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Dynamic Financial Inclusion in ASEAN 8: Do Macroeconomics and Financial Technology Matter?

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Abstract: This study aims to estimate the effects of macroeconomic indicators and financial technology on financial inclusion in ASEAN 8 during 2010-2018. There are three financial inclusion indicators, which include debit card ownership (Model 1), credit card ownership (Model 2), and domestic credit to GDP ratio (Model 3). Furthermore, the dynamic panel is applied to demonstrate dynamic financial inclusion models. The findings show that the domestic credit to GDP ratio is influenced by the unemployment rate, inflation, and financial technology. In addition, Model 1 and 2 show that the FEM is a robust model, while Model 3 indicates that REM is a robust model. This study encourages governments in ASEAN 8 to manage macroeconomic indicators progressively and stably to expand equal financial inclusion for the community.

Keywords: Financial Inclusion; Macroeconomy; Financial Technology; Dynamic Panel

JEL Classification: C23; E58; G21; O33

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Introduction

Financial inclusion encourages and facilitates all individuals to engage in a broad and integrated financial system (Berry, 2015; Appleyard, Rowlingson, & Gardner, 2016; Salignac, Muir, & Wong, 2016). In general, the definitions of financial inclusion tend to vary or are not universal. Put simply, Lenka and Barik (2018) described that financial inclusion is identical to the process of providing various financial products and services such as deposit and credit facilities, check services, mobile/internet banking and insurance facilities for poor and low-income households at affordable costs. At the high-level conference held in Seoul, South Korea in November 2010, financial inclusion became one of the nine main pillars of the Global Development Agenda (GPFI, 2011). The access to finance through financial inclusion will improve savings among people who are not familiar with formal finance such as farmers, so that they can manage their expenses. Demirguc-Kunt, Klapper and Singer (2017) said that this access is important for people living in the poor category, because the financial inclusion will help them reduce inequality and poverty.

Financial inclusion can be measured by several indicators. The latest financial inclusion indicators have been published by the World Bank since

2011 in the form of Global Findex. Chikalipah (2017) utilized bank account ownership as an indicator of financial inclusion. Similarly, Raza, Tang, Rubab, and Wen (2019) used indicators such as the number of bank accounts and the number of bank branches. Furthermore, Inoue (2018) used several financial inclusion indicators such as the number of bank branches, the number of bank account ownership, and financial deepening. Meanwhile, the composite approach to the financial inclusion index was carried out by Sharma (2016); Lenka and Barik (2018). Sharma (2016) employed three dimensions of financial inclusion indicators, namely: (a) banking penetration such as the number of deposit and loan accounts, (b) the availability of banking services such as the number of bank branches and the number of ATMs, and (c) the practice of banking services such as the ratio deposits per GDP and credit ratio per GDP. In addition, the three dimensions of financial inclusion used by Lenka and Barik (2018), namely: (a) banking penetration including the number of bank account ownership, (b) the availability of financial services including the number of ATMs, bank branches, and the number of employees, and (c) the practice of banking services among other such as the volume of credit per GDP ratio and the volume of debits per GDP ratio.

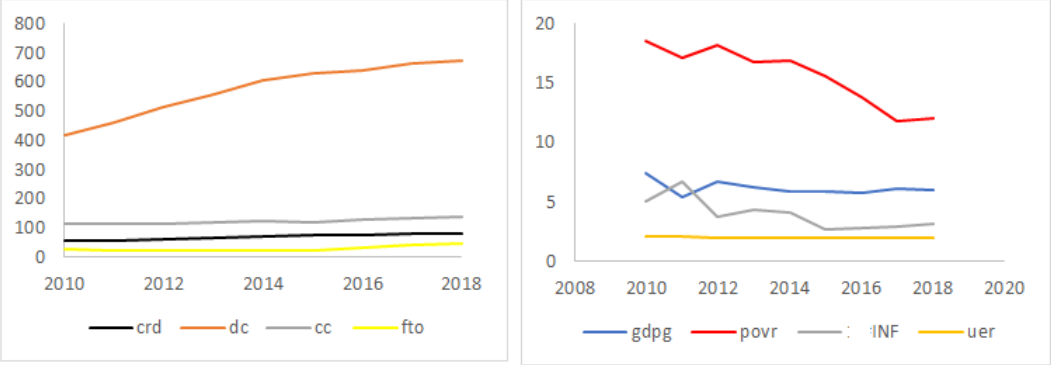

Figure 1 Financial Inclusion, Financial Technology and Macroeconomic Indicator in ASEAN Countries during 2010-2018
Source: The World Bank, Findex and Google Trend (processed)
Note: crd = domestic credit/GDP (%); dc = debit card ownership (%); cc = credit card ownership (%); fto = financial technology observer (index); gdpg = economic growth (%); povr = poverty rate (%); inf = inflation (%); and uer = unemployment rate (%).

