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## **An Effect of Internet Penetration on Income Inequality in Southeast Asian Countries**

Caria Ningsih<sup>1</sup>, Yong-Jae Choi<sup>2</sup>

### **ABSTRACT**

Income inequality has become one of the major economic policy issues in developed and developing countries alike. Among ASEAN countries we have witnessed rising income inequality in Indonesia, Lao, Singapore and Vietnam over the recent years while the other ASEAN countries, such as Cambodia, Malaysia, Philippines, and Thailand have shown more or less reduced income inequality.

This study examines determinants of income inequality in Southeast Asian countries. Using panel regression analysis, this study focuses on the impact of technological change, globalization and tax policy on income inequality.

This study shows that internet penetration as a proxy of technological change has reduced income inequality significantly, tax revenue to GDP ratio has also reduced income inequality, but the effect is not significant. Globalization measured by FDI and trade to GDP ratio has increased income inequality, although FDI impact is not significant. Other control variables, such as ratio of secondary education enrollment, real GDP per capita and depreciation of real exchange rate have significantly improved income inequality. On the other hand, real interest rate and inflation have affected income inequality insignificantly in ASEAN countries.

*Keywords: Income Inequality, Internet Penetration, Gini Index, ASEAN*

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## 1. Introduction

Recently income inequality has become one of the major economic policy issues in developed and developing countries alike. High and sustained level of inequality entails large social cost (Stiglitz, 2012) and reducing income inequality is considered as one of the key conditions for economic growth and sustainability.

With this study we examine determinants of income inequality in ASEAN (The Association of Southeast Asia Nations) countries. According to The Chartbook of Economic Inequality (2017) and World Development Indicator (2017), over the recent years income inequality has become worse in four ASEAN countries, namely Indonesia, Lao, Singapore and Vietnam. Particularly, Indonesia has suffered the biggest increase in the Gini index. Meanwhile the rest ASEAN countries, such as Cambodia, Malaysia, Philippines, and Thailand have shown more or less reduced income inequality<sup>3</sup>.

These observations motivate us to investigate the determinants of income inequality in ASEAN countries focusing on globalization, technological change and tax policy, controlling other factors influencing income inequality.

## 2. A Literature Review

Zhuang et al. (2014) conceptualize income inequality by defining income as the product of an asset and its rate of return. For example, income to capital is equal to capital multiplied by its rate of return. Changes in income inequality can then be attributed to a combination of changes in the distribution of assets and changes in relative return of these assets among individuals or groups of individuals or across different areas. They contend that technological progress, globalization, and market-oriented reform can affect a large part of movements of relative returns to various types of assets such as unskilled vs. skilled workers, labor vs. capital, and assets in

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<sup>3</sup>ASEAN consists of ten-member countries, namely Thailand, Malaysia, Indonesia, Singapore, The Philippines, Brunei Darussalam, Lao PDR, Cambodia, Myanmar and Vietnam. This study only includes 8 ASEAN countries since sufficient data is not available for Brunei Darussalam and Myanmar.

rural vs. in urban areas as well as those in interior vs. in coastal regions.

Dabla-Norris et al. (2015) argue that the followings are the driving forces of income inequality: technological change, trade openness, financial globalization, financial deepening (access), changes in labor market flexibility, redistributive policies by government and education. Aizenman et al. (2012) claim that structural changes consisting of economic incentives, human and physical capital accumulation, technological change, capital markets and education access, social changes, and political changes have a far-reaching impact on income inequality, particularly in developing countries of Asia.

A number of other studies also examine the determinants of income inequality, summarized in Table 1, and the links between the determinants and inequality are discussed below.

