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Article

Indicators of banks and economic indicators on non-cash payments in ASEAN-7 countries

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Abstract: This research explores the intricate relationship between digitalization, economic development, and non-cash payments in the ASEAN-7 countries over a ten-year period from 2011 to 2020. Focusing on factors such as commercial bank branches, broad money, and inflation, the study employs panel data regression analysis to investigate their impact on automated teller machine (ATM) usage. The findings reveal that commercial bank branches significantly influence ATM usage, emphasizing the role of accessibility, services, and technological preferences. Broad money also shows a significant impact on ATM transactions, reflecting the interplay between fund availability and non-cash transactions. However, inflation does not exhibit a direct influence on ATM usage. The research underscores the importance of maintaining service quality and security in the banking sector to enhance digital financial inclusion. Future research opportunities include exploring diverse non-cash payment methods and extending studies to countries with significant global economic impacts. This research contributes valuable insights to policymakers aiming to enhance digital financial inclusion policies, ultimately fostering economic growth through the digital economy in the ASEAN-7 region.

Keywords: digitalization; economic development; ASEAN-7; non-cash payments; automated teller machines (ATMs); commercial bank branches; broad money; inflation; panel data regression analysis

1. Introduction

According to Awali (2020), the economic sector is the most crucial sector as it is directly related to human survival. In the process of economic development, digitalization has become an integral part, bringing about significant impacts on economic activities. In order to improve the quality and the usage of digital finance, Mikhaylov (2023) mentioned that government need to implicate the digital financial regulation rather comparable to traditional financial regulation that already exist. Alongside technological advancements, particularly the Internet of Things (IoT), it has also had a substantial impact on digital activities worldwide, including ASEAN countries. Singapore, Malaysia, and the Philippines are countries that have experienced rapid growth in digital transactions (Paryadi, 2016). In succession, in 2021, Singapore, Malaysia, and the Philippines had smartphone users at 96.9%, 96.8%, and 74.22%, respectively. Apart from these three ASEAN countries, Vietnam and Indonesia have the highest number of smartphone users globally. In 2021, Vietnam recorded 74.2% users, while Indonesia also ranked as a country with a significant smartphone user base at 62.1%. Additionally, Laos and Myanmar had internet users at 62% and 43.3%, respectively, in 2021.

In addition to digital penetration in ASEAN countries, based on **Figure 1**, it can be observed that Indonesia has the largest number of internet users compared to other ASEAN countries, totaling 194 billion in 2020. Furthermore, it is estimated that by 2025, Indonesia is predicted to generate a digital economy worth US$ 133 billion. Malaysia and Singapore, on the other hand, have the lowest number of internet users among ASEAN countries, reaching only 29 billion and 5 billion, respectively. However, Malaysia and Singapore have the highest digital penetration rates, standing at 89% and 88%, respectively.

In contrast to the five ASEAN countries mentioned, Laos and Myanmar are ASEAN nations with low levels of digital penetration. Their respective digital penetration rates in 2020 were only 42% and 40.8% (World Bank, 2022). As noted by Safril et al. (2016), Myanmar has a workforce with low competency in the information technology sector. Additionally, Laos and Myanmar have the lowest per capita incomes in ASEAN, making it challenging for their populations to afford internet data packages (Safril et al., 2016).

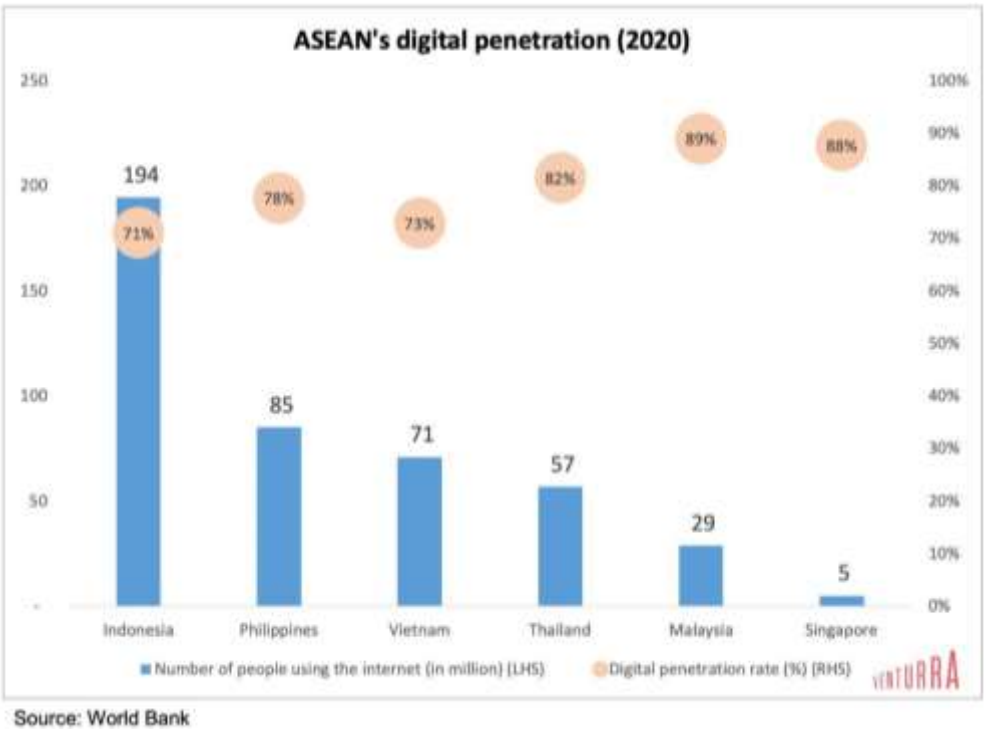

Figure 1. Digital penetration in ASEAN in 2020.
Source: World Bank (2022).

As previously mentioned, digital penetration determines how productive a country is in utilizing the internet, such as in the use of e-commerce and non-cash payments. According to Chen et al. (2019), non-cash payment refers to all transactions made using digital payments and cards (both credit and debit). Non-cash payments are considered a more impactful digital activity compared to the use of e-commerce in the digital development process. This is because non-cash payments can be applied to all transactions or economic activities of society, including e-commerce transactions. Saroy et al. (2023) argue that the use of non-cash payments in Indian banks can enhance banking efficiency. This is supported by previous research indicating that

non-cash payments can improve efficiency and security in companies in the Czech Republic (Srivastava, 2019).

