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The Nexus between Financial Inclusion and Monetary Policy: The Case Study of Selected ASEAN Countries

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A R T I C L E I N F O

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A B S T R A C T

This study examines the relationship between financial inclusion and monetary policy in nine selected ASEAN (Association of Southeast Asian Nations) countries during 2010-2019. To answer the objective of this study, the Vector Error Correction Model (VECM) is used to analyze the effect of financial inclusion on inflation. In addition, the causality between financial inclusion and monetary policy is also examined in this study. The data used are panels data. The multidimensional approach of IFI (index of financial inclusion) is constructed to represent a comprehensive financial inclusion measurement. The results showed that financial inclusion had a negative effect on inflation in the long-term and short-term; it indicates that an increase in financial inclusion will lower inflation which eventually increases the effectiveness of monetary policy in Indonesia, Malaysia, Thailand, Philippines, Singapore, Vietnam, Cambodia, Myanmar, and Laos. Moreover, a causality exists between financial inclusion indicators and monetary policy in selected ASEAN countries. This study concludes that financial inclusion through access and usage of financial services improves the efficiency of monetary policy in nine selected ASEAN countries in controlling inflation. This study suggests that monetary authorities must emphasize the link between financial inclusion and monetary policy objectives. Advanced financial inclusion can help policymakers formulate and implement monetary policies contributing to economic stability and sustainable growth.

A B S T R A K

Penelitian ini bertujuan mengkaji hubungan antara inklusi keuangan dan kebijakan moneter di sembilan negara terpilih di ASEAN (Association of Southeast Asian Nation) pada periode 2010-2019. Untuk menjawab tujuan penelitian ini, digunakan Vector Error Correction Model (VECM) dalam menganalisis pengaruh inklusi keuangan terhadap inflasi. Selain itu, dilakukan pengujian kausalitas antara inklusi keuangan dan kebijakan moneter. Data yang digunakan adalah dalam bentuk panel. Pendekatan multidimensi IFI (index financial inclusion) digunakan untuk pengukuran inklusi keuangan yang komprehensif. Hasil VECM menunjukkan bahwa inklusi keuangan berpengaruh negatif terhadap inflasi dalam jangka panjang dan jangka pendek; Hal ini mengindikasikan bahwa peningkatan inklusi keuangan akan menurunkan inflasi yang pada akhirnya meningkatkan efektivitas kebijakan moneter di Indonesia, Malaysia, Thailand, Filipina, Singapura, Vietnam, Kamboja, Myanmar, dan Laos. Selain itu, terdapat kausalitas antara indikator inklusi keuangan dan kebijakan moneter di negara-negara ASEAN. Studi ini menyimpulkan bahwa inklusi keuangan melalui akses dan penggunaan jasa keuangan, dapat meningkatkan efisiensi kebijakan moneter di sembilan negara ASEAN terpilih dalam mengendalikan inflasi. Studi ini menyarankan bahwa otoritas moneter perlu menekankan hubungan antara inklusi keuangan dan tujuan kebijakan moneter. Inklusi keuangan lanjutan dapat membantu pembuat kebijakan dalam merumuskan dan menerapkan kebijakan moneter yang berkontribusi pada stabilitas ekonomi dan pertumbuhan berkelanjutan.

1. INTRODUCTION

Financial inclusion has received considerable attention in recent years after the global financial crisis of 2008. In this regard, financial inclusion is designated to facilitate the vulnerable groups, such as low-income segments of society and unbanked

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people, to utilize the formal financial institution services without barriers to access, and no unserved nor underserved of society will be excluded from its growth and benefits (World Bank, 2019). Generally, financial inclusion refers to facilitating formal financial services to all segments of society (Elsherif, 2019). It means that everyone, including individuals and organizations, has easy access to and can successfully use appropriate financial services to satisfy their financial needs at reasonable costs in a well-regulated environment (Demirguc-Kunt et al., 2018).

ASEAN, G20, APEC, GCC, and international financial organizations: **T**he World Bank, the International Monetary Fund, including the Asian Development Bank, are currently emphasizing the importance of developing financial services to stabilize the macroeconomic activity, advance economic development, also reach underserved consumers through enabling financial inclusion. In addition, under the ASEAN Economic Community (AEC) Blueprint 2025, financial inclusion in ASEAN is one of the strategic objectives of the financial sector integration vision for 2025 (ASEAN Secretariat, 2019). Therefore, the Working Committee on Financial Inclusion was established to support the implementation of national financial inclusion strategies in ASEAN in 2016 (OECD, 2018). Sustainable economic growth, achieving macroeconomic stability, low inflation rate, and expansion of employment opportunities are the economic goals of the central banks. These objectives can be fulfilled if the monetary policy mechanism operates optimally. Lapukeni (2015) stated that monetary policy is part of the government's primary means of economic policy in controlling monetary variables to achieve macroeconomic objectives. Furthermore, the monetary policy implemented by the central bank is intended to regulate the money supply so that economic growth gets stable, which is reflected in the low inflation rate and unemployment (Doan Van, 2019). Therefore, the transmission of the monetary policy mechanism needs to be managed.

