Economics Development Analysis Journal Vol (4) (2022)

Economics Development Analysis Journal

http://journal.unnes.ac.id/sju/index.php/edaj

Economic Globalization in Asean Countries: A Panel Cointegration Analysis

Kandi Dwi Pratiwi[1]✉ , [2]Ika Yuni Wulansari

[1]Directorate of Production Account, Badan Pusat Statistik, Indonesia

[2]Department of Statistics, Politeknik Statistika STIS, Indonesia

Article Information

History of Article
Received July 2022
Accepted September 2022
Pusblished November 2022

Keywords:
Gross Domestic Product; causality; panel; cointegration

Abstract

Economic globalization refers to the increasing interdependence of world economies due to the growing scale of cross-border trade of commodities and services, the flow of international capital and the vast and rapid spread of technologies. The process of economic globalization in improving the economy takes time. ASEAN consists of ten countries and each has different behaviors. The development of economic globalization and the speed in increasing economic openness for each ASEAN country is different, hence the need to analyze the relationship between time and across countries using panel data. Therefore, this study aims to analyse further the effect of economic globalization on ASEAN GDP in the short and long term. It uses ICT, economic freedom, and economic openness (trade openness and financial openness) as proxies of economic globalization. The analysis method is a panel cointegration analysis and Dumitrescu-Hurlin panel causality test. The result shows that GDP growth is significantly influenced by ICT, financial openness, and economic freedom in the long term. This study reveals that economic freedom affects GDP growth positively in the long term. Conversely, ICT and financial openness have drawbacks in the long run. Meanwhile, only ICT and trade openness significantly influence GDP growth in the short term. Finally, this study reveals that economic globalization has different impacts on the economy in the short and long term.

✉ Corresponding author :
Address: Directorate of Production Account, BPS
E-mail: kandi.dwi@bps.go.id

ISSN 2252-6560

INTRODUCTION

The impact of globalization can be seen in all aspects of life. Globalization is not a new phenomenon from a historical perspective, but the process has been very fast in the last few decades. Globalization is defined as the expansion of global relations between countries (UN, 2004). Globalization can be formed in three dimensions which are economic, political and cultural. The increasing trend of economic globalization as the most common aspect of globalization can be reflected in the increase of global trade and services, international capital flows, and the broader use of technology globally (Shangquan, 2000). According to UNDP (1999), capital in economic globalization can take the form of portfolio investments or Foreign Direct Investment (FDI).

Makki & Somwaru (2004) states that international trade and Foreign Direct Investment (FDI) are catalysts for economic growth. International trade between countries will increase market access opportunities for domestic products globally. In addition, the inflow of capital will encourage the accumulation of capital and technology which in turn will increase economic growth (Hye & Lau, 2015). FDI inflows will stimulate the development of human capital in investment destination countries. This study uses Information and Communication Technology (ICT), economic freedom, and economic openness as proxies of economic globalization.

Table 1. ASEAN Economic Indicators 2010-2020

Indicator	Value (USD billion)				Global Share (%)			
	2010	2015	2018	2020	2010	2015	2018	2020
Nominal GDP	1931.2	2455.6	2986.4	3000	2.9	3.3	3.5	3.5
Trade in Goods	2001.4	2272.9	2817.4	2600	6.5	6.8	7.2	7.7
Exports	1049	1171.7	1432.6	1357	6.9	7.1	7.3	8.0
Imports	952.4	1101.1	1384.8	1243	6.2	6.6	6.9	7.3
Trade in Services	439.2	640.2	778.6	637	5.7	6.5	6.8	6.6
Exports	213.8	317.9	404.9	321	5.5	6.4	6.9	6.7
Imports	225.4	322.3	373.8	316	5.9	6.6	6.7	6.6
FDI Inflows	108.2	118.7	154.7	137.3	7.9	5.8	11.9	13.7
Outflows	63.3	69	69.6	46.2	4.6	4.1	6.9	5.5

Source: ASEAN Integration Report & ASEAN Key Figures, 2022 (Processed)

In the era of digitalization, ICT, economic freedom, and economic openness play an essential role in a country's economy. An indicator mainly represents a country's economic performance in a particular period is called the Gross Domestic Product (GDP). High GDP is one of the goals to be achieved by all developed and developing countries, because it represents high production. A high production rate is linked to people's increased purchasing power. As a measuring tool for the economy, GDP has several roles, including measuring economic growth, comparing economies between countries, describing the economic structure of a nation, and as a basis for government policies.