Figure 1 describes the development of financial inclusion, macroeconomic, and financial technology indicators in ASEAN 8 during 2010-2018. All financial inclusion indicators have upward trends, especially the debit card ownership. This indicates that the public has responded to the existence of financial institutions by saving for daily transactions. However, the increase in credit card ownership and domestic credit to GDP ratio is relatively slow. This means that there is a business risk and relatively low financial transactions in ASEAN 8 which become obstacles to the acceleration and expansion of financial inclusion. Similarly, the condition has happened in the development of financial technology. Meanwhile, developments illustrated in macroeconomic indicators show an upward trend. A significant decrease occur in the poverty rate. The development of economic growth, inflation, and unemployment rates tend to be stable.

Based on GDP growth data (annual in %) published by the World Bank, ASEAN countries experience accelerated growth, with an average of 6.02% during 2010 - 2018. Le, Chuc, and Taghizadech-Hesary (2019) described that Asia has strong growth. Therefore, policymakers should improve the poor access to financial services to ensure normal growth. On 7-8 April 2016, the Asian Development Bank Institute, the APEC Business Advisory Council, and the Foundation for Development Cooperation held a forum to discuss the issue of Financial Inclusion in the Digital Age. The forum discussed the importance of accessing financial services to individuals and groups to be able to get benefit from broad and integrated financial service products.

Many empirical studies estimate the financial inclusion models both at the level of a country and cross-country analysis. In addition, various approaches or methods have been used to estimate the determinants of financial inclusion. Chikalipah (2017) identified several factors that influenced financial inclusion in Sub-Saharan Africa (SSA) in 2014 using the OLS method. Those factors were literacy, GDP growth rate, population density, infrastructure index, and GNI per capita. Meanwhile, Inoue (2018) employed independent variables such as poverty, real GDP per capita, inflation, and trade openness. Specifically, Lenka and Barik (2018) found that changes in financial inclusion in India did not produce significant growth in rural areas compared to cities. There is a gap of financial inclusion in rural and urban areas which can be caused by a large number of multinational companies in urban areas that drive financial services in urban areas to be more adequate. The development of the financial inclusion index (FII) was conducted by Goel and Sharma (2017) that a value of $0<IFI\leq0.4$ indicates low financial inclusion, $0.4<FII\leq0.6$ describes medium financial inclusion, and $0.6<FII\leq1$ describe high financial inclusion. The findings of the previous empirical study motivated proofing of the influence of macroeconomic and financial technology on financial inclusion in ASEAN 8. This study focuses on dynamic panel modeling of financial inclusion.

This study aims to estimate the effects of macroeconomic indicators and financial technology on financial inclusion in ASEAN 8 during 2010-2018. There are financial indicators which become financial inclusion proxies, namely: debit card ownership, credit card ownership, and domestic credit to GDP ratio. Meanwhile, the selection of the eight ASEAN countries is based on relatively similar developments in economic indicators. Many ASEAN countries are still experiencing problems in accelerating financial inclusion due to limited financial system accessibilities and capabilities at the level of the banking industry and society. Furthermore, 2010 is chosen as an indication of the efforts of ASEAN countries to strengthen the implementation of the banking (financial) integration framework.

This empirical study contributes to the existence of literature in several ways. First, the financial inclusion models consist of three-panel models because it uses three dependent variable or indicators so that it will provide information on the impact of macroeconomic indicators and financial technology on each model properly. Second, dynamic panels are used to estimate the effect of lagged financial inclusion indicators on each estimation model. Third, the financial technology observer is used to determine the impact of the

number of users and seekers of financial technology transactions on financial inclusion in ASEAN 8 during 2010-2018.

