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11 January 2022

Online at <https://mpra.ub.uni-muenchen.de/111462/>
MPRA Paper No. 111462, posted 13 Jan 2022 14:05 UTC

ICT and financial development: Empirical evidence from ASEAN countries

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Abstract

This paper empirically investigates the impact of Information and Communication Technology (ICT) on financial development proxied by Domestic credit/GDP and Money supply/GDP in ten ASEAN countries over the period 2000-2020. Results from fixed effects for panel data show that ICT stimulates financial development by both proxies. Remarkably, the impact of ICT on financial development proxied by Money supply/GDP is stronger than that proxied by Domestic credit/GDP, implying the important channel of Money supply/GDP through which ICT can stimulate financial development. In addition, other important determinants of financial development are confirmed in the context of ASEAN countries, including economic growth, trade openness, and urbanization. The findings consolidate the utilization of ICT to boost financial development in ASEAN countries.

Key words: ASEAN countries; Financial development; ICT.

JEL Classification: L96; O16; O32; O33

1. Introduction

In the modern era, the world is changing by the impact of the Fourth Industrial Revolution (Industry 4.0) with the foundation of information and communication technology (ICT). The remarkable growth of those technology has been building the

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concrete foundation for many other fields such as economy, culture, and society to improve the quality of living standard.

In fact, ICT development has been playing an important role in the progress of regional integration and connectivity efforts. Moreover, as the region continues moving onward to further and deeper in economic coordination and community constructions, the role of ICT will be expected to be more important. According to The Association of Southeast Asian Nations (ASEAN, 2020), ICT is the core component of the economy, contributing to all fields of socio-economic growth and development, especially for a transitioning digital economy like ASEAN.

In 2005, ASEAN began to construct broader collaboration with non-ASEAN countries by purposely enhancing the ICT sector performance. To begin with, ASEAN signed ICT Cooperative Partnership for Common Development with China. After two years, both parties had an agreement on the plan of implementing the ASEAN-China ICT Cooperative Partnership. In terms of this agreement, China is willing to support ASEAN through advancing ICT infrastructure, building human capability, increasing trade and investment within the ICT sector, advancing network and information security and also subsidizing the funding by establishing the ASEAN-China Cooperation Fund (ACCF). In the same year, ASEAN-Japan ICT Work Plan 2007–2008 also consisted of both sides. Under this agreement, Japan was expected to assist ASEAN on telecommunication framework, data security, the formulation of regional policy and administrative system. Additionally, the ASEAN-India Partnership was also an important aspect of the cooperation in the ICT sector, especially in the area of software development and ICT capacity building. Besides those countries, ASEAN already started intensive negotiations with several other countries such as Australia, New Zealand, the Republic of Korea and even the

European Union (Irawan, 2014). Thus, ICT infrastructure witnessed the upward movement specifically mobile cellular subscriptions and internet users as displaying in figure 1. Moreover, the ASEAN ICT Master plan 2015 and 2020 (ASEAN, 2015, 2020) has expressed clearly the importance of the ICT framework. The improvement in the ICT field in ASEAN is also witnessed in other aspects, including an expansion for work in the ICT sector, alteration to digital government services, and financial development.