Table 1. A Summary of Empirical Results

Determinants	Proxies	Literature
financial openness	<ul style="list-style-type: none"> <li>- foreign assets and liabilities/GDP (+)*</li> <li>- inward FDI stock/GDP (+)*</li> <li>- inward portfolio equity stock/GDP (-)</li> <li>- inward debt stock to GDP (+)</li> <li>- capital account openness (-)</li> <li>- capital account openness (+)*</li> <li>- international financial integration, using the stock of external assets (liabilities)/GDP and the level of equity (portfolio &amp; FDI) cross-holding/GDP (+)*</li> <li>- financial globalization, using the stock of portfolio equity asset and the stock of direct investment asset (liabilities) (+)*</li> </ul>	<ul style="list-style-type: none"> <li>Dabla-Norris et al. (2015)</li> <li>Jaumotte et al. (2008)</li> <li>Dimitrios et al. (2014)</li> <li>Jaumotte et al. (2008)</li> <li>Jaumotte et al. (2008)</li> <li>Jaumotte et al. (2008)</li> <li>Dimitrios et al. (2014)</li> <li>Cabral et al. (2016)</li> <li>Cabral et al. (2016)</li> </ul>
trade openness	<ul style="list-style-type: none"> <li>- exports and imports/GDP (-)</li> <li>- exports and imports/GDP (+)</li> <li>- exports and imports/GDP (+)*</li> <li>- export/GDP (-)*</li> </ul>	<ul style="list-style-type: none"> <li>Dabla-Norris et al. (2015)</li> <li>Seven and Coskun (2016)</li> <li>Dimitrios et al. (2014)</li> <li>Lee and Kim (2016)</li> <li>Demirgüç-Kunt and Levine (2007)</li> <li>Cabral et al. (2016)</li> <li>Jaumotte et al. (2008)</li> </ul>

	<ul style="list-style-type: none"> <li>- import/GDP (+)</li> <li>- 100 minus tariff rate (-)*</li> <li>- The free trade agreement (FTA) number in good trade to the WTO (-)*</li> <li>- The free trade agreement (FTA) number in good trade to the WTO (+)*</li> </ul>	<p>Jaumotte et al. (2008)</p> <p>Jaumotte et al. (2008)</p> <p>Lee and Kim (2016)</p> <p>Lee and Kim (2016)</p>
technological change	<ul style="list-style-type: none"> <li>- ICT capital/capital stock (+)*</li> <li>- high technology exports/GDP (-)*</li> <li>- ICT spending/GDP (-)</li> <li>- R&amp;D/GDP (-)</li> </ul>	<p>Dabla-Norris et al. (2015)</p> <p>Jaumotte et al. (2008)</p> <p>Jaumotte et al. (2008)</p> <p>Dimitrios et al. (2014)</p> <p>Dimitrios et al. (2014)</p>
tax policy	<ul style="list-style-type: none"> <li>- top marginal tax (-)*</li> </ul>	<p>Cabral et al. (2016)</p>
government spending	<ul style="list-style-type: none"> <li>- government spending/GDP (-)*</li> <li>- government final consumption/GDP (-)</li> </ul>	<p>Dabla-Norris et al. (2015)</p> <p>Cabral et al. (2016)</p> <p>Seven and Coskun (2016)</p>
education access	<ul style="list-style-type: none"> <li>- education Gini (a proxy for education access) (+)</li> <li>- share of population with at least a secondary education (+)</li> <li>- average years of education (-)</li> <li>- average years of schooling (-)*</li> <li>- % of labor force that has finished tertiary education (-)</li> <li>- % of labor force that has finished secondary education (-)</li> <li>- secondary enrolment (-)</li> <li>- the logarithm of the initial average years of school attainment (+)</li> </ul>	<p>Dabla-Norris et al. (2015)</p> <p>Jaumotte, et al. (2008)</p> <p>Jaumotte, et al. (2008)</p> <p>Lee and Kim (2016)</p> <p>Dimitrios et al. (2014)</p> <p>Dimitrios et al. (2014)</p> <p>Seven and Coskun (2016)</p> <p>Demirgüç-Kunt and Levine (2007)</p>
financial deepening/development	<ul style="list-style-type: none"> <li>- private credit/GDP (+)*</li> <li>- private credit/GDP (-)*</li> <li>- stock market capitalization as % of GDP (-)</li> <li>- bank aggregate (using 5 indicators: liquid liabilities/GDP, private credit/GDP, bank deposit/GDP, bank private credit/GDP &amp; deposit money bank asset/GDP) (+)</li> <li>- market aggregate (using 3 indicators: stock market capitalization/GDP, stock market total value</li> </ul>	<p>Dabla-Norris et al. (2015),</p> <p>Jaumotte et al. (2008)</p> <p>Demirgüç-Kunt and Levine (2007)</p> <p>Dimitrios et al. (2014)</p> <p>Seven and Coskun (2016)</p> <p>Seven and Coskun (2016)</p>

