FINTECH INNOVATION AND BANK PERFORMANCE: EMPIRICAL EVIDENCE FROM SINGAPORE, THAILAND AND INDONESIA

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Abstract: ***This study assesses the impact of financial technology companies on the performance of commercial banks in Indonesia, Thailand and Singapore. Using a Fixed Effects regression model with unbalanced panel data from 25 banks over the period 2016-2023, the study measures bank performance using the CAMEL framework. The results show that financial technology companies have a positive impact on profitability and capital adequacy, but a negative impact on cost management, credit risk and bank liquidity with different levels across countries.***

• Keywords: *non-bank fintech, bank performance, CAMEL.*

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1. Introduction

Financial Technology (FinTech) has significantly transformed the financial landscape, is gradually reshaping the entire financial system through the application of technological solutions to core financial services (Arner et al., 2016). In the dynamic economic space of the ASEAN region, Singapore, Thailand and Indonesia are particularly notable for their vibrant FinTech ecosystems, supported by strong government policies and initiatives, and high levels of technology adoption in the banking sector.

This study aims to examine the multi-faceted impacts of FinTech in the context of three key ASEAN countries Singapore, Thailand, and Indonesia using a panel-data approach grounded in the CAMEL evaluation model.

The rest of the study is structured as follows: Section 2 presents the literature review and research hypotheses. Section 3 describes the methodology. Section 4 presents the empirical results and discussion. Finally, Section 5 concludes and suggests future research directions.

2. Literature Review

2.1. Non-bank FinTech

The Non-bank FinTech refers to non-bank organizations that provide financial services on a technology platform, operating independently of the traditional banking ecosystem (Lee & Shin, 2018).

The multidimensional impact of Non-bank FinTech on bank performance has become the focus of research by many scholars in the field of finance and banking (Thakor, 2020), focusing on two opposing schools of thought, which are named the "FinTech complements banks" hypothesis and the "FinTech substitutes banks" hypothesis (Cornelli et al., 2020; Thakor, 2020; Li et al., 2017).

Consistent with the complementary hypothesis, Cornelli et al. (2020) argues that FinTech plays a complementary role, creating a symbiotic relationship with traditional banks. In contrast, following the FinTech substitution hypothesis, Nguyen et al. (2021) states that FinTech platforms have the potential to completely replace the traditional financial intermediation role of banks in many areas, especially customer-facing services such as payments, consumer finance, and wealth management.

Although the two theories above present opposing perspectives, Chen et al. (2019) have proposed an integrated analytical framework in which the impact of FinTech on bank performance emphasizing a segmentation perspective.

2.2. CAMEL

The CAMEL framework provides a comprehensive approach to assessing bank financial health by examining five key dimensions: Capital adequacy, Asset quality, Management efficiency, Earnings, and Liquidity.

Capital adequacy is an important factor in ensuring financial stability and risk resilience of banks. According to the "FinTech complements banks" hypothesis, Non-bank FinTech can play a complementary role, helping banks optimize capital resources, improve risk management efficiency, and expand financial mobilization channels. Conversely,

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according to the "FinTech Substitution Hypothesis" hypothesis, Non-bank FinTech may undermine banks' role as financial intermediaries, thereby reducing their ability to maintain capital adequacy.

H1. Non-bank FinTech positively affects the capital adequacy of banks.

Asset quality is an important indicator of a bank's financial safety and stability. According to the "FinTech complements banks" hypothesis, Non-bank FinTech can help banks improve their credit risk control capabilities by providing advanced technologies such as artificial intelligence, big data and blockchain, thereby supporting the credit assessment process, early detection of risky transactions and improving the efficiency of non-performing loan management. However, according to the "FinTech Substitution Hypothesis" hypothesis, Non-bank FinTech can negatively impact banks' asset quality by increasing risk-taking across the entire financial system.

H2. Non-bank FinTech negatively affects the asset quality of banks.

From the perspective of "FinTech complements banks", Non-bank FinTech can improve the management efficiency of banks by providing technologies that optimize operational processes. However, in reality, Non-bank FinTech can have a negative impact on bank management efficiency. Competitive pressure from FinTech companies forces traditional banks to significantly increase investment in digital transformation, integrate new technologies, and improve management systems, which increases operating costs in the short term (Lee et al., 2021).