Research Method

Previous Empirical Studies

An empirical study of financial inclusion focusing on the relationship between economic growth and the increase of complexity of the financial system was introduced by Goldsmith (1969). More broadly, this empirical study has developed in the issue of financial inclusion (Le et al., 2019). Berry (2015) argued that financial inclusion takes place in response to financialization, by increasing the participation and involvement of individuals in the financial system. Salignac et al. (2016) explained that access to financial services rises the concept of supply and demand for financial inclusion. Basic formal financial services include credit, savings, insurance, payment, and money transfer facilities. Without these services, individuals often use informal financial sources or financial exclusions, which may harm individuals (Inoue, 2018). Furthermore, formal financial inclusion begins with having a deposit account at a bank or other financial service provider, to make and receive payments and saving money (Demirguc-Kunt et al., 2017). Ellis (2007) added that financial market liberalization is not enough to ensure financial inclusion in individuals who are still limited to financial access services. In addition, financial inclusion problems also occur in micro, small, and medium enterprises due to limited access to credit and domestic and foreign markets (ADBI, 2016; Hunter, 2016).

The relation between financial development and economic growth has been widely analyzed in several literatures in economic field (Goldsmith, 1969; Gleb, 1989; King & Levine, 1993; and Fry, 1997). Empirically, research on the relation between the two variables has been done by Sharma (2016), which found that financial inclusion stimulates economic growth in India. The same finding has been explained by Iqbal and Sami (2017). Therefore, financial sector policy reform and innovation need to be carried out appropriately and progressively in India. Furthermore, Lenka and Barik (2018) explained that the expansion of financial inclusion in India was also supported by financial inclusion policies at both the city and village levels. However, financial inclusion growth in cities is higher than in villages. Thus, a significant increase or decrease in economic growth will have significant implications for financial inclusion (Anarfo, Abor, & Osei, 2019). A different thing was found by Chikalipah (2017) that good financial literacy will encourage an increase and expansion of financial inclusion compared to macroeconomic indicators such as economic growth and GDP per capita in Sub-Saharan Africa countries. Empirical development carried out in this study is the selection of GDP growth as one of the determinants of three financial inclusion indicators in ASEAN 8 during 2010-2018 using dynamic panels. In addition, inflation is also a determining factor in financial inclusion in the dynamic panel model.

Meanwhile, the link between financial inclusion and poverty has been made by Lal (2017). His findings showed that financial inclusion through cooperative businesses has a

significant impact on reducing poverty levels in India. Furthermore, Inoue (2018) revealed that financial inclusion and financial depth have a negative and significant effect on poverty in India. This empirical study uses poverty and unemployment rates in the ASEAN 8 under a dynamic panel model.

Empirically, the link between financial inclusion and financial technology has been made by Lashitew, Tulder, and Liasse (2018), Mushtaq and Bruneau (2019), Sabir, Latif, Qayyum and Abass (2019). They explained that technological instruments in business transactions develop rapidly in developing countries. Lashitew et al. (2018) estimated the relation between financial technology and financial inclusion in Pakistan with an emphasis on increasing technological innovation in financial instruments, improving domestic economic conditions and institutions. Financial technology is proxied by indicators consisting of mobile accounts, sending money, and receiving money. Meanwhile, institutions are explained by the rule of law indicator. In addition, Mushtaq and Bruneau (2019) estimated the relation between financial technology, financial inclusion, macroeconomics, and institutions in selected emerging economies with the generalized method of moments (GMM) during 2001-2012 while Sabir et al. (2019) conducted estimation during 1996-2015. They determined the number of different macroeconomic and institutional variables with different numbers of emerging countries. However, their findings indicate that financial technology can drive the expansion of financial inclusion. This empirical study develops estimates in the form of selecting the financial technology observer as a proxy for financial technology in ASEAN 8 during 2010-2018. It means that individuals who are increasingly searching for and choosing financial technology instruments are expected to encourage the acceleration and expansion of financial inclusion in ASEAN 8.

Dataset

This study selected three indicators as proxies for financial inclusion in ASEAN 8 during 2010-2018 obtained from financial index publications. These three indicators are indicators that are commonly used in the empirical analysis of financial inclusion. Meanwhile, macroeconomic indicators consist of economic growth, inflation, poverty rate, and unemployment rate. The data was obtained from the World Bank publication. Furthermore, this study establishes the indicator of financial technology observer as a proxy for financial technology obtained from Google Trend. ASEAN countries that became the study sample were Indonesia, Malaysia, Thailand, Cambodia, the Philippines, Vietnam, Lao PDR, and Myanmar. These countries have similar characteristic bents in the development of economic and financial indicators.