According to World Bank data (2022), non-cash payments in ASEAN countries have shown significant progress. As noted by Sinay et al. (2021), the number of ATMs in ASEAN nations has increased, accompanied by a rise in the number of e-wallet users. ATMs are still deemed necessary amid the surge in digital payments, as they are considered a non-cash payment facility that provides convenience to the public, given the significant ICT infrastructure gap in ASEAN (L. Q. T. Tran and Nguyen, 2022; Q. D. Tran and Huynh, 2022). Additionally, according to Aslam et al., (2019), ATMs not only offer convenience but also enhance transaction security.

In addition to ATMs, non-cash payments are closely related to smartphone ownership. Smartphones enable individuals to conduct transactions more easily through digital payment methods like mobile banking and e-banking. According to Lei et al. (2022), smartphone ownership is negatively correlated with ATM usage, meaning that the higher the smartphone ownership, the lower the ATM usage. However, according to Gupta et al. (2022), Msamba et al. (2022), ATMs remain a popular choice among the public due to the convenience they offer and their accessibility to individuals of all socioeconomic levels (reliability).

Furthermore, based on the research findings of Kredina et al. (2022) also added in their study that the number of bank branch offices is not correlated with the number of ATMs, as there are often more ATMs than bank branches. However, according to Petkov (2023), bank branch offices are still crucial for increasing financial inclusion through the services they provide. Therefore, the number of bank branch offices, with all their functions, will also impact the usage of ATMs and non-cash payments. According to Chen et al. (2019), factors influencing non-cash payments in Asian countries include the penetration of digital payments and debit cards. This means that deeper digital payment and debit card penetration will increase the use of non-cash payments. Additionally, based on the research findings of Mwatsika (2016) ATMs provide satisfaction to banking consumers in Malawi. This demonstrates that ATMs remain a positive choice for transactions in the community.

This research aims to analyze the impact of banking factors, specifically the number of bank branches, and economic indicators such as inflation and broad money, on the level of non-cash payments (the number of ATMs) in ASEAN-7. Furthermore, for comprehensive results, this study also includes the variable of smartphone ownership to determine whether digital payments have an influence on ATM transactions. This research is expected to make a positive contribution to the government's efforts to enhance the quality of digital financial inclusion policies, ultimately contributing to economic growth through the digital economy. The structure of this research body is introduction, review of literature, methodology, findings and conclusion.

2. Review of literature

2.1. Quantity theory of money

The theory of the quantity of money was first introduced in 1911 by American economist Irving Fisher in his book titled "The Purchasing Power of Money". Fisher

explained that the quantity theory of money states that nominal income results from the combination of the amount of money in circulation and the velocity of money (D. Anggraini and Rahayu, 2022). This theory relies on quantitative analysis and combines the principles of long-term money neutrality with monetary theory that emerged in response to changes in the economy through adjustments in short-term interest rates (Dimand and Betancourt, 2012). Bank Indonesia has stated that the payment system plays a crucial role in facilitating economic activities for both the public and businesses. The maintenance of financial system infrastructure through the operation of the payment system is a crucial factor in promoting financial and monetary stability. In Indonesia, there are monetary aggregates known as M1 or narrow money and M2 or broad money (Istanto and Fauzie, 2014).

In their research (Agusmianata et al., 2018), various forms of money are mentioned. The first is "uang kartal", which refers to physical cash made of paper and metal issued by the central bank. Next is "uang giral", which pertains to the recorded deposit balances in banks that create "uang giral". These balances can be withdrawn at any time without penalty and are equivalent in value to their nominal amount. They can also be exchanged for "uang kartal". According to Boediono (1982), both "uang kartal" and "uang giral" fall under the category of M1 or narrow money.

According to Agusmianata et al. (2018), the third type of money is quasi-money, which consists of documents or certificates that have value and can be used as valid means of payment but are less liquid. Examples include time deposits, fixed-term deposits in local currency, foreign currency demand deposits, deposit certificates, and the like. Quasi-money is categorized under M2 or broad money. According to Utami & Suryaningsih (2011), M2 includes M1, quasi-money, and securities.

In a study conducted by Utami and Suryaningsih (2011) titled "Analysis of the Influence of M1 (narrow money) and M2 (broad money) on the Inflation Rate in Indonesia", it was found that narrow money has a significant negative influence on the inflation rate, whereas broad money has a significant positive influence on the inflation rate.

The Quantity Theory of Money posits that there is a direct relationship between an increase in the money supply and rising prices, or inflation, and that the growth of the money supply is a primary cause of inflation (F. P. Anggraini and Setiawan, 2021). In research conducted by (Prasasti and Slamet, 2020), it is explained that an increase in the money supply is the primary determinant of the inflation rate.

As a result, the supervision of money circulation is an essential aspect that needs to be carried out by Bank Indonesia, given its wide-ranging implications for other macroeconomic variables. According to Prasasti and Slamet (2020), in their research, they found that inflation is fundamentally a complex economic phenomenon.

Some highly influential impacts of inflation include income and wealth redistribution among different groups and distortions in relative prices and the output of different goods. Various efforts have been made by the government to control the inflation rate.

2.2. Payment system theory

According to Law Number 23 of 1999 concerning Bank Indonesia, Article 1 point

6 states that the Payment System refers to a system consisting of a set of rules, institutions, and mechanisms used to carry out fund transfers with the aim of fulfilling obligations arising from economic activities. According to Abidin (2015), the payment system in society must ensure efficient and secure money transfers so that people can feel comfortable conducting transactions in their economic activities. According to Bank Indonesia (2019), the term "payment system" refers to a system consisting of a set of rules, institutions, and mechanisms used to transfer funds with the aim of fulfilling obligations arising from economic activities. The concept of the payment system emerged alongside the concept of "money" as a medium of exchange or intermediary in transactions involving goods, services, and finance. In principle, the payment system involves three processing stages, including authorization, clearing, and final settlement.

2.3. Cash payment

According to Solikin and Suseno (2002), a cash payment system can be defined as a system where the instruments used are physical forms of money, such as paper currency and coins, which are used in the process of purchasing goods or services. Meanwhile, money is defined as an object with intrinsic value that serves as a medium for conducting transactions or exchanging goods and services. In a study conducted by Muhammad (2021), it is concluded that cash plays several important roles in the economic system. Firstly, cash serves as a medium of exchange, allowing the exchange of desired goods and services using money. Additionally, cash also functions as a store of value, enabling individuals to save or store money for future use. Furthermore, cash acts as a unit of account, facilitating calculations and record-keeping in various transactions. Lastly, cash also serves as a standard for deferred payment, making borrowing and lending transactions easier.

