INTERNATIONAL JOURNAL OF INDUSTRIAL MANAGEMENT (IJIM)
ISSN: 2289-9286 e-ISSN: 0127-564X
VOL. 9, ISSUE 1, 91 – 98
DOI: https://doi.org/10.15282/ijim.9.0.2021.5958

ORIGINAL ARTICLE

The Impact of ICT and FDI as Drivers to Economic Growth In ASEAN-8 Countries: A Panel Regression Analysis

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ABSTRACT – Over the last few years, information and communication technology (ICT) has become a key catalyst for economic growth. The durability of this technology is demonstrated by the rapid proliferation of the Internet, mobile phones and cellular networks across the globe. However, among economic scholars, the question of exactly how the spread of ICT affects economic development and FDI, especially in ASEAN countries with differences in levels of income, remains unanswered. The aim of this study was essentially to explore the relationship between ICT dissemination, FDI and economic growth in ASEAN-8 countries. By using data from 2003 to 2017, the panel regression analysis was used to evaluate these relationships. The results showed that the dissemination of ICT and FDI are important and they have a positive effect on the ASEAN-8 countries' economic development.

ARTICLE HISTORY
Received: 29-11-2020
Accepted: 3-01-2021

KEYWORDS
ICT diffusion,
FDI,
Economic growth,
ASEAN-8

INTRODUCTION

Innovation in ICT is diverse across nations and plays a crucial role in the development of the economies. Information communication technology (ICT) has altered the way people connect, do business and learn. Moreover, with the rapid spread of COVID-19, digital technology and connectivity have proved to emerge as a key tool and the best alternative to physical instruments and system. Subsequently, the shift to online applications during this pandemic period has caused the increase in Internet usage worldwide and become a new normal to everyone's lifestyle.

In the Southeast Asia region, the usage of digital technologies has grown rapidly. In 2017 alone, over 95% of the population of Brunei was connected to the Internet. However, the connection rate was quite low for Cambodia and Indonesia i.e. 34 % and 25 %, respectively. This is shown in Figure 1.

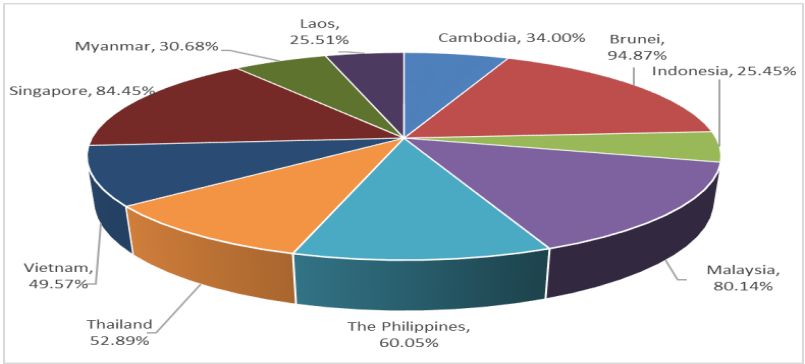

Figure 1: Individuals Using the Internet in 2017 (% of the population)

Meanwhile, the prevalence of mobile phone usage in the ASEAN nations is high. Thailand, Malaysia, Indonesia, and Cambodia have recorded mobile phone utilisation rates that are comparable to Singapore, which is a high-income nation. In contrast, Laos is the only nation that has documented significantly lower usage level of mere 50 subscriptions for every 100 individuals. A significant amount of evidence has emerged to imply the catch-up growth seen in the territory in terms of mobile phone utilisation. This is contributed by almost two-thirds of the ASEAN-based population who use their smartphones for Internet access (OECD 2018), as shown in Figure 2.

