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DOES FINANCIAL TECHNOLOGY REDUCE INFLATION? LESSONS LEARNT FROM SUMATRA

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The purpose of this paper is to investigate the impact of financial technology (Fintech) on the inflation rate. The contribution reflects in the creation of a new index for Fintech, involving several indicators using principal component analysis. The data utilized belong to a panel dataset pertaining to the 10 provinces of the island of Sumatra, Indonesia, spanning from January 2020 to June 2023. The pooled mean group (PMG) estimation method is employed in order to test the relationship between Fintech and the inflation rate. The research findings of the study indicate that Fintech is capable of reducing inflation in the long run. Therefore, this research study implies the necessity to intensify the use of Fintech for the purpose of creating an efficient economic environment and promoting economic stability.

Keywords: financial technology, inflation, Sumatra, pooled mean group

JEL Classification: E31, G23

INTRODUCTION

Digitalization has shaped a new habitus in the economy, altering the structure and patterns of interaction among economic players, including households and businesses. The intensity of digitalization has become more pronounced following the COVID-19 pandemic. The social activity restrictions during the COVID-19 pandemic have necessitated societal adaptation to the interaction patterns that minimize physical contact. In response to this, various innovation disruptions have emerged based on leveraging information technology to support all societal activities, such as commercial activities, teaching and learning, as well as office-related tasks. Furthermore, the adoption of digital technology is a strategic effort to modify business processes so as to accommodate evolving business and market demands (Adeyinka, 2023).

Financial technology (Fintech) represents the form of disruptive innovation that amalgamates technology and financial services so as to support more modern business models (Chang, Baudier, Zhang, Xu, Zhang & Arami, 2020). Fintech serves as a reflection

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of the digitization progress within the financial services industry based on information technology (Puschmann, 2017). Disruptive innovations such as Fintech have disrupted conventional models in the financial services industry, impacting the industry's structure, intermediary technologies, and marketing models (Beck & Smits, 2018; Al nawayseh, 2020; Alt, Machkour & Abriane, 2020). Furthermore, the presence of Fintech has become an alluring force due to a shift in societal preferences towards online financial services, utilizing the Internet media for digital access. In turn, the incorporation of technology in the financial services industry is becoming a part of the innovation diffusion process aiming to offer transactional convenience to the entire community.

Fintech has the potential to offer various solutions that traditional financial institutions have thus far been unable to provide. Fintech plays an important role in reaching diverse groups of people, particularly the unbanked, by providing them with access to finance. Moreover, the advantages of the Fintech business model highlight cost efficiencies in financial services, the enhanced accessibility and quality of financial services, and the establishment of a more diverse financial landscape (Jagtiani & Lemieux, 2018). Therefore, Fintech can contribute to economic efficiency through reduced transaction costs and the improved allocation of capital and loans.

The cost reduction resulting from the use of Fintech is expected to lead to increased efficiency in the output supply within the economy, thereby exerting downward pressure on inflationary conditions, which assertion is supported by the previous studies examining the impact of Fintech adoption on inflation. The findings of Y. B. Romdhane, S. Kammoun and S. Loukil (2023) consistently demonstrate the fact that Fintech plays a role in reducing inflation in several Asian countries. This study implies that the government should prioritize the enhancing of the digital infrastructure in order to accelerate Fintech development. In the context of Indonesia, R. P. Hariadhy, A. S. Danutirta and M. Lubis (2022) investigated the relationship between the development of Fintech and the monthly inflation rate, their findings indicating that the development of Fintech correlated negatively with monthly inflation in Indonesia.

Spatially, the regions in Sumatra Island, Indonesia, hold a significant potential for the development of financial technology. This potential can be identified through several indicators. Firstly, based on data obtained from East Ventures (EV), the digital competitiveness index shows that the index increased for all the provinces in Sumatra in 2022 compared to the previous year. Notably, Northern Sumatra and the Riau Islands rank among the top 10 provinces in Indonesia with the highest digital competitiveness and literacy indices. Secondly, according to the latest data obtained from the Financial Services Authority (OJK) spanning from April 2022 to April 2023, the cumulative value of the loans disbursed by Fintech lending indicates that Sumatra's provinces collectively contributed nearly 50% (49.45%) to the total loan disbursement for the non-Java region.

The development of Fintech in Sumatra Island provides a potential intervention to address inflation stability amidst the increasing inflation rate in various regions in Sumatra Island. However, the influence of Fintech on inflation needs to be further identified. Several previous studies have confirmed the role of Fintech in stabilizing inflation rates (Romdhane *et al*, 2023; Mittal, Kathuria, Saini, Dhingra & Yadav, 2023). However, there are other studies that present contrasting findings, suggesting that the presence of Fintech may worsen inflation rates. The study by A. Anggraini and G. Agustin (2022) found that an increase in credit card transactions would support inflation through the intervening variable of money velocity. Furthermore, the findings of B. D. Saraswati, G. Maski, D. Kaluge and R. K. Sakti (2020) also provide the evidence that the development of Fintech will affect the effectiveness of monetary policies in Indonesia, particularly in maintaining long-term inflation stability.