2.4. Non-cash payment

In recent years, the role of cash as the primary means of payment has undergone significant changes due to advancements in non-cash payment systems, which are considered more cost-effective and efficient (Permatasari and Purwohandoko, 2020). The improvement of these payment systems is supported by the use of Payment Cards (APMK), which include the use of ATM/debit cards and credit cards in the payment process (Lintangsari et al., 2018).

According to research conducted by Lubis (2019), non-cash payment systems refer to a framework involving regulation, contracts, expertise, and infrastructure as means to facilitate the processes of sending, validating, and instructing payments, with the goal of simplifying the exchange of "value" among individuals and other entities, such as banks, domestic institutions, and international institutions. In non-cash payment systems, various instruments are used to conduct transactions, including Payment Cards (APMK), checks, promissory notes, debit notes, as well as electronic money in card-based and server-based forms (Bank Indonesia, 2019). In the advancement of non-cash payment systems, there is no specific indicator that can be used for precise measurement. However, in various previous studies, the development of non-cash payments is generally measured based on transaction volume data

conducted through payment instruments such as ATM/debit cards and credit cards (Lintangsari et al., 2018).

The increased use of non-cash transactions can lead to a reduction in the costs of printing and circulating paper currency. When individuals conduct transactions using electronic payment facilities with a certain amount of money, the payment process becomes faster, and the funds used in that transaction can be reused for subsequent transactions by the recipient of the funds from the previous transaction (Salimah and Wahyuningsih, 2020).

3. Research hypothesis

There are several theories supporting the influence of Commercial Bank Branches on ATMs, namely Trust Theory: The presence of commercial bank branches can enhance public trust in the banking system and banking technology such as ATMs. Physical bank branches provide a sense of trust and security to customers, making them more comfortable using ATMs. Reach Theory: This theory argues that the extensive presence of commercial bank branches can expand the reach of banking services. Although ATMs provide access to both cash and non-cash transactions, bank branches still play a crucial role in providing more complex services such as financial consultations, managing complex accounts, and handling special requests. Therefore, the widespread presence of bank branches can increase the number and usage of ATMs.

Furthermore, there's the Complementarity Theory, which states that the presence of commercial bank branches and ATMs complement each other. Bank branches provide direct services to customers, while ATMs offer 24/7 access to cash and non-cash transactions. The combination of bank branches and ATMs provides customers with a broader range of options for accessing banking services, thereby increasing ATM usage. The Efficiency Theory argues that the presence of commercial bank branches can drive ATM usage to enhance operational efficiency. By providing ATM facilities to customers, banks can reduce the workload at physical branches and expedite transaction processes. This can reduce the time customers spend in queues and improve the efficiency of ATM usage.

There is previous research supporting this hypothesis, as demonstrated by Petkov (2023), which shows that bank branch offices are still crucial for increasing financial inclusion through the services they provide. Therefore, the number of bank branch offices, with all their functions, will certainly have an impact on the level of transactions at ATMs and non-cash payments. A similar study was conducted by Humphrey (1994), who found a positive and statistically significant relationship between bank branch offices and the intensity of ATM usage. Therefore, the hypothesis for the variable "commercial bank branches" is formulated as follows:

H1: Commercial Bank Branches have an influence on Automated Teller Machines (ATM).

There are several theories that support the influence of Broad Money on ATM usage, including the Financial Intermediation Theory. This theory states that financial institutions, including commercial banks that provide ATMs, play a role in intermediating between fund providers (depositors) and fund recipients (borrowers or

spenders). ATMs help provide access to cash or non-cash transactions to bank customers, which is part of financial intermediation activities. However, this theory does not directly address the influence of "Broad Money" on ATM usage.

Furthermore, there's the Liquidity Preference Theory, which suggests that people tend to have a preference for easily accessible liquidity or cash. ATMs provide easy and quick access to cash, fulfilling individuals' liquidity needs. If the amount of "Broad Money" increases in the economy, theoretically, the availability of cash may also increase, which can affect the demand and usage of ATMs. However, this theory is more focused on individual preferences for liquidity rather than the direct relationship between "Broad Money" and ATM usage.

There is previous research supporting this hypothesis, conducted by Kredina et al. (2022) which found a strong, positive, and significant correlation between Broad Money and ATM in 2007 and 2008, while in 2019 and 2020, the relationship between the two completely disappeared. Similar research was also conducted by Afifah (2017), who found a positive relationship between M2/Broad Money and ATM in both the short and long term. Based on this explanation, the proposed hypothesis for the broad money variable is:

H2: Broad Money influences Automated Teller Machines (ATM).

There are two economic theories indirectly related to ATM usage. First, the Liquidity Preference Theory states that individuals tend to have a preference for liquidity or easily accessible cash. In situations of inflation, where prices tend to rise, the demand for cash may increase because people want immediate access to money for daily needs. In this case, ATM usage may increase as it is one of the convenient ways to access cash during inflation. Second, the Exchange Theory focuses on the relationship between the supply and demand for money in economic transactions. In times of inflation, where prices are rising, people tend to use more cash for everyday purchases. ATM usage can increase in this scenario due to the increased demand for cash and the need to make cash withdrawals more frequently.

There is previous research that supports this hypothesis, conducted by (Kouladoum et al., 2022) titled "The Impact of Digital Technology on Financial Inclusion", which shows that inflation has a positive impact on the number of automated teller machines. Similarly, according to the research by Hidayat (n.d.), it was found that there is a significant relationship between non-cash payments (ATM) and inflation. Therefore, based on the explanation, the hypothesis formed for the inflation variable is:

H3: Inflation affects Automated Teller Machines (ATM).

4. Methodology

4.1. Type of research

This research employs quantitative descriptive analysis. Descriptive analysis involves defining, classifying, and categorizing phenomena and their relationships (Amir et al., 2009). Meanwhile, quantitative research is a type of research that utilizes numerical data and is analyzed using statistical tools (Sugiyono, 2017). In brief, this research uses numerical data that can be easily classified or categorized and is analyzed using statistical methods.

4.2. Operational definition of variables

This study employs four variables, which are Automated Teller Machines (ATM), Commercial Bank Branches (CBB), Broad Money (BM), and Inflation. Each variable is described in **Table 1**.

Table 1. Operational definition of variables.