According to Loukoianova & Yang (2018), financial inclusion has the potential to alter monetary policy transmission channels by enhancing the role of interest rates in the economy. Moreover, financial inclusion encourages monetary policy transmission mechanisms more successfully, stimulates financial intermediation efficiency, and prevents money laundering or idle balance. Monetary authorities are better informed through financial inclusion and better predict monetary aggregates (Lapukeni, 2015).

Gali et al. (2004) discussed financial inclusion in the central bank's policy rule and model stability. Their findings showed that formal financial institutions should not ignore the potential importance of consumers. As financial inclusion diminishes, monetary policy rules may become destabilizing, and financially excluded customers are not immediately influenced by interest rates, making the monetary policy less effective. Anarfo et al. (2019) revealed that the monetary policy efficacy in an economy is determined by the number of people who have access to formal financial services.

Despite the substantial gains and the robust progress of account ownership worldwide, financial inclusion gaps persist in many parts of the world. According to Demirguc-Kunt et al. (2018), 1.7 billion adults worldwide were unbanked in 2017. Table 1 shows that financial inclusion is relatively high across the ASEAN countries in Malaysia, Thailand, and Singapore; at least 80% of adults in 2017 had a bank account for saving and payments. In contrast, Cambodia, Laos, and Myanmar's basic account ownership are pretty low, ranging from 21% to 29% in 2017. ASEAN countries such as Indonesia, Malaysia, Thailand, and the Philippines have adopted national strategies for developing and strengthening the financial inclusion framework. Nevertheless, access to financial services has achieved remarkable progress in Vietnam in recent years, although the percentage of adults having an account decreased by 0.8% from 2014 to 2017.

Access and usage to formal financial services in ASEAN (Association of Southeast Asian Nations) varies widely. While some ASEAN countries are leading the way in financial inclusion, others can only offer access to basic financial services. In Malaysia, most households actively utilize banks for saving or borrowing, and frequently mobile phones are used to make payments. In contrast, informal financing remains heavily used in regions such as Myanmar, and less than 40% of households have bank accounts (Loukoianova & Yang, 2018). Low access and usage of formal financial services cause people's awareness of savings to be low and encourages people to use informal financial services such as loan sharks or money lenders. As a result, formal financial institutions are less effective in collecting savings and deposits, and the number of loans disbursed by financial institutions to the public decreases.

The low level of the index of financial inclusion in several ASEAN countries has encouraged the UN Capital Development Fund (UNCDF) to plan broader regulatory reforms in the development of the financial sector since 2020, in particular being able to make several ASEAN countries such as Myanmar, Laos, and Cambodia to be able to expand financial inclusion, remove barriers, and encourage expansion. A regional approach to financial inclusion can be identified as an important complement to national efforts and an important strategy to support ASEAN economic integration (UNCDF, 2020).

Table 1. Adults with Bank Account in ASEAN Countries (%)

Country	2011	2014	2017
Indonesia	19.6	36.1	48.9
Malaysia	66.2	80.7	85.3
Myanmar	NA	22.8	26.0
Philippines	26.6	31.3	34.5
Vietnam	21.4	31.0	30.8
Cambodia	3.7	22.2	21.7
Lao PDR	26.8	NA	29.1
Singapore	98.2	96.4	97.9
Thailand	72.7	78.1	81.6

Source: World Bank-Global Findex, (World Bank, 2020).

Therefore, increasing financial inclusion in ASEAN countries can help the effectiveness of monetary policy in achieving its main objectives of maintaining price stability, which is reflected in stable and low inflation. However, the role of financial inclusion in ASEAN countries is still less involved by policymakers in regulating monetary policy to control inflation and attain price stability. It is shown in the lack of empirical studies on financial inclusion and monetary policy. Further research is needed to determine the impact of financial inclusion on the effectiveness of monetary policy in ASEAN countries. Hence, this article seeks to fill the gap and solve the problem by analyzing the impact of financial inclusion on monetary policy as reflected in the inflation of selected ASEAN countries (2010 – 2019). Therefore, this article is expected to provide empirical evidence for the evaluation and consideration of policymakers in implementing financial inclusion to formulate monetary policy, which eventually contributes to controlling inflation and sustainable growth. Other than that, to give a deeper insight for further research of the relationship between financial inclusion and monetary policy.

