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Information and Communication Technology (ICT) and Income Inequality in ASEAN-5 Countries

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Abstract

Digital economy basically refers to an economy that is based on digital technologies. Embracement of digital economy transforms the economic growth of a nation. Countries that are blessed with a successful digitalization can boost its economic performance; however, it might trigger the income inequality of a country. On this note, income inequality in ASEAN country is relatively higher than other countries. Hence the aim of this study is to examine the relationship between ICT and income inequality in ASEAN-5 countries over the study period of 2009 to 2018. Employs static and dynamic panel data estimation method, the results show mobile-cellular telephone subscription to have the strongest effect on income inequality among the ICT indicators. The findings suggest countries to focus on the innovation of ICT especially on the mobile-cellular telephone subscription, fixed broadband subscription and fixed telephone subscription to achieve economic growth and hence reduce income inequality. Investments in ICT infrastructure promote ICT technology cooperation as well as the advancement of ICT especially on the rise in employment in ICT sector, transformation of government services into digital form to confront with the income inequality.

Keywords: Information and communication technology, economic growth, income inequality, ASEAN-5

Introduction

Information and Communication Technology (ICT) refers to the telecommunications that provide the access of information primarily on communication technology. ICT often studied how modern communication technologies affect society includes Internet and wireless network as well as other communication mediums via instant messaging, voice over IP (VoIP) and video-conferencing. ICT plays an important role to gain the competitive advantage on the development of a country (Seki, 2008). The expanding of ICT has a promising potential to generate foreign exchange earnings as well as job opportunities to enable a firm to increase the productivity and profit (Spiezia, 2012). With the positive expected contribution of ICT development toward the economic growth of a country, it is

viewed as one of the many approaches to combat poverty (Roller & Waverman, 2001; Alevriadou, 2016).

Income inequality refers to the extent due to the occurrence of the uneven distribution of income among a population. Increases in income inequality will indeed lower down the economic growth according to Organization for Economic Cooperation and Development (2014). This is because income inequality not only have negative consequences on the economic growth but it will lead to political and social issues (Ismail, 2018; Onyali, Okerekeoti, 2018). It harms the economic growth of a country. Thus, income inequality is an important issue to be effectively discussed and deal with in order to boost the economic growth in the country.

In macroeconomic level, the expansion of ICT to economy trends held the potential of new sources of productivity opportunities. Evidence showed a positive return on the investment in ICT sector with the combination of human capital participation in economy as well as the organizational change. The expansion of ICT sector has a promising potential to generate foreign exchange earnings as well as job opportunities. Development in ICT can fosters the economic growth in the country (Czernich et al., 2011).

Table 1: Differences of the Globalization Waves.

Type	Characteristics	Driver
"Traditional" trade	-Separation of production and consumption across international borders - Final goods trade	-Reductions in transportation costs
Modern ICT trade	- Unpacking of production, logistics and consumption: age of connectivity. - Trade in smaller quantities of physical goods and services - Changing tradable nature of services. - Bundling of goods and services	-Reductions in transport, coordination and mainly costs of sharing information - Digitalization

Source: Organization for Economic Cooperation and Development (2014)

Globalization develops or transforms the economics of growth and development. Almost all the countries around the world including ASEAN countries carry their economy through practices of ICT which is known as digital economy. In the recent years, innovation of ICT received much attention from the government of ASEAN countries, businesses and regional bodies. Countries that are blessed with the success of ICT innovation will eventually boost its economic performance. Table 1 shows the differences of globalization waves. According to Organization for Economic Cooperation and Development (2014), in a traditional trade, the setting of the production and consumption are separated across international borders and mainly focus on the final good trade. Modern trade through ICT is much better on its data flows, connectivity and interoperability than traditional trade where its policy focused on market access. Effect of the changes in new technology towards the