Variable	Operational Definition	Unit	Data Source
ATM (Automated Teller Machines)	ATM is a computerized telecommunications device that provides clients of financial institutions access to financial transactions in public places.	Per 100.000 adults	World Bank https://databank.worldbank.org
CBB (Commercial Bank Branches)	CBB are retail locations of commercial banks and other resident banks that function as commercial banks providing financial services to customers and are physically separate from the headquarters but not legally regulated as separate subsidiaries.	Per 100.000 adults	World Bank https://databank.worldbank.org
BM (Broad Money)	BM is the sum of currency outside banks; demand deposits other than those of the central government; time, savings, and foreign currency deposits of residents other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and bonds.	% of GDP	World Bank https://databank.worldbank.org
Inflation, Consumer prices	Inflation is measured by CPI, which represents the annual percentage change in the average cost for consumers to obtain a fixed basket of goods and services at a particular interval.	Annual %	World Bank https://databank.worldbank.org

4.3. Research sample

The population used in this study consists of the ASEAN countries. There are 7 out of the 11 ASEAN member countries that are sampled in this study, including Indonesia, Malaysia, Singapore, the Philippines, Brunei Darussalam, Vietnam, and Cambodia. Other ASEAN member countries are not included in this study due to limitations in data availability for some variables published up to the time this research was conducted. These excluded countries are Myanmar, Laos, Thailand, and Timor-Leste.

4.4. Research period

The estimation period used in this study is 10 years, from 2011 to 2020. This period was chosen because during these years, there were developments in non-cash payments in ASEAN countries. Additionally, in 2019-2020, non-cash payments were observed to have significantly expanded due to the COVID-19 pandemic.

4.5. Data collection method

This research uses secondary data with the dependent variable being Automated Teller Machines (ATM). This study is also an extension of previous research conducted by Kredina et al. (2022) which discussed the influence of mobile cellular subscriptions, commercial bank branches, broad money, and inflation on Automated Teller Machines. Meanwhile, the independent variables are commercial bank branches, broad money, and inflation obtained from the World Bank.

4.6. Data analysis method

This research method utilizes panel data regression analysis, combining cross-sectional and time-series data. E-views 9 software is employed for analyzing the effects of non-cash payments (ATM), the bank indicator (CBB), and economic indicators (BM and Inflation). In testing the panel data regression method, there are several steps to be taken, including:

1) Model Selection Test (Common, Fixed, Random)

There are three model approaches used in panel data analysis: Pooled Least Square or common effect model (CEM), fixed effect model (FEM), and random effect model (REM). To determine the most optimal model, the steps to follow can be found in **Table 2**:

Table 2. Significance testing of panel model.

No.	Significance Testing of the Model	Test Formula	Description	Decision
1.	CE or FE	Chow Test	Reject H0 if the Cross-Section F probability is less than 0.05.	FE is better than CE
2.	FE or RE	Hausman Test	Reject H0 if the probability of Breusch-Pagan test is less than 0.05.	FE is better than RE
3.	CE or RE	Lagrange Multiplier Test	Reject H0 if the probability of Breusch-Pagan test is less than 0.05.	RE is better than CE

a) Chow Test

The Chow test is a testing method used to determine whether the model used is a common effect or fixed effect model. The testing procedure involves the following hypotheses:

- H0: Common effect model
- H1: Fixed effect model

The basis for rejecting the null hypothesis is done using the Chow statistic (*F*-statistic) which is calculated and follows an *F*-distribution with degrees of freedom (*df*) equal to n − 1 for the numerator. If the calculated *F*-statistic is greater than the critical *F*-table value, then H0 will be rejected. Therefore, it can be concluded that the panel data regression technique with fixed effect performs better than the common effect.

b) Hausman Test

The Hausman test is a statistical test used as a basis for selecting the best model between the fixed effect or random effect model in panel data analysis. This test is formulated with the following hypotheses:

- H0: Random effect model
- H1: Fixed effect model

Rejection of the null hypothesis (H0) can be done using the Hausman statistic compared to the critical value of the chi-square distribution. If the Hausman test result exceeds the critical value of the chi-square statistic, then H0 is rejected. This indicates that the appropriate estimation for panel data regression is the fixed effect model. Conversely, if the Hausman test result does not exceed the critical value of the chi-square statistic, H0 is accepted, which means the random effect model is more suitable for panel data regression estimation.

c) Lagrange Multiplier Test (LM Test)

The Lagrange Multiplier test aims to determine the choice between using a common effect model or a random effect model. This test is conducted by formulating the hypotheses as follows:

- H0: Common effect model
- H1: Random effect model

The LM test is based on the Breusch-Pagan probability. If the Breusch-Pagan probability value is less than the alpha value, then H0 is rejected, which means that the appropriate estimation for panel data regression is the random effect model, and vice versa.

2) Classic Assumption Test

a) Normality Test

The normality test is used to verify the adequacy of the normal distribution of the adjusted residual values in the regression model. Data will be considered normally distributed if the probability value is > 0.05.

b) Multicollinearity Test

The multicollinearity test is conducted to evaluate whether there is a significant or perfect correlation between independent variables in the regression model. If there is a strong correlation between the independent variables, it can be concluded that there is multicollinearity in this research. The multicollinearity test is conducted using the Pair Wise Correlation method, and if the Correlation Coefficient value is < 0.80, there is no multicollinearity.

c) Heteroskedasticity Test

Heteroskedasticity testing aims to identify the presence or absence of violations of classical assumptions. Heteroskedasticity refers to the non-uniformity of the variance of residuals across all observations in the regression model. The requirement in the regression model is the absence of heteroskedasticity indications. Application to the Glejser heteroskedasticity test:

- When the *p*-value > 0.05: there is no heteroskedasticity
- When the *p*-value < 0.05: there is heteroskedasticity

The next step before entering hypothesis testing is to analyze panel data regression. The equation model is as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e \quad (1)$$

where:

Y = Automated Teller Machines (ATMs)

α = Alpha

β_(1)-β_(4) = Regression Coefficient

X_(1) = Mobile Cellular Subscription (MCS)

X_(2) = Commercial Bank Branches (CBB)

X_(3) = Broad Money (BM)

X_(4) = Inflation (Inf)

e = Error

3) Hypotheses Test

a) Partial Test (*T* Test)

Uji The *T*-Test refers to the testing method used to evaluate the significance of the influence of independent variables (*X*) on the dependent variable (*Y*) by comparing the significance value (*p*-value). Here are the criteria for the *T*-Test:

- When the *p*-value is < 0.05, H0 is rejected, and Ha is accepted, meaning the independent variable affects the dependent variable.
- When the *p*-value is > 0.05, H0 is accepted, and Ha is rejected, meaning the independent variable does not affect the dependent variable.

b) Simultaneous Test (*F* Test)

The *F*-Test is a method used in this study to determine whether there is a joint influence of all independent variables on the dependent variable by comparing the calculated *F*-statistic with the critical *F*-value. Here are the criteria used in the *F*-Test:

- When the *p*-value is < 0.05, Ha is accepted, and H0 is rejected, meaning the independent variables collectively influence the dependent variable.
- When the *p*-value is > 0.05, Ha is rejected, and H0 is accepted, meaning the independent variables collectively do not influence the dependent variable.

c) Coefficient of Determination (*R* Squared)

The coefficient of determination, or the model fitness test, is a test used to evaluate the ability of independent variables to explain the dependent variable. The range of *R*-squared values is between 0.00 and 0.99, and the closer it is to 1.00, the more suitable a model is considered to be.