	traded/GDP, stock market turnover ratio) (-)	
GDP per capita	- GDP per capita (+)* - GDP per capita (+)	Seven and Coskun (2016) Cabral et al. (2016) Lee and Kim (2016)
interest rate	- interest rate (+)*	Areosa (2016)
inflation rate	- annual GDP deflator (+)* - the growth rate of GDP deflator (+)*	Seven and Coskun (2016) Demirgüç-Kunt and Levine (2007)
exchange rate	- Real Effective Exchange Rate	Jeanneney, S. Guillaumont and P. Hua. (2001).
employment share	- agricultural industry employment share (+)* - manufacturing industry employment share (-)* - manufacturing industry employment share (+) - service industry employment share (+)* - unemployment (+)*	Jaumotte, et al. (2008), Dimitrios et al. (2014) Jaumotte, et al. (2008) Dimitrios et al. (2014) Dimitrios et al. (2014) Lee and Kim (2016)

### **Links between globalization and inequality**

In general, globalization refers to how much connected or open a country is to the rest of the world. Globalization is viewed as trade liberalization (Winters, 2004), financial liberalization (Kose et al, 2006), or liberalization of foreign direct investment (FDI) and industrial policy (Harrison and Rodríguez-Clare, 2010).

Research interests regarding the potential impact of trade openness on income distribution goes back to Heckcher-Ohlin-Samuelson model, which predicts that trade openness is beneficial for unskilled labor in developing countries. In fact Jaumotte et al. (2008) show that greater export or lower tariff reduces income inequality. However, Cabral et al. (2016) show that a higher ratio of trade to GDP increases inequality.

In terms of financial openness, Demirgüç-Kunt and Levine (2007) find that financial integration reduces inequality. This study emphasizes that financial development can boost the poorest income, then it reduces income inequality. However, a large number of observed studies show that financial openness increases inequality (Fallon and Lucas, 2002; Choi, 2006; Jaumotte et al., 2008; Dimitrios, et al. 2014; Dabla-Norris et al., 2015; and Cabral et al., 2016).

Furthermore, Goldberg and Pavcnik (2007) report that the relationship between globalization (measured by tariff, trade flows and FDI inflows as percentage of GDP) and inequality is inconclusive. Lee and Kim (2016) and Suryahadi (2001) on their part find that trade flows have mixed effects on inequality.

### **Links between technological change and inequality**

Technological change can influence the distribution of income among different factors of production. Technological change is often embodied in capital, which implies that it could have an impact on the income distribution between labor and capital. If technological change favors skilled labor (more educated or more experienced) over unskilled labor by increasing its relative productivity, it could render the skill premium – the ratio of skilled to unskilled wages – to rise, which would increase income inequality. (Zhuang et al., 2014).

The empirical literature provides a mixed evidence for the links between technological change and inequality. Jaumotte et al. (2008) and Dabla-Norris et al. (2015) show that greater ICT capital stock is associated with higher income inequality. But high technology exports is found to reduce income inequality (Jaumotte et al., 2008). A ratio of ICT spending or R&D to GDP is found to reduce income inequality but they are insignificant (Dimitrios et al.; 2014).

Over a couple of decades we have witnessed major developments in information and communications technologies (ICT), which have a significant impact on the ways of consumption, production and lifestyle. The most prominent technological change in ICT is the use of internet. Taking this into account, we use internet penetration as a proxy of technological change.