Table 1 informs the research variables. Dependent variables consist of debit card ownership or DC (Model 1), credit card ownership or CC (Model 2), and domestic credit to GDP ratio or CRD (Model 3). Meanwhile, independent variables include economic growth (GDPG), recovery rate (POVR), inflation (INF), unemployment rate (UER), and financial technology observer (FTO).

Table 1 Description of Research Variables

Variables	Description
Debit card ownership (DC)	Debit card ownership (% age 15+)
Credit card ownership (CC)	Credit card ownership (% age 15+)
Domestic credit to GDP ratio (CRD)	Domestic credit to the private sector (% of GDP)
Financial Technology Observer (FTO)	Numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. A score of 0 means there are not enough data for this term.
Economic growth (GDPG)	GDP growth (annual %)
Poverty rate (POVR)	Poverty headcount ratio at national poverty lines (% of the population)
Inflation (INF)	Inflation, consumer prices (annual %)
Unemployment rate (UER)	Unemployment, total (% of total labor force)

Source: The World Bank, Findex and Google Trend

Empirical Method

This empirical study estimates the effect of macroeconomics and financial technology on financial inclusion in ASEAN 8. Financial inclusion indicators include debit card ownership, credit card ownership, and domestic credit to GDP ratio. Furthermore, three dynamic panel models will be estimated. The panel model used is in the short panel because the panel period is less than 10 years. The basic model of the dynamic panel basic model has been explained by Pesaran (2015) where the dependent variable is influenced by the lagged of the dependent variable.

Model 1 will estimate the effect of macroeconomics and financial technology (FTO) on dynamic debit card ownership (DC). Macroeconomic indicators used to consist of economic growth (GDPG), the poverty rate (POVR), and inflation (INF). This modeling is the development of previous empirical studies that only emphasize economic growth and poverty. Thus, the dynamic panel model to be estimated is as follows:

$$DC_{it} = \alpha_0 + \beta_1 DC_{it-1} + \beta_2 GDPG_{it} + \beta_3 POVR_{it} + \beta_4 INF_{it} + \beta_5 FTO_{it} + \varepsilon_{it} \quad (1a)$$

Equation (1a) is a Pooled OLS or Common Effects Model (CEM) which can be developed into a Fixed Effect Model (FEM) and Random Effects Model (REM). FEM is known as the Least-Squares Dummy Variable (LSDV) model. The FEM equation adds the D (dummy) variable in the model that describes the intercept differences (see Equation 1b). Meanwhile, REM assumes that α1 is random. We can add ε as a random error so that the term error of REM is w, where w = ε + u (see Equation 1c).

$$DC_{it} = \alpha_{0+} \alpha_1 D_{ni} + \beta_1 DC_{it-1} + \beta_2 GDPG_{it} + \beta_3 POVR_{it} + \beta_4 INF_{it} + \beta_5 FTO_{it} + \varepsilon_{it} \quad (1b)$$

$$DC_{it} = \alpha_0 + \beta_1 DC_{it-1} + \beta_2 GDPG_{it} + \beta_3 POVR_{it} + \beta_4 INF_{it} + \beta_5 FTO_{it} + w_{it} \quad (1c)$$

The α_0 is the intercept while β_1, β_2, β_3, β_4, and β_5 are the parameters/slopes of the equation. The values of β_1, β_2, and β_5 are > 0, while β_3 and β_4 are < 0. Furthermore, the i is the cross-section of ASEAN 8 countries.