2. THEORETICAL FRAMEWORK AND HYPOTHESES

The definition of financial inclusion varies across the literature. For instance, according to De Tran & Koker (2019), financial inclusion is generally described as ensuring equitable and transparent access to and using formal financial services at a reasonable cost. In other words, it ensures access to financial resources and services to all segments of economic actors, especially low-income groups, at affordable costs (Mbutor & Uba, 2013). In the Global Financial Development Report 2014 by World Bank, financial inclusion is defined as the proportion of individuals, firms, or businesses who utilize financial services (World Bank, 2014).

Tram et al. (2021) stated that a measure of financial inclusion is required to understand the current state of financial inclusion in an economy and to track the movement of the policy initiatives undertaken to encourage financial inclusion. Ensuring standardization of financial inclusion indicators internationally, the Alliance for Financial Inclusion (AFI), the World Bank, and the GPFI (Global Partnership for Financial Inclusion) agreed on three fundamental dimensions of financial inclusion: access, usage, and quality. Data from both the supply and demand sides were included to create a comprehensive view (Demirguc-Kunt et al., 2015; GPFI, 2016). AFI (2019) stated that access and use of financial services are two fundamental dimensions to consider in measuring financial inclusion. Measuring the quality of financial inclusion is challenging because it necessitates subjective criteria based on opinion and perception (AFI, 2016). However, it was decided that the quality dimension would be addressed as part of a broader measurement framework of financial inclusion (AFI, 2019).

Theoretically, monetary policy is a policy by the monetary authority to control interest rates and monetary amounts to achieve the intended economic goals (Mishkin, 2020). Therefore, monetary policy is an important instrument for

central banks to use to achieve macroeconomic stability, which is reflected in price stability, boosting economic growth, and keeping unemployment and inflation low. This article considers the number of literatures that indicates the link between financial inclusion and monetary policy effectiveness. First, according to Mehrotra & Yetman (2014), the ratio of output volatility to inflation volatility in the optimal monetary policy is enhanced by the share of financially included consumers. Higher levels of financial inclusion may facilitate households' consumption smoothing during periods of shocks, where households can easily access financial services for savings and borrowing, lowering output volatility and inflation volatility. Therefore, the central bank increasingly focused on maintaining inflation and price stability (Mehrotra & Yetman, 2014).

Second, through increasing financial inclusion, the effectiveness of monetary policy can be improved via the interest rate channel of monetary transmission (Loukoianova & Yang, 2018). As financial inclusion rises, consumers and producers will save and borrow more from the formal financial institution. As a result, their economic decisions should be more influenced by interest rates. The interest rates' transmission from the financial sector to the real sector will be determined by the economy's demand for consumption and investment, which then affect the size of aggregate demand and eventually affect the inflation rate and real output of the economy (Anowor & Okorie, 2016). According to Mehrotra & Yetman (2015), because interest rates strongly influence economic activity, financial inclusion is anticipated to increase the role of interest rates in monetary transmission.

The monetary policy transmission mechanism affects the economy through various channels. The interest rate channel is the basic channel and basic explanation of the monetary policy transmission from standard Keynesian theory (Lengnick & Wohltmann, 2016). According to Mochtar et al. (2020), the interest rate channel can be viewed as the first route to directly respond to changes in the monetary policy stance through changes in short-term interest rates on the money market. The interest rate channel emphasizes the importance of the price in the financial market to various economic activities in the real sector. In this regard, interest rates in the financial sector will subsequently affect the inflation rate and real output (Bonga-Bonga & Simo-Kengne, 2018).

According to Anarfo et al. (2019), another channel that demonstrates the connection between financial inclusion and monetary policy is the bank lending channel. Bank lending is a channel that focuses on bank loans, the primary funding source for households and small-to-medium-sized businesses. When the government implements a tight monetary policy, the money supply shrinks, forcing banks to rebalance their portfolios, reducing the number of loans they can offer. When bank loans are reduced, this results in a decrease in investment by small businesses (Anarfo et al., 2019; Lengnick & Wohltmann, 2016). With a reduction in loan supply, banks will raise lending interest rates at higher borrowing costs. As a result, as borrowing costs rise, the number of financially included consumers will decline (Anarfo et al., 2019).

In comparison, an expansionary monetary policy increases the money supply and inflation, resulting in more loans at lower borrowing costs due to increased bank reserves. Loan expansion will increase investment spending, as many households and businesses rely on loans to finance their activities. As a result, lower borrowing costs can help increase financial inclusion (Arshad et al., 2021; Dabla-Norris et al., 2021).

The bank lending channel is a channel for transmitting monetary policy rooted in banking literature. Thus, the monetary policy transmission channel depends on the health of banks and individual finances because it determines the level of access to credit. Excessive credit availability can increase the risk of bad debts and financial instability, affecting inflation (Arshad et al., 2021). When financial inclusion increases, it becomes possible to establish a sound and stable banking system, thus assisting the monetary authorities in controlling inflation and improving individual financial health. Therefore, the monetary policy transmission channels provide evidence of the link between monetary policy and financial inclusion.