H3. Non-bank FinTech negatively affects the managerial efficiency of banks.

The ability to generate stable earnings is fundamental to ensuring the long-term viability and resilience of banks amid an increasingly competitive financial landscape. According to the "FinTech complements banks" hypothesis, FinTech is not necessarily a competitor, but can become a supporting factor for banks to improve productivity. Elsaid (2021) shows that if banks know how to integrate technology from Non-bank FinTech through collaboration, learning, or direct investment, they can increase operational efficiency, reach new customers, and expand digital services, thereby improving profitability. Empirical evidence shows that the impact of Non-bank FinTech on banks' ROA can be mixed, depending on the banks' response strategy. Some studies, such as Nguyen et al. (2021), and Li et al. (2022) note a negative impact, especially when FinTech dominates strategic segments such as digital payments or consumer lending.

H4. Non-bank FinTech positively affects on earnings power of banks.

Liquidity management is an important factor in the commercial banking system. According to the "FinTech complements banks" hypothesis, Non-bank FinTech can help commercial banks improve liquidity by expanding capital mobilization channels and optimizing transaction processes. On the contrary, according to the "FinTech Substitution Hypothesis" hypothesis, Non-bank FinTech may reduce bank liquidity as customers switch to non-bank financial services. The rapid expansion of P2P Lending and BNPL (Buy Now Pay Later) platforms may reduce bank deposit balances, affecting banks' ability to maintain liquidity in the long term (Cheng & Qu, 2020).

H5. Non-bank FinTech positively affects the liquidity management of banks.

3. Data and Methodology

Data for this study were collected from banks in each of Singapore, Thailand, and Indonesia, selected so that their total market capitalization was approximately 50% of the total banking industry capitalization in each country and that they had adopted FinTech technology in their business model. The sample included 25 banks over the 8-year period from 2016 to 2023, with a total of 190 bank-year observations. Financial reports were collected from reputable financial data sources such as the Monetary Authority of Singapore (MAS) and global financial data platforms such as Eikon (Refinitiv) and Bloomberg.

Regression model:

$$Y_{i,t} = \beta_0 + \beta_1 LOG_{FIN\,i,t} + \beta_2 SIZE_{i,t} + \beta_3 LLR_{i,t} + \beta_4 AGE_{i,t} + \beta_5 DG_{i,t} + \beta_6 GDP_t + \beta_7 CPI_t + \beta_8 RIR_t + \varepsilon_{i,t}$$

Where $Y_{i,t}$ is dependent variable (five factors of CAMEL - CAR, NPL, CTI, ROA, and LTD respectively).

Table 1: Variables description

Variable	Type	Description	Measurement
Panel 1: Bank performance			
CAR	Dependent	Capital adequacy	Total capital / total risk weighted asset
NPL	Dependent	Asset quality	Total non-performing loans / total loans
CTI	Dependent	Management efficiency	Cost / Income
ROA	Dependent	Earning power	Income before discontinued operations & extraordinary items / total assets

Variable	Type	Description	Measurement
LTD	Dependent	Liquid ratio	Net loans / total deposits
Panel 2: Non-bank FinTech			
LOG_FIN	Independent	Degree of Non-bank FinTech	Logarithm of total number of Non-bank FinTech companies per year and country
Panel 3. Bank Control variable			
SIZE	Control	Firm size	Logarithm of total assets
LLR	Control	Loan loss reserves	Loan loss reserves / total loans
AGE	Control	Bank age	Logarithm of number of years since establishment
DG	Control	Deposit Growth	Annual growth rate of total deposits
Panel 4. Macro Control variable			
GDP	Control	Economic growth	GDP growth rate
CPI	Control	Change in prices paid by consumers	Consumer price index
RIR	Control	Real interest rate	Nominal interest rate - inflation rate

4. Results

4.1. Descriptive Statistics

Table 2: Descriptive Statistics

Variable	Observation	Mean	Std.Dev	Minimum	Maximum
CAR	190	20.16	4.15	13.71	38.7
NPL	190	1.39	0.39	1.1	4
CTI	190	45.37	1.91	40	49.67
ROA	190	1.42	0.56	-0.05	2.71
LTD	190	89.26	15.26	40.94	137.7
LOG_FIN	190	2.17	0.17	1.86	2.49
SIZE	190	4.6	0.65	3.26	6.57
LLR	190	4.12	2.58	0.01	13.68
AGE	190	1.77	0.24	1.04	2.16
DG	190	0.07	0.11	-0.18	1.08
GDP	190	2.92	3.18	-6.05	9.69
CPI	190	1.94	1.76	-0.85	6.08
RIR	190	4.12	3.18	-1.55	9.99