There is a fact that the inflation trends in the provinces of Sumatra continue to rise, which is coupled with the inconsistent results regarding the impact of Fintech on the inflation rate. This study aims to investigate whether Fintech can or cannot play a role in reducing

the inflation rate in Sumatra. To the best of the author's knowledge, no previous studies have been conducted on Fintech and inflation rates, specifically not so for the provinces of Sumatra. Prior studies have only encompassed broader regions, such as Indonesia (Narayan & Sahminan, 2018; Saraswati *et al*, 2020), Asia (Romdhane *et al*, 2023), the MENA zone countries (Kammoun, Loukil & Loukil, 2020), and 30 countries (Mumtaz & Smith, 2020). Therefore, this study seeks to provide additional references and fill the research gap by examining Fintech studies on inflation at the regional level. The data used in this study consist of the panel data obtained from the provinces in Sumatra Island for the period from January 2021 to June 2023. Subsequently, the hypothesis tested in this study is as follows:

H1: Fintech has a significant statistical impact on inflation in Sumatra Island.

The pooled mean group (PMG) method will be used to estimate and test the hypothesis in this study. The remainder of this research is structured into a few more sections. The second section provides a summary of the empirical findings from the existing literature. The third section explains the research methodology and data. The fourth section presents the empirical results and discussions, while the conclusions are presented in the fifth section.

REVIEW OF THE EMPIRICAL LITERATURE

In the digital era, the role of the Internet and information technology has become a primary focus in inflation analysis in a lot of countries. M. N. Çoban (2022) notes an interesting phenomenon that, with the increasing penetration of the Internet, the inflation rates in the ASEAN-5 countries show a declining trend. This observation aligns with the findings of M. H. Yi and C. Choi (2005), who state that increased investment in the Internet infrastructure may help reduce inflation. The underlying rationale is that the rapid development of the Internet has the potential to alter the traditional correlation between money and inflation.

Furthermore, A. F. Priyono (2016) asserts that the Internet should be leveraged not only for communication, but also for research and development and cost efficiency as well. In other words, the utilization of the Internet that enhances cost efficiency is expected to have a deflationary effect on commodity prices. Similarly, K. Charbonneau, A. Evans, S. Sarker and L. Suchanek (2017) also document the deflationary effects of digitization in European countries, although they suggest that such implications should be addressed by policymakers.

The digitization wave and an increased penetration of the Internet particularly in the financial sector have catalyzed the rapid evolution of Fintech. Fintech has transformed the financial industry, particularly in the domains of loan offerings, payments, investments, and various financial services. Through its efficiency and accessibility, Fintech has the potential to influence monetary dynamics and ultimately impact inflation rates. In response to these changes, M. Z. Mumtaz and Z. A. Smith (2020) examined the role of Fintech in the transmission mechanism of the monetary policy and found that the development of Fintech did not alter the velocity of money and the income multiplier. However, mobile and digital technologies, the cryptocurrencies like Litecoin and Ethereum included, emerge as the strong predictors of money demand. Their research also indicates that the monetary policy has a significant effect in post-Fintech implementation, with higher monetary policy rates increasing borrowing costs and broadening the output gap.

Meanwhile, S. W. Narayan and S. Sahminan (2018) explored the influence of Fintech on Indonesia's macroeconomy, specifically so on its potential to curb inflation and strengthen the rupiah against the US dollar. Another research study carried out by Y. B. Romdhane *et al* (2023) sought to clarify the impact of Fintech on Asian economies, with a specific focus on the two pivotal indicators — namely inflation and unemployment — during the period spanning from 2011 to 2017. This investigation reveals a robust and positive correlation between the progress of financial technology and a reduction in both inflation and unemployment, particularly when such technological

advancements are actively embraced. Digital finance essentially emerges as a newfound catalyst in propelling economic development.

Additionally, the study conducted by B. D. Saraswati *et al* (2020) investigated the impact of financial inclusion and Fintech on the efficacy of the monetary policy, specifically through the interest rate channel considering the cost of capital and substitution effects. Their empirical findings reveal that financial inclusion influences the inflation rate, serving as a proxy for the effectiveness of the monetary policy, both in the short run and in the long run. Conversely, Fintech exerts an influence on inflation only in the short run. Similarly, R. Mittal *et al* (2023) explored the interplay between financial inclusion, Fintech, and the effectiveness of the monetary policy in India, only to identify in their study a positive association between financial inclusion, Fintech, and inflation as a proxy for the efficacy of the monetary policy, both in the short run and in the long run. However, the relationship between Fintech and inflation turns to be negative when the cost of the capital effect is integrated in the model.

B. D. Saraswati, G. Maski, D. Kaluge and R. K. Sakti (2022) studied the impact of Fintech on household consumption. Their empirical findings indicate that Fintech has a positive impact on household consumption both in the short run and in the long run. These findings suggest that, while Fintech can drive economic growth, it may also encourage higher consumption, which could potentially lead to an increase in inflation. Additionally, D. S. Puspita, B. D. Saraswati and A. T. Pertiwi (2023) examined the influence of e-money on inflation in Indonesia and found that e-money had a negative effect on the inflation rate, indicating that e-money was capable of controlling inflation. Therefore, a cashless society policy is an appropriate measure to control inflation rates.