Growing empirical literature discusses how financial inclusion may affect the monetary policy mechanism. Elsherif (2019), using a VECM (Vector Error Correction Model) method, revealed that financial inclusion and monetary policy transmission in Egypt are linked via a long-term relationship and that bi-directional causality exists between monetary policy (inflation (CPI)) and financial inclusion. The study by Saraswati et al. (2020), using Indonesia as a sample and VECM as the estimation method, discovered that the level of financial inclusion affects achieving the inflation target, which is an indicator of monetary policy effectiveness, via the interest rate channel in the

mechanism of monetary policy transmission. Additionally, the study demonstrates that financial inclusion significantly affects household consumption behavior and corporate investment; in this case. These two consumption behaviors serve as the primary variables in the monetary policy transmission mechanism via the interest rate channel, ultimately affecting the inflation rate.

Lenka & Bairwa (2016) and Jungo et al. (2021) discovered that financial inclusion has a negative and statistically significant effect on inflation in SAARC and Sub-Saharan Africa, implying that increasing financial inclusion improves monetary policy transmission aimed at reducing inflation. Lenka & Bairwa (2016) also discovered that while the exchange rate and interest rate negatively correlated with inflation, the exchange rate is not statistically significant in SAARC countries. Anarfo et al. (2019) also stated that, in the monetary policy, the changes in aggregate demand due to the changes in lending interest rate, and money supply, will affect the inflation rate and eventually promote the financial inclusion degree.

Numerous theoretical and empirical studies have established a correlation between financial inclusion and monetary policy in most countries. Furthermore, empirical research frequently uses inflation (the consumer price index) as a proxy for monetary policy. Therefore, this study hypothesizes a negative correlation between financial inclusion and inflation (CPI) as the proxy of monetary policy.

3. RESEARCH METHOD

Data Type and Source

The study analyzes the relationship between financial inclusion and monetary policy in selected ASEAN countries using panel data and various econometric techniques. The sample includes nine ASEAN member countries: Singapore, Indonesia, Malaysia, Thailand, Philippines, Cambodia, Laos, Myanmar, and Vietnam, with annual time series data spanning 2010 to 2019.

The IMF and World Bank databases, specifically the IMF-Financial Access Survey (IMF-FAS), were used to obtain data on financial inclusion indicators based on access and usage dimensions. The inflation rate (Consumer Price Index) as the proxy of monetary policy effectiveness, and the controlled variables, i.e., lending interest rate, exchange rate, and money supply, are compiled from the World Development Indicators (WDI) by World Bank and International Financial Statistics (IFS) by the IMF (International Monetary Fund). Lending interest rate, exchange rate, and money supply are taken as existing variables in economic theory to assess the effectiveness of monetary policy transmission and to prevent omitted bias variables (Elsherif, 2019; Evans, 2016).

Index of Financial Inclusion Formulation

Before conducting the modeling estimation to analyze the relationship between financial inclusion and monetary policy, the multidimensional IFI (index of financial inclusion) estimation is constructed. The estimation in this article refers to Sarma (2012) in constructing the index of financial inclusion (IFI) because the formula represents a comprehensive measurement of financial inclusion. The results of IFI calculations capture information about the dimensions of financial inclusion in the range 0 to 1, where 0 indicates complete financial inclusion and 1 indicates complete financial inclusion. Following Sarma (2012), the index of financial inclusion (IFI) formula can be specified as follows:

$$IFI = \frac{1}{2}\left[\frac{\sqrt{{d_1}^2+{d_2}^2+\ldots+{d_n}^2}}{\sqrt{n}} + \left(1-\frac{\sqrt{(1-d_1)^2+(1-d_2)^2+\ldots+(1-d_n)^2}}{\sqrt{n}}\right)\right] \quad (1)$$

Where IFI refers to the index of financial inclusion, d denotes the dimension, and n is the number of dimensions.

The measurement of an index of financial inclusion of this study composite two dimensions: usage dimension and access dimension. The usage dimension in this study consists of four indicators: ATMs per 100,000 adults (ATMAD), ATMs per 1,000 km² (ATMKM), Commercial bank branches per 100,000 adults (CBBAD), Commercial bank branches per 1,000 km² (CBBKM). The access dimension in this study consists of two indicators: Outstanding loans from commercial banks (% of GDP) (LGDP) and outstanding deposits with commercial banks (% of GDP) (DGDP).

Analysis Method

This study employed the Vector Error Correction Model (VECM) to investigate the impact of financial inclusion on monetary policy transmission in nine selected ASEAN countries. VECM offers an advantage in interpreting and separating the components of long-term and short-term

relationships in time series data and can dynamically detect causality between variables used in research.