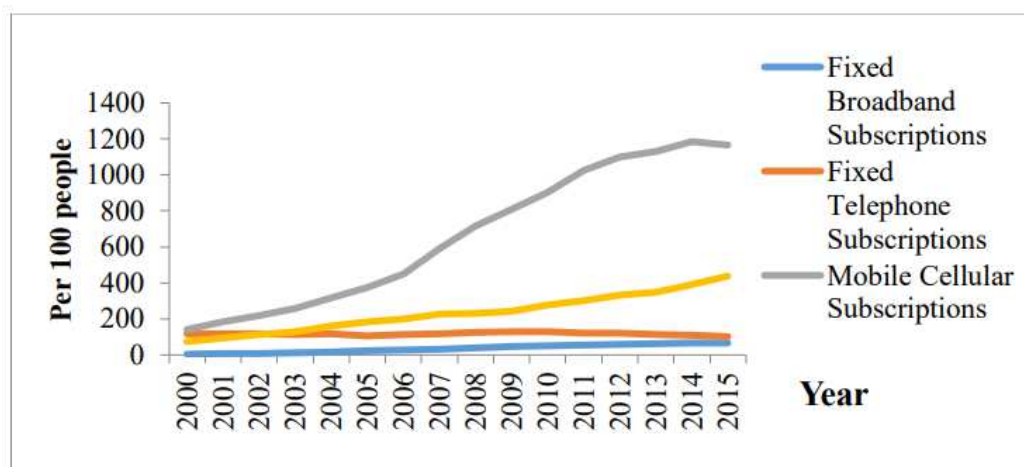


Figure 1: ICT Infrastructure in ASEAN (World Bank, 2016).

According to Lechman and Marszk (2015), the development of ICT has been shaping the financial market by their functions as they empower the spread of data and information, diminish the failures of the market such as the time delay or the inaccuracy of information. The flow of information is enhanced by the ICT which is the priority for the decentralized financial markets to work efficiently and effectively. Regarding the above, the increase in customers' needs to access their financial accounts as well as simplify the financial transactions on their phones has led to the access to high-speed Internet (broadband network) yields special attention, as the communication system is built based on the wide bandwidth, it can process the information-carrying capacity quickly, empowering the increase of the financial activities in markets such as trading (Stigler, 1961; Morck, Yeung & Yu, 2000).

As concluded by Levine (1997), the impact of financial development has been consolidating on economic growth through the rapid development of ICT. The diffusion of ICT can reduce the market imperfections, promoting financial functions such as enhancing transparency and deducting the main market frictions. Furthermore, it also eliminates the managers' monitor and exerting corporate regulation (Sassi & Goaid, 2013).

Being considered as one of the most influential factors to the financial development of a country, ICT is always a common topic which is being discussed among many researchers and it also has been being enjoyed many incentives policies by the governments to create the ideal development and connect the other part of the world. However, the impact of ICT on financial development is still a research gap in the context of ASEAN countries. Therefore, this paper aims to examine the impact of the ICT on financial development in ASEAN countries, taking many other determinants into account.

2. Literature review

Developing countries need to advance the ICT sector and exploit opportunities for leapfrogging even with a weak financial system (Claessens et al., 2002). However, Shamim (2007) proved that the component of the financial sector developed by the better telecommunication infrastructure is positively connected to long-term economic growth. This investigation highlighted that an expansion of mobile phone subscribers and internet users influence emphatically to a financial depth which is the backbone of any country to grow and also emphasized the idea that in developing countries with weak financial systems, ICT may play a crucial role in financial development, as they are a cheap and easily available means of communication and data acquisition.

Waverman et al. (2005) concluded that cost could be viewed as an essential

variable in determining the level of electronic application utility since the price of products or service delivery is determined by cost which is based on the gap of demand and supply in the market. Various studies (Dimelis & Papaioannou, 2010; Madden & Savage, 1998) pointed out that the efficiency in attracting and improving the level of domestic and foreign investment by developing the country's infrastructure through the adaption of ICT. In the meantime, other investigations (Lechman & Marszk, 2015; Norton, 1992; Chowdhury, 2006; Sepehrdoust & Ghorbanseresht, 2019; Freund & Weinhold, 2004; and Ismail & Omar, 2019) highlighted that the development of ICT contribute to the proficient implementation of financial foundation in financial markets by encouraging trade, notwithstanding, the usage of ICT services is built upon cost.

According to Mačiulytė-Šniukienė and Gaile-Sarkane (2014), ICT advancement factors such as ICT infrastructures, ICT utilities, ICT readiness and ICT productions and trade are interrelated and contribute positively to labor productivity and overall economic growth of a nation.

