Modern Finance

Modern Finance Institute

Article

Leverage, capital adequacy, and financial stability in the fintech industry: Evidence from Indonesia

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Abstract: The paper examined the influence of leverage and capital adequacy on fintech's financial stability in Indonesia. We utilize both quantitative and qualitative methods. The findings showed that leverage significantly constrained the financial stability of the fintech industry in the short run. Contrarily, capital adequacy has no significant effect on financial stability. Specifically, the qualitative results indicated that a high liability-to-asset ratio depressed the financial stability of the fintech industry. However, the influence of the asset-to-equity ratio on financial stability depends on asset quality, liquidity, and riskiness. Furthermore, the respondents noted the insufficiency of capital requirements in the fintech industry. Thus, fintech firms should focus on asset quality, while regulators should tighten capital regulation.

Keywords: fintech, z-score, leverage, financial stability, capital adequacy, ARDL, interview.

JEL Code: G23, G32, G28.

Citation: Baita, A. J., Bardiah, D., Suhail, S., Basalma, E. O. (2024). Leverage, capital adequacy, and financial stability in the fintech industry: Evidence from Indonesia. *Modern Finance*, *2*(2), 1-18.

Accepting Editor: Adam Zaremba

Received: 25 May 2024
Accepted: 13 July 2024
Published: 14 July 2024

1. Introduction

Indonesia has experienced a significant surge in financial technology (fintech) adoption over the past decade, driven by rapid digitization, increasing internet and smartphone penetration, and a growing young and tech-savvy population (Setiawan et al., 2021). Based on the "P2P Lending Statistics Report" issued by Indonesia's Financial Services Authority (OJK), the outstanding fintech loan recorded 23% year-on-year growth in February 2024, while the total number of borrowers reached 236,687 at the same time (OJK, 2024). This points to the buoyancy of the fintech landscape in the Indonesian financial architecture and signifies the growing acceptance and adoption of fintech lending solutions among borrowers in Indonesia. As Suryono et al. (2021) note, the significant growth in loan disbursement highlights fintech's role in providing alternative financing sources to under-served population segments.

Key players in the Indonesian fintech sector include established financial institutions and innovative startups. Banks and financial service providers have embraced fintech to enhance their digital offerings and reach a broader customer base (Harsono et al., 2024). At the same time, startups and technology companies have disrupted traditional financial services by introducing innovative products and services that cater to the evolving needs of consumers (Dkw & Awatara, 2018). As a result, digital payments remain one of the most significant segments within the fintech industry, with e-wallet providers such as

GoPay, OVO, and DANA gaining substantial market share (Koesworo et al., 2019). Peer-to-peer lending platforms like KoinWorks, Investree, and Modalku have also experienced rapid growth, facilitating access to credit for individuals and small businesses (Dkw & Awatara, 2018). Trends in fintech investment reflect the growing confidence and interest in Indonesia's fintech sector. Venture capital funding for fintech startups has increased, with notable investments in payment solutions, lending platforms, and Insurtech companies (Sawitri, 2021). This influx of investment capital has fueled innovation and expansion within the fintech ecosystem, driving competition and product diversity (Diniyya et al., 2021).

The Indonesian government has recognized the potential of fintech to drive financial inclusion and economic growth. OJK has been actively involved in discussions and collaborations with various stakeholders to support fintech development, provide regulatory guidance, and ensure a conducive environment for digital financial innovation (OJK, 2023). However, with the rapid growth and innovation in the fintech sector, concerns have emerged regarding the financial stability of companies operating in Indonesia. Factors such as regulatory compliance, risk management practices, cybersecurity threats, and market competition pose challenges to the long-term sustainability and resilience of fintech firms (Murinde et al., 2022)

Understanding and assessing the financial stability of fintech in Indonesia is crucial not only for regulatory authorities and policymakers but also for investors, consumers, and industry stakeholders. It requires a comprehensive analysis of the regulatory framework, technological advancements, risk mitigation strategies, consumer trust, and market dynamics that influence the overall stability of the fintech ecosystem. This background sets the stage for exploring the complexities and nuances of fintech's financial stability in Indonesia, highlighting the need for research and policy interventions to foster a healthy and robust fintech sector that contributes positively to the country's financial and economic development.

The paper identifies research gaps that necessitate the conduct of this research. First, existing studies have not adequately assessed the financial stability of fintech. Despite being a nascent area, Cevik (2024) notes emergent empirical research on the linkage between fintech and banks' financial stability; however, the findings remain mixed. Fintech studies focus on firm-level financial performance (e.g., Papadimitri et al. 2021). However, Papadimitriou et al.'s (2021) micro-level analysis offers limited policy insights for designing macroprudential policy. Second, fintech-stability studies tilt towards the fintech's efficacy on the banking industry in both developed and developing economies (e.g., Cevik, 2024; Nguyen & Dang, 2022; Sikalao-Lekobane, 2022). However, researchers relegated fintech's financial stability, whose financial instability could trigger a crisis in the financial system. Third, Sikalao-Lekobane (2022) acknowledges the criticality of formulating macroprudential guidelines for emerging nonbanking financial institutions such as the fintech industry. Such action should align with risk mitigation and financial stability, particularly for the fintech industry and its potential to pose system-wide risks. Fourth, we have not yet found research on the financial drivers of the fintech industry's financial stability in Indonesia despite the country's activeness in Southeast Asia's fintech hub. Hence, assessing the financial factors influencing fintech's financial stability at the industry level is necessary to uncover the baseline parameters and ensure its robustness. Expectedly, this effort will push the knowledge frontiers in Finance. More so, understanding the extent and drivers of fintech's stability will facilitate the adoption of early warning signals to protect the investors and other stakeholders in the industry. From the preceding background, the research objectives aim to assess the relationship between leverage and financial stability of Indonesia's fintech industry. In addition, it analyzed the relationship between capital adequacy and financial stability of Indonesia's fintech industry.