The VECM is a time series model stationary at the first difference and contains an error correction term. Therefore the error correction model or VECM estimation brings the two I(1) series back to long-term equilibrium (Wooldrige, 2020). To avoid false regression problems in non-stationary time series regression, it is necessary to regress the time series properly to create stationary time-series data (Gujarati & Porter, 2009).

To investigate the relationship between financial inclusion and monetary policy transmission in selected ASEAN countries, four-stage procedures are needed to model VECM in the study. The first stage involves unit root testing to check the stationarity of the data. The second stage is the Johansen test to check the presence of a cointegrating relationship between the variables in the study. The third stage is VECM modeling to examine the long-run and the short-run relationship among variables. The fourth stage is the granger causality test to determine the causality between financial inclusion indicators and inflation as the proxy of monetary policy effectiveness.

Empirical Model

The empirical model estimates the effect of the index of financial inclusion and control variables (lending interest rate, exchange rate, and money supply) on inflation (CPI) as the proxy for the effectiveness of the monetary policy. This model determines the relationship between financial inclusion and inflation as the final monetary policy target in the nine selected ASEAN countries. The VECM equations models in this study based on the empirical study by Saraswati et al. (2020) are specified as follows:

$$\Delta INF_{it} = \alpha_1 + \sum_{k=1}^{p} \emptyset_{11k}\, \Delta INF_{it-k} + \sum_{k=1}^{p} \emptyset_{12k}\, \Delta IFI_{it-k} + \sum_{k=1}^{p} \emptyset_{13k}\, \Delta LR_{it-k} + \sum_{k=1}^{p} \emptyset_{14k}\, \Delta EXR_{it-k} + \sum_{k=1}^{p} \emptyset_{15k}\, \Delta M2_{it-k} + \lambda_{1i} ECT_{it-1} + u_{1it} \quad (2)$$

Where INF, IFI, LR, EXR, and M2 stand for inflation (CPI), index of financial inclusion, lending interest rate, exchange rate, and money supply, respectively. ECT denotes the error correction term, Δ represents the first difference, and k is the lag length.

4. DATA ANALYSIS AND DISCUSSION

Unit Root Test

According to Gujarati (2021), the starting point is determining the stationarity of the data by conducting the unit root test. The unit root test was carried out using the Augmented Dickey-Fuller (ADF) Test method. The ADF stationary test on this study's variables is shown in Table 2.

Table 2 shows that the ADF unit root test indicates that not all variables are stationary at their level, particularly IFI and EXR variables greater than the critical value of 5% or alpha (0.05). The result of the stationarity test at the level fails to reject the null hypothesis and leads to conducting the first difference testing.

Table 2. Augmented Dickey-Fuller Unit Root Test at "Level"

Variable	ADF	P-Value	Description
INF	-3.18364	0.0007	Stationary
IFI	3.60599	0.9998	Non-Stationary
EXR	3.86253	0.9999	Non-Stationary
LR	-2.44533	0.0072	Stationary
M2	-2.55880	0.0053	Stationary

Source: Data processed, 2022

Table 3. Augmented Dickey-Fuller Unit Root Test at "First Difference"

Variable	ADF	P-Value	Description
INF	-8.04039	0.0000	Stationary
IFI	-2.92791	0.0017	Stationary
EXR	-5.34739	0.0000	Stationary
LR	-5.64733	0.0000	Stationary
M2	-8.66822	0.0000	Stationary

Source: Data processed, 2022

Table 3 presents the results of the first difference testing. It reveals that all the variables used in this study are stationary at the first difference. The probability value of ADF t-statistics

for each variable is below the critical value of 5% (α = 0.05).

Cointegration Test

The cointegration test is intended to determine the long-term relationship among variables. This study uses the Johansen Cointegration Test method for cointegration testing. If the trace statistic value is greater than the critical value of 5%, then the alternative hypothesis stating the number of cointegrations is accepted.

Based on Table 4, the trace statistic and maximum Eigenvalue at r = 0 are greater than the critical value with a significance level of 5%. Therefore, it can be explained that five rank variables have a cointegration relationship in the 5% (0.05). Thus, the cointegration test results indicate that among the movements of INF, IFI, LR, EXR, and M2, there is a relationship between stability and similarity of movements in the long term.

Table 4. Johansen Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value	Prob.*
None *	0.914471	176.4701	69.81889	0.0000
At most 1 *	0.679525	90.40864	47.85613	0.0000
At most 2 *	0.539671	50.58034	29.79707	0.0001
At most 3 *	0.411252	23.42689	15.49471	0.0026
At most 4 *	0.130279	4.885410	3.841466	0.0271

* The trace test indicates 5 cointegrating eqn(s) at the 0.05 level
Source: Data processed, 2022

Vector Error Correction Model (VECM)

After testing the data of this study, the panel data passed all the test procedures and can be used for further estimation. The estimation model for this study used VECM (Vector Error Correction Model). This study uses three significance levels, 1%, 5%, and 10%, to see the significance level between the variables.