5. Findings (also called results)

5.1. Descriptive analysis

Based on the table output 3, it can be concluded that N (the number of data points for each variable) is 70. This number comes from the 7 samples in this study, which are the ASEAN-7 countries from 2011 to 2020. Based on the **Table 3**, it can also be seen that X1 (Commercial Bank Branches) has a minimum value of 3.100000 and a maximum value of 23.17000. These values indicate that the range of Commercial Bank Branches values sampled in this study covers a range from 3.100000 to 23.17000, with an average value of 130.5811 and a standard deviation of 5.403301. The highest number of Commercial Bank Branches is in Brunei in 2011, while the lowest number occurred in Vietnam in 2012.

Table 3. Descriptive analysis.

	X1	X2	X3	Y
Mean	10.69271	90.97657	2.724143	43.06914
Median	9.065000	87.43500	2.625000	50.42500
Maximum	23.17000	150.2900	18.68000	92.69000
Minimum	3.100000	36.74000	−1.260000	6.030000
Std. Dev.	5.477595	34.53818	2.848640	22.33648
Skewness	0.637558	−0.077359	2.629088	0.169515
Kurtosis	2.437924	1.650586	15.37696	1.918296
Jarque-Bera	5.663734	5.380829	527.4432	3.747988
Probability	0.058903	0.067853	0.000000	0.153509
Sum	748.4900	6368.360	190.6900	3014.840
Sum Sq. Dev.	2070.280	82309.11	559.9179	34425.36
Observations	70	70	70	70

Source: Processed data on Eviews 9.

Furthermore, based on the presented **Table 3**, it can be concluded that variable X2, which is broad money, has a minimum value of 36.74000 and a maximum value of 150.2900. This finding depicts the variation in broad money values sampled in this study, which ranges from 36.74000 to 150.2900, with an average value of 90.92738 and a standard deviation of 34.53818. The highest broad money value occurred in Singapore in 2020, while the lowest value occurred in Indonesia in 2011.

Next, based on the **Table 3**, it can be concluded that for variable X3, inflation has a minimum value of −1.260000 and a maximum value of 18.68000. This finding indicates that the sampled inflation values in this study range from −1.260000 to 18.68000, with an average of 2.724143 and a standard deviation of 2.848640. The highest inflation occurred in Vietnam in 2011, while the lowest inflation occurred in Brunei in 2017.

Based on the presented **Table 3**, it can be found that variable Y, which is ATM usage, has a minimum value of 6.030000 and a maximum value of 92.69000. This depicts that in this study, ATM usage has a range of values from 6.030000 to 92.69000, with an average usage of 43.06914 and a standard deviation of 22.33648. It's worth noting that the highest ATM usage was recorded in Brunei in 2012, while the lowest value occurred in Cambodia in 2011.

5.2. Model selection test

Chow Test:

Table 4. Chow test result.

Effects Test	Statistic	d.f.	Prob.
Cross-section F	26.118296	(6.60)	0.0000
Cross-section Chi-square	89.895012	6	0.0000

Source: Processed data on Eviews 9.

Based on the findings of the Chow test conducted (see **Table 4**), it can be concluded that the obtained probability, which is 0.0000 < 0.05, indicates that the selected model is the Fixed Effect model.

Hausman Test:

Table 5. Hausman test result.

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	17.720495	3	0.0005

Source: Processed data on Eviews 9.

Based on the Hausman test result in **Table 5**, it can be concluded that the obtained probability, which is 0.0005 < 0.05, indicates that the selected model is the Fixed Effect model.

Lagrange Multiplier Test:

Table 6. Lagrange multiplier test result.

	Test Hypothesis		
	Cross-section	**Time**	**Both**
Breusch-Pagan	31.21401	2.565529	33.77954
	(0.0000)	(0.1092)	(0.0000)

Source: Processed data on Eviews 9.

Based on the Lagrange multiplier test result in **Table 6**, it can be concluded that the obtained probability, which is 0.0000 < 0.05, indicates that the selected model is the Random Effect model. To choose the best model among the three techniques, namely CEM, FEM, and REM, a Chow, Hausman, and Lagrange Multiplier test is required. The conclusion from the test results of these three models is as follows:

From the summary **Table 7**, it can be determined that the chosen model is the REM or Random Effect model.

Table 7. Conclusion of model selection test.

Test	**Provisions**	**Conclusion**
Chow	H0: The appropriate model is CEM (probability value > 0.05) H1: The appropriate model is FEM (probability value < 0.05)	0.0000 < 0.05 (FEM)
Hausman	H0: The appropriate model is REM (probability value > 0.05) H1: The appropriate model is FEM (probability value < 0.05)	0.0005 < 0.05 (FEM)
Lagrange Multiplier	H0: The appropriate model is CEM (probability value > 0.05) H1: The appropriate model is REM (probability value < 0.05)	0.0000 < 0.05 (REM)

Source: Processed data by author.

5.3. Classic assumption test

Normality Test:

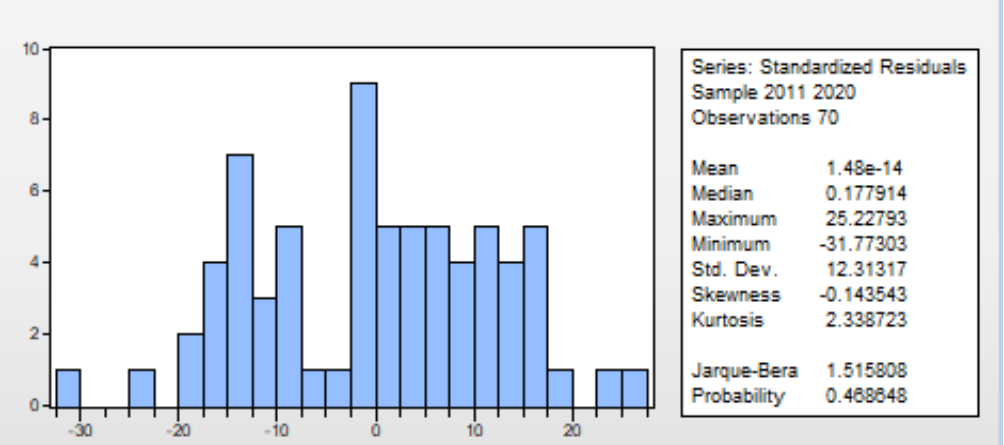

Figure 2. Normality test estimation test.