The study collected primary and secondary data related to the financial factors influencing the financial stability of the fintech industry. We collected secondary data that

provided quantitative information about financial stability, leverage, capital adequacy, firm size, and inflation. On the other hand, interviews were conducted to collect information about the respondents' views on the implications of financial and regulatory factors for the fintech firms' financial stability. Moreover, we employed quantitative and qualitative methods to complement and validate our findings. This is vital due to the paucity of quantitative data on financial stability and its financial drivers in Indonesia.

In summary, the quantitative findings revealed that leverage significantly inhibited the financial stability of the fintech industry, while capital adequacy was insufficient to upscale the financially stable fintech industry. Concerning control variables, inflation appeared to stifle financial stability, while firm size had varying effects. Based on the results of interviews, high leverage (liability-to-asset ratio) constrained financial stability in the fintech industry. However, the asset-to-equity ratio could enhance financial stability, provided the assets were liquid and less risky. All the respondents agreed that capital adequacy could improve financial stability; however, they contended that regulatory capital was insufficient. Thus, regulators should link capital regulation to the market dynamics and in proportion to firm size.

The research contributes to the empirics and practice of financial stability in the fintech industry. In the empirical literature, previous studies concentrated on the implications of fintech firms on the financial stability of the banking industry. In addition, previous research in the fintech space was preoccupied with the financial inclusion benefits of fintech firms and regulations and technological disruptions in the industry. This study investigated the financial factors influencing the fintech industry's financial stability. From a practical point of view, the study engaged practitioners and regulators in the industry to explore their experiences with financial stability in the fintech industry. This benefits fintech's practice by providing expert suggestions to scale up financial stability and draw the attention of regulators to strengthen capital and risk management regulations.

The research is composed of six parts, including an introduction. Sections 2 and 3 include a literature review and research methods, respectively. Sections 4 and 5 present, interpret, and discuss the quantitative and qualitative findings. Finally, Section 6 concludes the research, provides implications, and recommends further research directions.

2. Literature review

2.1. Theoretical literature

The theoretical literature on financial stability documented the importance of financial institutions for extending credit services to firms and consumers and effective risk management (Damane & Ho, 2024; Ajello et al., 2022). By converting short-term deposits into long-term loans, leverage could trigger financial instability for banks and other financial institutions. Despite assets outstripping liabilities, financial institutions remained susceptible to financial instability due to the illiquidity of short-term deposits (Ajello et al., 2022). According to Damane and Ho (2024), financial stability requires allocating resources and managing risk efficiently. They identified capital adequacy, quality of assets, high returns, liquidity position, and susceptibility to market risk as critical metrics for assessing the financial soundness of financial institutions.

2.2. Financial drivers of financial stability

Empirically, researchers have not paid considerable attention to the role of financial factors in influencing fintech's financial stability. However, Kharisma (2021) points to adequate capital reserves for absorbing losses and sustaining operations during financial downturns. It acts as a shock absorber, particularly during financial stress. In many jurisdictions, including Indonesia, regulatory bodies impose minimum capital requirements to safeguard the financial health of fintech firms (Kharisma, 2021). Likewise,

managing credit and operational risks is crucial for maintaining financial stability. In order to reduce default risk, Rosenblum et al. (2015) observe that lending-based fintech firms require a robust credit scoring system for assessing borrowers' creditworthiness. Again, economic conditions such as growth and inflation could significantly determine the fintech firms' financial stability (Agarwal et al., 2020). FinTech's potential risks and benefits on financial stability indicate the interconnectedness between macroeconomic stability and the emergence of financial technologies (Vučinić, 2020).

Macroprudential regulation can spur fintech development. Sikalao-Lekobane (2022) assesses the linkage between macroprudential policy and the fintech credit trajectory in twenty-five countries in advanced and advancing economies using quarterly data between 2005 and 2019. The findings establish that overall macroprudential regulation promotes the fintech industry. Specifically, lending-targeted regulation improves fintech credit; however, the borrower-based policy does not influence fintech growth. More so, tight macroprudential policy facilitates the development of the fintech industry since it reduces banks' lending capacity, while loose regulation does not.

Access to funding and risk management are crucial for the stability of the fintech industry. For access to funding, Baltgailis and Simakhova (2022) emphasize the need for financial support and investment in fintech companies to drive their growth and innovation, which includes venture capital, private equity, and other forms of investment. In Indonesia, factors such as digital funding and payment, government regulations, and communication infrastructure impact fintech development in Indonesia (Sartika et al., 2021). Similarly, effective risk management practices are crucial for maintaining financial stability. This includes managing credit risk, operational risk, and cybersecurity risk. For instance, peer-to-peer (P2P) lending platforms need robust credit scoring mechanisms to assess borrower creditworthiness and mitigate default risk (Rosenblum et al., 2015). Regarding fintech performance, Papadimitri et al. (2021) explore the effect of leverage on fintech's financial performance in the US by sampling 146 firms between 2000 and 2016. They establish the deleterious effect of leverage proxies on a firm's performance. However, firm size improves financial performance in the sample firms. The results remain robust after employing risk-weighted return on assets as the alternative dependent variable.

Another strand of literature analyzes the linkage between fintech and banking financial stability. The most recent literature is Cevik's (2024) research, which examines the role of fintech in driving overall financial stability using global datasets spanning 2012 and 2020. The results uncover the insignificant negative effect of fintech on financial stability. Furthermore, the author segregates the sample countries into developed and developing. The findings show that fintech promotes financial stability in the developed world while it depresses stability in the developing block. However, neither result is statistically significant. Similarly, Nguyen and Dang (2022) analyze the repercussions of fintech on banking stability in Vietnam by covering the 2010-2020 period. They document the significant adverse effects of fintech on Vietnamese banking stability at both firm and country levels. Likewise, bank size significantly decreases banking stability at the corporate level. Related research by Sikalao-Lekobane (2022) finds an insignificant effect of fintech credit on bank risk-taking indicators (z-score and portfolio risk), while bank size significantly decreases financial stability. The author uncovers the non-linear effect of fintech on bank risk-taking. Fintech increases banking risk in the short term but reduces bank risk in the long term as banks collaborate with the fintech industry.