The VECM result in Table 5 shows that in the long-term, four variables have a significant effect on inflation (INF), namely IFI, LR, LOG(EXR), and LOG(M2), at a 1% significance level. Therefore, in the long-term, the effect of the index of financial inclusion (IFI), lending interest rate (LR), an exchange rate (EXR), and money supply (M2) on inflation (INF) are negative and statistically significant.

Table 5. VECM estimation

Variable	Coefficient	t-statistics
Long-term Relationship		
INF (-1)	1.000000	-
IFI (-1)	-3.020719	[-5.26643]*
LR (-1)	-0.211249	[-4.85596]*
LOG (EXR (-1))	-0.167694	[-3.92554]*
LOG(M2(-1))	-3.518667	[-6.18016]*
Short-term Relationship		
EC_t	-1.194619	[-3.28641]*
D(IFI(-3))	-84.83544	[-1.89009]***
D(IFI(-4))	-63.69728	[-1.50484]
D(LR(-1))	2.104840	[1.82234]***
D(LOG(M2(-1)))	-5.200382	[-2.96304]*
D(LOG(M2(-2)))	-4.666015	[-2.80084]*
D(LOG(M2(-3)))	-3.149234	[-2.56969]**
D(LOG(M2(-4)))	-1.266870	[-1.40091]
R-Squared		0.799960
Adj R-Squared		0.476817

Note: *t-table 1% = 2.6349; **t-table 5% = 1.987; ***t-table 10% = 1.662
Source: Data processed, 2022

In the short term, the variables that are statistically significant to inflation (INF) are the index of financial inclusion (IFI) in lag 3, the lending interest rate in lag 1, and the money supply

(M2) at lags 1, 2, and 3. In the index of financial inclusion (IFI), the inflation (INF) variable is affected by the previous behavior of the lag-variable D(IFI(-3)) at a 10% level of significance. In lending interest rate, the condition of INF is affected by previous behavior of the lag-variable D(LR(-1)) at a 10% significance level. And for the money supply (M2) variable, the condition of INF is affected by the previous behavior of the lag variables of D(LOG(M2(-1))), D(LOG(M2(-2))), and D(LOG(M2(-3))).

The R-squared value in this estimation model is 0.799960, indicating that all independent variables: index of financial inclusion (IFI), an exchange rate (EXR), lending interest rate (LR), and money supply (M2), can explain the inflation (INF) variable by 79.99%, while other variables outside the model influence the rest.

The impulse response function (IRF) and variance decompositions (VDC) were also estimated in this study to know the response of the inflation variable on the index of financial inclusion shocks and the contribution degree of independent variables in influencing the dependent variable.

Based on Figure 1, it can be explained that from the first period until the tenth period, the inflation (INF) response to the shock on the index of financial inclusion (IFI) variable fluctuates. The inflation response to the shock index of financial inclusion (IFI) variable is negative in the fourth, fifth, and eighth periods. While the rest, the inflation response, is positive to the shock in the index of financial inclusion.

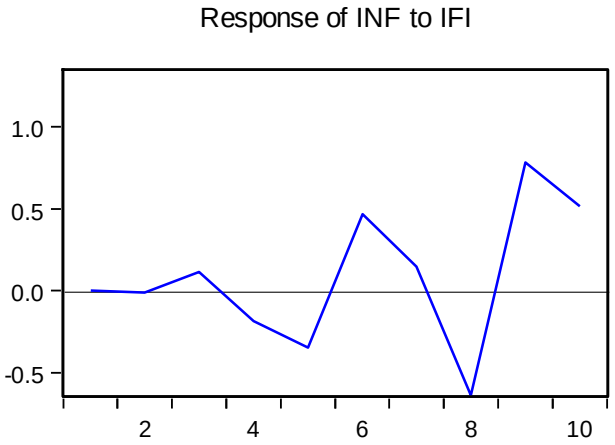

Figure 1. Impulse Response

Variance decomposition, also called forecast error variance decomposition, is a VECM model tool measuring a variable's ability to explain variations in each variable shock in the system (Wooldrige, 2020). Table 6 shows that, in the first period, inflation was strongly influenced by the inflation shock itself by 100%. The index of financial inclusion, exchange rate, lending interest rate, and money supply have not affected inflation. In the second period, the variables IFI, LR, EXR, and M2 began to affect inflation (INF), where the most influential variable apart from inflation itself was the LR, and the least variable that influenced INF was the IFI variable at the second period until the fourth period.