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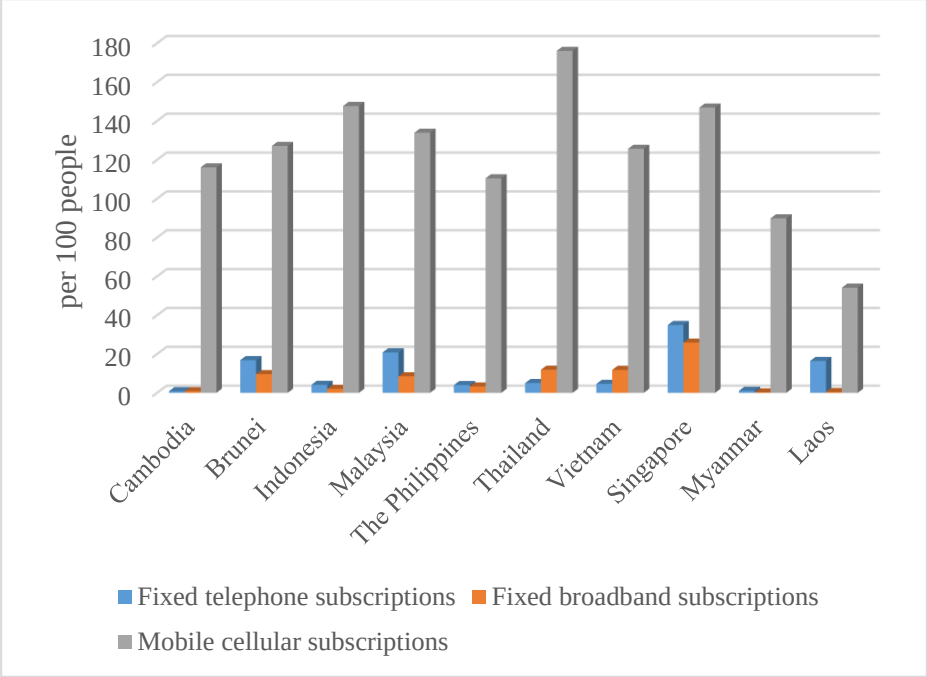

Figure 2: ICT Penetration (per 100 people)

FDI is an undertaking rendered in business intrigues situated in another country by a person or a company of a nation. FDI generally takes place when an international business capital is purchased by a financial professional, including controlling interest or establishing ownership in foreign companies. FDI inflows through the provision of new investment, management skills and technological advancement lead to economic growth through improvement in the productivity level (Pegkas, 2015). Not only that, FDI also contributes to the technology spillovers of the host nation (Eudelle & Shrestha, 2017).

The theories predict that ICT would have a significant association with growth, employment and productivity, but mixed results have been given by studies, especially for developing nations. This is due to the lack of awareness about the diffusion of ICT and innovation in these countries. This is consistent with the findings of Toader et al. (2018), whereby their work showed that the main factor for economic growth is ICT. A 2017 United Nations Conference (UNCTAD) study estimated that between 2010 and 2015, the number of Internet users had increased by 60 percent, while most of the world's residents remained disconnected. When available, broadband availability in developing countries is usually very slow and expensive, limiting the ability of organisations and individuals to use this technology in their daily operations. Meanwhile, in a few developed countries, more than 70 % of the population is interested in buying goods online, but less than 2% of those in the less developed countries (LDCs) are interested in online purchases (UNCTAD, 2017).

Looking at these results, there is still a gap in looking at the role of FDI to enhance the digital economy of the ASEAN countries. The goal of this study is therefore to examine the relationship between digitalisation, FDI and economic growth in the ASEAN region.

This paper can be divided into a few sections accordingly. The first section presents the introductory part, and section two contains the literature review. The third section discusses research methodology, followed by section four on the findings of the study. Finally, section five offers a conclusion and recommendation.

LITERATURE REVIEW

Digitalization is a new way of life since the beginning of year 2000s, where information and communication technologies (ICTs) played a driving force in spurring socio-economic growth. The beneficial outcome of ICT for the economic growth in developed countries such as United States and European countries, is well established (Shahiduzzaman and Alam, 2014; Evangelista et al. 2014; Hanclova et al., 2015; Das et al., 2016; Toader et al. 2018; Chien et al., 2020). However, due to the lack of ICT-growth studies, there are insufficient records of the impact of ICT on developing countries and low-income countries (Yousefi, 2011; Sepehrdoust, 2018; Fern´andez-Portillo et al., 2020).