capability of the workers as well as the income inequality will greatly influence the growth of the country. ICT could be the strike factors to foster the economic growth. As a result, poverty rate will decrease in the country. Particularly, Singapore is the headway on the emphasizing the e-commerce expansion in the economy. Network penetration can become one of the key factors affecting the performance of e-commerce in a country. In Singapore, the network penetration rate is at 73% which the highest in the region. Therefore, the growing presence of ride-sharing services like Uber, Grab and GO Jek had been introduced through a mobile application in order to exploit the ICT advancement of the country. In addition, Thailand is the world's second-biggest maker of hard disk drives (HDDs) after China in 2015 with Western Digital and Seagate Technology among the biggest producers (Kearney & Axiata, 2016). Communication Technology Policy (2011-2020) as the framework for developing ICT in Thailand act as the foundation to push up the economy in Thailand (Ministry of Digital Economy and Society, 2014). Indonesia has a slow ICT growth in the past decade. According to Eick (2007), the privatization and liberalization of Internet Service Provider (IPS) only started in early 1990s in order to improve the telecom availability of the country. In the same study by Eick (2007), the government of Indonesia only spent 0.6% of their GDP in 2001 toward the local telecom infrastructures which is much lower compare to the other ASEAN country during that period of time. The distribution of accessibility toward wireless connection is also skewed toward the big cities with 75% and 15% of the country's internet subscribers are located in Jakarta and Surabaya respectively. This shows that the remaining of the country has a limited access toward the wireless connection. The legal infrastructure of e-commerce in Indonesia based on its Electronic Information and Transaction Act 2008 (Ruslijanto, 2012). Indonesia has made significant progress in ICT.

As one of the ASEAN members, Malaysia is consider as one of the high paced developing Asian country. Malaysia managed to establish an e-commerce laws based on the Electronic Commerce Act 2006 and the Electronic Government Activities Act 2007. The Personal Data Protection Act was being introduced in Malaysia by then it became the first ASEAN member to pass a privacy legislation in line with the rapid growth of the industry in order to protect the new-emergence segment of consumer known as e-consumers. Philippines had the significantly the fastest growing trend in ICT and being entitles as the fastest growing internet population country. ICT is the major engine of Philippines economy. The Philippines is more open to foreign trade, investments and relations during early of 1990s. First cellular telephone network and first Internet connection in Philippines enabled Internet services to be widely spread. In year 2018, e-commerce in Philippines expected to play a tremendous potential in growth in the future. The adaptative of online shopping trends with the rising of internet users projected to reach USD-million in year 2018 (Villegas, 2014).

There is hesitation arises from the relationship between ICT and income inequality. ICT development plays a significant role act as a major contributor to poverty alleviation. Therefore, the general objective of this study is to examine the relationship between Information and Communication Technology (ICT) and income inequality in ASEAN-5 countries. As far as this study is concerned, existing studies focusing on income inequality in ASEAN countries appear to be limited. Past studies such as Richmond and Triplett (2016) examined the relationship between ICT and income inequality of 107 foreign countries while Yilmaz et. al. (2018) investigated the impact of ICT

penetration on poverty which involved 182 foreign countries. This represents an important gap. On this note, this study aims to examine the nexus between various ICT services and income inequality of ASEAN-5 countries. This study can be a useful reference tool for researchers, academicians, policy makers and government in the decision making. Next section offers the theoretical motivation with the empirical evidence on the issue of ICT and income inequality follows by the data and methodology sections. Empirical results will be presented in the next section and lastly about the conclusion and future research direction of the study.

Literature Review

Kuznets hypothesized that as economy grows, market force first increased and decrease income inequality in his theory (ScienceDirect, 2019). In early development, investment opportunities only available for those who have extra or excess income capabilities. They will invest more and gain more incomes. As for those people who are working from the rural area, they might be held down wages widening the income gap (Moffatt, 2019). He believed inequality would follow an inverted U-shape. As notional income per capita increases, the inequality will rise in initial stage then falls after reaching the highest degree. Kuznets (1955) found that the income inequalities are higher in developing country compared to those in developed country. According to Kuznets (1955); Onyali, Okerekeoti (2018); Jusoh, Salleh, Embong, & Mamat (2018), endogenous growth theory emphasizes the technical process of the rate of investment, stock of human capital and the size of capital stock. The Schumpeter model explained the dynamic analysis of the economy. It implies the theory of economic development and innovations in the market. Schumpeter said the role of an entrepreneur is an important production factor for example in the development process in the market. The economy will expand in the market. Sometimes, when inequality problems exist, growth can be described as with a create destruction.

