values below 0.05. For example, GDP shows an ADF t-statistic of -5.345 with a p-value of 0.000 after first differencing, demonstrating that the series is stationary and suitable for cointegration and VECM analysis.

B. Optimal Lag Selection

g	La	LogL	LR Stat	p-Value	AI C	S C	H Q
0		55.102	NA	NA	-	-	-
1		122.89	89.112**	0.00	-	-	-
	4		*	0	3.841	3.022	3.526
2		125.21	12.512**	0.04	-	-	-
	5			2	3.682	2.286	3.140
3		128.30	13.275*	0.08	-	-	-
	6			1	3.621	1.647	2.851
4		130.11	8.176	0.12	-	-	-
	4			9	3.512	0.960	2.515
5		132.00	7.921	0.14	-	-	-
	8			4	3.450	0.321	2.226

The results of the optimal lag test indicate that both the Akaike Information Criterion (AIC) and Hannan–Quinn (HQ) criteria recommend a lag length of 1, as they yield the lowest information values, whereas the Schwarz Criterion (SC) suggests a lag of 2. However, adding more than one lag is not statistically significant and reduces model efficiency. Therefore, considering both estimation accuracy and efficiency, and giving precedence to the AIC which is generally more sensitive for time-series data this study selects lag 1 as the optimal lag for the VECM analysis.

C. Johansen Cointegration Test

Hipotesis Nol (r)	Trace Statistic	Nilai Kritis 5%	Max-Eigen Statistic	Nilai Kritis 5%	Keputusan
r = 0 (tidak ada CI)	69.87	47.85	32.14	27.58	Tolak Ho
	5	6	7	4	
r ≤ 1	37.72	29.79	21.34	21.13	Tolak Ho
	8	7	6	1	
r ≤ 2	16.38	15.49	10.11	14.26	Tolak Ho
	2	5	9	4	
r ≤ 3	6.263	3.841	6.263	3.841	Tolak Ho

Based on the Johansen cointegration test results using the Trace Statistic and Max-Eigenvalue approaches, more than one significant cointegrating vector was identified among the variables Outstanding FinTech, NPL, CAR, and GDP. This is evidenced by test statistics exceeding the 5% critical values and p-values below 0.05 for ranks up to $r \leq 3$. Therefore, it can be concluded that a long-run equilibrium relationship exists among the variables, confirming the suitability of applying the Vector Error Correction Model (VECM) in this study.

D. Granger Causality Test

Hipotesis Kausalitas	F-Statistik	Probabilitas	Keputusan
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Fintech			
→ CAR	5.421	0.011	Diterima
Fintech			
→ NPL	1.942	0.158	Ditolak
Fintech			
→ PDB	4.273	0.034	Diterima
CAR →			
Fintech	0.772	0.389	Ditolak
NPL →			Lemah
Fintech	3.128	0.069	(marginal)
PDB →			Lemah
Fintech	2.856	0.082	(marginal)

The results of the Granger causality test indicate that FinTech adoption significantly influences CAR and GDP, with p-values of 0.011 and 0.034, respectively. This suggests that the growth of FinTech contributes to enhancing banks' capital resilience and stimulating economic activity. Conversely, no causal relationship was found from FinTech to NPL, nor from the other variables to FinTech, although NPL and GDP exhibit marginally weak effects ($p < 0.10$). These findings reinforce the role of FinTech as an exogenous variable exerting a significant impact on financial sector stability.

E. Short-Run VECM Results

Variabel Bebas	Δ CAR (Koef./p-val)	Δ NPL (Koef./p-val)	Δ PDB (Koef./p-val)
Δ Fintech(-1)	0.127 / (0.021)	0.038 / (0.167)	0.214 / (0.043)
Δ CAR(-1)	-	-0.012 / (0.745)	0.063 / (0.389)
Δ NPL(-1)	-0.026 / (0.414)	-	-0.017 / (0.597)
Δ PDB(-1)	0.184 / (0.032)	0.029 / (0.228)	-
ECT(-1)	-0.423 / (0.001)	-0.074 / (0.241)	-0.358 / (0.005)

The VECM estimation results indicate that, in the short run, FinTech adoption has a positive and significant effect on CAR and GDP, suggesting that increased FinTech activity can strengthen banks' capital resilience and stimulate economic growth. In contrast, no significant short-run impact of FinTech on NPL was observed. Furthermore, the error correction term (ECT) coefficients for CAR and GDP are negative and statistically significant, indicating the presence of a short-term adjustment mechanism toward long-run equilibrium at rates of 42% and 35% per period, respectively.