Model 2 will estimate the effect of macroeconomics and financial technology (FTO) on dynamic credit card ownership (CC). This model is also used as a robustness test against Model 1. Macroeconomic indicators consist of economic growth (GDPG), the poverty rate (POVR), and inflation (INF). The dynamic panel model to be estimated is as follows:

$$CC_{it} = \alpha_0 + \beta_1 CC_{it-1} + \beta_2 GDPG_{it} + \beta_3 POVR_{it} + \beta_4 INF_{it} + \beta_5 FTO_{it} + \varepsilon_{it} \quad (2a)$$

Equation (2a) is a Pooled OLS or Common Effects Model (CEM). Meanwhile, FEM is explained by Equation (2b) while REM is described by Equation (2c).

$$CC_{it} = \alpha_0 + \alpha_1 D_{ni} + \beta_1 CC_{it-1} + \beta_2 GDPG_{it} + \beta_3 POVR_{it} + \beta_4 INF_{it} + \beta_5 FTO_{it} + \varepsilon_{it} \quad (2b)$$

$$CC_{it} = \alpha_0 + \beta_1 CC_{it-1} + \beta_2 GDPG_{it} + \beta_3 POVR_{it} + \beta_4 INF_{it} + \beta_5 FTO_{it} + w_{it} \quad (2c)$$

The α_0 is the intercept while β_1, β_2, β_3, β_4, and β_5 are the parameters/slopes of the equation. The values of β_1, β_2, and β_5 are> 0, while β_3 and β_4 are <0. Furthermore, the i is the cross-section of ASEAN 8 countries.

Model 3 will estimate the effect of macroeconomic and financial technology (FTO) on the dynamic domestic credit to GDP ratio (CRD). This model is also utilized as a robustness test for Models 1 and 2. Macroeconomic indicators used to consist of economic growth (GDPG), unemployment rate (UER), and inflation (INF). The dynamic panel model to be estimated is as follows:

$$CRD_{it} = \alpha_0 + \beta_1 CRD_{it-1} + \beta_2 GDPG_{it} + \beta_3 UER_{it} + \beta_4 INF_{it} + \beta_5 FTO_{it} + \varepsilon_{it} \quad (3a)$$

Equation (3a) is a Pooled OLS or Common Effects Model (CEM). Meanwhile, FEM is explained by Equation (3b) while REM is described by Equation (3c).

$$CRD_{it} = \alpha_0 + \alpha_1 D_{ni} + \beta_1 CRD_{it-1} + \beta_2 GDPG_{it} + \beta_3 UER_{it} + \beta_4 INF_{it} + \beta_5 FTO_{it} + \varepsilon_{it} \quad (3b)$$

$$CRD_{it} = \alpha_0 + \beta_1 CRD_{it-1} + \beta_2 GDPG_{it} + \beta_3 UER_{it} + \beta_4 INF_{it} + \beta_5 FTO_{it} + w_{it} \quad (3c)$$

The α_0 is the intercept while β_1, β_2, β_3, β_4, and β_5 are the parameters/slopes of the equation. The values of β_1, β_2, and β_5 are> 0, while β_3 and β_4 are <0. Furthermore, the i is the cross-section of ASEAN 8 countries.

Result and Discussion

This empirical study estimates the effects of macroeconomic indicators and financial technology on financial inclusion in ASEAN 8. Financial inclusion is proxied by three indicators namely debit card ownership (DC), credit card ownership (CC), and domestic credit to GDP ratio (CRD). The mean DC value is 572.3225%. It means that on average, an

ASEAN community member has more than 1 debit card. The countries that have relatively low percentages of debit card ownership are Cambodia, Myanmar, and Lao PDR while the countries that have high percentages of debit card ownership are Vietnam, Thailand, the Philippines, Malaysia, and Indonesia. From 2010-2018, the mean CC value in ASEAN 8 was 121.4883%. Countries that have a relatively low CC percentage are Cambodia, Myanmar, and Lao PDR. Meanwhile, the mean CRD value is 67.9301%. Countries that have relatively high CRD percentages are Vietnam, Thailand, and Malaysia. Thus, the development of financial inclusion in Vietnam, Thailand, and Malaysia tend to be more progressive than the five ASEAN countries.