Furthermore, financial stability analysis in the banking industry can provide lessons for the fintech industry. In this regard, Benbouzid et al. (2022) analyzed seventy banks across twenty-five countries between 2010 and 2019. The findings demonstrate that a higher capital ratio and lower leverage promote a stable banking system. Ali et al. (2019) analyze the financial risk-stability connection by focusing on 24 Pakistani Islamic and conventional banks from 2007 to 2015. The results reveal the influence of bank size, liquidity risk, funding risk, and low corruption levels on banks' financial stability. In

contrast, credit risk hurts bank stability. Similarly, Saif-Alyousfi and Saha (2021) focus on Islamic and conventional banks in the GCC region covering 1998-2017. Both capital adequacy and bank size appear to improve banking stability.

Furthermore, AlKhouri and Arouri (2019) investigate the impact of diversification on banks' financial stability. They implemented a two-step system GMM to explore 69 Islamic and conventional banks in the GCC from 2003 to 2015. The results show that asset diversification and efficiency improve bank stability in the GCC market. In contrast, bank growth negatively affects bank stability. Mokni et al. (2016 they investigated the determinants of insolvency risk in Islamic and conventional banks in MENA throughout 2002-2009. The researchers employ a panel model, including system GMM, to address endogeneity problems and use the Z-score as the dependent variable. They establish that higher equity capital reduces risk-taking for both conventional and Islamic banks, though the effect is insignificant for Islamic banks. Inflation also has an impact on banks' insolvency risks. Besides banking, Abraham (2024) examined the implication of leverage on firms' earnings in India by covering the 2008-2023 period. The findings established that the liability-asset ratio (leverage) significantly reduces firms' total earnings, thus constraining firms' performance. Following the preceding discussion, we developed the following research hypotheses concerning the fintech industry.

H1: Leverage significantly affects the financial stability of the fintech industry.

H2: Capital adequacy improves the financial stability of the fintech industry.

2.3. Other non-financial factors influencing financial stability of fintech

According to Kharisma (2021), regulatory compliance is a fundamental determinant of financial stability for fintech companies. Adhering to regulations helps fintech firms operate within legal boundaries, mitigating risks associated with regulatory breaches. (2015) observe that adhering to regulations by fintech firms could affect their financial stability. Additionally, cybersecurity measures are vital to protect against data breaches and cyberattacks, which can have severe financial and reputational repercussions (Venkatachary et al., 2017).

Furthermore, continuous innovation and the adoption of advanced technologies contribute to the financial stability of fintech companies. Innovative solutions can improve operational efficiency, enhance customer experience, and create competitive advantages. For example, as a form of financial technology, fintech utilizes various technological tools and innovations to offer various services, including payment systems, peer-to-peer lending, investment management, and crowdfunding. The regulatory framework established by the Central Bank of Indonesia (BI) and the Financial Services Authority (OJK) aims to encourage innovation in the financial sector while ensuring consumer protection and risk management (Al-Araj et al., 2022). In addition, competition within the fintech sector also affects financial stability. Fintech companies must balance competitive pressures with sustainable business practices to ensure long-term financial health. Strategic partnerships and collaborations can help mitigate competitive risks and create synergies that enhance stability (Klus et al., 2019).

3. Data and methods

The study utilized both qualitative and quantitative methods to achieve the research objectives. The quantitative method employed an autoregressive distributed lag model. In contrast, the qualitative method adopted semi-structured interviews to elicit the participants' responses based on their experiences in the fintech industry.

3.1. Quantitative method

3.1.1. Data and variables

The researchers collected fintech data from OJK (Indonesia's Financial Services Authority). The data provided information related to lending, borrowing, financial

statements of the fintech industry, provincial distribution of outstanding loans, number of loan accounts, number of borrowers, amount borrowed, and other relevant financial metrics. The study sample covered 34 periods spanning from May 2021 to February 2024. The sampling technique was based on non-probability sampling. Data availability determined the sample size. Besides, the variables of interest comprised financial stability measures, leverage indicators, capital adequacy ratio, fintech size, and inflation. Following the work of Saif-Alyousfi and Saha (2021), we adopted two proxies of financial stability using the z score. These indicators are computed as:

$$Financial\ Stability1\ = \frac{ROA+\ CAR}{\sigma ROA}, \quad \text{Financial Stability2} \ = \frac{ROE+\ CAR}{\sigma ROE} \qquad [1]$$

In addition, we compute three measures of leverage using assets, liabilities, and equity. Following Benbouzid et al. (2022), we adopted the liability-to-asset ratio and asset-to-equity ratio as proxies of leverage. Another related variable was the capital adequacy ratio. Likewise, the size of the fintech industry is captured by total assets, while the monthly change in the consumer price index represents the inflation rate. Table 1 summarizes the research variables.

Table 1. Variable measurements

Variable	Measurement	Source
Financial Stability1	It is the sum of the return on asset and capital asset ratio divided by the standard deviation of return on asset (in log).	Saif-Alyousfi & Saha (2021)
Financial Stability2	It is the sum of return on equity and capital-asset-ratio divided by the standard deviation of return on equity (in log).	Saif-Alyousfi & Saha (2021)
Leverage 1	This is the ratio of liabilities to assets.	Benbouzid et al. (2022)
Leverage 2	This is the ratio of assets to equity.	Benbouzid et al. (2022)
Capital adequacy	It is defined as the ratio of equities to assets.	Saif-Alyousfi & Saha (2021)
fintech size	It is the total assets converted into a log form.	Original data from OJK
Return on asset	Net income as a ratio of asset	OJK
Return on equity	Net income as a ratio of equity	OJK
Inflation	Percent change in consumer price index	BPS-Statistics Indonesia

3.1.2. Model specification

This study employed an autoregression distributed lagged model (ARDL) following Nsor-Ambala & Amewu (2023), who applied ARDL to uncover the finance innovation-growth trajectory in the Ghanaian economy. Accordingly, they observed the persistent efficiency of ARDL even when the sample size was small. Equation 1 presented the ARDL model given the p lag of dependent variables (FS1 and FS2) and the q lag of explanatory variables.

$$FS_t = \alpha_0 + \sum_{i=1}^{p} \beta_i LEV_{t-i} + \sum_{i=0}^{q_1} \delta_i CAR_{t-i} + \sum_{i=0}^{q_2} \gamma_i FSZ_{t-i} + \sum_{i=0}^{q_3} \rho_i INF_{t-i} + \varepsilon_t, \qquad [2]$$

where q stands for the lag length of the explanatory variables LEVERAGE(LEV), Capital Adequacy (CAR), Firm Size (FSZ), and Inflation (INF). We applied automatic lag selection using EViews version 13.