F. Long -Run VECM Result

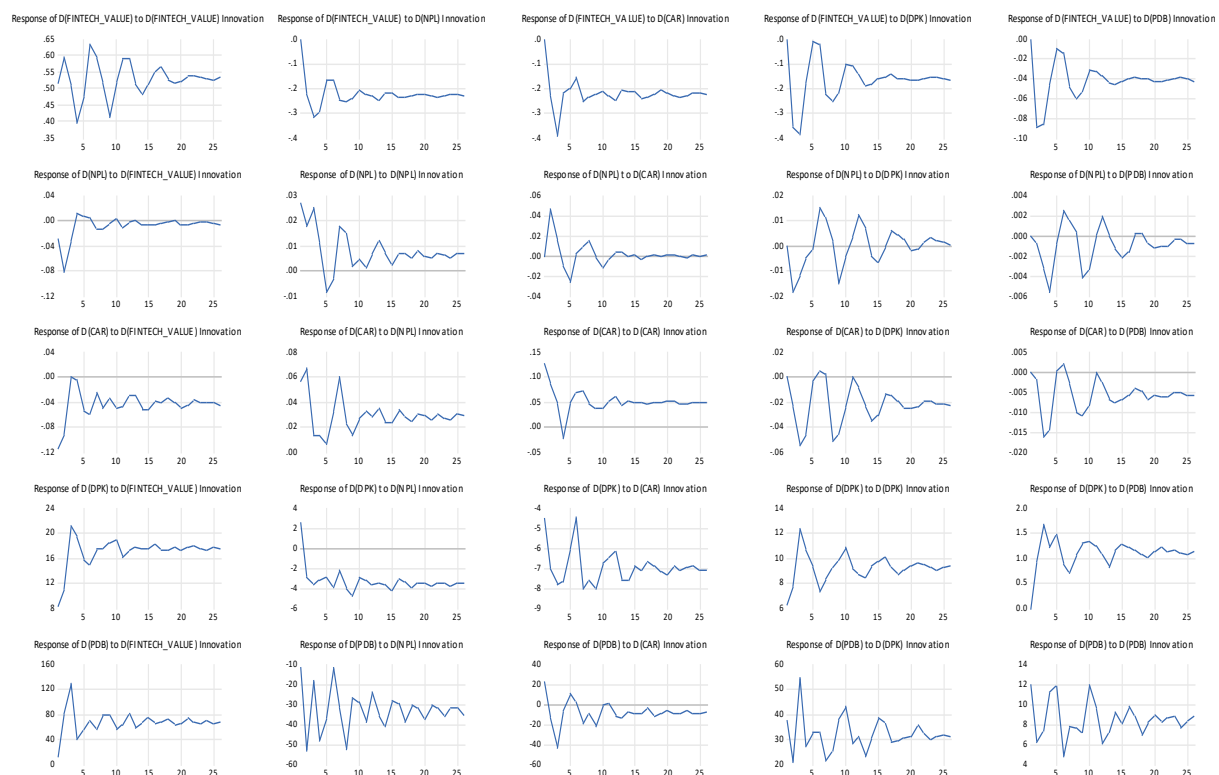
Hubungan Jangka Panjang	Koefisien	t-Statistik	Probabilitas	Signifikansi
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Fintech → CAR	0.735	2.941	0.006	Signifikan
Fintech → NPL	0.204	1.371	0.179	Tidak signifikan
Fintech → PDB	1.012	3.224	0.003	Signifikan
NPL → CAR	-0.098	-	0.412	Tidak signifikan
PDB → CAR	0.624	2.687	0.011	Signifikan

The long-run VECM estimation results indicate that Outstanding FinTech has a significant and positive impact on CAR and GDP, with coefficients of 0.735 and 1.012, respectively. This suggests that FinTech growth contributes to strengthening banks' capital base while supporting Indonesia's economic expansion. Additionally, GDP exerts a significant positive effect on CAR, highlighting a mutually reinforcing relationship between macroeconomic conditions and banking stability. However, the impact of FinTech on NPL, as well as the relationship between NPL and CAR, is not statistically significant, indicating that credit risk has not been directly affected by FinTech development in the long run.

Impluse Respenden

Response to Cholesky One S. D. (d.f. adjusted) Innovations



The figure presents the Impulse Response Function (IRF) results from the VECM, illustrating how each variable (CAR, NPL, GDP, and FinTech) responds to shocks originating from other variables within the system. Overall, the responses are most pronounced in the initial periods and gradually return to zero, indicating that the majority of the effects are temporary. Shocks from FinTech generate positive responses in both GDP and CAR, suggesting that FinTech growth promotes banking stability and economic activity in the short term. In contrast, responses to NPL shocks are relatively volatile and less stable. These results confirm the presence of dynamic

interactions among the variables and reinforce the VECM findings regarding both the short-run and long-run impacts of FinTech on the financial sector.

CLOSING

Conclusion

Based on the VECM analysis of data spanning 2018 to 2024, this study concludes that the development of financial technology (FinTech) has a significant impact on both banking sector stability and Indonesia's economic growth in the short and long term. In the short run, FinTech adoption positively and significantly contributes to the Capital Adequacy Ratio (CAR) and Gross Domestic Product (GDP), reflecting its role in strengthening banks' capital structures and supporting national economic expansion. Conversely, no significant effect is observed on Non-Performing Loans (NPL), indicating that credit risk has not been directly influenced by FinTech activity during the short-term period. In the long run, the findings reveal a positive and significant relationship between FinTech adoption, CAR, and GDP, suggesting a structural linkage between FinTech development and macroeconomic stability. The Johansen cointegration test confirms the existence of a long-term equilibrium relationship among the variables, reinforcing the suitability of the VECM approach in this study. Furthermore, the Granger causality test indicates that FinTech functions as an exogenous variable affecting other indicators, while remaining largely unaffected by CAR, NPL, or GDP. The Impulse Response Function (IRF) analysis corroborates these results, showing that responses to FinTech shocks are initially positive and gradually diminish over time. Additionally, the significant error correction term (ECT) highlights the presence of adjustment mechanisms toward long-run equilibrium. Overall, this study demonstrates that FinTech advancement plays a pivotal role in enhancing financial system resilience and promoting economic growth in Indonesia. Nevertheless, careful regulatory oversight is necessary to mitigate potential systemic risks, particularly in the management of credit risk.

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