There is inconclusive evidence on the relationship between ICT and income inequality. Parham (2004) described ICT-driven growth in the adoption of ICT. The contribution of ICT to economic growth offers many approaches to combat poverty (Roller & Waverman, 2001). ICT increases the productivity and profit of the country and at the same time facilitates the increment of the individual and household income (Spiezia, 2012). Technological change might disrupt the original market wealth concentration (Latzer, 2009). According to Tong and Dall'erba (2008), ICT and income inequality is positively related in China. During the rapid growth of developing in the country at study year range, ICT's industry in China is facing challenges. One major concern will be the uneven distributed of ICT growth especially based on the number of Internet users and such disparities rise up the inequalities in income and opportunities. Similar studies done showed ICT is positively correlated with wage inequality (Iacovone & Pereira-Lopez, 2018). Both high-skilled worker and low-skills workers receive higher wages in more ICT-progressive industries than non-ICT-progressive industry causing more income inequality problems (Iacovone & Pereira-Lopez, 2018). Thus, ICT might positively relate to income inequality. The results are mixed.

Data and Methodology

The data sets for the variables are obtained from the World Bank Group and International Telecommunication Union. This study exploits the panel data of the ASEAN-5 namely Singapore, Thailand, Indonesia, Malaysia and Philippines over a period of 2003-2018.

Richmond and Triplett (2016) examined the relationship between ICT and income inequality from a cross-national perspective which involved 107 countries. This study reviews the relationship of the explanatory variables such as volume of Internet users *(X_1)* in million, mobile cellular telephone subscription *(X_2)* in million, fixed broadband subscription (X_3) in million and fixed telephone subscription *(X_4)* in million with ASEAN-5 income inequality as the dependent variable represents by Gini Coefficient (Richmond & Triplett, 2016). In order to clearly identify the relationship between the independent variables and the dependent variable, control variables will being included in order to control in the study where these variables are expected to be correlated with the estimated outcomes. The specific relationship it may contaminate the results. Thus, it is important to include control variables in the model.

Generally, there are two ways to estimate a model based on the assumption made either to employs a static panel estimation or a dynamicestimation. For static panel estimation, it involves Pooled Ordinary Least Squares (POLS) model, Fixed Effect Model (FE) and Random Effect Model (RE). Firstly, Hausman test is used to test the endogeneity in the explanatory variables to test whether fixed or random effect model is appropriate (Sheytanova, 2014). Hausman statistic is computed as:

$$W = (\beta_{fe} - \hat{\beta}_{re})'(\hat{\Sigma}_{fe} - \hat{\Sigma}_{re})(\beta_{fe} - \hat{\beta}_{re}) \quad (1)$$

Where the covariance matrix for FE and RE models are estimated respectively. If Hausman statistic is bigger than its critical value, null hypothesis is rejected thus the FE model is favorable and vice versa.

Fixed effect (FE) model is a statistical model with parameters that are fixed and consist of non-random quantities. FE model for k factors can be expressed in following way:

$$y_{it} = \alpha_i + \beta_1 x_{1,it} + \ldots + \beta_k x_{k,it} + \varepsilon_{it} \quad (2)$$

There is no overall intercept included in the model in which α_i is unique and unknown intercept for each individual unlike the constant term β_o, the slopes of β parameters are same for all individuals with the assumptions that are valid for FE model (Sheytanova, 2014). The FE models always gives consistent estimated results but unfortunately it is inefficient compare to RE model estimates.

Sometimes, the used of the static panel data techniques are inconsistent. Arrellano-Bond estimator or known as Arrellano-Bond Difference Generalized Moment Method (GMM) which is the estimation that takes into account the serial correlation used to estimate dynamic panel data models. The solution of utilizing instrumental variables (Anderson and Hsiao, 1981). However, it ended up being inefficient with higher variance than Arrellano-Bond estimator. There are three type of Arrellano-Bond difference GMM include one step, two step and two steps with robust standard-errors in testing the model. In Arrellano-Bond method, the first-difference of the regression equation

has been suggested to eliminate the country-specific effect. It addresses the efficiency-sample size trade-off by using time-specific instruments as follow:

$$(y_{it} - y_{i,t-1}) = \varphi\ (y_{i,t-1} - y_{i,t-2}) + \gamma\ (x_{i,t-1} - x_{i,t-2}) + (v_{it} - v_{i,t-1}) \quad (3)$$