In South East Asia, particularly since 2016, the usage of digital technology has increased rapidly with over 80% of adults connected to the Internet in Singapore; and over 20% in Indonesia, Cambodia, Laos and Myanmar. More people

have been able to connect to wireless networks and digital services because of the rapid spread of mobile broadband and Internet use. Meanwhile, more than 25% of the people in Singapore and 24.5% in Indonesia, Myanmar, Laos and Cambodia have access to fixed broadband networks (OECD, 2017).

Referring to Toader et al. (2018), in the EU Member States, the effect of ICT infrastructure on economic growth is positive and high; but the degree of impact varies depending on the form of technology being studied. Samimi et al (2015) found that both developed and developing nations have a strong and positive link between ICT and economic growth. This finding is compatible with the findings of Das et al. (2016) and Bahrini & Qaffas (2019). On the other hand, Phradan et al (2018) discovered a positive relationship between broadband and Internet with consumer price index and economic growth. The impact of the growth of gross domestic capital on both broadband and internet users is also positive and important. Sedika and Emamb (2019) have shown that for OECD nations, emerging and developed economies, the impact of ICT on economic growth is greater than its influence on MENA and developing countries. Moreover, as far as mobile and fixed broadband networks are concerned, the spread of ICT gives a significant positive impact to drive growth in OECD countries as well as developed economies. However, this is not happening in the MENA and developing countries.

A study by Saidi & Mongi (2018) carried out in 21 high-income nations using a causality effect showed unidirectional causality from education to mobile phones to economic growth, from internet user to mobile phone users to research and development. On the other hand, bidirectional causal relationship occurs between research and development and economic growth, and between internet users and economic growth. Adeleye & Eboagu (2019) revealed that the introduction of ICT in Africa has a significant positive association with economic development. They also revealed that mobile subscription has the highest elasticity across all requirements, and the greatest possibility to allow Africa to bypass traditional stages of growth. Meanwhile, Chien et al (2020), investigated the linear and non-linear effects of ICT diffusion on financial development for 81 countries covering America, Asia, Europe and Africa regions over the period 1990–2015. Their results revealed that Internet growth and fixed-line telephone growth can spur FD in all regions, while mobile cellular growth causes a positive effect on financial development only in Africa. Therefore, for policy makers of financial development, strengthening the expansion of the Internet and fixed-line telephones is conducive to the financial development in all the regions' countries; but the growth of mobile cellular is helpful for financial development only in African countries.

In the meantime, Khalili et al. (2014) acknowledged the unidirectional of Granger causality resulting from the contribution of ICT to total factor productivity in long-term. In the meantime, the contribution of total factor productivity among EU countries is significant and negative relationship with ICT. Nair et al (2020) examined the endogenous relationships between R&D, ICT infrastructure development and economic growth in the OECD countries between 1961 and 2018. Their findings indicated that both R&D and ICT infrastructure development contribute to long-term economic growth in the OECD countries. The short-run dynamics show the existence of complex inter-relationships among these variables. This outcome confirmed that, to achieve sustained economic growth, policymakers in the OECD economies should carry out integrated framework that implements co-development policies consisting of R&D investment, ICT diffusion and economic growth-enhancing initiatives.

In another aspect, according to Latif et al. (2018) the contribution of ICTs to FDI is also vital. ICT boosts FDI and foreign trade in five BRICS countries based on the data from 2000 to 2014. This result is consistent with the findings from Pradhan et al. (2017) where improved ICT enhances efficiency and competitiveness, and contributes to positive spillover to the country. Hence, it leads to more FDI inflows; in which, as a result, will increase economic growth. Their research was conducted in 32 OECD developed countries.