In order to test for the existence of long-run equilibrium, we conducted an ARDL bound test, as expressed in Equation 3.

$$\Delta FS_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta LEV_{t-i} + \sum_{i=0}^{q} \delta_i \Delta CAR_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta FSZ_{t-i} + \sum_{i=0}^{q} \rho_i \Delta INF_{t-i} + \tau_1 \Delta FS_{t-1} + \tau_2 \Delta LEV_{t-1} + \tau_3 \Delta CAR_{t-1} + \tau_4 \Delta FSZ_{t-1} + \tau_5 \Delta INF_{t-1} + \varepsilon_t, \qquad [3]$$

where τ_1-τ_5 estimates the short-run dynamics, and β_i, δ_i, γ_i, and ϱ_i estimate the long-run relationship. Equation 4 also shows the error correction model.

$$\Delta FS_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta LEV_{t-i} + \sum_{i=0}^{q} \delta_i \Delta CAR_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta FSZ_{t-i} + \sum_{i=0}^{q} \rho_i \Delta INF_{t-i} + \tau ECT_{t-1} + \varepsilon_t, \quad [4]$$

where ECT represents the error correction term, and τ indicates the speed of adjustment.

3.2. Qualitative method

To complement the quantitative method, we utilized the qualitative method using semi-structured interviews. The adoption of interviews in investigating the financial development of lending institutions such as banks and fintech aligns with previous studies (e.g., Umar et al., 2020; Yumna, 2019). We collected primary data by interviewing six (6) respondents who have practical experiences in fintech companies and regulatory agencies. Following Hamadou et al. (2024) work, we manually tabulated and analyzed the data collected. The interviews were conducted in June 2024. The study selected the interviewees based on their industry, regulation, and research expertise in fintech. Hence, three respondents occupied managerial positions and worked in Amartha and Qazwa fintech companies. Two respondents worked in the regulatory agencies (OJK and Bank Indonesia), while one interviewee was a university lecturer.

4. Quantitative results

4.1. Descriptive statistics

Table 2 replays the summarized reports of the variables' averages and standard variability. This consists of the arithmetic mean, standard deviation (SD), and minimum and maximum values.

Table 2. Summary statistics

Variable	CODE	Mean	SD	Min.	Max.
Financial Stability1	FS1	14.56	1.26	12.57	17.46
Financial Stability2	FS2	7.78	0.20	6.31	9.50
Leverage 1	LEV1	0.46	0.05	0.39	0.55
Leverage 2	LEV2	0.00	0.00	0.00	0.00
Capital adequacy	CAR	0.54	0.05	0.45	0.61
fintech size	FSZ	3.73	0.10	3.60	3.88
Inflation	INF	0.28	0.31	-0.21	1.17

Source: Authors' computation using E-Views 13.

From Table 2, FS1 is 14.56, implying higher fintech financial stability concerning ROA. It has minimum and maximum values of 12.57 and 17.46, respectively. The mean of FS2 is about half of FS1, reflecting the lower ROE relative to ROA. However, FS2 has a lower SD than FS1, which shows a low variability of ROE. The mean value of LEV1 is 0.46, with a 0.05 standard deviation, while the mean LEV2 is nearly zero. Furthermore, CAR, FSZ, and INF have 05.4%, 3.73, and 2.8% averages, respectively.

4.2. Unit Root Tests and ARDL Results

The research employed breakpoint unit root tests, and Table 3 presents the results. Table 3 shows that all the dependent variables (FS1 and FS2) are nonstationary at level; their p-values are more significant than 0.05. Nevertheless, their p-values are less than 0.01 each at the first difference, indicating that they are first differenced stationary. Similarly, FSZ is differenced stationary as its significance is below 0.01 at the first difference. Among the independent variables, LEV1 and CAR are stationary at level, while LEV2 is first-order stationary. INF is also stationary at the level, with its significance level falling below 0.01. Based on the unit root results, we can proceed and conduct the ARDL model because none of the variables is stationary beyond the first difference, and all the dependent variables are stationary at the first difference.

Table 3. Results of breakpoint unit root test

Variable	Level		First Diff.		Integration
	t-statistic	P-value	t-statistic	P-value	
FS1	-3.533	0.369	-6.253***	<0.01	I(1)
FS2	-2.791	0.792	-6.156***	<0.01	I(1)
LEV1	-4.829**	0.016			I(0)
LEV2	-2.417	0.923	-6.947***	<0.01	I(1)
CAR	-4.828**	0.016			I(0)
FSZ	-2.225	0.960	-5.826	<0.01	I(1)
INF	-6.923***	<0.01			I(0)

Note: ***, ** & * shows 1, 5, and 10 percent significance levels, respectively. Source: Authors' computation using E-Views 13.

The authors computed the short-run relationship to determine the effect of LEV and CAR on fintech's financial stability (FS). The goal was to determine if LEV and CAR matter for financial stability in Indonesia's fintech industry. However, we did not examine the long-run results due to the short-term nature of the available data. Table 4 presents the results of the short-run analysis.