With the moment conditions of:

$$E[y_{i,y-s}(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0; s \geq 2; t = 3,\ldots,T \quad (4)$$

Arrellano and Bond (1991) showed the way to construct estimators based on moment equations from further lagged levels of dependent variable and the first-differenced errors. Arrellano and Bond (1991) proposed the first-differences transformation to eliminate the country-specific effects.

$$y_{it} = B_1 + B_2 y_{it-1} + B_3 X_{it} + \lambda_i + \varepsilon_{it} \quad (5)$$

$$\Delta y_{it} = \delta \Delta y_{i,t-1} + b' \Delta x_{it} + \Delta \varepsilon_{it} \quad (6)$$

By introducing the serial correlation in the error term and the regressor-error correction. It is valid under the assumption that the error term is not serially correlated and the lag of the explanatory variables are weakly exogenous. Specification of model as below:

$$YI_{it} = \beta_0 + \beta_1 VOIU_{1,it} + \beta_2 MCT_{2,it} + \beta_3 FB_{3,it} + \beta_4 FT_{4,it} + \beta_5 CB_{5,it} + \beta_6 PA_{6,it} + \beta_7 UR_{7,it} + \varepsilon_{it} \quad (7)$$

where YI represents income inequality as the dependent variable. VOIU is the volume of internet users, MCT represents the mobile-cellular telephone subscription, FB represents fixed broadband subscription while FT denoted by fixed telephone line subscription. The controlling variables are CB, crude birth; PA, total population aged 65 and UR, urbanization rate. After that, the model will be tested through Skewness/Kurtosis normality tests to ensure that the variables are normally distributed at the same time, diagnostic tests which consist of White test, Wooldridge test and Variance Inflation Factor (VIF) was estimated to ensure the goodness of fits in the model. Meanwhile, Arrellano-Bond difference GMM estimator will be tested by post estimation tests, Sargan Test and AB Test.

Results and Discussion

The model is tested by POLS, RE, FE and GMM analysis. The results are presented in Table 2 below.

Table 2: Results of POLS, RE, FE and GMM Data Analysis

	Pooled OLS	Random Effect	Fixed Effect	Arrelano-Bond (1991) difference GMM One Step (constant=0)
Constant	3.686 **(9.22)*** **	3.686 **(9.22)*** **	4.125 **(7.76)** **	-
lagYI	-	-	-	0.442 **(2.79)*** **
lVOIU	0.019 (0.96)	0.019 (0.96)	0.053 (2.21)	0.034 (1.46)
lMCT	-0.095 **(-4.15)*** **	-0.095 **(-4.15)*** **	-0.009 (-0.23)	-0.125 **(-2.06)** **
lFB	0.042 **(3.17)*** **	0.042 **(3.17)*** **	0.014 (0.96)	0.043 **(1.67)***
lFT	-0.023 (-1.43)	-0.023 (-1.43)	-0.034 **(-1.31)*** **	-0.035 (-1.33)
lCB	0.240 **(3.58)*** **	0.240 **(3.58)*** **	0.228 **(2.69)*** **	0.254 **(2.82)*** **
lPA	0.035 (0.54)	0.035 (0.54)	-0.579 (-3.09)	0.002 (-0.15)
lUR	-0.086 **(-1.87)***	-0.086 **(-1.87)***	-0.141 **(-1.11)*** **	0.001 (0.34)
Hausman	-	32.34 **(0.0000)*** **		-
Breush-Pagan LM	0.00 (1.0000)		-	-
Sargan Test	-	-	-	63.38 (0.3247)
AB Test (prob-z)	-	-	-	Order 1= **(-4.36)*** ** Order 2= **(2.44)** **

Note: *, ** and *** indicate the respective 10%, 5% and 1% significance level

lagYI; Lag Income Inequality, lVOIU; Volume of Internet Users, lMCT; Mobile Cellular Telephone Subscription, lFB; Fixed Broadband Subscription, lFT; Fixed Telephone Line Subscription, lCB; Crude Birth Rate, lPA; Total Population Aged 65 and Above; lUR; Urbanization rate