Meanwhile, internet and mobile phone penetration have a substantial impact on FDI inflows whereby it results in positive net effects on accelerating the economic growth of 25 sub-Saharan African countries based on the finding from Asongu & Odhiambo (2019).

METHODOLOGY

Model Specification and Data Analysis

The data were collected from the World Bank from 2003 to 2017. With the exception of Laos and Myanmar, the ASEAN countries chosen by this study are the members of the Association of Southeast Asian Nations (ASEAN). Laos and Myammar were excluded owing to the lack of ICT awareness in both countries. This study used panel regression analysis to examine the impact of FDI and ICT dissemination (shown by fixed broadband subscriptions and the percentage of people using the Internet as a proxy for ICT diffusion) on the economic growth of ASEAN-8 countries.

The regression estimations are shown as below:

$$\text{Model 1:} \quad LY_{it} = \alpha_0 + \alpha_1 LI_{it} + \alpha_2 LIN_{it} + \varepsilon_{it} \qquad (1)$$

$$\text{Model 2:} \quad LY_{it} = \beta_0 + \beta_1 LI_{it} + \beta_2 LFB_{it} + \varkappa_{it} \qquad (2)$$

$$\text{Model 3:} \quad LY_{it} = \gamma_0 + \gamma_1 LI_{it} + \gamma_2 LIN_{it} + \gamma_3 LFB_{it} + \nu_{it} \qquad (3)$$

Where;
LY= Natural log of GDP per capita as a proxy for economic growth
LI = Natural log of FDI net inflows made by non-resident investors in Malaysia
LIN = Natural log of percentage individuals using the Internet in every state
LFB = Natural log of fixed broadband subscriptions

We applied 3 regression techniques in this study. First, with the assumption that both the intercept and the slope of any country are the same over time, the Pooled OLS was used. Heterogeneity in such units is bound to occur as the panel data would relate to each region. The GLS pooled cross-sectional time assumes that all countries have the same behaviours. In other words, the slope and intercept of all countries over time and individuals are considered to be constant. Such assumptions of uniform behaviour reject any kind of heterogeneity that is, in fact, very likely to prevail. In order to integrate the heterogeneity of each nation for each cross-sectional unit, this study will therefore evaluate the GLS random effect estimator (RE) and GLS fixed effect estimator (FE) in our model.

Pooled estimation methods for OLS, Random Effect (RE) and Fixed Effect (FE) are designed to eliminate omitted variable bias by assuming that each explanatory variable is either correlated or uncorrelated to the non-observed individual effect (Jeffrey, 2009). The problem of omitted variables occurs because the linear regression model is incorrectly defined, which may be due either to the unknown effect of the omitted variable on the dependent variable or to the lack of data.

The Breusch-Pagan and Hausman tests are the basis for choosing the best estimation model. The Breusch-Pagan findings in Table 3 show that for all models, GLS with random effect is stronger for all models than GLS with pooled least square at 1 % significance level. This outcome suggests that the data include group-specific effects. The Hausman test also indicates that the null hypothesis of the lack of association between the individual effects and the explanatory variables is not accepted and the GLS estimator of the fixed effect is inconsistent.

This research will conduct fixed-effect GLS and random-effect GLS regressions to treat group-specific effects. The Hausman test, meanwhile, would be used to test the right model, assuming that the individual effects in the model are not associated with other regressors.

FINDINGS AND DISCUSSIONS

This chapter offers empirical evidence of the role of ICT dissemination and FDI in improving the economic output of ASEAN. A detailed description of the characteristics of the variables used in the study is given in Table 1, listing the standard deviations of the statistical means and the variables.