The current research confirms the fact that Fintech does play a crucial role in controlling inflation, which indicates that the Fintech revolution, with all its innovations and efficiencies, can influence inflation dynamics differently from traditional factors. According to the previously reviewed literature, many researchers have delved into the determinants of inflation, such as the money supply level (Long, Hien & Ngoc, 2021; Islam, 2022), interest rates (Mishkin, 1992; Booth & Ciner, 2001), exchange rates (Pham, 2019; Valogo, Duodu, Yusif & Baidoo, 2023), oil prices (Köse & Ünal, 2021; Zakaria, Khiam & Mahmood, 2021), and government spending (Kandil, 2005; Zhang, 2022). However, despite numerous traditional factors influencing inflation, the role of Fintech in this context seems to have received insufficient attention.

With its specific focus on Sumatra Island, this study aims to fill the gap in the literature by investigating how Fintech influences inflation in the region. Understanding the contribution of Fintech to inflation dynamics is expected to provide new insights for policymakers and relevant stakeholders.

RESEARCH METHOD AND DATA

Data and variables

Over the past seven years, there has been a notable increase in the number of the registered Fintech companies with the Indonesian Fintech Association (AFTECH), as is shown in Figure 1. Concurrently, Figure 2 shows that the inflation rates across nearly all the regions of Sumatra have consistently surpassed the national average, simultaneously having shown a rising trend over the last three years. These trends highlight the significance of examining the economic dynamics and regional stability in Sumatra.

The data analyzed in this research study consist of the secondary time series data covering the monthly period for the 10 provinces of Sumatra Island, namely Bengkulu, Jambi, Bangka Belitung Islands, Riau Islands, Lampung, Aceh, Riau, Western Sumatra, Southern Sumatra, and Northern Sumatra from January 2020 to June 2023. The data were obtained from various government agencies, including Statistics Indonesia, Bank Indonesia, and the Financial Services Authority.

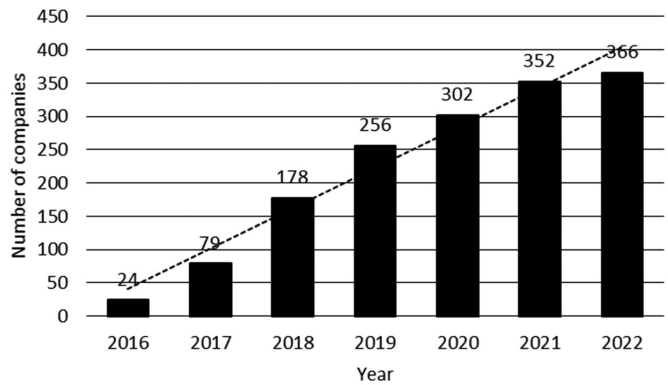

Figure 1 The number of the Fintech companies in Indonesia from 2016 to 2022

Source: Authors, based on AFTECH, 2023

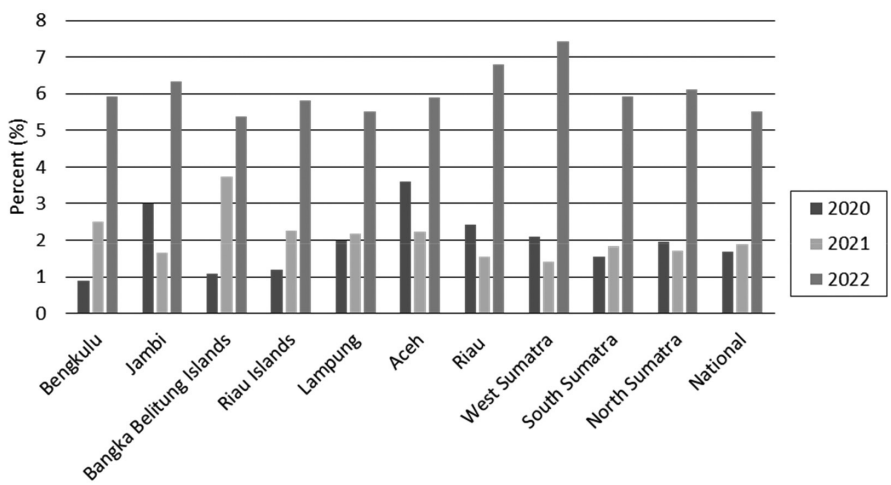

Figure 2 The inflation rate trends of the provinces in Sumatra from 2020 to 2022

Source: Authors

To examine the impact of Fintech on inflation, the consumer price index (CPI) was employed as the dependent variable. Given the limitations of global availability for the Fintech index data, Fintech was proxied in this study by the financial inclusion index formed from the four variables reflecting the activities of the financial technology use. These variables include ATM transaction value, credit card transaction value, the number of electronic money cards, and the cumulative distribution of loans. The indicators of the Fintech index can be observed in Table 1 in detail. The selection of the Fintech index components was based on data availability and referred to the variables for the index construction by G. Feng, W. Jingyi, W. Fang, K. Tao, Z. Xun and C. Zhiyun (2019). Furthermore, the Fintech index used in this study was constructed using Principal Component Analysis (PCA), the method previously applied in the studies by C.-C. Lee, X. Li, C.-H. Yu and J. Zhao (2021). In this study, PCA was utilized so as to reduce the dimensionality

of the data from the correlated variables through linear transformation, obtaining a single measure. The resulting index can depict the overall variability among the correlated Fintech components (Ahamed & Mallick, 2019; Lee *et al*, 2021).