The contribution of the exchange rate and the money supply variables to inflation is higher than the index of financial inclusion contribution in the second period until the fourth period. However, the contribution of IFI started to rise more than the LOG(EXR) and LOG(M2) variables in the fifth period. In the fifth period, the ability of the IFI variable to influence INF is rising with a value of 4.70%. In the ninth period, the IFI variable began to have more influence on INF rather than the LR variable, which was 25.16%. Meanwhile, the contribution of the LR variable in the ninth period is 18.93%. Looking at the tenth period, the independent variable with the biggest contribution to inflation is the index of financial inclusion, which is 25.39%. Followed by the lending interest rate with a value of 19.83%, then the money supply by 6.39%, and the smallest contribution is the exchange rate with a value of 6.26%.

Table 6. Variance decomposition result

Period	S.E.	INF	IFI	LR	LOG (EXR)	LOG (M2)
1	1.341744	100.0000	0.000000	0.000000	0.000000	0.000000
2	1.581431	88.45687	0.005515	9.349343	0.882925	1.305345
3	1.675313	83.64113	0.466846	13.86828	0.838510	1.185233
4	1.778187	79.04244	1.484597	16.10180	1.818015	1.553143
5	1.890171	74.59684	4.699362	16.16115	3.039703	1.502941
6	1.982933	68.08442	9.767593	17.58458	3.146265	1.417147
7	2.075925	62.12933	9.399075	20.16594	4.553928	3.751730
8	2.236336	54.75866	16.21184	20.92670	4.695348	3.407443
9	2.375386	48.69322	25.16452	18.93001	4.187679	3.024571
10	2.575848	42.13058	25.39012	19.82553	6.261232	6.392532

Source: Data processed, 2022

Granger Causality Test

The causality test is shown on factors affecting inflation (INF), namely financial inclusion indicators. They consist of the number of ATMs per 100,000 adults (ATMAD), number of ATMs branches per 1000 km² (ATMKM), number of commercial bank branches per 100,000 adults (CBBAD), number of commercial bank branches per 1000 km² (CBBKM), outstanding deposits with commercial banks (% of GDP) or also called as the ratio of total deposits to GDP (DGDP), and outstanding loans from commercial banks (% of GDP) or also called as the ratio of total loans to GDP (LGDP).

Table 7. Granger Causality test

Null Hypothesis	F-Statistic	Prob.	Result
ATMAD does not Granger Cause INF	4.20839	0.0192	Rejected H_0
INF does not Granger Cause ATMAD	0.15540	0.8564	Accepted H_0
ATMKM does not Granger Cause INF	1.45776	0.2404	Accepted H_0
INF does not Granger Cause ATMKM	0.18872	0.8285	Accepted H_0
CBBAD does not Granger Cause INF	0.96232	0.3873	Accepted H_0
INF does not Granger Cause CBBAD	3.24903	0.0451	Accepted H_0
CBBKM does not Granger Cause INF	1.40625	0.2523	Accepted H_0
INF does not Granger Cause CBBKM	0.71902	0.4910	Accepted H_0
DGDP does not Granger Cause INF	4.45302	0.0153	Rejected H_0
INF does not Granger Cause DGDP	3.16733	0.0486	Accepted H_0
LGDP does not Granger Cause INF	5.37615	0.0069	Rejected H_0
INF does not Granger Cause LGDP	1.79997	0.1733	Accepted H_0

Source: Data processed, 2022

From Table 7, the financial inclusion indicators that have a statistically significant effect on inflation are the number of ATMs per 100,000 adults (ATMAD) with a magnitude of 0.0192; outstanding deposits with commercial banks (DGDP) with a magnitude of 0.0153; and outstanding loans from commercial banks (LGDP) with magnitude 0.0069. Therefore, ATMAD, DGDP, and LGDP reject the null hypothesis because they have a granger causality to inflation. Meanwhile, the inflation variable is statistically significant to the number of commercial bank branches per 100,000 adults (CBBAD) with a magnitude of 0.0451 and outstanding deposits with commercial banks (DGDP) with a magnitude of 0.0486. It implies that a one-way causality exists in ATMAD to INF, LGDP to INF, and INF to CBBAD, meaning that ATMAD and LGDP may influence INF, while INF may influence the CBBAD variable.

Moreover, there is a two-way causality between the outstanding deposits with commercial banks (DGDP) variable, or the ratio of total deposits to GDP, and inflation (INF), which indicates that these two variables can influence each other.