Table 2 Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max
DC	overall	572.3225	561.2078	0.6995	1887.9820
	between		579.7744	4.2654	1689.8750
	within		129.1920	151.2323	810.5426
CC	overall	121.4883	148.4165	0.0010	431.1013
	between		156.4689	0.4534	395.5370
	within		17.4221	51.0766	177.9990
CRD	overall	67.9301	47.0383	4.7700	149.3700
	between		48.2342	15.4278	139.5656
	within		12.1741	34.2201	106.2301
GDPG	overall	6.1244	1.5921	0.8400	9.6300
	between		1.2239	3.7667	7.5189
	within		1.0980	3.1978	9.8678
POVR	overall	15.6360	9.6199	0.4000	42.2000
	between		9.2512	0.7889	32.1200
	within		4.0745	2.4993	26.2093
INF	overall	3.9250	2.8271	-0.9000	18.6800
	between		1.7174	1.6856	6.5678
	within		2.3185	-1.7628	16.0372
UER	overall	1.9632	1.4490	0.3900	5.6100
	between		1.5060	0.6022	4.5689
	within		0.2954	1.1399	3.0043
FTO	overall	27.2138	25.0743	0.0000	72.8000
	between		22.3322	1.6522	58.9178
	within		13.6451	6.2093	66.0715

Source: Secondary data (processed)

The mean value of economic growth in ASEAN 8 is 6.1244%. During 2010-2018 several ASEAN countries had economic growth rates above 6% such as Cambodia, Myanmar, and Lao PDR. Meanwhile, the mean inflation rate is 3.9250%. Myanmar and Vietnam have experienced inflation rates above 6% for several years. The mean poverty rate in ASEAN 8 is 15.6360%. ASEAN countries that have poverty rates above 15% are Cambodia, Myanmar, Loa PDR, and the Philippines. This condition indicates that the economic conditions of ASEAN 8 countries are still full of the economic development cycle problems which are based on high levels of poverty and low-income distribution. Furthermore, the mean unemployment rate is 1.9632%. The three countries that are still obstructed by unemployment rate control constraints are the Philippines, Malaysia, and Indonesia.

Thus, the three countries are relatively difficult to absorb labor in the domestic market compared to other countries in ASEAN 8.

Table 3 describes the estimated results of dynamic debit card ownership (DC). DC is an indicator of financial inclusion in the dynamic panel model (Model 1). Based on the Hausman test results, it can be seen that FEM is the best panel model. FEM estimation results show that the DC lag has a significant and positive effect on DC. It means that the development of debit card ownership in ASEAN 8 is currently closely related to the dynamics of debit card ownership in previous periods. Meanwhile, macroeconomic and financial technology indicators have no significant effect. This finding is different from the Pooled OLS and REM estimation results which indicate that macroeconomic indicators (such as economic growth and inflation) and financial technology have a significant effect. However, an increase in economic growth and financial technology led to a decrease in debit card ownership in ASEAN 8. Simply stated, this condition indicates that economic growth and financial technology achieved have not been able to encourage significant and evenly distributed public savings activities for all people. Other indications show that an increase in inflation causes an increase in debit card ownership (Pooled OLS and Random Effects estimation results). It means that people tend to reduce the risk of monetary value at the time of inflation by saving with the hope that they can obtain the appropriate interest rate on savings/deposits.

Table 3 Financial Inclusion under Dynamic Debit Card Ownership

Variable	Pooled OLS	Fixed Effect	Random Effect
DC(-1)	1.013 (0.025) [40.86]***	0.738 (0.079) [9.33]***	1.012 (0.026) [39.48]***
GDPG	-11.240 (5.646) [-1.99]*	-7.381 (7.394) [1.00]	-11.208 (5.780) [-1.94]*
POVR	0.491 (1.520) [0.32]	1.272 (1.886) [0.67]	0.503 (1.547) [0.33]
INF	5.954 (2.842) [2.10]**	-2.325 (3.551) [0.65]	5.801 (2.861) [2.03]**
FTO	-0.658 (0.360) [-1.83]*	0.169 (0.581) [0.29]	-0.690 (0.367) [-1.88]*
Constant	79.605 (48.120) [1.65]*	207.135 (71.591) [2.89]**	81.582 (49.566) [1.65]*
R-square:			
Within		0.7959	0.7766
Between		0.9978	0.9991
Overall	0.9901	0.9860	0.9901
Wald Chi-square	1164.16***		
(F-statistics)		39.78***	5228.64***
LM Test	0.34		
Hausman Test			12.51**
Observations	64	64	64

Source: The authors' estimation

Note:
() denotes standard error
[ ] denotes Z-statistics
***, ** and * denote significant levels at 1%, 5% and 10%, respectively

The R-square of the Fixed Effects Model (FEM) is about 0.7959 (within-group). It means that 79.59% of the dependent variable is influenced by variations in the dependent variable. Furthermore, the R-square of cross-sectional estimation is 99.78% (between groups). Meanwhile, the R-square of the overall estimation is 98.60%.