In an effort to control the external variables that may influence inflation, the four control variables - the exchange rate (ER); the interest rate (IR); money supply (MS); and the gross regional domestic product (GRDP) were introduced in order to avoid simultaneous bias. The current studies have confirmed that inflation is influenced by the exchange rate (Valogo *et al*, 2023), the interest rate (Nchor & Darkwah, 2015), money supply (Long *et al*, 2021), and the GDP (Koulakiotis, Lyroudi & Papasyriopoulos, 2012). Table 1 explains the operationalization of the variables used in this study.

Model specification

This study aims to identify the influence of Fintech on the inflation rate in Sumatra Island region. The model employed in this study adopts a dynamic approach, taking into consideration the factors of inertia or adjustments that occur as the community needs to adapt to developments in financial technology. Consequently, the impact of Fintech cannot directly affect the inflation rate due to the presence of the lag factors. The model utilized in this study reads as follows:

$$Log\_INF_{it} = \beta_0 Log\_INF_{it-1} + \beta_1 FTI_{it} + \beta_2 Log\_ER_{it} + \beta_3 IR_{it} + \beta_4 Log\_MS_{it} + \beta_5 Log\_GRDP_{it} + \varepsilon_{it} \quad (1)$$

where INF_{it} represents the inflation rate proxied by the consumer price index, FTI_{it} depicts the Fintech index, ER_{it}, IR_{it}, MS_{it}, and $GRDP_{it}$ serve as the control variables for the exchange rate, the policy interest rate of the Bank Indonesia, money supply, and the gross

Table 1 The operationalization of variables

Variable	Measurement	Definition	Source
Consumer price index (INF)	*Index*	The consumer price index in a certain region.	Statistics Indonesia
Indicators of Fintech			
Transaction value at ATMs (ATM)	*Million Rupiah*	The total transaction value on ATM cards includes both cash withdrawal transactions and/or fund transfers.	Bank Indonesia
The value of credit card transactions (CREDIT)	*Million Rupiah*	The total transaction value on credit cards includes both spending transactions and/or cash withdrawals.	Bank Indonesia
Electronic money (EM)	*Unit*	The number of the electronic money cards owned both chip- and server-based.	Bank Indonesia
The accumulation of loan disbursement (LEND)	*Million Rupiah*	The cumulative disbursement of the loans distributed by the Fintech companies (peer-to-peer lending).	Financial Services Authority
Fintech index (FTI)	*Index*	The Fintech composite index	-
Control Variables			
Exchange rate (ER)	*Indonesian Rupiah*	The exchange rate of the US dollar against the Indonesian rupiah.	Bank Indonesia
Interest rate (IR)	*Percentage*	The interest rate policy level of the Bank Indonesia.	Bank Indonesia
Money supply (MS)	*Billion Rupiah*	The total of broad money M2.	Bank Indonesia
Gross regional domestic product (GRDP)	*Billion Rupiah*	The total value added of the goods and services produced from all economic activities in an area.	Statistics Indonesia

Source: Authors

regional domestic product, respectively, ε_{it} is the error term, β_1 is the main coefficient to examine the impact of the FTI on inflation, $i=1,...,N$ represents the cross-sectional units, and $t=1,...,T$ denotes the time periods.

Given the fact that our data consist of the 10 provinces and cover the period of 42 months, and the resulting total of 420 observations with the number of the time series dimensions being greater than the number of the cross-sectional dimensions, the GMM method is not suitable for the analysis made in this study and it may encounter problems related to autocorrelation in the residuals of the first-difference estimation (Roodman, 2009). Therefore, panel ARDL or pooled mean group (PMG) were employed for the analysis carried out herein. The PMG estimator developed by M. H. Pesaran, Y. Shin and R. P. Smith (1999) can examine the relationship among variables both in the short run and in the long run. This method permits for heterogeneity in the short-run coefficients, on the one hand, and homogeneity in the long run, on the other. The PMG estimator also exhibits integrated variables in I(0), I(1), or a combination. The ARDL model used in this study can be shown as follows:

$$\Delta y_{it} = \varphi(y_{i,t-1} - \delta_1 f_{i,t-1} - \delta_2 x_{i,t-1}) + \sum_{j=1}^{p-1} \lambda_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \lambda'_{ij} \Delta f_{i,t-j} + \sum_{j=0}^{q-1} \lambda''_{ij} \Delta x_{i,t-j} + \omega_{it} \quad (2)$$

where y represents the dependent variable, namely inflation; f is Fintech; x represents the set of the control variables, namely the exchange rate, the interest rate, money supply, and the GRDP; φ shows the error correction term (ECT); δ_1 and δ_1 depict the long-run coefficient of Fintech and the control variables, respectively; λ, λ', λ'' represent the short-run coefficients of lagged inflation, Fintech, and the control variables, respectively.