Compared to other countries globally, the GDP produced by the Association of Southeast Asian Nations (ASEAN) in 2020 contributed 3.5 percent of the world GDP (Table 1). This figure increased by 0.6 percent compared to 2010 and most likely will continue to grow in the following years given ASEAN's relatively high economic growth. However, the impact of COVID-19 pandemic caused economic growth in world, including ASEAN, have a contraction. In the World Economic Outlook (IMF, 2021), world economic growth in 2020 contracted by 3.27 percent. The economic growth of ASEAN countries also contracted by 3.3 percent. In addition, an increase in GDP was also followed by a rise in the volume of trade and FDI inflows.

Furthermore, the share of global trade has continued to increase in goods and services.

According to the ASEAN (2021), the industrial and service sectors have contributed significantly to ASEAN GDP since 2010. The contribution from services tends to continue to grow. Until 2018, the contribution of services reaches more than 50 percent of GDP. Meanwhile, the agricultural sector's contribution tends to decrease from 2010 to 2018 and drop to 10.3 percent in 2018. This trend indicates a movement from the primary sector to the tertiary sector, where the ASEAN economy no longer relies on the agricultural sector and is slowly shifting to the service sector. These indications are in line with the theory of structural change. The theory of structural change focuses on the process economic transformation in developing countries, which were initially subsistence and based on the agricultural sector towards an economic structure dominated by the industrial and service sectors (Todaro & Smith, 2012). The role of economic globalization in ASEAN is thought to be related to changes in the region's economic structure. The use of ICT will increase electronic-based economic activities, facilitate trade access in obtaining goods and services, and increase transactions between countries. Economic freedom and economic openness will also boost economic relations between countries.

In the current globalization era, GDP, in reality, significantly influenced by extraterritorial factors (institutional factors). Research by Toader et al. (2018) stated that ICT positively impacts European Union countries' gross domestic product. Moreover, a study conducted by Bengoa & Sanchez-robles (2003) concludes that FDI and economic freedom positively influenced the GDP growth of 18 countries in Latin America. Meanwhile, Hussin & Saidin (2012) stated that FDI, economic openness, and nominal fixed investment positively affected GDP. Some of the studies presented used panel data regression analysis to analyze the presence or absence of relationships between variables. However, those studies could not state how the effect was in the short and long term.

Research by Venturini (2009) describes the relationship between ICT in economic growth in the US and 15 European Union (EU) countries from 1980 to 2004 in the short and long term. Panel dynamic ordinary least square (PDOLS) and dynamic seemingly unrelated dynamic regression (DSUR) panels were used in this study, using GDP and ICT Capital as proxies for economic growth and ICT, respectively. This study indicates that in the long and short term, economic growth is positively influenced by ICT. This positive impact is also supported by several other research results, including those conducted by Gilling (1975); Hardy (1980); Jipp (1963); Saunders et al. (1983); Kirikkaleli et al. (2018); Saba and Ngepah (2022). However, research by Ishida (2014) concludes to the contrary that ICT development contributes directly to reducing energy consumption but does not have a positive effect on driving the economy. The research results by Ishida (2014) align with the research conducted by Nabi et al. (2022) that ICT expansion significantly negatively affects economic growth in the long run in N11 countries.