Digital divide, which is the gap between individuals, households, businesses and geographic areas with regard to their use of the internet, is associated with the effect of internet on income inequality. With digital divide, the benefit of internet may accrue only to a group of people who have access to the internet (OECD, 2001). Noh and Yoo (2008) show that digital divide tends to increase income inequality since ICT rewards those who know how to utilize it with high income and socio-economic advantages. Meanwhile internet penetration may help decrease income inequality. This

is because broader internet access mostly affects the younger generation, who have relatively low income. The effect of internet penetration on income inequality is therefore an empirical question.

### **Links between tax policy and inequality**

OECD (2012) argues that tax and transfer systems reduce overall income inequality in most countries. Taxes and transfers not only affect the distribution of income, but also have an impact on GDP per capita by influencing labor use and productivity. Islam et al. (2017) noted that the declining of income tax ratio causes the increasing of income inequality.

Cabral et al. (2016) show that top marginal tax reduces income inequality. The study by Islam et al. (2017) uses an income tax as a percentage of GDP and finds that the increasing of income inequality has been related with the decreasing of income tax ratio in OECD countries. However, they do not take into account indirect tax revenues and changes in the tax mix.

### **Links between others and inequality**

Jaumotte et al. (2008) and Dabla-Norris et al. (2015) show that financial deepening proxied by the ratio of private credit to GDP contributes to rising income inequality in emerging or developing countries. Because a ratio of credit to the private sector by deposit money banks and other financial institutions gives more benefit for the rich, and less advantage for the poor. However, studies by Dimitrios et al. (2014) and Seven and Coskun (2016) report that the effect of financial deepening on inequality is not significant.

Dabla-Norris et al. (2015) and Cabral et al. (2016) show that government spending reduces income inequality. But, in Seven and Coskun (2016), government consumption is found to be insignificant.

In numerous studies (Jaumotte et al., 2008; Dimitrios, et al., 2014; Dabla-Norris et al., 2015; Seven and Coskun, 2016) a variety of proxies for education are used. They tend to reduce income inequality but they are all insignificant.

Seven and Coskun (2016) and Cabral et al. (2016) show that an increase in GDP



per capita widens income inequality<sup>4</sup>. Regarding the impact of income inequality on economic growth, Barro (2000) argued that inequality reduces growth in poor countries, but promotes economic growth in rich countries. List and Gallet (1999) supports this type of Kuznet's curve, an inverted U-shaped curve between per capita GDP and income inequality for lower- or middle-developed countries. They further show that the relationship between income inequality and per capita GDP income becomes positive for higher-developed countries.

Seven and Coskun. (2016) show that inflation leads to greater income inequality. Real value of debt falls with inflation but at the same time the real value of assets rises. The latter effect may dominate the former one with rising inflation pushing up the income inequality.

A study by Areosa (2016) reports that a contractionary effect of interest rate shock enhances income inequality.

There seems to be no definite conclusion regarding the effect of the change in exchange rate on income inequality. Jeanneney and Hua (2001) investigates the impact of the real exchange rate on income inequality in urban and rural areas of China. It is shown that appreciation of a currency increases labor productivity in rural areas relatively more than that in urban areas lowering income inequality. This is attributed to the fact that appreciation increases the relative price of non-tradable goods and workers in rural areas with relatively low income mainly produce non-tradable goods. On the other hand, Tabor (2015) reported that the rich or the middle class in Indonesia may benefit more from increasing imports due to rupiah appreciation since they tend to spend more on imported goods and foreign services than the low-income class.

Regarding employment shares of various industries, Jaumotte et al. (2008) and Dimitrios et al. (2014) show that high employment share of agricultural or manufacturing industry results in high income inequality. On the other hand, Dimitrios, et al. (2014) show that high employment share of service industry is associated with high income inequality.

Based on the data availability, this study uses the following control variables:

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<sup>4</sup> The effect is insignificant in Cabral et al. (2016).

financial deepening; government expenditure on education to GDP; a secondary education enrollment to population; real interest rate; GDP deflator as a proxy of inflation rate; a natural logarithm of real per capita GDP and its squared; and lastly, real exchange rate per US dollar.