Referring to Table 2, the static panel estimation shows the results for POLS model and RE model that are quite similar in term of coefficient value. What differs them is the significance level of the variables. Under Hausman null hypothesis tested, p-value is 0 which is less than 0.05. H_0 is not rejected. Fixed Effect (FE) model is appropriate. Under Breush-Pagan LM null hypothesis, the p-value is estimated as 1.000 which is larger than the 5% significant level. From the POLS results computed, only two ICT independent variable are significant, the mobile cellular telephone subscription (lMCT) and the fixed broadband subscription (lFB) is significant at 1% of significance level. Meanwhile, control variables, crude birth rate (lCB) is significant at 1% significance level while urbanization rate (lUR) is significant at 10% significance level. As for FE model, only one ICT independent variable fixed telephone line subscription (lFT) is significant at 1% significance level. Control variables, crude birth rate (lCB) and urbanization rate (lUR) are significant at 1% significance level. Hence, Pooled Ordinary Least Square (POLS) model is appropriate. The POLS model is written as,

$$IYI_{it} = 3.686 + 0.019\log VOIU_{1,it} - 0.095\log MCT_{2,it} + 0.042\log FB - 0.023\log FT + 0.24\log CB_{5,it} + 0.035\log PA_{6,it} - 0.086\log UR_{7,it} + \varepsilon_{it} \quad (8)$$

β_0 is the intercept of the model, which is 3.686. β_1 is the coefficient of volume of online users, which is 0.019. It is estimated that an increase in the volume of internet users of 1%, on average, will leads to an estimated increase in income inequality by 0.019%. There is a positive relationship between volume of online user and income inequality which is different from our negative prediction before because quality improvements are very important to face the challenges to measure the aggregate effects of the Internet at aggregate level especially in a broader Internet ecosystem (Corrado & Van Ark, 2016). β_2 is the coefficient of mobile cellular telephone subscription, which is -0.095. An increase in the mobile cellular telephone subscriptions by 1%, on average, leads to a decline in income inequality by 0.095%. There is a negative relationship between mobile cellular telephone subscription and income inequality. According to study by Richmond and Tripplett (2016), it is estimated that the mobile cellular telephone subscription managed to reduce the income inequality of 109 countries. In recent years, the technological advancement in the development of mobile cellular telephone has managed to create a positive competition in term of pricing strategy among the suppliers. Mobile phone has become one of the necessary medium to transfer the impact of ICT development to a nation. Accessibility of the population toward the mobile phone surely will create different economic opportunity generated from the growth of digital sector. β_3 is the coefficient of fixed broadband subscription, which is 0.042. An increase in the fixed broadband subscription of 1%, on average will leads to an increase in the income inequality by 0.042%. There is a positive relationship between fixed broadband subscription and income inequality. Fixed broadband subscriptions are expensive in general to an individual or onto a network. Fixed broadband has a significant positive effect on income inequality, which the effect is considered largest among other ICT measures (Richmond & Triplett, 2016). However, the effect might not appear consistently within the lowest-income-countries because ICT has yet to reach the sufficient thresholds of access in order to affect the aggregate income distribution. β_4 is the coefficient of fixed telephone line subscription, which is -0.023. An increase in the fixed telephone line subscription by 1%, on average, leads to decrease in the income inequality by 0.023%. One of the examples in India, telephone line subscription reached the rural area via the introduction of Public Call Offices (PCOs) to support the

poverty-reducing strategies. Besides, the increase in the penetration rate of fixed telephone raise GDP per capita by 0.45% (Roller & Waverman, 2001) and hence reduce income inequality.

Generally, the study estimated that there is negative relationship between the income inequality in the ASEAN-5 (YI_{it}) with ICT independent variables; the mobile-cellular telephone subscription (lMCT) and the fixed telephone line subscription (lFT). Meanwhile it is estimated that there is a positive impact between the volume of internet users (lVOIU) and the fixed broadband subscription (lFB) toward the dependent variable of this model. From the results computed, only one ICT independent variable is significant at 5% of significance level which is the fixed telephone line subscription (lFT).