Table 1: Descriptive Statistics of Variables

Variable	Mean	Std. Dev.	Min	Max
LY	8.554802	1.396576	6.227688	10.94625
LI	22.09797	1.66353	18.2171	25.27515
LIN	0.5583795	2.052747	-5.726056	3.327105
LFB	3.044555	1.377271	-1.344883	4.552473

The correlation matrix, showing the strength of the relationships between the variables under analysis, is shown in Table 2 below. This will demonstrate whether it is weak or good for a relationship. The correlation matrix shows that the growth of GDP (LY) correlates positively with the diffusion of FDI (LI) and ICT represented by (LIN and LFB). The table of the correlation matrix shows the relationships between all the variables used in the analysis. The values showed that GDP (LY) is strongly correlated with LIN at 0.6983 and LFB at 0.6930, respectively. Meanwhile, at 0.8922, it is

suggested that LFB (fixed broadband subsription) and LIN (internet usage) have a positive relationship. The lowest value, meanwhile, is 0.1763 between LGDP and FDI. The matrix of correlation dictates which variables are highly correlated and to prevent serial correlation problems.

Table 2: Correlation Matrix

	LY	LI	LIN	LFB
LY	1.000000			
LI	0.1763	1.000000		
LIN	0.6983	0.4945	1.000000	
LFB	0.6930	0.4054	0.8922	1.000000

Referring to Table 4, all independent variables analysed in Model 1, Model 2 and Model 3 based on Pooled OLS are significant and have positive relationship with GDP except for FDI in all the models. The values of goodness of fit (R^2) are 0.74 (Model 1), 0.71(Model 2) and 0.78 (Model 3). Therefore, the variations in growth explained by the independent variables are at about 74%, 71% and 78% for Model 1, Model 2 and Model 3, respectively. The test for overall fitness is shown by F-test and the result indicates that the null hypothesis is to be rejected. This implies that the dependent variable, i.e. economic growth, has been affected by at least one or more of the independent variables. The individual coefficient of the approximate model was then evaluated following the rejection of the null hypothesis in the F-test. The t-test on each variable suggests that LI (FDI), LIN (internet usage) and LFB (fixed broadband subscription) are significant at 1% and 10% levels in Model 1, Model 2 and Model 3, respectively.

The selection of the best estimation model is determined based on the values of Breusch-Pagan and Hausman tests. The Breusch-Pagan results in Table 3 show that the result of GLS with random effect is better than GLS with pooled least square at 1% significance level for all the models. This result indicates that there are group-specific effects in the data.

In treating the group-specific effects, this study will perform GLS with fixed effect and GLS with random effect regressions. To test the appropriate model with the hypothesis that the individual effects are uncorrelated with the other regressors in the model, the Hausman test will be utilized. Based on the result from Hausman test shown in Table 3, it can be concluded that for LY estimation, for all the three models, the random effect GLS results outperformed the fixed effects. The results from Hausman test also suggest that the null hypothesis of the lack of association between individual effects and the explanatory variables is not accepted, and the fixed effect GLS estimator is incoherent.

The findings for random effect indicate that LI (FDI) has a significant and positive relationship with LY (GDP) at 1% significance level for all models. The result is consistent with the findings from Pengkas (2015), where FDI can contribute to new investment, improve managerial skills and facilitate transfer of technology, increase the productivity of labor and enhance economic growth. Moreover, FDI can also assist on the development of host nation through technology spill-overs. This is consistent with the results of Eudelle & Shrestha (2017), whereby many countries have a good potential for economic growth but lack domestic investments. Therefore, FDI is in the position to bridge the gap between the investment needed to stimulate economic development and the investment available locally.

In the meantime, ICT diffusion proxies, namely LFB (fixed broadband subsription) and LIN (internet usage), also demonstrate a significant and positive relationship with LY (GDP) at 1 percent significance level. The findings of Toader et al. (2018), Vu (2017), Castaldo et al. (2018) and Latif et al. (2018) are consistent with these results. Overall, the majority of scholars agreed that the development of ICT infrastructure enables businesses to benefit from cheap labour and resources as well as convenient access to local and foreign markets.