Table 4. Short-run relationship

	Dependent Variable: FS1		Dependent Variable: FS2	
Variables	1	2	3	4
FS(-1)	0.50***	0.53***	0.48**	0.50***
FS(-2)	-0.85***	-0.96***	-0.72**	-0.95***
FS(-3)	0.76***	1.16***	0.70***	1.18***
LEV1	-48.40		-53.29	
LEV1(-1)	-256***		-546***	
LEV1(-2)	-121*		-256	
LEV1(-3)	1.16***		1.46***	
LEV2		-552		-647
LEV2(-1)		252		160
LEV2(-2)		320		1709
LEV2(-3)		-1488***		-3753***
CAR	-47.90	-0.82	-53.04	-1.30
CAR(-1)	-256***	0.42	-546***	0.38
CAR(-2)	-121*	1.57	-255	4.90
CAR(-3)		-5.31***		-11.52***
FSZ	-0.50***	-1.99	-0.77**	-2.58
FSZ(-1)	0.25*	1.14	0.33	1.21
FSZ(-2)	0.47***	1.35	0.85**	5.49*
FSZ(-3)	-0.42***	-4.70***	-0.80***	-11.48***
INF	-0.01*	-0.00	-0.01	-0.00
INF(-1)	-0.02***	-0.01*	-0.03***	-0.01
INF(-2)	-0.01***	-0.01**	-0.02*	-0.02**
INF(-3)	-0.02***	-0.02**	-0.03	-0.04***
Adj. R^2	0.98	0.97	0.94	0.95
F-stat.	87.44***	69.46***	29.17***	31.27***

Note: ***, ** & * shows 1, 5, and 10 percent significance levels, respectively. Source: Authors' computation using E-Views 13.

From the results of Table 4, the lagged values of financial stability significantly influence the current period of financial stability measures up to three months. The first and third lagged values of FS positively affect the current financial stability, while the

lagged value for the second month decreases FS. Despite little variations in the size of their coefficients, the results remain consistent across the two proxies of FS. In columns [1] and [3], LEV1 has an insignificant negative effect on FS1 and FS2, while its first lag significantly constrains FS1. Besides, the second lag of LEV1 has significant and insignificant depressing effects on FS1 and FS2, respectively. However, the third leg is positively significant in influencing FS1 and FS2. Similarly, CAR decreases FS1 and FS2, though it is significant in the first and second lags for FS1 (column [1]) and the first lag of CAR in column [3].

In columns [2] and [4], we replaced LEV1 with LEV2 to examine its repercussions on the financial stability of FS1 and FS2. The results revealed insignificant effects of the asset-to-equity ratio (LEV2) on financial stability for the current, first, and second lagged values, respectively. Although the third lagged LEV2 is negatively significant, the overwhelming evidence shows no connection between LEV2 and FS1 and FS2. The same results hold for CAR, which has no significant influence on FS1 and FS2 except in the third lagged values.

Considering the control variables, overwhelming evidence confirms the inhibiting effect of FSZ on FS1 and FS2. The current and third lagged values indicate a significant constraining effect of FSZ on financial stability, while the second lagged values show consistently significant positive implications for financial stability. Likewise, current as well as lagged values of INF have a deleterious influence on FS in the fintech industry. This implies that INF risks the financial stability of fintech in Indonesia.

More so, we conduct the Wald test to confirm if the short-period coefficients, alongside their lagged values, are jointly significant in influencing FS. Table 5 summarizes the results of the Wald test.

Table 5. Wald test

	Dependent Variable: FS1		Dependent Variable: FS2	
Variable	Chi2	Chi2	Chi2	Chi2
FS	53.46***	64.04***	37.19***	19.66***
LEV1	131.06***		83.55***	
LEV2		7.07***		8.69***
CAR	34.83***	11.82***	28.60***	12.24***
FSZ	45.16***	8.09***	25.95***	10.12***
INF	42.39***	7.15***	21.54***	5.14**

Note: ***, ** & * shows 1, 5, and 10 percent significance levels. Source: Authors' computation using E-Views 13.

Table 5 shows that the lagged values of FS are jointly significant in influencing the current FS for all the models. In addition, each explanatory variable and its lagged values are statistically significant in explaining FS. The findings remain significant in all the two models (FS1 and FS2) using different indicators of LEV (LEV1 and LEV2).

Furthermore, we conduct a stability test using the CUSUM test. If the blue line is within the upper and lower bounds, the model is said to be stable. Because we applied research models, we present the results of the CUSUM test in Figures 1 and 2 for FS1 and FS2, respectively.

The Figures 1-2 results show that both models were stable as the blue lines neither exceeded the upper bounds nor fell short of the lower bounds.