Table 3: Goodness of Fit Tests Results

Heteroscedasticity	60.91
(White test-chi stat)	**(0.0043)*** **
Serial Correlation	3.20
(Wooldridge test- F stat)	(0.1482)
Multicollinearity	7.47
(mean VIF)	

Note: *** indicates 1% significance level

The heteroscedasticity result shows in Table 3 that the P- value (Prob. Chi-Square) is 0.0043 which is lower than 5 percent significance level, $\alpha = 0.05$. Thus, H_0 is rejected and it means that the null hypothesis of homoscedasticity in the model rejected where the variances are not constant in the model. The correlation result show that p-value (Prob. F stat) is 0.1482 which is higher than 5 percent significance level, $\alpha = 0.05$. Thus, H_0 fail to reject and it means that the null hypothesis of no serial correlation in the model is being accepted. Based on the assumption of 10 < VIF < 0.1 where the result shows the mean VIF is 7.47, it means there is no multicollinearity problems between independent variables. Hence, heteroscedasticity occurred in the model. So, the model needs to be corrected.

Dynamic panel estimation, Arrellano-Bond difference GMM in One Step with zero constant produces the best results in GMM estimation. From the results computed, referring back to estimation result in Table 5, only two ICT independent variable are significant, the mobile cellular telephone subscription (lMCT) is significant at 5% of significance level while the fixed broadband subscription (lFB) is significant at 10% of significance level. Meanwhile, the control variable, crude birth rate (lCB) is estimated to be significant at 1% significance level. The Arrellano-Bond difference GMM-One Step model is written as:

$$lYI_{it} = 0.001 + 0.442 laglYI_{1,it} + 0.034 \log VOIU_{1,it} - 0.125 \log MCT_{2,it} + 0.043 \log FB_{3,it} - 0.035 \log FT_{4,\ it} + 0.254 \log CB_{5,it} + 0.002 \log PA_{6,it} - 0.001 \log UR_{7,it} + \varepsilon_{it} \quad (9)$$

β_0 is the intercept of the model, which is 0.001. λ Is the coefficient of lagged dependent variable of income inequality (lgYI), which is 0.442. There is an effect of past dependent on current dependent as it is significant at 1 % significance level. β_1 is the coefficient of volume of online users,

which is 0.034. An increase in volume of internet users of 1%, on average, leads to increase in income inequality by 0.034 %. There is a positive relationship between volume of online user and income inequality which is different with our negative prediction before. β_2 is the coefficient of mobile-cellular telephone subscription, which is -0.025. An increase in mobile-cellular telephone subscription of 1%, on average, leads to decrease in income inequality by 0.025%. There is a negative relationship between mobile-cellular telephone subscription and income inequality, which is same with our prediction before. β_3 is the coefficient of fixed broadband subscription, which is 0.043. An increase in fixed broadband subscription of 1%, on average, leads to increase in income inequality by 0.043%. There is a positive relationship between fixed broadband subscription and income inequality, which is different with our prediction before. β_4 is the coefficient of fixed telephone line subscription, which is -0.035. An increase in fixed telephone line subscription of 1%, on average, leads to decrease in income inequality by 0.035%. There is a negative relationship between fixed telephone line subscription.

From the results computed, only two of the ICT independent variables are significant which are the mobile-cellular telephone subscription (lMCT) that is significant at 5% significance level and the fixed telephone line subscription (lFT) which is significant at 10% while crude birth rate (lCB) is significant at 1 % significance level. For Sargan test, the result (Refer Table 2) proves that overidentifying restriction instruments are valid in the model as the p-value (Prob. Chi-Square) is 0.3247 which is more than 5 percent significance level, $\alpha = 0.05$. Thus, H_0 is not rejected and it means that the null hypothesis of overidentifying restriction instruments are valid in the model and it is not correlated with the errors. Meanwhile, according to AB test, first order serial correlation exists in the first and second order. Hence, the robust Arrellano-Bond test is used to overcome the serial correlation in the model.

Table 4: Skewness/Kurtosis Tests Results

Pr(Skewness)	0.1014
Pr(Kurtosis)	0.1350
Pro.Chi-Square	0.0868
Observation	75

The model being tested whether the variables are normally or abnormally distributed and the results are shown in Table 4. The results show that P- value (Prob. Chi-Square) is 0.0868 which is more than 5% significance level, $\alpha = 0.05$. Thus we fail to reject the H_0 and it means that the null hypothesis of variables is normally distributed in the model is being accepted.