### 3. An Econometric Model and Data

Based on the literature review but constrained by data availability, we set up the following panel regression model, eq. (1). Income inequality is regressed on globalization (financial and trade openness), technological change (internet penetration), tax policy, and a number of control variables including financial deepening, access to education, GDP per capita, interest rate, inflation rate and exchange rate. A positive coefficient of an explanatory variable indicates that an increase in the variable tends to increase income inequality.

$$INQ_{it} = \beta_0 + \beta_1 GLO_{it} + \beta_2 TEC_{it} + \beta_3 TAX_{it} + \beta_4 X_{it} + \theta_i + \varepsilon_{it} \quad (1)$$

Here subscripts  $i$  and  $t$  represent country and year, respectively and

$INQ_{it}$  = level of income inequality

$GLO_{it}$  = globalization measured with financial openness and trade openness

$TEC_{it}$  = Technological change measured with internet penetration

$TAX_{it}$  = tax policy

$X_{it}$  = Control variables including financial deepening, a government expenditure on education, a ratio of secondary education enrollment to population, real GDP per capita, real interest rate, inflation rate, and real exchange rate

$\theta_i$  = country (cross section) dummies

$\varepsilon_{it}$  = an error term with mean 0 and variance  $\sigma^2$ .

We use annual observations for the set of the eight ASEAN countries (Cambodia, Indonesia, Lao PDR, Malaysia, the Philippines, Singapore, Thailand and Vietnam) over the period from 1995 to 2014.

There are several measurements of income inequality, including Gini index, Theil index, quintile ratio, income shares of the top 1 percent or 5 percent of population, and a growth incidence curve. Among these measurements, the Gini index is the most popular one and data is readily available.

The Gini index can take a range of values from 0 (all individuals have the same income: perfect equality) to 1 (income is taken by only one person in the population: perfect inequality). In this paper, the standard Gini index is multiplied by 100 for ease of interpretation. The Gini Index of Indonesia is obtained from Chartbook of Economic Inequality (2017) and those of other ASEAN countries are collected from World Bank, Development Research Group (World Bank, 2017).

As we see in Table 2, income inequality went down in four countries (Cambodia, Malaysia, Philippines and Thailand) and went up in the other four countries (Indonesia, Lao PDR, Singapore and Vietnam) from 1995 to 2014. Indonesia has shown the highest increase in the Gini index.

Table 2. Trends of income inequality in ASEAN countries

Country	Gini index		
	1995	2014	Growth rate (%) per year
Cambodia	38.15	28.88	-1.3
Indonesia	34.20	41.00	1.0
Lao PDR	35.04	35.51	0.1
Malaysia	48.52	46.19	-0.3
Philippines	43.65	43.13	-0.1
Singapore	44.30	46.40	0.2
Thailand	43.18	39.54	-0.4
Vietnam	35.54	37.59	0.3

We use net inflow of FDI as a percentage of GDP and the sum of imports and exports as a share of GDP as proxies of globalization. Both of the data are drawn from the World Development Indicator (WDI) online database published by the World Bank (World Bank, 2017).

Internet penetration is measured by the number of Internet users per 100 people. Internet users are individuals who have used the Internet (from any location) in the last 12 months. Internet can be used via a computer, a mobile phone, a personal digital assistant, a game machine, digital TV etc. It is obtained from World Telecommunication/ICT Development Report and database of International Telecommunication Union and World Bank estimates (World Bank, 2017).

In order to examine the effect of tax policy on income inequality, we need data for an effective tax rate and an index for progressiveness of tax system in each country. Unfortunately, those data for ASEAN countries are not available. Alternatively, this study uses income tax revenue as a percentage of GDP for a proxy of tax policy. The source of data for income tax revenue is Government Finance Statistics Yearbook and International Monetary Fund (World Bank, 2017).

A government expenditure on education as a percentage of GDP and a ratio of secondary education enrollment to population is drawn from International Comparison Program database of World Bank (World Bank, 2017).

Real interest rate is collected from International Financial Statistics (World Bank, 2007). GDP deflator is obtained from World Bank national accounts data (World Bank, 2007). Finally, real exchange rate is drawn from ADB Key Indicator and World Bank data (World Bank, 2017).

The descriptive statistics of the set of data is summarized in the following Table 3.