Before examining the PMG estimation, various preliminary tests were done. First, the cross-sectional dependence test was employed in order to scrutinize the existence of cross-sectional dependence within the panel data. Second, a unit-root test (i.e. the second-generation panel unit-root test) was done so as to assess the stationarity of the data, after which the presence of the long-term relationship among the variables was investigated using the Westerlund cointegration test. Ultimately, the causality test was conducted in order to identify the causal relationship among the variables. The diverse statistical tests performed in this study are likely to enhance the robustness of the empirical findings.

Fintech measurement

In this study, the PCA method was applied in order to construct the Fintech index. The PCA is a method employed for extracting information from large datasets and can alleviate multicollinearity within a model (Sun, Khan & Ren, 2023). Utilizing four indicators, this research study compiles the Fintech index with the resulting variables referred to as the FTI. This index can represent advancements in the financial sector as it captures information about each digital financial activity, laying the foundation of Fintech.

Table 2 Principal component analysis for the Fintech index

Components	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.014	2.352	0.754	0.754
Comp2	0.663	0.444	0.166	0.919
Comp3	0.219	0.114	0.055	0.974
Comp4	0.104		0.026	1.000
Variables	Comp1	Comp2	Comp3	Comp4
Log_ATM	0.533	-0.317	-0.321	0.716
Log_CREDIT	0.499	-0.460	0.683	-0.269
Log_EM	0.541	0.103	-0.567	-0.613
Log_LEND	0.417	0.823	0.330	0.202

Source: Authors

Table 2 accounts for the results of the principal component analysis for the Fintech index (FTI) based on the four financial technology indicators. The findings reveal that the eigenvalue of the first component is 3.014, progressively decreasing to the fourth component, which shows the lowest change at 0.104. Furthermore, the first component explains

approximately 75.4% of the variation in the dependent variables, whereas the second, third, and fourth components contribute around 16.6%, 5.5%, and 2.6%, respectively. Clearly, the first principal component demonstrates the highest level of variation. Therefore, this study intends to utilize Comp1 as the Fintech indicator.

RESULTS AND DISCUSSION

Table 3 shows the descriptive statistics of all the variables used, displaying the figures prior to the logarithmic transformation, thus pointing to the fact that the average monthly inflation rate in the provinces of Sumatra is 0.818%, with the highest inflation reaching 8.55% and the lowest standing at -1.36%. These inflation statistics signal the importance of maintaining stability in Sumatra's inflation in order to mitigate higher fluctuations. Furthermore, the Fintech variable used in this research study is constructed using the PCA to obtain the measure that can represent the variation of the Fintech-forming variables. The average Fintech index in the provinces of Sumatra is relatively low, at only 476 x 10^{-11}, and most provinces in Sumatra have negative Fintech indices throughout the observation period. Northern Sumatra has the highest Fintech index, reaching 3.189, whereas Bengkulu has the lowest Fintech index. Interestingly, the standard deviation values of inflation and the Fintech index are relatively low, indicating that the values of both variables are not broadly dispersed from their means.

The presented correlation matrix is used to identify the potential multicollinearity among the variables of this study. The results given in Table 4 reveal that inflation shows a significant negative correlation with Fintech, characterized by a relatively low correlation

Table 3 The descriptive statistics

	INF	FTI	ER	IR	MS	GRDP
Mean	0.8187143	476 x 10^{-11}	14683.43	4.184524	7379310	68965.57
Std. dev.	1.544446	1.000004	520.2556	0.8248445	717274.8	65286.11
Min	-1.36	-2.6476	13662	3.5	6047999	38.77
Max	8.55	3.189422	16367	5.75	8528022	255479.4
Obs	420	420	420	420	420	420

Source: Authors

Table 4 The correlation matrix

Variables	Log_INF	FTI	Log_ER	IR	Log_MS	Log_GRDP
Log_INF	1					
FTI	-0.143*** (0.003)	1				
Log_ER	0.099** (0.043)	0.062 (0.205)	1			
IR	-0.145*** (0.003)	-0.004 (0.939)	0.258*** (0.000)	1		
Log_MS	0.049 (0.315)	0.408*** (0.000)	0.181*** (0.000)	-0.092* (0.060)	1	
Log_GRDP	0.163*** (0.001)	-0.189*** (0.000)	0.007 (0.887)	-0.003 (0.955)	0.037 (0.454)	1

Note: *, **, and *** indicate the significance levels at 10%, 5%, and 1%, respectively.

Source: Authors

coefficient. Furthermore, the interest rate is the only control variable negatively correlated with inflation. In contrast, the other control variables, such as the exchange rates, money supply, and the GRDP, show positive correlations with inflation. The relatively low magnitudes of the correlation coefficients for each variable indicate the absence of multicollinearity among the variables examined in this study (Gujarati & Porter, 2009). The finding underscores the reliability of the estimation results in this study.