Table 4 Financial Inclusion under Dynamic Credit Card Ownership

Variable		Pooled OLS	Fixed Effect	Random Effect
CC(-1)		0.997 (0.0162) [61.47]***	0.661 (0.084) [7.92]***	0.998 (0.0219) [45.57]***
GDPG		-2.743 (1.139) [-2.41]**	-0.643 (1.175) [0.55]	-1.750 (1.231) [-1.42]
POVR		-0.162 (0.232) [-0.70]	-0.066 (0.298) [0.22]	-0.209 (0.269) [-0.78]
INF		0.569 (0.509) [1.12]	-0.034 (0.498) [0.07]	0.672 (0.511) [1.32]
FTO		0.090 (0.063) [1.42]	0.322 (0.086) [3.75]***	0.122 (0.071) [1.71]*
Constant		17.910 (9.434) [1.90]*	39.838 (13.343) [2.99]**	11.349 (10.645) [1.07]
R-square:				
	Within		0.7409	0.6975
	Between		0.9949	0.9992
	Overall	0.9966	0.9899	0.9955
Wald Chi-square		2620.38***	29.17***	4279.82***
(F-statistics)				
LM Test		0.06		
Hausman Test			13.35**	
Observations		64	64	64

Source: The authors' estimation

Note:
() denotes standard Error
[ ] denotes Z-statistics
***, ** and * denote significant levels at 1%, 5% and 10%, respectively

A dynamic panel of financial inclusion estimates is carried out on Model 2 to obtain robust estimation results (Table 4). The Hausman test shows that FEM is the right panel model. FEM estimation results describe that credit card ownership (CC) is significantly influenced by lagged of CC and financial technology. The number of credit card ownership (CC) in the previous period led to an increase in the current CC period. Furthermore, financial technology (FTO) has a significant and positive effect on CC. This finding is following the hypothesis developed in Model 2. It means that the higher the community seeks and utilizes financial technology, it will encourage an increase in financial inclusion in ASEAN 8. The parameter of constant also indicates a significant and positive influence. Thus, FEM estimation results are better than Pooled OLS and REM estimation results.

The R-square of FEM is 74.09% (within-group). It means that 74.09% of the dependent variable is influenced by variations in the independent variable. Besides, the R-square of cross-sectional estimation is 99.49% (between groups). Meanwhile, the R-square of the overall estimation is 98.99%.

Previous empirical studies indicate that macroeconomic indicators such as economic growth, poverty (unemployment), and inflation have a significant effect on financial inclusion. Based on Tables 3 and 4, it can be seen that the results of the dynamic panel estimation show that economic growth, poverty, and inflation have no significant effect. For this reason, this empirical study carries out an estimation in Model 3 and obtains a more robust estimation model.

Table 5 Financial Inclusion under Dynamic Domestic Credit to GDP Ratio

Variable	Pooled OLS	Fixed Effect	Random Effect
CRD(-1)	0.969 (0.016) [59.67]***	0.956 (0.048) [20.04]***	0.964 (0.026) [36.88]***
GDPG	0.328 (0.447) [0.73]	0.040 (0.560) [0.07]	0.091 (0.497) [0.18]
UER	-1.562 (0.510) [-3.06]***	-2.171 (2.032) [-1.07]	-1.629 (0.931) [-1.75]*
INF	-0.887 (0.203) [-4.38]***	-0.945 (0.215) [-4.40]***	-0.931 (0.201) [-4.62]***
FTO	-0.115 (0.301) [-3.74]***	-0.099 (0.037) [-2.70]**	-0.106 (0.032) (-3.28)***
Constant	12.789 (4.151) [3.08]***	16.372 (6.278) [2.61]**	14.603 (4.803) [3.04]***
R-square:			
Within		0.8965	0.8963
Between		0.9972	0.9978
Overall	0.992	0.9914	0.9919
Wald Chi-square	1439.71***	88.39***	1558.65***
(F-statistics)			
LM Test	4.17**		
Hausman Test		0.24	
Observations	64	64	64