**Table 3. Summary Statistic**

Variable	Obs.	Mean	Std. Dev.	Min	Max
GINI index	160	40.54	4.92	28.88	49.15
Tax revenue (% of GDP)	160	13.73	3.84	4.45	22.88
Foreign direct investment, net inflows (% of GDP)	160	5.24	5.39	-2.76	26.52
Trade (% of GDP)	160	141.99	96.32	45.51	439.66
Internet users (per 100 people)	160	17.35	22.04	0.00	80.90
Government expenditure on education, total (% of GDP)	160	3.35	1.37	1.00	7.66
Secondary education enrollment to population	160	6.75	1.66	2.65	10.20
Real interest rate (= nominal deposit interest rate minus inflation rate)	160	-1.01	11.43	-	13.78
Inflation, GDP deflator (annual %)	160	7.55	13.77	-5.02	127.97
ln Per capita GDP, PPP	160	8.76	1.11	6.69	11.34

Real exchange rate (= nominal EXR x (CPI of US dollar/CPI domestic)											
						160	5987.06	7473.88	1.19	25476.90	
	CAMB	INA	LAO	MLYS	PHILP	SGPR	THAI	VIET	Min	Mean	Max
GINI	35.49	36.6 2	35.82	46.98	44.23	46.48	41.19	37.46	35.49 (Camb)	39.32	4698 (Sgpr)
Tax/GDP	8.49	13.6 8	10.36	15.82	13.45	13.72	15.00	19.34	8.49 (Camb)	13.70	19.34 (Viet)
FDI/GDP	6.24	1.10	3.86	3.57	1.51	16.75	3.13	5.80	1.10 (Ina)	3.71	16.75 (Sgpr)
TRADE/GDP	113.09	57.8 9	76.66	184.71	86.48	370.36	119.99	126.71	57.89 (Ina)	116.5 4	370.36 (Sgpr)
Internet	1.67	5.49	3.40	37.57	11.05	50.54	13.38	15.68	1.67 (Camb)	12.22	50.54 (Sgpr)
Govt on Edu/GDP	1.58	2.54	2.35	5.52	2.84	3.28	4.12	4.57	1.58 (Camb)	3.06	5.52 (Mlys)
(EDU/POP)*100	5.14	7.53	6.12	9.31	7.12	5.17	6.73	6.91	5.14 (Camb)	6.82	9.31 (Mlys)
Real Interest	-1.49	2.24	12.46	1.35	0.78	-0.55	0.87	1.12	-12.46 (Lao)	0.83	2.24 (Ina)
Inflation deflator	4.10	13.9 1	19.42	3.88	5.71	0.82	3.04	9.56	0.82 (Sgpr)	4.90	1942 (Lao)
Log GDP real per cap	7.38	76.4 4	7.87	9.69	8.36	10.86	9.20	7.99	7.38 (Camb)	8.78	76.44 (Ina)
(ln GDP real/CAP)^2	54.71	76.4 4	62.08	93.91	69.92	117.97	84.74	64.01	54.71 (Camb)	73.18	117.97 (Sgpr)
Real EXR	4636.65	1170 1	10705 .67	3.40	50.33	1.45	36.11	20762. 0	1.45 (Sgpr)	2343. 5	20762.01 (Viet)
Credit/GDP	17.07	32.4 2	10.02	121.96	35.71	101.83	119.60	60.96	10.02 (Lao)	48.33	121.96 (Mlys)
Domestic credit to private sector (% of GDP)						156	46.88	46.36	3.48		166.50

Note: All variables are in index form and averaged over a twenty-year period

**Table 4. Within-ASEAN country averages during 1995 to 2014, and the order statistics of the total observations pooled across ASEAN countries and years**

#### 4. Empirical Results

To examine determinants of income inequality, we estimate the basic model in eq. (1).

We also consider lag-one variables for eq. (1) in order to consider possible time lag for explanatory variables to influence income inequality. To identify possible nonlinear relationship between real GDP and the GINI index, we estimate two specifications of eq. (1) with and without a squared term of a natural logarithm of real GDP per capita.