The provinces in Sumatra are expected to have the potential to influence each other mutually due to regional cooperation among the provinces. Additionally, the efforts to stabilize inflation made by the Regional Inflation Control Team (TPID) in Sumatra may foster trade cooperation among the regions throughout Sumatra. Thus, testing for cross-sectional dependence (CSD) is essential to ascertain whether there is mutual influence among the regions in Sumatra. Neglecting this test may lead to unreliable estimations. The CSD test performed in this study employs the Breusch-Pagan Lagrange Multiplier (LM) test, which provides accurate estimations when T>N (Breusch & Pagan, 1980). Therefore, the LM test is relevant for this study as the number of the time dimensions (42) is greater than the number of the cross-sectional dimensions (10). The CSD test results in Table 5 confirm that the null hypothesis reading that there are no CSD in the data should be rejected, showing that the *p*-value is significant, which on its part confirms the presence of CSD in this study. Then, it indicates that a shock in one region can probably influence another in this study. As a result, the presence of CSD required that second-generation tests, including the unit root test, the cointegration test, and long-term estimation should be employed.

Since the empirical study has confirmed the presence of cross-dependence among the variables, the first-generation panel unit root test, such as the Levin, Lin, and Chu (LLC) unit root test, is irrelevant to adopt as it is unable to produce unbiased estimation in the presence of cross-sectional dependence (Levin, Lin & Chu, 2002). Consequently, the study employs the second-generation unit root test, namely the cross-sectionally augmented Im, Pesaran, and Shin (CIPS) approach, which takes into account the issue of cross-sectional dependence (Pesaran, 2007). The CIPS test examines the null hypothesis of nonstationary against the alternative hypothesis.

The results of the unit root test performed in this study are reported in Table 6. For the I(0) order, the null hypothesis of nonstationary, inflation, Fintech, the exchange rate, the interest rate, and money supply is not accepted at the 1% significance level, whereas only the GDP fails to reject the null hypothesis. Furthermore, all the variables applied in this study reject the null hypothesis at the I(1) order, thus indicating that all the variables are stationary. Therefore, the variables used in this study are stationary of mixed order at the level and the first difference, while no variable has proven to be stationary at the second difference, which on its part indicates that the variables unveil the cointegration relationship in the long run.

Subsequently, whether the variables employed show a long-term relationship or not was examined. The cointegration test developed by J. Westerlund (2007) was done in this study. The test is based on whether the Error Correction Term (ECT) equals zero for the panel Error Correction Model (ECM) or not. This cointegration test approach is considered to be more reliable compared to the traditional cointegration methods as it is more flexible and more adequate to accommodate specific short-term unit dynamics, trends, and slope parameters, as well as the presence of cross-sectional dependence (Persyn & Westerlund, 2008). The results of the cointegration test are presented in Table 7. These results indicate that the *p*-values for the error correction terms for the mean groups (G_t and G_a) and the panel (P_t and P_a) are significant. Therefore, the null hypothesis of no cointegration is rejected as such, suggesting that all the variables used in this study have a long-term relationship.

Table 5 The cross-sectional dependency test

Chi2	747.335
Prob.	0.000***

Note: *** indicates the significance level of 1%.

Source: Authors

Table 6 The stationarity test

Variables	Log_INF	FTI	Log_ER	IR	Log_MS	Log_GRDP
Level	-5.922***	-3.916***	2.610***	2.610***	2.610***	-2.159
First Difference	-6.190***	-6.053***	2.610***	2.610***	2.610***	-6.051***

Note: *** indicates the significance level of 1%.

Source: Authors

Table 7 The cointegration test

Statistics	Value	Z-value	P-value
G_t	-3.752	-3.670	0.000***
G_a	-21.649	-2.560	0.005***
P_t	-20.193	-11.739	0.000***
P_a	-49.005	-14.303	0.000***

Note: *** indicates the significance level of 1%.

Source: Authors

This study applies the panel ARDL or PMG approach to investigate the impact of Fintech on inflation both in the short run and in the long run. The Akaike Information Criterion (AIC) was utilized for the optimal lag selection, resulting in the selection of (3, 4, 4, 4, 4, 4) for the PMG. Table 8 displays the PMG estimation results for the panel of the provinces of Sumatra Island. The short-term estimation results show that the coefficient for lagged inflation (-1) is positive and significantly different from zero at the 5% and 10% levels, thus indicating the fact that the inflation of the previous period significantly contributes to an increase in the inflation of the current period. However, the positive coefficient estimate for Fintech is not statistically significant, which implies