Figure 1. Cusum test for the FS1 model

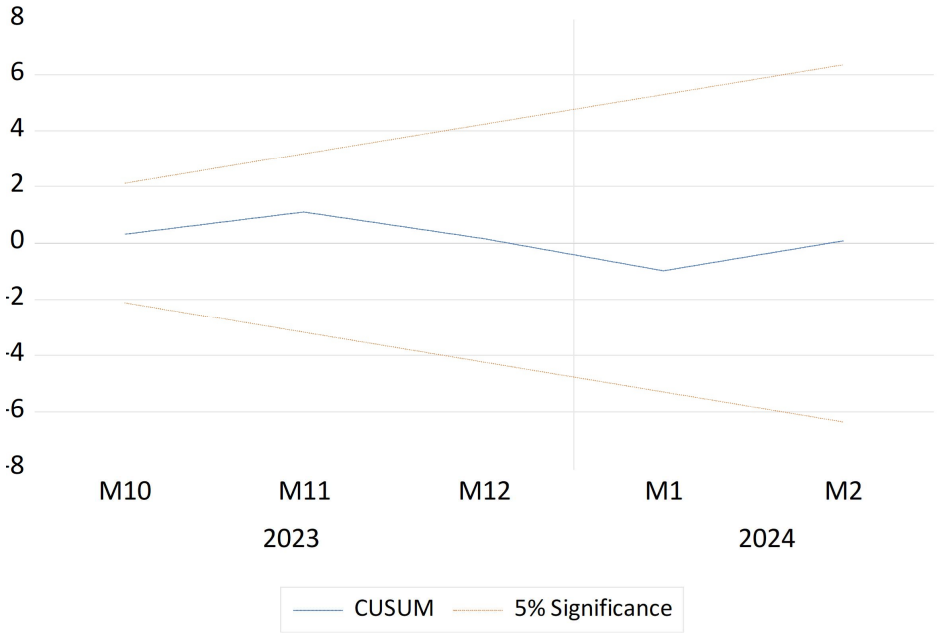

Figure 2. Cusum test for the FS2 model

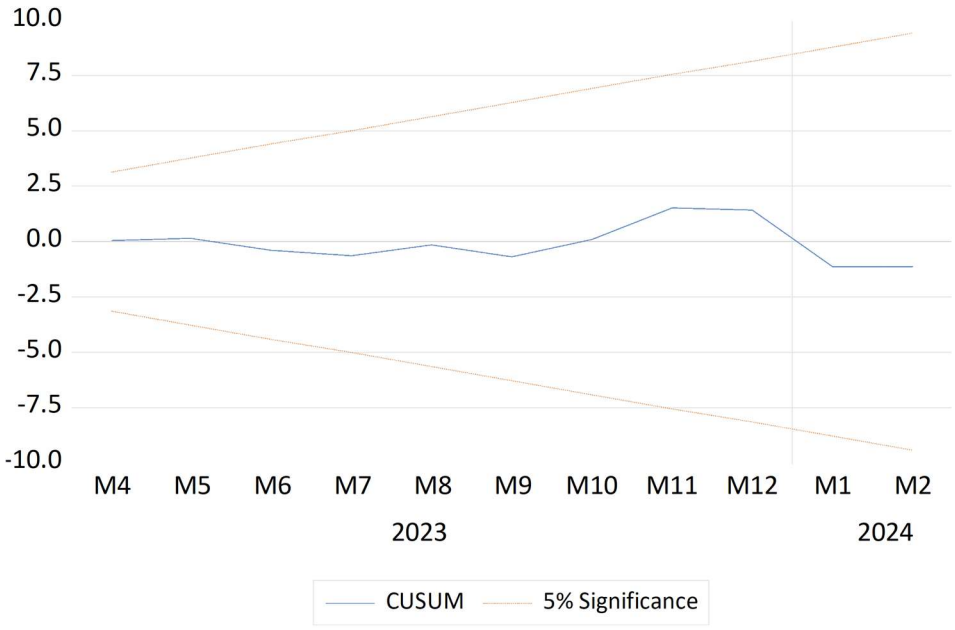

Table 6 presents the diagnostic testing results for the two models to ensure the ARDL model's robustness.

Table 6. Diagnostic Testing

Diagnostic Test	Statistics	1	2	3	4
Omitted variable	t-stat.	4.74***	1.03	0.720	1.678
Serial correlation	F-stat.	0.066	1.397	0.042	1.77
Heteroscedasticity	F-stat.	1.502	1.309	1.426	2.07
Normality	Jarque-Bera	0.534	0.651	0.923	0.58

Note: ***, ** & * shows 1, 5, and 10 percent significance levels, respectively. Source: Authors' computation using E-Views 13.

The diagnostics results in Table 6 reveal that all the statistics are insignificant for Models 1 and 2. With the exception of t-statistics in column [1], the other three t-statistics for the omitted variable test prove that the models do not suffer misspecification. Based on the serial correlation test, the F statistics are insignificant, indicating the non-existence of serial correlation in the models. More so, the heteroskedasticity tests confirm the homoscedasticity and constant variance. Finally, the Jarque-Bera tests indicate that the residuals are normally distributed.

5. Qualitative results

We interviewed six respondents with expert opinions regarding the Indonesian fintech industry to complement the quantitative results. Table 7 shows the respondents' profiles regarding educational level, nature of work (division), work experience (in years), and position occupied. In addition, the respondents are coded from R1 to R6.

Table 7. Profile of the respondents

Code	Education	Specialization	Division	Experience	Position
R1	MBA	Finance	Strategic Planning	4	Team Business Partner
R2	Masters	Computer science	Product Development	4	Head of Product
R3	Masters	Economics	Risk Management	5	Risk Officer
R4	PhD.	Finance	Financial Regulation	5	Financial Supervisor
R5	Masters	Economics	Monetary Policy	5	Economist
R6	PhD.	Financial Technology	Academic	5	Lecturer

Source: Interview data.

Table 7 shows three categories of respondents: fintech practitioners, regulators, and academics. The first three respondents are staff of fintech firms; the fourth and fifth respondents work in financial regulatory agencies, and the sixth respondent is an academic and researcher specializing in fintech. Four respondents hold master's degrees, while the other two have PhD.

5.1. Level of financial stability of the fintech industry

We asked the participants about the industry's overall financial stability. The respondents believed the industry had been on a stable path; however, all the interviewees identified regulatory challenges as the impediments to its financial stability. Here, we report three respondents' responses associated with risk management and policy.

> The fintech industry in Indonesia is stable but remains susceptible to economic shocks and regulatory changes due to its relatively young age. As the industry grows, it is crucial to establish robust financial frameworks and risk management practices to ensure long-term stability (R3).

> The fintech industry in Indonesia has shown commendable growth and a reasonable level of stability. However, it is crucial to recognize that the industry is still evolving, and with this rapid growth comes the need for stringent regulatory oversight to prevent potential systemic risks (R4).

> The fintech industry in Indonesia is promising and holds a vast potential for stability. However, being in its early stages, it is susceptible to market and regulatory fluctuations. As the industry matures, a robust regulatory framework will be essential to maintaining and enhancing stability (R5).

Besides, there was unanimity that financial stability was at the infant stage because the industry was evolving.

5.2. Capital requirements and financial stability of the fintech industry

The respondents viewed the current state of capital requirement as the bare minimum; regulators must design capital requirements for fintech companies that incorporate the industry's financial stability. To achieve this, they should link capital regulation with the dynamics of the fintech industry.

> While the existing capital requirements provide a solid foundation, they must evolve in tandem with the industry's rapid growth (R1).
>
> The current capital requirements are a decent starting point but insufficient (R2).
>
> While the current capital requirements provide a solid foundation, they need to evolve in tandem with the industry's rapid growth. I am not entirely satisfied with the current capital requirements. They provide a baseline, but as the industry diversifies, the requirements must be more specific to cater to the different risk profiles of various fintech segments. This is not just a recommendation but necessary to ensure financial stability across the board (R3).
>
> The current capital requirements are a good start but must be more nuanced and adaptive (R4).
>
> The capital requirements are a positive step, but they need to be more flexible and adaptive to cater to the diverse nature of fintech firms (R5).
>
> The current capital requirements are a good foundation but must be more dynamic and specific to different fintech sectors. A more tailored approach would ensure that all industry segments are adequately covered and financially stable (R6).