An investigation by Benhabib and Spiegel (2005) referred to electronic applications that determine the level of economic growth and its speed. Furthermore, Salahuddin and Gow (2016) pointed out that sustainable development is possessively contributed by the use of electronic applications (e.g. Internet applications). Especially, Alshubiri et al. (2019) found that ICT positively affects financial development in six Gulf Cooperation Council (GCC) countries over the period 2000-2016. However, the impact of ICT proxied by broadband is stronger than that proxied by Internet users.

Based on the above studies, we expect that ICT can have a positive impact on financial development in ASEAN countries.

3. Model

Based on the above arguments and previous related studies, this research employs regression model of panel data to assess the impact of ICT on financial development.

The regression model is proposed as follows:

$$FD_{i,t} = \beta_0 + \beta_1 * ICT_{i,t} + \beta_2 * GDPG_{i,t} + \beta_3 * URBAN_{i,t} + \beta_4 * TRADE_{i,t} + \vartheta_{i,t} + \varepsilon_{i,t}$$

Where i is the country; t is the year; β_1 , β_2 , β_3 and β_4 are the respective coefficients; ϑ is the country-specific effect; and ε is the error term.

The dependable variable is financial development (FD) which is measured by two proxies, including: i) domestic credit to the private sector as a percentage of gross domestic product (GDP), and ii) broad money supply as a share of GDP. The independent variable is ICT, proxied by the internet users (% of population). Internet users consist of both corporate and individual internet users. This element includes various sources: computers, mobile phones, personal digital associates, gaming gadgets, digital television, and so on.

The control variables in our model are GDP growth (GDPG), urbanization (URBAN), and trade openness (TRADE). In our study, GDPG, URBAN, and TRADE are measured by GDP growth constant prices USD 2010, urban population as a share of total population, and ratio of export and import in GDP, respectively. The selection of these control variables are based on the previous studies on determinants of financial development, being justified as follows.

First, scholars and policymakers have debated the relationship between economic growth and financial development for a long time. On one hand, an important bunch of authors like McKinnon (1973), Levine et al. (2000), Chirstopoulos and Tsionas (2004) have theoretically and empirically demonstrated that there is causal direction from financial development to economic growth. On the other hand, other scholars believed that the direction is away economic growth toward financial development. Since the

economy is growing, there is an increasing in demand for financial services. This point of view was supported by Gurley and Shaw (1967), Goldsmith (1969), and Jung (1986).

Second, The increase in the size of markets and demand for financial services are the most direct channels by which trade openness can impact financial growth. In this context, an increase in trade openness might lead to a supply of new financial instrument. With that requirements, financial institutions are required to adapt by providing better insurance and risk diversification (Svaleryd and Vlachos, 2002). A set of researchers (Niroomand et al., 2014; Kim et al., 2010; and Polat et al., 2015) confirmed the existences of a relationship between trade openness and financial development. Beck (2002) discovered that nations with more mature financial structures have higher share of export in GDP, concluding that financial development is upgraded when a country's borders are opened to both capital and trade flows. Similarly, Baltagi et al. (2009) demonstrated that both trade and financial openness are statistically significant determinants of banking sector growth, and that opening up one without the other can still result positively in financial development.

Third, it is believed that financial development encourages the development of modern industry and the growth of the urban population, and that urbanization promotes financial development as well. Financial development will be improved in certain level by urbanization (Williamson, 1965; Ciccone & Hall, 1996; Da Mata et al., 2007; Brulhart & Sbergami, 2009; and Lewis, 2014). Positive urbanization strategies, with the aim of stimulating financial development, are commonly used in emerging countries (Friedmann, 2006). The concentration of people and companies in cities makes it easier to access finance, encourage business ideas, and conduct business in a wider local market (an urban market with a higher density of consumers) to do

business (Glaeser et al., 2010). According Bertinelli and Black (2004), there are various of channels through which urbanization affects financial development. The agglomeration of people and businesses that happens as a result of urbanization decreases production costs. Urbanization helps economies to gain competitive advantages on a global scale as reduction in transaction costs, and enable companies to specialize internally which is lowering production costs (Kumar & Kober, 2012; and Krugman, 1991). Additionally, urbanization will have a positive effect on all aspects of finance and human capital through migration, remittances, and active interaction between urban and rural areas. Knowledge, manufacturing expertise, technology, and finance will all benefit in regions where migrants have left (McKenzie and Sasin, 2007).