Source: Processed data on Eviews 9.

Based on the normality test in **Figure 2**, the probability is 0.468648 > 0.05, which means the data is normally distributed.

Multicollinearity Test:

Table 8. Multicollinearity test result.

	X1	X2	X3
X1	1.000000	−0.410711	−0.293513
X2	−0.410711	1.000000	−0.265643
X3	−0.293513	−0.265643	1.000000

Source: Processed data on Eviews 9.

To find out whether or not there is multicollinearity in the regression model, it can be seen from the tolerance value and the variance inflation factor (VIF) value (see **Table 8**), it shows the correlation between independent variables. The correlation between X1 and X2 is −0.410711, which is less than 0.8, indicating that there is no multicollinearity between variable X1 (commercial bank branches) and X2 (broad money). The correlation between X1 and X3 is −0.293513, which is less than 0.8, indicating that there is no multicollinearity between variable X1 (commercial bank branches) and X3 (inflation). The correlation between X2 and X3 is −0.265643, which is less than 0.8, indicating that there is no multicollinearity between variable X2 (broad money) and X3 (inflation).

Heteroskedasticity Test:

Table 9. Heteroskedasticity test result.

Variable	Coefficiet	Std. Error	t-Statistic	Prob.
C	8.520819	5.329528	1.598795	0.1146
X1	−0.012694	0.277591	−0.045729	0.9637
X2	0.013275	0.036266	0.366043	0.7155
X3	0.218857	0.272413	0.803400	0.4246

Source: Processed data on Eviews 9.

Based on the results in **Table 9**, it can be observed that the probability values for $x1$, $x2$, $x3$, and $x4$ are > 0.05, which means there is no heteroskedasticity present.

5.4. Regression analysis of panel data

Table 10. Panel data regression analysis result.

Variable	Coefficiet	Std. Error	t-Statistic	Prob.
C	5.156553	6.050754	0.852217	0.3972
X1	2.841934	0.340147	8.355005	0.0000
X2	0.095201	0.040858	2.330060	0.0229
X3	−0.417173	0.285657	−1.460396	0.1489

Source: Processed data on Eviews 9.

Based on the regression analysis result in **Table 10**, so the equation of panel data regression analysis is built as below:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e$$
$$Y = 5.156553 + 2.841934 X_1 + 0.095201 X_2 + -0.417173 X_3 + e \quad (2)$$

5.5. Hypothesis test

T-Test (Partial):

Based on the output result in **Table 11**, it can be observed that the probability value for variable *X*1 is 0.0000, which is < 0.05, indicating that variable *X*1 (commercial bank branches) has a significant effect on variable *Y* (automated teller machine). The probability value for variable *X*2 is 0.0229, which is < 0.05, indicating that variable *X*2 (broad money) significantly influences variable *Y* (automated teller machine). The probability value for variable *X*3 is 0.1489, which is greater than 0.05, indicating that variable *X*3 (inflation) does not significantly influence variable *Y* (automated teller machine).

Table 11. *T*-test result.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	2.841934	0.340147	8.355005	0.0000
X2	0.095201	0.040858	2.330060	0.0229
X3	−0.417173	0.285657	−1.460396	0.1489

Source: Processed data on Eviews 9.

F-Test:

Based on the output in the **Table 12**, the probability value (*F*-statistic) is 0.000000, which indicates it is smaller than 0.05. Therefore, H0 is rejected and Ha is accepted, meaning that the independent variables (*X*) collectively have a significant effect on the dependent variable (*Y*).

Table 12. *F*-test result.

R-squared	0.509954	**Mean dependent var**	9.979651
Adjusted R-squared	0.487679	**S.D. dependent var**	7.848775
S.E. of regression	5.617888	**Sum squared resid**	2083.004
F-statistic	22.89372	**Durbin-Watson stat**	0.546066
Prob (F-statistic)	0.000000		

Source: Processed data on Eviews 9.

Coefficient of determination (*R*-squared):

Table 13. Coefficient of determination test result.

***R*-squared**	0.509954	**Mean dependent var**	9.979651
Adjusted R-squared	0.487679	**S.D. dependent var**	7.848775
S.E. of regression	5.617888	**Sum squared resid**	2083.004
F-statistic	22.89372	**Durbin-Watson stat**	0.546066
Prob (F-statistic)	0.000000		

Source: Processed data on Eviews 9.

Based on the output in the **Table 13**, the Adjusted *R*-squared value in this study

is 48.76%, meaning that 51.24% is explained by variables outside the model in this study. Therefore, further research is needed to examine variables that have not been investigated in this study.

6. Discussion

6.1. The influence of commercial bank branches on automated teller machines (ATM)

Based on the results of the panel data regression analysis, it was found that the regression coefficient value of *X*1 is 2.8419340 with a probability value of 0.0000 < 0.05. This indicates that the variable Commercial Bank Branches has a significant positive influence on Automated Teller Machines (ATM). In other words, the higher the number of Commercial Bank Branches, the higher the usage of Automated Teller Machines (ATM). This finding supports previous research by Petkov (2023), which showed that bank branches are still essential for increasing financial inclusion through the services they provide. Therefore, the number of bank branches and their functions have an impact on the level of transactions in ATMs and non-cash payments.

Based on the **Figure 3**, it can be seen that the highest number of commercial bank branches is in Indonesia and Brunei, followed by Cambodia, Malaysia, and the Philippines. The lowest number of commercial bank branches is in Vietnam. According to the research findings, the number of commercial bank branches does influence the usage of ATMs in these countries. The more commercial bank branches a country has, the higher the number of ATM users.