In addition, most respondents believed that the current capital regulation is insufficient for achieving financial stability in the industry. They believe the capital requirement should reflect the fintech size and risk profile.

> Fintech firms are diverse, ranging from small startups to large, established companies, and a one-size-fits-all approach to capital requirements may not be sufficient. Tailored regulations considering each fintech firm's size, scope, and risk profile would be more effective in ensuring financial stability (R1).
>
> Different types of fintech companies have varying needs and risk profiles, and the regulations should reflect this diversity. For example, a peer-to-peer lending platform may face different risks than a digital payment service, and the capital requirements should be adjusted accordingly (R2).
>
> Different fintech sectors have varying levels of risk, and the capital requirements should reflect these differences to ensure comprehensive financial stability (R4).
>
> Each industry segment carries different risk levels, and the requirements should reflect these variances to ensure a more stable financial environment (R5).

5.3. Leverage and financial stability of the fintech industry

There are two categories of leverage: liabilities to assets-and asset-to-equity ratio. Regarding the liability-asset mismatch, the participants opined that accumulating more liabilities could stifle the financial stability of fintech firms.

> The accumulation of more liabilities relative to assets significantly impacts financial stability. High liabilities can strain a company's finances, especially if sufficient and high-quality assets do not back these liabilities. This imbalance can lead to liquidity issues and undermine investor confidence, which is crucial for the long-term sustainability of fintech firms (R1).

> An imbalance where liabilities outstrip assets can be pretty detrimental to financial stability. If not managed correctly, this scenario can lead to liquidity crunches and even insolvency. It underscores the importance of maintaining a healthy balance sheet and having adequate liquidity reserves to meet short-term obligations (R2).

> When liabilities accumulate faster than assets, it can strain financial stability significantly. High liabilities can lead to liquidity crises and undermine investor confidence, which is vital for the continued growth and stability of fintech firms (R3).

> High liabilities relative to assets can pose significant risks to financial stability. It can lead to liquidity issues and increased vulnerability to economic shocks. Hence, maintaining a balanced and healthy ratio of assets to liabilities is essential (R4).

> An accumulation of liabilities that outpaces assets can significantly compromise financial stability. Fintech firms must maintain a healthy balance between their liabilities and assets to prevent liquidity crises and ensure long-term stability (R5).

> It is accumulating liabilities faster than assets can significantly undermine financial stability. If not appropriately managed, it creates a precarious financial position, leading to liquidity issues and potential insolvency. This highlights the importance of maintaining a balanced and prudent financial structure (R6).

Accumulation of more considerable assets relative to equity does not guarantee financial stability. This is partly dependent on asset quality, riskiness, and liquidity. All the respondents believed that accumulating liquid and less risky assets facilitates financial stability in the fintech industry. Here, we reported selected respondents' views.

> […] nature and liquidity of these assets play a critical role. If the assets are liquid and can be easily converted to cash without significant loss of value, they provide a cushion against financial shocks. Conversely, despite being sizeable, illiquid or high-risk assets can exacerbate financial instability (R1).

> Fintech firms with larger assets than equity are not necessarily more stable. Their stability depends on the quality and liquidity of their assets. High-quality, liquid assets can buffer during financial distress, whereas illiquid or speculative assets can exacerbate risks (R2).

> Firms with substantial assets relative to equity can be more stable if these assets are of high quality and liquidity. The ability to convert assets to cash quickly without significant loss in value is a crucial determinant of financial stability (R5).

The results show that financial stability depends on the type of leverage. High liability relative to assets constrains financial stability even though most fintech firms engage in lending transactions. In contrast, more considerable assets relative to equity promote financial stability provided the assets are of high quality, liquid, and low risk.

5.4. Firm size and financial stability of the fintech industry

The size of fintech firms could imply their financial stability. Large fintech firms are more financially stable than their small counterpart are. All respondents observed this claim based on their practical experiences in the Indonesian fintech industry. Big size confers fintech's ability to leverage economies of scale, attract investment, and strategize risk management effectively.

> Big-sized fintech firms generally tend to be more financially stable than smaller ones. Larger firms benefit from economies of scale, better access to capital markets, and more comprehensive risk management frameworks (R1).

> Larger fintech firms tend to be more stable, primarily due to their ability to leverage economies of scale and attract more substantial investment. They also typically have more resources to invest in advanced risk management systems and compliance measures (R2).

> Generally, larger fintech firms are more stable due to their ability to attract significant capital and implement comprehensive risk management strategies (R3).

> Larger firms tend to be more stable due to their extensive resources and access to capital (R4).

> Typically, larger fintech firms exhibit more excellent stability due to their resource base and ability to manage risks more effectively (R5).

> Generally, larger fintech firms tend to be more stable due to their access to resources and advanced risk management capabilities (R6).

Notwithstanding the benefits of considerable size, small firms could enhance financial stability if they adopt robust financial risk management strategies, develop innovative business models, and focus on niche markets.

> […] Small firms with innovative solutions and agile management can achieve financial stability if they operate within well-defined niches and maintain solid financial practices (R2).

> […] small firms can also achieve stability if they focus on niche markets and maintain robust financial practices (R3).

> […] It is also vital for small firms to focus on robust risk management practices and financial prudence to achieve stability (R4).

> […] Small firms with innovative business models and solid financial practices can also achieve stability in their specific niches (R5).

> […] Small firms can also achieve financial stability by focusing on niche markets and maintaining strong financial practices and innovation (R6).

5.5. Risk management practices and financial stability of fintech industry

Financial stability is incomplete without sound risk management. Fintech firms adopt different risk management strategies. There are leaders and laggards. A firm's financial stability depends on the sophistication of its risk management practices. Leaders in the fintech industry conform to risk management best practices, which enhance financial stability. However, the risk management practices of laggards are not robust enough to maintain financial stability. Thus, we reported selected responses from practitioners, regulators, and academics.