4. Data and methodology

4.1. Data

This study examines a panel of 10 ASEAN countries, consisting of Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam in the period 2000 – 2020. All data are collected from the World Development Indicators (WDI) of the World Bank (2020). Table 1 provides definitions, measurements and expected signs of all variables. The descriptive statistics are presented in Table 2. It can be seen that on average, approximately 30% of the population in ASEAN accesses the Internet, depicting that ICT is a bright sector that is not fully explored. Moreover, domestic credit constitutes about 57% of GDP and the broad money supply/GDP is around 76%.

Table 1. Variables and measurements.

Variables	Measurements	Expected signs
Dependent variable		
(FD)	Domestic credit as a share of GDP (FD1)	

	Broad money supply /GDP (FD2)	
Independent and control variables		
ICT	Internet users (% of population)	+
GDPG	GDP growth constant prices USD 2010	+
URBAN	Urban population as a share of total population	+
TRADE	Ratio of export and import in GDP	+

Table 2. Descriptive statistics.

Variables	Obs	Mean	St.deviation	Minimum	Maximum
FD1	210	56.823	42.954	0	137.912
FD2	210	76.283	39.190	12.913	164.868
ICT	210	29.510	27.203	0	95
GDPG	210	5.669	3.1291	-2.508	14.525
URBAN	210	2.611	1.081	-1.474	6.263
TRADE	210	1.217	.9367	0	3.956

4.2. Methodology

Three methods are used to approximate the equation: Ordinary least square for panel data (OLS), fixed effects (FE), and random effects (RE). Since performing OLS with exogenous regressors, FE and RE are employed to eliminate the impact of national unobserved characteristics. Since the error words can be serially correlated and have non-constant variance, the author performs the probability ratio test for heteroscedasticity and the test for serial autocorrelation by Wooldridge (2002). After all, the F-tests (for FE), the Breusch and Pagan Lagrangian multiplier tests (for RE) and the Hausman tests (for FE and RE) are pointed out as the appropriate evaluation method.

Firstly, pool OLS and RE regression are performed. After that, the Breusch and

Pagan Lagrangian multiplier tests is employed to whether we choose what model. In this test, we have 2 hypothesis including if H_0 is when variance equals to zero, we will choose OLS model and if H_1 is when variance differs from zero, we will choose RE model. Finally, we run Hausman test to make decision between FE and RE model. If H_0 points out that difference in coefficient is not systematic, we will choose RE model and if H_1 shows that difference in coefficient is systematic, we will choose FE model.

5. Empirical results and discussions

Following the procedure of estimation methods for panel data as mentioned above, we begin our regression with OLS and RE for panel data. Results of the B-P Lagrangian multiplier tests reject the null hypothesis of no variances across countries, showing that RE is appropriate. Therefore, we continue running FE. Then, results from Hausman tests reject the null hypothesis of non-systematic difference in coefficients, indicating that FE is an appropriate estimator. Estimations results and relevant tests are reported in Table 3 and Table 4. In Table 3, FD is proxied by Domestic credit/GDP (FD1); while FD is represented by Money supply/GDP in Table 4.

Table 3. Regression results for FD1.

Dependent variable:	Random effect	Fixed effect
Domestic credit/GDP		
Independent variable		
ICT	0.261***(4.37)	0.257***(4.26)
GDPG	-1.069***(3.64)	-1.061***(3.61)
TRADE	3.714***(8.84)	2.298***(6.36)
URBAN	0.380*(1.98)	0.479*(1.86)
Constant	16.356***	16.006***
Year dummies	Yes	Yes
Obs.	210	210
B&PL test for RE	1147.53***	
F-stat	170.13***	139.94***
Hausman test for FE		198.28***

B&PL: Breusch & Pagan Lagrangian; Absolute T-statistics are in the parenthesis.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Table 4. Regression results for FD2.