Table 5: Corrected POLS Model and Corrected Arrellano-Bond Difference GMM

	Corrected Pooled OLS	Robust Arrellano-Bond Difference GMM
Constant	3.686	-
	(7.81)* **	
lagYI	-	0.442
		(2.49) **
lVOIU	0.095	0.034
	(0.91)	(1.47)
lMCT	-0.042	-0.125
	(-5.97)* **	**(-5.28)*** **
lFB	-0.023	0.043
	(2.08) **	**(2.16)** **
lFT	-0.039	-0.035
	(-1.37)	**(-1.69)** *
lCB	0.240	0.254
	(3.20)* **	**(2.37)** **
lPA	0.035	0.002
	(0.44)	(-0.37)
lUR	-0.086	0.001
	(-2.03)* **	(0.69)

Note: *, ** and *** indicate the respective 10%, 5% and 1% significance level

lagYI; Lag Income Inequality, lVOIU; Volume of Internet Users, lMCT; Mobile Cellular Telephone Subscription, lFB; Fixed Broadband Subscription, lFT; Fixed Telephone Line Subscription, lCB; Crude

Birth Rate, lPA; Total Population Aged 65 and Above; lUR; Urbanization rate

For the corrected POLS model, the mobile cellular telephone subscription (lMCT) is significant at 1% significance level while the fixed broadband subscription (lFB) is significant at 5% significance level. Besides, the crude birth rate (lCB) is significant at 1% significance level while urbanization rate (lUR) is significant at 5% significance level. Besides, for the robust Arrellano-Bond difference GMM model, the lagged dependent is significant to justify the model is dynamic. From the estimated result, the mobile cellular telephone subscription (lMCT) and the fixed telephone line subscription (lFT) are significant at 1% significance level. Meanwhile, the fixed broadband subscription (lFB) and the crude birth rate (lCB) are significant at 5% significance level. Besides, crude birth rate (lCB) is significant at 5% significance level.

Table 6: AB Test Results

First Order Pr(z)	**(0.0491)****
Second Order Pr(z)	(0.1059)

As for the AB test for robust Arrellano-Bond difference GMM model, the null of no first order serial correlation is rejected in first order at 5% significance level while it fails to reject in second order. Hence, the model is consistent in the second order. Hence, robust Arrellano-Bond difference GMM model is valid and being used as the final model.

Conclusion

This study explores the relationship between ICT and income inequality in ASEAN-5 countries over the study period of 2003 until 2018. The results of final GMM model in this study estimated the relationship between the variables representing the countries' ICT development and income inequality in ASEAN-5 countries; whereby the mobile-cellular telephone subscription (lMCT) and the fixed telephone line subscription (lFT) in ASEAN-5 countries has a significant negative effect on the income inequality. The mobile-cellular telephone subscription (lMCT) is significant at 1% significance level. Fixed telephone line subscription (lFT) is significant at 10% significance level and fixed broadband subscription (lFB) is significant at 5% significance level. The most significant factor among the ICT independent variables that influence the income inequality is the mobile-cellular telephone subscription (lMCT), which is -0.125 with its p-value, 0.000. An increase 1% in mobile-cellular telephone subscription, on average, leads to increase in income inequality by 0.125%. The results imply that ICT does affect the income inequality in ASEAN-5 countries. Hence, the ICT development should be considered in any future policies to combat the income inequality in ASEAN-5 countries.

The Robust Arrellano-Bond difference GMM model being used as the final model to estimate the relationship between ICT and income inequality of the countries. This study employs the dynamic panel estimation method. Unbiased and consistent parameters being derived. The lagged dependent variable is significant to justify the model is dynamic. There is no serial correlation in this model as being tested in robust Arrellano-Bond difference GMM model being. Hence, the model is valid.

From this research, it can be concluded that ASEAN-5's economic growth can be traced through the formation of their ICT policy in order to combat poverty. Investments in infrastructure and development of government policies that encourages the progress of ICT sector in the ASEAN-5 countries will surely combat the issue of income inequality in the country. ASEAN countries can aim to achieve global top economies within the next decade by focusing on economic growth through ICT in line with the vision of interconnected world with International Telecommunication Union (ITU) (2017).

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