A fixed effects model controls for possible time invariant unobserved country specific factors. The estimation results of these models are presented in Table 5.

**Table 5. Panel Regression Result with Fixed Effect Model**

Dependent Variable: GINI				
Variable	Without Lagged Variables		With Lagged Variables	
	1	2	3	4
<b>Constant</b>	83.0497 (3.5925)	25.6624 (2.8406)	86.7092 (3.4603)	34.0896 (3.6442)
<b>Tax revenue/GDP</b>	-0.0504 (-0.5901)	-0.0988 (-1.1580)	-0.0098 (-0.1065)	-0.0545 (-0.6002)
<b>FDI/GDP</b>	0.0247 (0.4066)	0.0756 (1.279)	0.0104 (0.1634)	0.05 (0.8048)
<b>Trade/GDP</b>	0.0169*** (2.1997)	0.013** (1.6892)	0.018*** (2.2171)	0.0153** (1.8765)
<b>Internet Users</b>	-0.0799*** (-3.2079)	-0.0454*** (-2.0815)	-0.0601*** (-2.2673)	-0.0278 (-1.2257)
<b>Govt Exp on Edu/GDP</b>	0.3722 (1.4310)	0.2428 (0.9296)	0.4082 (1.5078)	0.2816 (1.0475)
<b>Edu/Pop</b>	-0.6126*** (-2.5724)	-0.7885*** (-3.3711)	-0.5319*** (-2.0652)	-0.6927*** (-2.7565)
<b>Real Interest Rate</b>	0.035 (0.9570)	0.032 (0.8543)	0.0128 (0.3425)	0.0089 (0.2354)
<b>Inflation Rate</b>	0.0257 (0.7739)	0.0182 (0.5398)	0.0055 (0.1617)	-0.0018 (0.0527)
<b>Ln Real GDP per capita</b>	-12.5653*** (-2.2206)	2.2915** (1.8679)	-12.5344*** (-2.0233)	1.1615 (0.9065)
<b>(Ln Real GDP per capita)<sup>2</sup></b>	0.9119*** (2.6868)		0.8446*** (2.2581)	
<b>Real EXR</b>	-0.0002***	-0.0001	-0.0002***	-0.0002**

	(-2.0371)	(-1.4444)	(-2.2582)	(-1.8298)
<b>Diagnostics:</b>				
<b>Number of observations</b>	160	160	152	152
<b>Adj R-squared</b>	0.8667	0.8609	0.8619	0.8577
<b>SE of Regression</b>	1.7966	1.8355	1.8282	1.856

\*\*\* Statistically significant at the 5% level, t-values in squared brackets

\*\* Statistically significant at the 10% level, t-values in squared brackets

Overall, the four regression models in Table 5 explain more than 85% of the variations in the Gini index. The regression results of models 1 and 3 are qualitatively identical. On the other hand, there are some differences in the regression results of models 2 and 4. Internet penetration is significant in the regression of model 2 while it is not in the regression of model 4. The estimated coefficients of inflation have different signs but they are insignificant. Real exchange rate is insignificant in the regression model 2 while it is in the regression of model 4. As it is seen in the regression of models 1 and 3, the squared term of log of real GDP per capita is significant suggesting nonlinear relationship between log of real GDP per capita and the Gini index.<sup>5</sup> Ignorance of this nonlinear relationship might have caused some inconsistencies between the regression results of models 2 and 4 mentioned above. Taking these into account, we focus on model 1 for our discussion below.

Globalization turns out to increase income inequality in ASEAN countries. While trade as a percentage of GDP has a significant effect on income inequality, FDI as a percentage of GDP turns out to be insignificant. When ASEAN countries mostly export simply assembled products without much forward or backward linkage with domestic market, trade openness may bring about benefits only for exporting industry and cause income inequality to rise.

Interestingly, higher internet penetration is shown to mitigate income inequality in ASEAN member countries. We may conclude that the inequality-reducing effect that comes from better access to the internet for the younger generation dominates the inequality-increasing effect due to higher use of the internet by the rich. According to Internet Society and TRPC (2015), ASEAN countries can be divided into three clusters based on internet penetration. Indonesia belongs to the third cluster with the lowest performance together with Cambodia, Myanmar and Lao PDR. This might suggest that although the internet penetration has grown rapidly, there still exists much room for promoting internet access and improving income inequality in Indonesia.