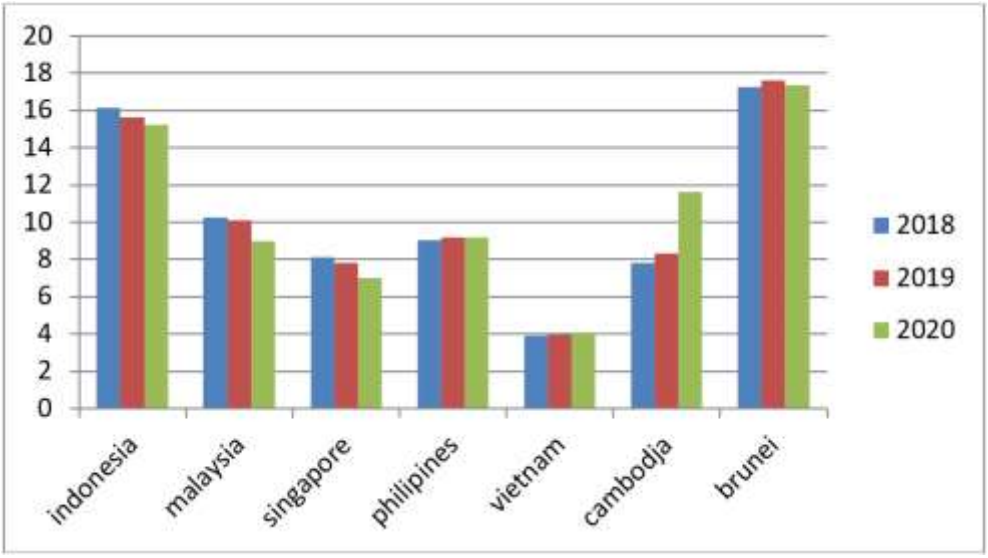

Figure 3. The number of commercial bank branches in the 7 ASEAN countries.

Commercial bank branches can influence the usage of ATMs through several ways as follows:

1) Accessibility and Location: The number and location of commercial bank branches can impact ATM usage. If there are many commercial bank branches scattered across various regions, people will have easy access to visit these branches and conduct transactions directly with tellers. In this situation, ATM

usage may not be very high because people prefer using in-branch services. However, if bank branches are limited or located far from residences or workplaces, people are more likely to use ATMs as an alternative for their banking transactions.

2) 24-Hour Banking Services: ATMs are typically available for use 24 hours a day, 7 days a week. If commercial bank branches have limited operating hours, ATM usage can increase because people can access their funds or conduct banking transactions whenever needed outside of regular banking hours.
3) Convenience and Speed: ATM usage is typically faster and more convenient compared to waiting in long queues at a bank branch. If bank branches experience long queues or slow service, people may prefer to use ATMs to save time and receive quicker service.
4) Facilities and Features: ATMs can provide various features such as cash withdrawals, balance checks, fund transfers, bill payments, and more. If bank branches do not offer the same facilities or restrict certain types of transactions, people are more likely to use ATMs to meet their banking needs.
5) Behavioral Changes and Technology: ATM usage is also influenced by behavioral changes and technological advancements. People who are more inclined to adopt new technology and conduct electronic transactions may use ATMs more frequently as part of their digital lifestyle. On the other hand, if people still prefer to transact in person with a teller or are not accustomed to using banking technology, they may visit bank branches more often.

In conclusion, the usage of ATMs can be influenced by the number of commercial bank branches, accessibility, services, facilities, and technology preferences, as well as the behavior of the community. These factors play a role in determining whether people are more inclined to use ATMs or visit bank branches for their banking transactions.

6.2. Broad money has an impact on automated teller machines (ATM)

Based on the results of the panel data regression test, it was found that the regression coefficient of *X*2 is 0.095201 with a probability value of 0.0229, which is greater than 0.05. This means that the variable broad money significantly and positively affects Automated Teller Machines (ATM), indicating that the higher the level of broad money, the higher the usage of Automated Teller Machines (ATM). This study supports previous research by Kredina et al. (2022) that found a strong, positive, and significant correlation between Broad Money and ATM in 2007 and 2008.

Referring to the **Figure 4**, it shows that the highest level of broad money is found in Singapore. Based on data cited from the World Bank, Singapore also is the country with the highest smartphone ownership.

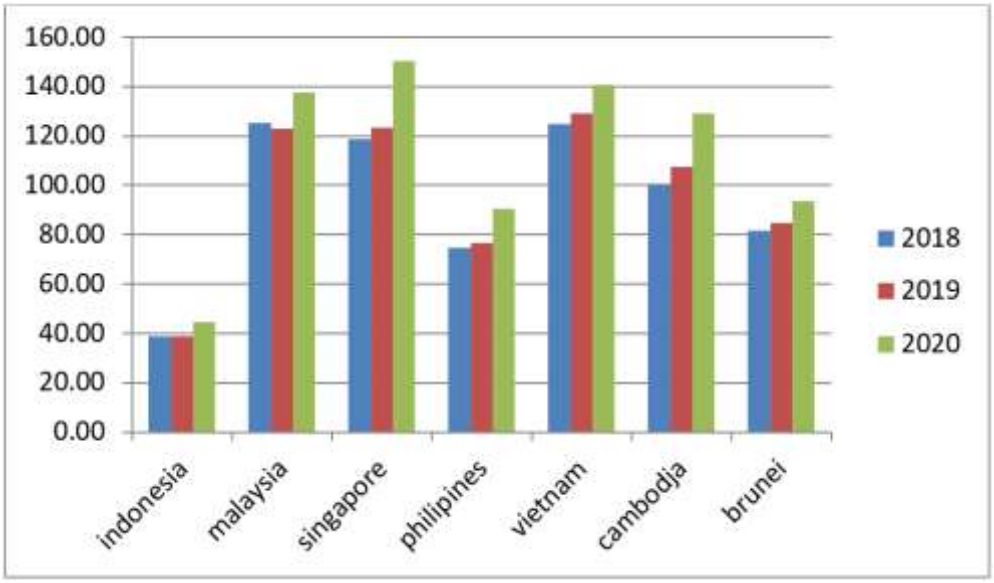

Figure 4. The level of broad money in the 7 ASEAN countries.

Broad money is a term used to describe the total amount of money circulating in an economy at a given time. This includes cash and deposits that are easily accessible to the public. The relationship between broad money and ATM usage can occur through the following mechanisms:

1) Availability of funds: The amount of broad money available in an economy can influence the amount of funds available to individuals or businesses. If broad money increases, it means there is more money available to the population as a whole. This can encourage ATM usage because people are more likely to withdraw cash from their accounts through ATMs for their daily expenses.
2) Accessibility to funds: ATM usage depends on the accessibility to funds that individuals possess. If the amount of cash available in someone's bank account increases due to an increase in broad money, then ATM usage can also increase. More people might use ATMs to withdraw cash regularly or for urgent needs.
3) Accessibility to funds: ATM usage depends on the accessibility to funds that individuals possess. If the amount of cash available in someone's bank account increases due to an increase in broad money, then ATM usage can also increase. More people might use ATMs to withdraw cash regularly or for urgent needs.