Discussion

Through the VECM estimation, the index of financial inclusion (IFI) has a negative and statistically significant relationship with inflation (INF) at a level of 1% in the long term. It implies that for every increase in the index of financial inclusion by 1%, inflation will decrease 3.02% in the long-term, thereby enhancing price stability and achieving the effectiveness of monetary policy transmission in selected ASEAN countries

(Indonesia, Malaysia, Thailand, Singapore, Philippines, Vietnam, Myanmar, Cambodia, Lao PDR). Moreover, in a short-term relationship, the index of financial inclusion at lag 3 is also negative and statistically significant at the 10% significance level. It implies that in the 3rd period, an increase of 10% in the index of financial inclusion will decrease inflation by 84.83% in the short-term period.

The result is aligned with previous studies in Indonesia (Saraswati et al., 2020) and another previous study with a sample outside ASEAN countries (Elsherif, 2019; Huong, 2018; Jungo et al., 2021; Lenka & Bairwa, 2016). The studies found an inverse relationship between the index of financial inclusion and inflation as a proxy for the effectiveness of monetary policy transmission. The negative relationship is due to the increased ease of access and use of financial services. Monetary authorities will find it easier to control and target inflation.

Furthermore, shocks in terms of the increase in financial inclusion will be responded to by a reduction in inflation in the fourth, fifth, and eighth periods. In this respect, the high development of financial inclusion due to increased access and use of financial services, especially in a financial institution such as banking, may suppress inflation. The contribution of financial inclusion has increased for ten periods, particularly in the 10th period. The index of financial inclusion contributed 25.39% to the effectiveness of monetary policy in selected ASEAN countries. The result is in line with Saraswati et al. (2020). They found a high contribution, specifically a 55% contribution in the tenth period of financial inclusion, to the effectiveness of monetary policy in Indonesia.

Based on the Granger causality result, there is a two-way causality relationship between the ratio of total deposits to GDP as the financial inclusion indicator with inflation as an indicator of monetary policy. It implies that the ratio of total deposits to GDP and monetary policy through inflation influence each other. In addition, there is one-way causality between the number of ATMs per 100,000 adults to inflation, the number of commercial bank branches per 100,000 adults to inflation, and inflation to the ratio of total loans to GDP. Further findings in this study's macroeconomic or control variables (exchange rate, lending interest rate, and money supply) through the VECM estimation only lending interest rate following the economic theory and previous studies. The result shows that lending interest rates are negatively related to inflation. Thus, the lending interest rate increase causes the economy to slow down and eventually reduces inflation in selected ASEAN countries. From the VECM result of financial inclusion and inflation as the proxy of monetary policy, it can be concluded that the effect of financial inclusion on inflation in the long-term and short-term is to accept the alternative hypothesis and reject the null hypothesis.

5. CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

This article used panel data on selected ASEAN countries (Indonesia, Malaysia, Singapore, Thailand, Philippines, Cambodia, Laos, Myanmar, and Vietnam) to investigate the relationship between financial inclusion and inflation, which served as a proxy of monetary policy effectiveness from 2010 to 2019. The study's objective is achieved by using the applied VECM method to estimate the impact of the index of financial inclusion on inflation (CPI).

Based on the VECM estimation results, the index of financial inclusion, which included access and usage dimensions, has a negative and statistically significant relationship with inflation in the long and short term. It implies that increasing financial inclusion has the potential to reduce inflation while also improving monetary policy transmission effectiveness significantly. Thus, financial inclusion benefits Indonesia, Malaysia, Singapore, Thailand, the Philippines, Cambodia, Laos, Myanmar, and Vietnam's monetary policy effectiveness in controlling inflation. Moreover, the index of financial inclusion has some role in explaining variations in monetary policy effectiveness by 25.49%.

From the Granger causality result, there is a two-way causality between the financial inclusion indicator, namely the ratio of total deposits to GDP with the monetary policy in selected ASEAN countries. It indicates that not only financial inclusion indicators can influence the monetary policy transmission in controlling inflation, but a monetary policy to reduce inflation also may influence several financial inclusion indicators. It can leverage the degree of financial inclusion in selected nine ASEAN countries.

This study suggests that monetary authorities and financial organizations must emphasize the link between financial inclusion and monetary policy objectives. As in the findings of this study, financial inclusion can help the effectiveness of monetary policy transmission in stabilizing price levels and controlling inflation. Therefore, advanced financial

inclusion can help policymakers formulate and implement monetary policy and eventually contribute to economic stability and sustainable growth.

Nowadays, data on financial inclusion is still very limited, including ASEAN countries such as Myanmar, Cambodia, and Lao PDR. Therefore, improvements are needed in terms of research and data on financial inclusion indicators. Lack of information from the supply and demand side will increase uncertainty and undermine the confidence of financial organizations in making financial inclusion a national strategy. Implementing financial inclusion in policies requires a better understanding of how financial inclusion can address policy issues through information and data.

This study has limitations in the data on financial inclusion indicators due to the limitations of secondary data. Further research should add indicators of financial inclusion in banking penetration so that research on financial inclusion is more extensive.

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