Dependent variable:	Random effect	Fixed effect
Money supply/GDP		
Independent variable		
ICT	0.380***(5.37)	0.374***(4.25)
GDPG	-1.075***(3.07)	-1.074***(3.05)
TRADE	3.475***(8.49)	2.816***(7.04)
URBAN	0.204**(2.28)	0.363**(2.30)
Constant	22.307***	21.224***
Year dummies	Yes	Yes
Ob.	210	210
B&PL test for RE	1053.78***	
F-stat	298.50***	172.01***
Hausman test for FE		197***

B&PL: Breusch & Pagan Lagrangian; Absolute T-statistics are in the parenthesis.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Results in Table 3 and table 4 provide interesting findings as below.

First, ICT positively affects financial development proxied by both Domestic credit/GDP (FD1) and Money supply/GDP (FD2) in ASEAN countries significant at 1% significance level. Particularly, 1% increase in internet users leads to 0.257% improvement in financial development proxied by Domestic credit/GDP, and 0.374% that proxied by Money supply/GDP, indicating the important role of ICT in stimulating financial development in ASEAN economies. This finding is consistent with Lechman & Marszk (2015), Alshubiri et al. (2019), and Ismail & Omar (2019), who confirmed this relationship for developed countries. With this finding, we affirm that the positive impact of ICT on financial development is still correct in the context of developing countries like those of ASEAN.

Second, the impact of ICT on financial development proxied by both Domestic credit/GDP is stronger than that proxied Money supply/GDP, implying the important channel of Money supply/GDP through which ICT can stimulate financial development. This is the novel contribution of this study.

Third, other factors of financial development are found in ASEAN context, including GDP growth, urbanization, and trade openness. On the one hand, our results show that economic growth deters the financial development proxied by both indicators. As illustrated in Table 3 and Table 4, GDP growth has the negative effect on both financial development proxies, being statistically significant at 1% level. This finding is consistent with Narayan and Narayan (2013) but differs from Beck and Levine (2004) who found that bank credit and economic growth substantially have a positive relationship for a panel of 40 developed and developing economies. On the other hand, trade openness and urbanization positively affect two proxies of financial development. Specifically, 1% increase in trade openness leads to increases of 2.298% and 2.816% in Domestic credit/GDP and Money supply/GDP, respectively. The

finding on the positive impact of trade openness on financial development is in line with Kim et al. (2010), Menyah et al. (2014), Niroomand et al. (2014), and Polat et al. (2015). Meanwhile, urbanization significantly contributes to the financial development in both terms of Domestic credit/GDP and Money supply/GDP in ASEAN countries. This finding supports previous studies by Ciccone and Hall (1996), Brulhart and Sbergami (2009), and Lewis (2014).

6. Conclusion and policy implication

This paper empirically investigates the impact of ICT on financial development proxied by Domestic credit/GDP and Money supply/GDP in ten ASEAN countries over the period 2000-2020. Results from fixed effects for panel data show that ICT stimulates financial development by both proxies. Remarkably, the impact of ICT on financial development proxied by Money supply/GDP is stronger than that proxied by Domestic credit/GDP, implying the important channel of Money supply/GDP through which ICT can stimulate financial development. In addition, other important determinants of financial development are confirmed in the context of ASEAN countries, including economic growth, trade openness, and urbanization.

Findings in our study provide evidence for policy makers to utilize ICT to boost financial development in ASEAN countries, especially through the channel of money supply/GDP. Other policies to stimulate financial development through Domestic credit/GDP and Money supply/GDP should focus more on trade openness and urbanization.

Compliance with ethical standards: Disclosure of potential conflicts of interest

Conflict of interest: The authors declare that they have no conflict of interest.

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