The capital adequacy ratio (CAR) recorded a mean value of 20.16% with a standard deviation of 4.15%, reflecting a significant capital reserve level that far exceeds the minimum threshold of 8% under Basel III standards. It is noteworthy that even the minimum value in the sample (13.71%) is still significantly higher than the regulatory requirement, reflecting the prudent strategy in capital management of ASEAN banks.

The mean non-performing loan (NPL) ratio in the sample was 1.39%, with a range of 1.1% to 4.0%, meaning that the majority of banks in the sample maintain good asset quality. However, the presence of some institutions with NPLs exceeding the 3% threshold, an alarming point according to Laeven and Majnoni (2003) - suggests that there is significant differentiation in credit risk management policies among banks.

The cost-to-income ratio (CTI) averaged 45.37%, with a relatively low standard deviation (2.54%), indicating a relative level of uniformity in cost management efficiency among ASEAN banks. Notably, the highest CTI value in the sample is 49.67%, reflecting the efforts to contain costs across the industry.

The return on assets (ROA) recorded a mean value of 1.42%, with a standard deviation of 0.56% and a range of -0.05% to 2.46%. It is worth noting the presence of sub-negative values in the sample, reflecting the significant challenges faced by some banks in the context of the COVID-19 pandemic.

The loan-to-deposit ratio (LTD) has a mean value of 89.26%, with a large standard deviation (24.43%) and a wide range from 40.94% to 137.70%. This significant dispersion reflects deep differences in liquidity management strategies and capital structure among the sample banks. Notably, about 25% of the sample observations have LTD exceeding the 100% threshold, a warning point according to Basel III, indicating that a significant proportion of ASEAN banks are operating with potentially high liquidity risk. Conversely, the presence of institutions with LTD below 50% may reflect an overly conservative strategy or limited ability to expand the loan portfolio.

The variable LOG_FIN has a mean of 2.17 (equivalent to about 148 on the original scale before logarithmization), with a standard deviation of 0.17. The distribution of this variable is relatively uniform between 1.86 and 2.49, reflecting significant differences in the level of fintech ecosystem development among ASEAN countries.

4.2. Model results

Table 3: Findings from regression analysis

Variables	Model 1 CAR	Model 2 NPL	Model 3 CTI	Model 4 ROA	Model 5 LTD
LOG_FIN	7.724*** (1.943)	1.186** (0.403)	9.230*** (0.681)	2.746*** (0.203)	-77.190*** (8.450)
SIZE	-2.216** (0.785)	-0.230** (0.087)	-0.045 (0.126)	-0.011 (0.038)	-1.239 (1.568)
LLR	0.189 (0.135)	0.058* (0.023)	-0.031 (0.032)	-0.009 (0.010)	-1.593*** (0.398)
AGE	1.040 (1.394)	0.164. (0.198)	0.175 (0.305)	0.070 (0.091)	13.054*** (3.786)
DG	-0.212 (2.381)	-0.009 (0.217)	-0.487 (0.640)	0.043 (0.191)	1.592 (7.934)
GDP	-0.240 (0.194)	-0.015 (0.014)	-0.068 (0.068)	-0.010 (0.020)	0.781 (0.849)
CPI	-0.256 (0.323)	0.056* (0.028)	0.062 (0.103)	0.025 (0.031)	0.417 (1.273)
RIR	0.484** (0.178)	-0.001 (0.015)	0.032 (0.062)	-0.002 (0.019)	0.162 (0.770)
Constant	10.190 (5.152)	-0.713 (0.410)	25.341 (1.384)	-4.593 (0.413)	242.216 (17.168)
Observations	190	190	190	190	190
	0.26329	0.46726	0.72395	0.72293	0.44074
Adjusted	0.19978	0.42133	0.70015	0.69905	0.39253

*Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Model 1: CAR

The key explanatory variable, LOG_FIN is positively and significantly associated with CAR at the 1% level. This evidence is consistent with the "FinTech Complement Hypothesis", which posits that financial technology can generate positive externalities for traditional banks. Specifically, the pressure of technological innovation encourages banks to modernize their capital structure, enhance capital buffers, and integrate risk-based capital adequacy monitoring tools.