Table 8 PMG estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long-term equation				
FTI	-1.172	0.155	-7.558	0.000***
IR	-0.260	0.061	-4.271	0.000***
Log_ER	-21.699	4.654	-4.663	0.000***
Log_MS	4.607	1.557	2.958	0.004***
Log_GRDP	3.276	1.460	2.245	0.026**
Short-term equation				
ECT (-1)	-0.509	0.218	-2.330	0.021**
D(Log_INF(-1))	-0.361	0.163	-2.218	0.028**
D(Log_INF(-2))	-0.106	0.149	-0.710	0.479
D(FTI)	0.296	0.273	1.085	0.280
D(FTI(-1))	0.258	0.370	0.697	0.487
D(FTI(-2))	0.017	0.299	0.055	0.956
D(FTI(-3))	-0.055	0.202	-0.274	0.784
D(IR)	0.923	0.331	2.786	0.006***
D(IR(-1))	-0.042	0.343	-0.124	0.902
D(IR(-2))	-1.998	0.527	-3.789	0.000***
D(IR(-3))	1.078	0.347	3.107	0.002***
D(Log_ER)	16.337	8.053	2.029	0.044**
D(Log_ER(-1))	7.726	9.266	0.834	0.406
D(Log_ER(-2))	11.429	5.845	1.955	0.052*
D(Log_ER(-3))	3.966	3.374	1.176	0.241
D(Log_MS)	-1.452	3.023	-0.480	0.632
D(Log_MS(-1))	12.428	4.875	2.549	0.012**
D(Log_MS(-2))	4.977	3.195	1.558	0.121
D(Log_MS(-3))	11.139	2.422	4.600	0.000***
D(Log_GRDP)	8.226	3.135	2.624	0.009***
D(Log_GRDP(-1))	-0.649	1.000	-0.649	0.517
D(Log_GRDP(-2))	0.294	2.040	0.144	0.885
D(Log_GRDP(-3))	-3.687	2.383	-1.547	0.124
C	-91.729	39.024	-2.351	0.019
S.D. dependent var	0.727	Mean dependent var		0.016
Akaike info criterion	1.373	S.E. of regression		0.425
Schwarz criterion	3.730	Sum squared resid		31.562
Hannan-Quinn criteria	2.304	Log likelihood		-43.321

Note: *, **, and *** indicate the significance levels of 10%, 5%, and 1%, respectively. The model selection method: AIC. The selected model: ARDL (3, 4, 4, 4, 4, 4).

Source: Authors

that digital financial transaction activities reflected in Fintech do not have a significant impact on the occurrence of inflation in the short run, a plausible explanation for this finding being that, in the short run, the imperfect information about and incomplete utilization of Fintech advancements by society may limit the impact on consumer consumption patterns and ultimately do not alter the inflation rate (Saraswati *et al*, 2020). Interestingly, most of the control variables have a significant positive impact on the inflation in the provinces of Sumatra in the short run. Furthermore, it is observed that the coefficient of the ECT is negative and significant at the 5% and 10% levels, indicating the presence of a long-term equilibrium. The ECT coefficient of -0.509 suggests that any deviation from the long-term equilibrium corrects itself at a speed of 0.509.

The results of the long-term estimation indicate a significant negative impact of Fintech on inflation in the provinces of Sumatra Island during the observation period, with the coefficient of -1.172, which is implicative of the fact that a 1-unit increase in the Fintech index will reduce inflation by 1.172 percent, assuming that other variable influences should remain constant, which suggests that intensifying Fintech activities enhances efficiency in financial transactions and can suppress transaction costs. These findings align with the study by Y. B. Romdhane *et al* (2023), who concluded that the active use of Fintech in two-way transactions, both in sales and in purchases, had a reducing effect on inflation. Furthermore, Fintech activities such as loan distribution can support optimal economic growth through cost efficiency and the provision of more effective services, thereby alleviating the demand-side inflationary pressures. In turn, the ease of access provided by Fintech to various economic actors may lead to efficiency, stimulate a higher output, and increase income (Mumtaz & Smith, 2020; Zhang, Tan, Hu, Wang & Wan, 2020; Abbasi, Alam, Du & Huynh, 2021).

The digitization aspect plays a crucial role in driving Fintech adoption. Digitization holds a significant position in the financial industry as it can reduce costs, improve access to and the quality of financial services, and create a more diverse financial landscape (Lee & Shin, 2018). Provincial governments in Sumatra must develop the digital infrastructure, including ATMs and other payment systems, to support noncash transaction activities. Additionally, the readiness of the community to adopt Fintech also presents challenges. Therefore, the development of Fintech needs to be balanced by providing financial literacy education and making consumer protection efforts, fostering trust among the public in using Fintech as an innovative financial service. Intensive education can ensure a more direct Fintech use and mitigate potential risks (Suryono, Budi & Purwandari, 2021).

Subsequently, the Dumitrescu–Hurlin panel causality test was done in this study in order to examine the causal relationships among the variables, the test being based on the null hypothesis that no homogeneous causality is present across the cross-sections. Two lags were selected for the causality test using the AIC approach. In Table 9, the results of the panel causality test indicate bidirectional causality between inflation and Fintech, and between inflation and money supply as well, with the *p*-values lesser than alpha. Unidirectional causality is perceived to exist between the interest rates and inflation, and between inflation and the exchange rates as well. The panel causality results underscore the need for policymakers to consider how innovations in financial technology and adjustments in monetary supply can impact inflation. In the meantime, the identification of unidirectional causality from the interest rates to inflation and from inflation to the exchange rates provides target insights for the monetary policy and the exchange rate management. These findings are essential for crafting effective economic policies, enhancing stability, and guiding strategic decisions in both financial and real sectors.