Meanwhile, research conducted by Bengoa & Sanchez-robles (2003) and Doucouliagos & Ulubasoglu (2006) show a positive direct and indirect influence of FDI and economic freedom in driving a country's economy. A similar research result is also shown by several other research results (Alesina, 1998; Barro, 1994; De Haan & Siermann, 1998; de Vanssay & Spindler, 1994; Nelson & Singh, 1998; Scully & Slottje, 1991; Torstensson, 1994). Economic freedom will reduce poverty and infant mortality, support democracy, and increase life expectancy. Tures (2003) states that economic freedom can lessen the potential for social conflict. However, Carlsson and Lundström (2002) and Heckelman (2000) obtained different results. Indeed, economic freedom is essential for the economic. However, it does not necessarily trigger an increase in economic growth as several categories in the index of economic freedom do not have a significant effect or even negatively affect economic growth.

Furthermore, previous studies showed that economic openness is essential in understanding the international interconnected between countries and its impact on the economy (Octavianingrum, 2015; Pernia & Quising, 2003; Safitriani, 2014). Lauridsen, Zeren, and Ari (2013) explained that countries that intensively conduct international trade would result in positive and sustainable economic development. Vogiatzoglou, Nhung, and Nguyen (2016) show that economic openness which refers to FDI, exports, and imports, influences GDP significantly and positively. However, Bibi, Ahmad, and Rashid (2014) revealed that a trade balance deficit due to trade activities makes economic openness do not affect economic growth.

There are two contrasting views regarding the impact of FDI on economic growth. First is the modernization theory, which argues that FDI has a positive impact by providing capital for investment and via knowledge transfer. The second view is of dependency theory, in accordance with that FDI negatively impacts economic growth. It is based on the premise that FDI creates monopolies, which prevent the full utilization of domestic resources and weaken the potential multiplier effect (Chaudhury et al., 2020).

Furthermore, research conducted in different countries which have different characteristics will produce different findings. Meanwhile, ASEAN consists of ten countries which each has different characteristics. Economic growth, ICT development, and economic freedom, and speed in increasing economic openness of each country in ASEAN are also not the same, so it needs to be analyzed using panel data from time to time. Then, the process of each variable in economic globalization to improve the economy also requires time. Therefore, this study aims to comprehensively analyze the effect of ICT, economic freedom, and economic openness on ASEAN member countries' GDP in the short and long term using a panel cointegration.

Many empirical studies aim to investigate the connection between ICT, economic freedom, economic openness, and GDP using time series data analysis in one country or using panel data. However, only a few empirical studies have analyzed this phenomenon by considering the effects in the short and long term. Meanwhile, the results of such research have crucial policy implications. Based on the theory and literature study, the research framework is provided in Figure 1.

Based on the research framework, the hypothesis is that information and communication technology, economic freedom, and economic openness (consisting of trade openness and financial openness) positively affect GDP in ASEAN member countries in the short and long run.

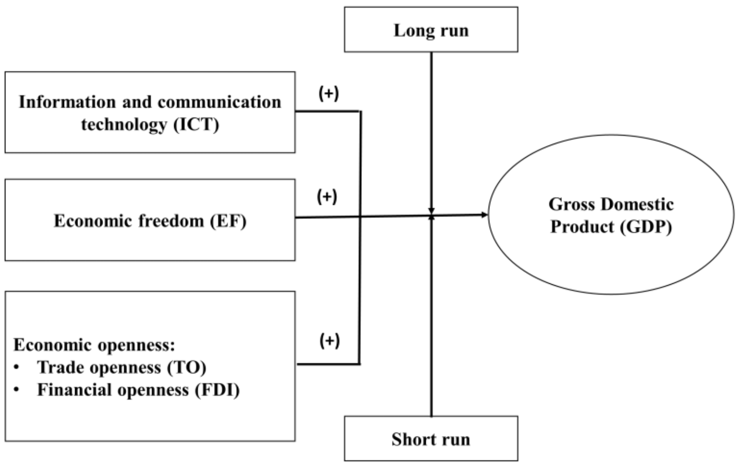

Figure 1. Research Framework
Source: Data Processed, 2022

RESEARCH METHODS

The data examined in this study are panel data of all ASEAN countries within eleven years, from 2008 to 2018. The data in this study are secondary data obtained from various sources. The USD GDP Purchasing Power Parity (GDP, PPP), trade openness, and investment openness are collected from the World Bank website. Meanwhile, The ICT Development Index (IDI) data and The Economic Freedom Index data are obtained from International Telecommunication Union (ITU) and The Heritage Foundation publications, respectively. There are limitations in this study because IDI data from ITU is only available until 2017 because there were revisions of indicators and countries were facing challenges in collecting and submitting quality data. The IDI data for 2018 was also obtained through projections.