Among the control variables, SIZE is negatively and significantly associated with CAR at the 1% level, suggesting that larger banks may operate with higher leverage, thus reducing their measured capital adequacy ratios. In contrast, RIR shows a positive and statistically significant relationship with CAR at the 5% level. Higher real interest rates may incentivize banks to increase their capital holdings to cushion against rising funding costs and macroeconomic uncertainty. Other variables such as LLR, AGE, DG, GDP, and CPI are statistically insignificant, although they contribute to controlling for contextual and institutional factors.

The result strongly supports Hypothesis H1, affirming that Non-bank FinTech development has a statistically significant and positive influence on the capital strength of commercial banks.

Model 2: NPL

LOG_FIN has a positive and statistically significant coefficient at the 1% level. This suggests that the rising development of Non-bank FinTech is positively associated with an increase in NPLs. This finding lends support to the "FinTech Substitution Hypothesis", which posits that Non-bank FinTech platforms are drawing away low-risk and high-quality borrowers from traditional banks. Consequently, banks are left with a more fragile and risk-prone lending base.

Regarding control variables, SIZE has a negative and highly significant effect on NPLs, indicating that larger banks tend to have better credit risk management. LLR is positively and significantly associated with NPLs, suggesting that banks facing higher non-performing loans tend to increase their provisioning to buffer against expected credit losses. Other macroeconomic control variables such as GDP, CPI, and RIR do not show statistically significant effects in this model but are retained to control for macro-level shocks and contextual variations during the study period.

The findings support the acceptance of Hypothesis H2: that the rise of Non-bank FinTech is associated with a decline in asset quality in commercial banks, particularly when those banks fail to modernize their credit risk controls in response to FinTech-driven competition.

Model 3: CTI

LOG_FIN has a positive and statistically significant impact. Since CTI is the cost/income ratio, a higher CTI value reflects lower management efficiency, so a positive coefficient indicates that the development of Non-bank FinTech reduces bank management efficiency. This result partially supports the hypothesis that FinTech Substitution Hypothesis, implying that as Non-bank FinTech companies expand their operations, banks are forced to invest more in technology infrastructure, digital transformation processes, as well as costs to maintain competitiveness, thereby increasing total operating costs (Li et al., 2022).

In terms of control variables, none of them are statistically significant at the 10% level, indicating that the management efficiency of banks during this period was more influenced by external factors such as FinTech, than internal factors such as size, age, or credit risk.

The model provides substantial support for Hypothesis H3, showing that Non-bank FinTech has a negative impact on bank management efficiency, specifically increasing the cost-to-income ratio (CTI).

Model 4: ROA

The coefficient for LOG_FIN is statistically significant and positively correlated with ROA. This result reinforces the argument of the "FinTech complements banks" hypothesis. Accordingly, integrating or learning from external financial technology can help banks expand digital services, reduce operating costs and optimize financial performance (Lee et al., 2021).

However, it is noteworthy that none of the control variables in the model show a statistically significant impact on ROA. This implies that, in the context of this study, the impact of FinTech plays a more prominent role than macroeconomic factors and internal characteristics of banks. This result also reflects the fact that the operational structure of the ASEAN banking system is shifting strongly under the influence of the financial technology wave, making FinTech a key factor shaping profitability in the current period.

The findings provide empirical backing for Hypothesis H4, which posits a positive relationship between Non-bank FinTech development and bank profitability especially for institutions capable of effectively adapting and leveraging external innovations.

Model 5: LTD

LOG_FIN has a negative and highly significant relationship with LTD. The findings imply that advancements and implementation of Non-bank FinTech solutions may contribute to more effective cash flow oversight and reduced liquidity strain within banks. This result is consistent with the view that "FinTech Complement Hypothesis" when it is assumed that technology - if effectively integrated - will help banks improve processing procedures, access capital more quickly and improve capital flow management capabilities (Cheng & Qu, 2020; Li et al., 2022).