CONCLUSION

This study investigates the influence of financial technology on the inflation rate. The results indicate that Fintech can potentially reduce inflation in the

Table 9 The pairwise Dumitrescu–Hurlin panel causality test

Null Hypothesis	W-Stat.	Zbar-Stat.	P-value.	Conclusion
FTI ⟶ Log_INF	6.280	5.835	0.000***	Rejected
Log_INF ⟶ FTI	4.575	3.443	0.001***	Rejected
IR ⟶ Log_INF	4.955	3.975	0.000***	Rejected
Log_INF ⟶ IR	3.024	1.266	0.206	Accepted
Log_ER ⟶ Log_INF	1.776	-0.484	0.628	Accepted
Log_INF ⟶ Log_ER	4.703	3.622	0.000***	Rejected
Log_GRDP ⟶ Log_INF	1.547	-0.805	0.421	Accepted
Log_INF ⟶ Log_GRDP	2.970	1.191	0.234	Accepted
Log_MS ⟶ Log_INF	3.640	2.131	0.033**	Rejected
Log_INF ⟶ Log_MS	3.812	2.372	0.018**	Rejected
IR ⟶ FTI	4.783	3.734	0.000***	Rejected
FTI ⟶ IR	3.228	1.553	0.120	Accepted
Log_ER ⟶ FTI	0.702	-1.991	0.046**	Rejected
FTI ⟶ Log_ER	3.593	2.065	0.039**	Rejected
Log_GRDP ⟶ FTI	4.262	3.003	0.003***	Rejected
FTI ⟶ Log_GRDP	5.723	5.053	0.000***	Rejected
Log_MS ⟶ FTI	5.824	5.195	0.000***	Rejected
FTI ⟶ Log_MS	4.701	3.620	0.000***	Rejected
Log_ER ⟶ IR	1.740	-0.535	0.593	Accepted
IR ⟶ Log_ER	8.344	8.731	0.000***	Rejected
Log_GRDP ⟶ IR	3.967	2.590	0.009***	Rejected
IR ⟶ Log_GRDP	2.657	0.752	0.452	Accepted
Log_MS ⟶ IR	1.902	-0.307	0.759	Accepted
IR ⟶ Log_MS	0.516	-2.252	0.024**	Rejected
Log_GRDP ⟶ Log_ER	3.905	2.503	0.012**	Rejected
Log_ER ⟶ Log_GRDP	6.199	5.721	0.000***	Rejected
Log_MS ⟶ Log_ER	1.634	-0.684	0.494	Accepted
Log_ER ⟶ Log_MS	0.428	-2.376	0.018**	Rejected
Log_MS ⟶ Log_GRDP	7.062	6.933	0.000***	Rejected
Log_GRDP ⟶ Log_MS	3.602	2.077	0.039**	Rejected

Note: ** and *** indicate the significance levels of 5% and 1%, respectively.

Source: Authors

long run. This study suggests that a more intensive use of Fintech can create an efficient economic environment and support economic stability. Not only does Fintech help reach the unbanked, but it also offers cost-efficient financial services, improves the quality and reach of financial services, and creates a more diverse financial landscape. This finding is consistent with the previous studies demonstrating the role of Fintech in stabilizing inflation rates in various countries. This study suggests the necessity of enhancing the digital infrastructure to expedite the development of Fintech, particularly in Indonesia.

The findings of the study offer valuable insights into the potential of financial technology (Fintech) to reduce inflation, particularly in Sumatra Island, Indonesia. The results reinforce the notion that Fintech can enhance economic stability by improving transaction efficiency and loan distribution as a component of economic digitalization. This study suggests that Fintech can effectively control inflation, particularly in the areas experiencing rapid Fintech growth, such as Sumatra. The findings imply that the central bank should integrate Fintech development in the monetary policy framework and consider it an essential factor in inflation analysis and policy decision-making. Furthermore, the central bank must collaborate closely with the other regulators so as to guarantee that Fintech's progress stays within the robust regulatory framework, promoting innovation and simultaneously mitigating related risks. Local governments in Sumatra play a crucial role in supporting the implementation of Fintech. They must ensure the availability of an adequate digital infrastructure and promote Fintech adoption among businesses and communities. These measures include improving access to the high-speed Internet, supporting digital education and training, and promoting financial inclusion through Fintech.

This study has several limitations that should be considered in future research. Specifically, the geographical focus on Sumatra restricts the generalizability of the findings, suggesting that further research should be done in order to explore the impact of Fintech on inflation in the other regions of Indonesia or even in other countries. Secondly, since this study relies on the secondary data, incorporating primary data (such as surveys or interviews) may be beneficial to gain a more comprehensive understanding of how Fintech influences economic agents' daily economic decisions. Another limitation is the study's timeframe, i.e. its spanning from January 2020 to June 2023. This period was chosen due to the availability of consistent and relevant data. Expanding the timeframe in future research could

provide a more robust analysis of the trends and the long-term effects of Fintech. Finally, future research should delve into the long-term effects of Fintech on broader economic aspects, such as employment growth and the development of small and medium-sized enterprises (SMEs).

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