> Risk management practices in the fintech industry are diverse. Leading firms have developed sophisticated risk management frameworks, while others lag. There is a need for industry-wide standardization and continuous improvement in these practices to ensure overall financial stability (R2).

> The risk management practices in the fintech industry are improving but need to be more comprehensive. Firms must adopt more sophisticated risk management frameworks to align with global standards and ensure long-term stability (R4).

> Risk management practices in the fintech industry are pretty varied. Leading firms have developed robust frameworks, but there is still a significant need for industry-wide improvements. Ensuring all firms adhere to high-risk management standards is essential for overall financial stability (R6).

5.6. Existing regulations

Regarding the implication of the existing regulatory framework for a stable financial environment, the respondents revealed that the regulations were soundly based on the national financial regulatory landscape. However, they contended that regulations should be dynamic and adjustable to keep pace with market and technological trends. To ensure dynamic regulations, regulators and market players should promote collaboration to reflect the interests of investors, managers, employees, and customers. We reported the views of two regulators in this respect.

> The current regulations are effective but must be continuously updated to keep pace with technological advancements and emerging risks. Collaborative efforts between regulators and industry stakeholders are crucial for developing sound regulatory frameworks (R4).

> The existing regulatory frameworks are robust but need continuous refinement to address the rapid changes in the fintech landscape. Regular updates and stakeholder engagement will maintain effective regulations (R5).

5.7. Other factors

We asked the respondents to identify other financial and non-financial factors that may aid financial stability in the Indonesian fintech industry. First, we presented the responses based on a financial perspective. Three respondents identified access to funding as a critical financial factor for promoting financial stability.

> Other critical factors that support financial stability include improved access to diverse funding sources […] (R1).

> […] improved access to funding, … are crucial for financial stability (R3).

> […] improved access to diverse funding sources…are vital for financial stability (R4).

Non-financial perspectives for enhancing financial stability include cybersecurity, internal control, investor and customer protection, innovation, and transparency.

> Critical factors that support financial stability include strong investor confidence, comprehensive cybersecurity measures, and robust consumer protection laws. […] fostering a culture of innovation … can significantly contribute to the industry's stability (R2).

> Critical factors include enhanced cybersecurity measures … improved financial infrastructure, and more robust investor protection laws. Additionally, fostering a culture of innovation…can contribute significantly to the industry's stability (R5).

> Factors such as enhanced investor confidence and robust cybersecurity measures…are crucial for financial stability. Fostering a culture of innovation while maintaining stringent financial and ethical standards can significantly contribute to the industry's long-term success and stability (R6).

6. Conclusions

The study investigated the financial drivers of financial stability in Indonesia's fintech industry by applying the ARDL model and conducting interviews. The quantitative results showed that leverage stifled financial stability, while capital adequacy had no significant influence on financial stability. In contrast, fintech size and inflation inhibited financial stability. The qualitative findings indicated that liability-based leverage would depress stability by constraining liquidity in the industry. In contrast, asset-based leverage would support stability, provided the assets were liquid and less risky. In addition, capital requirements facilitate financial stability; however, the current capital regulations are insufficient to ensure financial stability in the fintech industry.

Thus, financial regulators should monitor capital and leverage to ensure a stable fintech industry. Tight capital regulation and higher capital requirements are needed as the industry matures. In addition, regulators should monitor the leverage level to avoid excessive liability accumulation in the long term. This is envisaged to strengthen stability in the industry. Besides, fintech firms should improve asset quality and liquidity and reduce risks to achieve financially stable business operations.

The research limitation lies in the availability of the data. Although OJK publishes monthly reports on the fintech industry, the period is too short to conduct quarterly data analysis. As a result, we used a monthly time series for 34 months and combined quantitative and qualitative analyses to enhance the research findings. Hence, we recommend three areas for further research. First, future research should explore the determinants of fintech financial stability at the firm level as the data becomes available. Second, researchers should pay attention to the risk management practices of fintech firms in order to uncover their ability to adopt risk management best practices. Third, researchers should explore the implication of access to financing for fintech's financial stability at the firm level or industry-wide.

Author Contributions: Conceptualization, A.J.B, D.B. and E.O.B; methodology, A.J.B.; software, A.J.B.; validation, D.B.; formal analysis, A.J.B.; investigation, S.S.; data curation, A.J.B.; writing—original draft preparation, A.J.B.; writing—review and editing, S.S.; visualization, A.J.B.; supervision, D.B. All authors have read and agreed to the published version of the manuscript.

Funding: The researchers received no external funding to conduct this research.

Data Availability Statement: Fintech data are available at https://www.ojk.go.id/id/kanal/iknb/data-dan-statistik/fintech/Default.aspx. Inflation database is available at https://www.bps.go.id/en/statistics-table/1/OTEzIzE=/tingkat-inflasi-harga-konsumen-nasional-bulanan--m-to-m----sup-1--sup---2022-100-.html

Acknowledgments: We thank two anonymous reviewers for providing valuable comments. In particular, we appreciate the input of the editor-in-chief for consistent feedback. This helped in improving the quality of the paper.

Conflicts of Interest: There is any potential for conflict of interest.

Appendix A

Participant's Information

- Education:
- Nature of Work:
- Work Experience:
- Current Position:

Main Questions:

Financial Stability of the fintech Industry

1. What is the level of financial stability of the fintech industry in Indonesia?
2. Are capital requirements of fintech firms sufficient to ensure financial stability in the industry?
3. How does accumulating more liabilities relative to assets (or equity) affect financial stability in the fintech industry?
4. Are fintech firms with more significant assets than equity more financially stable?
5. Are big-sized fintech firms (in terms of assets) more financially stable than small-sized ones?
6. Are the fintech firms' risk management practices compatible with the industry's financial stability?
7. Are the existing regulations sound enough to foster financial stability in the fintech industry?
8. What other critical factors (financial and non-financial) support or hinder the financial stability of the fintech industry in Indonesia?

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