In addition to the main variable, some control variables also show significant effects on LTD. Notably, AGE has a positive effect, indicating that older banks tend to expand lending more than deposits. In addition, LLR exhibits a statistically significant negative relationship, suggesting that banks with greater provisioning practices often exercise more credit oversight, thereby maintaining more stable liquidity. In contrast, the remaining control variables are not statistically significant in the model, indicating that their impact on liquidity management in the context of FinTech is not prominent.

This result helps substantiate Hypothesis H5, which proposes that Non-bank FinTech can improve bank liquidity management, particularly through enhanced efficiency in capital mobilization and cash flow optimization.

Table 4. Overview of FinTech's Influence and Hypothesis Testing Outcomes

Variable	Regression result sign	Performance	FinTech's impact	Hypothesis confirmation
CAR	+	Capital adequacy	Positive	✓
NPL	+	Asset quality	Negative	✓
CTI	+	Management efficiency	Negative	✓
ROA	+	Earning power	Positive	✓
LTD	–	Liquidity management	Positive	✓

Conclusion

This study comprehensively assessed the impact of Non-bank FinTech on commercial banking performance in three representative countries in the Southeast Asian region. The empirical results show that the development of financial technology has a multidimensional impact on the five core dimensions of the CAMEL framework. Notably, Non-bank FinTech shows a positive impact on CAR and ROA of ASEAN banks. This reflects the role of technology in improving capital management efficiency and optimizing financial resources, helping banking institutions maintain a safe capital buffer while improving profitability. Similarly, the positive impact on liquidity management shows that FinTech helps improve the ability of banks to balance cash flows. These findings support the "FinTech complements banks" theory, in which financial technology acts as a strategic partner to help traditional financial institutions improve their operational efficiency and enhance their competitiveness (Li et al., 2017).

However, the study also found notable negative impacts, reflected in positive relationships with NPL and CTI ratios. This suggests that in the digital transformation phase, banks in ASEAN face challenges of increasing technology investment costs and potential credit risks from new business models. These negative aspects reflect competitive and substitution pressures from FinTech companies, partially supporting the "FinTech complement bank" theory, in which FinTech units may gradually take over traditional banking market shares in some service segments.

Notably, the results provide empirical evidence supporting both theories, reflecting the complex nature of the relationship between FinTech and banks. This suggests that the relationship between financial technology and banks is not simply cooperative or competitive, but also depends on the specific market context and operating sector.

References:

Arner, D. W., Barberis, J., & Buckley, R. P. (2015). The evolution of Fintech: A new post-crisis paradigm. Geo. J. Int'l L., 47, 1271.

Chen, M.A., Wu, S., & Yang, B. (2019). How valuable is FinTech innovation? Review of Financial Studies, 32(5), 2062–2106.

Cheng, M., & Qu, Y. (2020). Does bank FinTech reduce credit risk? Evidence from China. Pacific-basin finance journal, 63, 101398.

Cornelli, G., Frost, J., Gambacorta, L., Rau, P. R., Wardrop, R., & Ziegler, T. (2020). Fintech and big tech credit: a new database.

Elsaid, H. M. (2023). A review of literature directions regarding the impact of fintech firms on the banking industry. Qualitative Research in Financial Markets, 15(5), 693-711.

Lee, C. C., Li, X., Yu, C. H., & Zhao, J. (2021). Does fintech innovation improve bank efficiency? Evidence from China's banking industry. International review of economics & finance, 74, 468-483.

Lee, I., & Shin, Y. J. (2018). Fintech: Ecosystem, business models, investment decisions, and challenges. Business horizons, 61(1), 35-46.

Li, Y., Spigt, R., & Swinkels, L. (2017). The impact of FinTech start-ups on incumbent retail banks' share prices. Financial Innovation, 3(1), 26.

Li, G., Elahi, E., & Zhao, L. (2022). Fintech, bank risk-taking, and risk-warning for commercial banks in the era of digital technology. Frontiers in psychology, 13, 934053.

Nguyen, L., Tran, S., & Ho, T. (2022). Fintech credit, bank regulations and bank performance: A cross-country analysis. Asia-Pacific Journal of Business Administration, 14(4), 445-466.

Thakor, A. V. (2020). Fintech and banking: What do we know?. Journal of financial intermediation, 41, 100833.