Table 3: Results of Pooled OLS, Fixed-Effect and Random-Effect GLS Regression Estimation for Growth

	Pooled OLS			**GLS with Random Effect**		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constant	12.40***	8.582*	11.289***	7.506***	6.972***	7.568***
	(-3.05)	(6.78)	(7.95)	(3.64)	(15.74)	(18.93)
LI	-0.188**	-0.105***	-0.176***	0.0453***	0.054***	0.034***
	(-3.05)	(-1.74)	(-2.89)	(3.64)	(4.39)	(2.92)
LFB	0.550***		0.360***	0.0836***		0.055***
	(11.04)		(3.61)	(10.63)		(5.67)
LIN		0.754***	0.311***		0.125***	0.068***
		(10.33)	(2.20)		(9.92)	(4.51)
N	120	120	120	120	120	120
R^2	0.743	0.717	0.785	0.743	0.717	0.785

F	158.2	139.48	132.81	158.2	139.48	132.81
Prob.	0.00	0.00	0.00	0.00	0.00	0.00
Breusch-Pagan test				365.67***	480.22***	406.66***
Hausman test						

(cont..)	**GLS with Fixed Effect**		
	Model 1	Model 2	Model 3
Constant	7.489***	6.963***	7.555***
	(3.89)	(28.19)	(31.66)
LI	0.0462***	0.055***	0.035***
	(3.89)	(4.54)	(3.11)
LFB	0.0826***		0.054***
	(11.04)		(5.87)
LIN		0.124***	0.0671***
		(10.06)	(4.65)
N	120	120	120
R^2	0.743	0.717	0.785
F	158.2	139.48	132.81
Prob.	0.00	0.00	0.00
Breusch-Pagan test			
Hausman test	0.16	11.05	0.16

Notes: Number in parenthesis is the t-test results
***,** and * indicates significant at 1%, 5% and 10% l

CONCLUSION AND RECOMMENDATIONS

The main objective of this study is to measure the relationships between net foreign direct investment inflows, the percentage of Internet users, fixed broadband subscriptions (per 100 population) and economic growth in ASEAN-8 countries. The findings reveal that there is a positive relationship between the diffusion of FDI and ICT, and economic growth at 1% significance level. The finding also indicates that there is a strong positive relationship between FDI and economic growth. According to Pegkas (2015). Latif et al. (2018), Ali & Mingque, (2018) and Azam & Ahmed (2015), FDI could help to boost economic development. Moreover, the significant positive relationship between the percentage of internet users and fixed broadband subscriptions (per 100 inhabitants) with economic growth was also revealed for these countries. The results are consistent with the outcome from Toader et al. (2018), Vu (2017), and Castaldo et al. (2018) affirming that there is a positive and meaningful relationship between the two variables.

It can be inferred from the above findings that FDI and ICT dissemination play a very important role in influencing the the economic growth of ASEAN-8 countries. With better ICT infrastructure in these countries, it is possible to attract more foreign investors to invest in these countries, especially from multinational companies (MNCs). However, this approach is only viable if the importance of ICT and its latest applications in this field, such as Artificial Intelligence (AI), Big Data and the Internet of Things (IOT), are understood by both the public and private stakeholders. To ensure the effectiveness of this strategy, the government's action of developing the basic facilities of ICT infrastructures is very crucial. In addition, fostering the involvement of private sectors through various incentives may also increase more ICT usage in their operations.

During the COVID-19 crisis, ICT has become crucial and the technologies are playing a massive role to activate the social and economic activities during lockdowns and re-opening of the economies. The new normal of working from home (WFH) community, e-learning for primary, secondary and tertiary education and e-business for business community have boost the demand for social media, video conferencing, online networking devices, business online software, online banking and financial applications as well as chat systems. The society is now more dynamic in which there is a lifestyle change whereby new technologies and gadgets are heavily relied upon. Thus, further study should be carried out to look at the impact of ICT on the society's new normal especially during unpredictable situations, and its effects on economic growth.

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ACKNOWLEDGEMENT

The authors would like to thank the BOLD grant provided by Universiti Tenaga Nasional for the funding of this research. Grant Reference No: 10436494/B/2019053.
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