Source: The authors' estimation

Note:
() denotes standard Error
[ ] denotes Z-statictics
***, ** and * denote significant levels at 1%, 5% and 10%, respectively

Table 5 shows the estimated results of dynamic domestic credit to GDP ratio as one indicator of financial inclusion. The LM test indicates that the results of REM estimation are correct. REM estimation results inform that the domestic credit to GDP ratio (CRD) is influenced by the lag of CRD, unemployment rate, inflation, and financial technology. Moreover, the constant parameter of estimation also has a significant and positive effect. An increase in the domestic credit to GDP ratio (CRD) in the previous period was able to stimulate an increase in the CRD of the current period. This condition indicates the expansion of credit transactions in each ASEAN 8. Furthermore, the increase in the unemployment rate and inflation will have implications for the reduction in CRD. These results are in line with the hypothesis developed in Model 3. For this reason, ASEAN 8 governments are expected to be careful in formulating macroeconomic policies to control the amount of unemployment as well as low and stable inflation rates. However, an

increase in financial technology led to a decrease in CRD. This needs to be explored in-depth on how people utilize financial technology so that domestic credit transactions are reduced. Furthermore, the estimation results are not following the hypothesis formulated in Model 3 that financial technology will encourage an increase in domestic credit.

The R-square of REM is 89.63% (within-group). It means that 89.63% of the dependent variable is influenced by variations in the independent variable. Furthermore, the R-square of cross-sectional estimation is 99.78% (between groups). Meanwhile, the R-square of the overall estimation is 99.19%.

Previous empirical studies conducted by Sharma (2016), Lal (2017), Inoue (2018), Lenka and Barik (2018), Raza et al. (2019) and Anarfo, et al. (2019) found that macroeconomic variables had significant effects on financial inclusion. Meanwhile, this empirical study shows that economic growth has no significant effect. This can happen due to the inability of the level of economic growth to stimulate the public to increase banking and financial activities broadly and evenly. Furthermore, Lashitew et al. (2018), Mushtaq and Bruneau (2019), and Sabir et al. (2019) described that financial inclusion has close links with financial technology. These findings are in line with the results of the Model 3 estimation of this study. Thus, the estimation results of Model 3 dynamic panel in this study are considered robust estimation models.

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Conclusion

Financial inclusion can stimulate more efficient economy, deepen financial markets, and broaden banking activities in the community. This paper estimates the impact of macroeconomic and financial technology on financial inclusion in ASEAN 8. The dynamic panel method is chosen to identify past financial inclusion interactions in the current financial inclusion period. In addition, three financial inclusion indicators are used including debit card ownership, credit card ownership, and domestic credit to GDP ratio. The selection of these indicators is already relevant to previous empirical research. The empirical development that has been carried out is the use of dynamic panel methods and financial inclusion variables.

Model 1 shows that the fixed effect model is more appropriate. The estimation results explain that debit card ownership is significantly influenced by the lag of debit card ownership. Besides, Constant also has a significant effect. Meanwhile, macroeconomic and financial technology variables have no significant effect. This means that the independent variable does not have implications for dynamic financial inclusion in ASEAN 8 during the study period.

Model 2 describes that the fixed effects model is more appropriate. Financial inclusion is a proxy by credit card ownership indicators. Credit card ownership is significantly influenced by lagged credit card ownership, financial technology observer, and constant. The results of this estimation provide a better illustration than Model 1. It means that financial technology has significant implications for dynamic financial inclusion in ASEAN 8 during 2010-2018.

The final model is the random effects model as a more appropriate panel model. Domestic credit to GDP ratio is influenced by the lagged of domestic credit to GDP ratio, unemployment rate, inflation, financial technology observer, and constant. This means that macroeconomic indicators and financial technology have significant implications for financial inclusion in ASEAN 8 during the study period.

This empirical study provides inputs to economic and financial policymakers in ASEAN 8 to keep inflation rates low and stable. Furthermore, governments in the ASEAN 8 region should encourage and facilitate the expansion and acceleration of access to financial technology to the public to accelerate the implementation of financial inclusion on a massive and equitable basis for the wider community. However, this study has limitations in identifying non-economic factors that have significant implications for financial inclusion in ASEAN 8. Thus, further empirical research is expected to develop a model for estimating financial inclusion under non-economic factors. Furthermore, the selection of more appropriate dynamic models can also be used.

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