Indonesia has many remote and isolated areas due to the archipelagic nature of the

country. Geographic location of Indonesia can restrict growth and the development process, allowing some areas to develop faster than others. Sujarwoto and Tampubolon (2016) point out that the gap of internet access between groups with different ages, genders, income-levels, education-levels widens across urban–rural, city– countryside, and remote island-mainland island areas. As a consequence, unlike other ASEAN countries, an overall increasing in internet penetration may not have improved income inequality in Indonesia as much as expected. Building telecommunication infrastructures, particularly across districts in rural and remote islands, would improve the regional development in Indonesia and mitigate income inequality to a greater extent.

The regression shows that higher income tax revenue as a percentage of GDP increases income inequality in ASEAN countries but the effect is not significant. We do not attempt to make any assertive conclusion here. This insignificance of tax policy may be attributed to the fact that the proxy we use for tax policy does not fully capture the effects of tax policy on income inequality. We could have better measured the effects if the data for the progressiveness of tax system have been available.

Contrary to our expectation, government expenditure on education is found to increase income inequality but it is not significant. Meanwhile, as expected, secondary education enrollment significantly improves income inequality. With education, people can get a better job and salary. Expansion of access to education for wider population would mitigate income inequality.

As expected, higher real interest rate tends to raise income inequality but the effect is not significant. Contrary to our expectation, inflation rate turns out to increase income inequality (with exception of regression 4) but it is insignificant.

When only a natural logarithm of real GDP per capita is included in the regression (Regression 2 and 4), it is found that an increase in real GDP per capita increases income inequality. In Regression 1 and 3, we added the squared term of a natural logarithm of real GDP per capita to identify nonlinear relationship between real GDP per capita and income inequality. It is found that the squared term is significantly positive indicating the existence of U-shaped relationship between real GDP per capita and income inequality in ASEAN countries. This result contradicts with Kuznets who claimed the inverse U-shaped relationship between real GDP per capita and income inequality.

This result may be partly in line with List and Gallet (1999). They report that for low-developed to middle-developed countries, the relationship between real GDP per capita and income inequality is represented by an inverse U-shaped curve. However, for higher-



developed countries, the two variables move in the same direction, indicating an adverse consequence on income inequality.

Based on regression (1), we can find the threshold level of real GDP per capita where the slope of the curve shifts from negative to positive. From the first partial derivative being equal to zero ( $\frac{\Delta GINI}{\Delta \ln GDP} = 0$ ) or we have

$$-12.5653 + 0.9119 * 2 * \ln\_GDP = 0$$

$$\ln\_GDP = 6.9$$

$$GDP = 992.28 \text{ (Real GDP percapita)}$$

Thus, when real GDP per capita is lower than 992.28, the increase in GDP per capita reduces income inequality. On the other hand, the increase real GDP per capita increases income inequality when GDP per capita is greater than the threshold level.

Finally, an increase in real exchange rate significantly improves income inequality. It can be explained by the observation that the rich usually spend more on imported goods and foreign services than the poor. Depreciation of domestic currency raises the price of imported goods and foreign services and thus reduces the income of the rich.

## 5. Conclusion

This study investigates the relationship between income inequality (measured with the Gini Index) and tax policy, globalization, technological development, and a number of control variables including government expenditure on education, education enrollment to population, real interest rate, inflation rate, real GDP per capita, and exchange rate. Using annual observations for eight ASEAN member countries, we show that tax revenue to GDP and Internet penetration have influenced to improve income inequality, but the impact tax revenue share is not significant. Globalization that measured by FDI and trade to GDP have deteriorated income inequality, yet FDI impact is not significant. Other control variables, such as secondary education enrollment, real GDP per capita and depreciation of real exchange rate have significantly improved income inequality. On the other hand, real interest rate and inflation have affected income inequality insignificantly in ASEAN countries.

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