However, it's important to remember that ATM usage is also influenced by other factors such as technological advancements and individual preferences. While broad money can impact ATM usage overall, it's not the sole factor affecting ATM usage.

6.3. The influence of inflation on automated teller machines (ATM)

Based on the results of the panel data regression test, the coefficient value of $X3$ is −0.417173 with a probability value of 0.1489 < 0.05. This indicates that inflation has a negative impact on Automated Teller Machines (ATM), meaning that a higher inflation rate does not affect the usage of Automated Teller Machines (ATM). The findings of this study support previous research conducted by Ady (2016), who in their study did not find a significant impact of ATM card transactions (debit and credit) on inflation in Indonesia, because ATM instruments theoretically can influence inflation

if it goes through the money supply (M2/broad money) first.

Based on the **Figure 5**, it can be seen that the highest inflation rate is in the Philippines, especially in 2018, followed by Indonesia, Vietnam, Cambodia, Brunei, Malaysia, and Singapore as countries with the lowest inflation rates. According to the results of the research, the inflation rate in ASEAN-7 countries does not affect the number of ATM uses in that country.

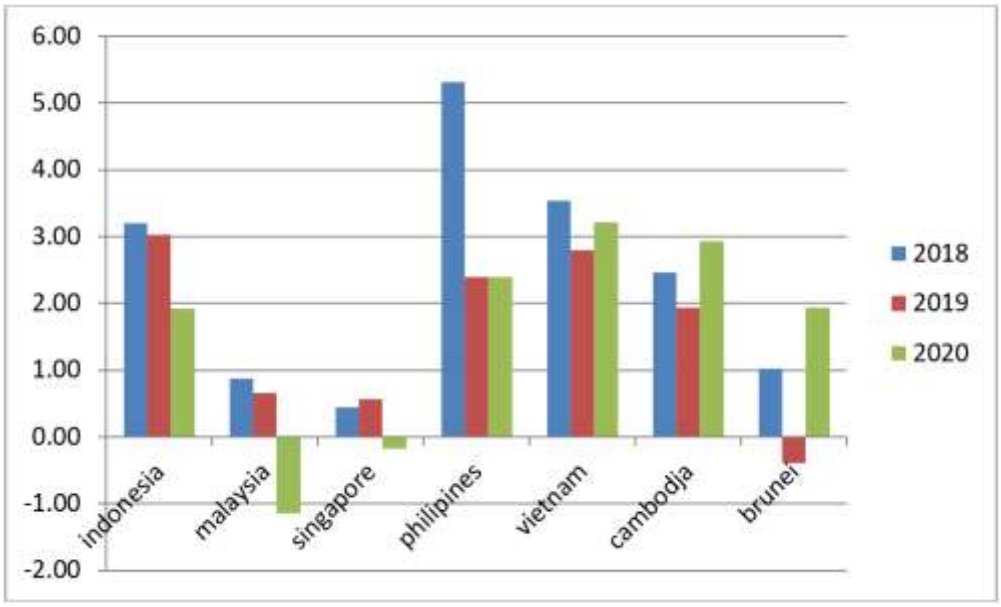

Figure 5. The inflation rate in 7 ASEAN countries.

Inflation is a general and sustained increase in the prices of goods and services in a country over a period of time. However, inflation does not directly affect the amount of ATM usage. Here are some reasons why inflation does not have a direct impact on ATM usage:

1) There is no direct relationship between inflation and ATM usage: Inflation is related to price changes in the market, while ATM usage is related to individual needs and preferences in conducting financial transactions. An increase in inflation does not directly affect the way people use ATMs.
2) Cashless transactions are more common: Cashless usage, including the use of debit or credit cards, transfers through online banking, and other digital payments, has become more common in recent years. This non-cash usage is not directly affected by inflation.
3) Inflation has no direct impact on banking infrastructure: While inflation may affect people's purchasing power and cost of living, there is no direct link to banking infrastructure, including ATMs. The number and accessibility of ATMs tend to be determined by business considerations, banking policies, and community needs, not by inflation.

While inflation does not have a direct influence on ATM usage, it can affect people's purchasing power and overall economic stability. This can impact individuals' spending decisions and their financial transactions in general.

7. Conclusion

The aim of this research was to investigate and analyze the influence of commercial bank branches, broad money, and inflation on automated teller machines (ATM) using panel data regression analysis. The results obtained in this study are as follows:

1) The number of ATM usages is significantly influenced by Commercial Bank Branches with a coefficient value of 2.8419340 and a probability value of 0.0000. The number of commercial bank branches can affect the usage of ATMs in ASEAN-7 countries because ATM usage can be influenced by the number of commercial bank branches, accessibility, services, facilities, technological preferences, and societal behavior. These factors play a role in determining whether people are more inclined to use ATMs or visit bank branches for their banking transactions.
2) The number of ATM usages is significantly influenced by Broad Money with a coefficient value of 0.095201 and a probability value of 0.0229. The broad money level can affect the usage of ATMs in ASEAN-7 countries because broad money and usage can occur through various mechanisms such as fund availability, accessibility to funds, and an increase in non-cash transactions. However, it is important to remember that ATM usage is also influenced by other factors such as technological advancements and individual preferences. While broad money can affect ATM usage overall, it is not the sole factor influencing ATM usage.
3) The number of ATM usages is not significantly influenced by inflation with a coefficient value of -0.417173 and a probability value of 0.1489. Inflation does not have a direct impact on ATM usage because there is no direct relationship between inflation and ATM usage. Inflation is related to individual needs and preferences in financial transactions. Although inflation does not have a direct impact on ATM usage, it can affect people’s purchasing power and overall economic stability. This can impact individuals' spending decisions and their financial transactions in general.

Based on the limitations of the study, recommendations for the governments of ASEAN-7 countries include providing facilities and improving their human resources to cope with digital transformation in non-cash payments. Banks are encouraged to maintain service quality that supports customer needs, ensure the security of customer transactions, and develop ATM user features.

Furthermore, for future researchers, they can conduct research on other non-cash payments such as e-money, e-wallets, QRIS, etc. Additionally, it is hoped that future researchers will be able to conduct studies involving countries with greater diversity and significant impacts on the global economy.

Authors contributions: Conceptualization, IN and AAM; methodology, AKP and MF; software, AKP and MF; validation, AKP, RAA and MF; formal analysis, SAP; investigation, SAP; resources, SAP; data curation, TLI; writing—original draft preparation, AAM; writing—review and editing, SAP; visualization, SAP; supervision, IN; project administration, TLI; funding acquisition, AAM, IN and SAP. All authors have read and agreed to the published version of the manuscript.

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