The analysis method used is panel cointegration analysis. Panel cointegration is widely applied in empirical macroeconomic and financial discussions. The advantage of this model is that the panel cointegration regression based on the Ordinary Least Square (OLS) estimator will produce consistent parameters. Several panel cointegration methods were developed in the early 1990s, including the Fully Modified OLS approach Phillips & Hansen (1990), and the Dynamic OLS approach Saikkonen (1991); Stock & Watson (1993). Meanwhile, the newest approach is the Integrated Modified OLS introduced by Vogelsang & Wagner (2014).

The general form of the Fully Modified OLS (FM-OLS) model:

$$y_{it} = \alpha_i + x'_{it}\beta + u_{it} \quad \text{.............................} (1)$$

The general form of the Dynamic OLS (D-OLS) model:

$$y_{it} = \alpha_i + x'_{it}\beta + \sum_{j=-qi}^{qi} c_{ij}\Delta x_{it+j} + v_{it} \quad \text{.....} (2)$$

The general form of the Integrated Modified OLS (IM-OLS) model:

$$y_{it} = f_i\delta + x'_{it}\beta + u_{it} \quad \text{.............................} (3)$$

Where i is the cross-sectional unit ($i = 1, 2, \dots, N$), and t is the time unit ($t = 1, 2, \dots, T$). y_{it} represents dependent variable across i and t; α_i is intercept across i for the FM-OLS model or D-OLS model; $\boldsymbol{x}$ is K-dimensional vector of independent variables; β is vector coefficients; u_{it} is error across i and t for FM-OLS model or IM-OLS model; q_i is order lag and lead; v_{it} is error across i and t for the D-OLS model; f_i is intercept across i for the IM-OLS model; and δ is a deterministic variable.

The first step to forming cointegration panel regression is to run cross-sectional dependence test. Cross-sectional dependence is defined as the interaction between cross-section units. Various tests can be used to analyze cross-sectional dependencies in panel data, including the Pesaran CD test, the BP-LM test, the scaled LM test, and the corrected-bias scaled LM test. This study uses four tests to check the relationship between cross-sections.

Next, check the stationarity test before the identification of the model. Stationarity is a condition when the mean and variance of a data set are constant. This study uses the Hadri and LLC tests to check a unit root's occurrence. One of the main reasons for testing the unit root panel is to increase the strength of the statistical tests of each univariate that builds panel data.

Thus, conducting a cointegration panel test to check the presence of cointegration between variables. The use of cointegration panel techniques with T dimensions' time series and N dimensions' cross-section has been a concern in much of the literature. Several tests can be done to detect the presence or absence of a long-term impact among variables, including the Kao test, the Pedroni test, and the Westerlund test. This study applies the three tests to investigate the long-term impact of ICT, economic freedom, and economic openness on ln GDP. The panel cointegration model formed in this study is as follows:

$$ln\widehat{(GDP)}_{it} = \widehat{\beta_1}(ICT)_{it} + \widehat{\beta_2}(EF)_{it} + \widehat{\beta_3}(TO)_{it} + \widehat{\beta_4}(FDI)_{it} \quad \text{..........} (4)$$

Where ln represents natural logarithm, GDP is Gross Domestic Product, ICT is

Information and Communication Technology, EF is economic freedom, TO is trade openness, and FDI is financial openness.

RESULTS AND DISCUSSION

Based on Figure 2, in general, the GDP of ASEAN countries from 2008 to 2018 has an upward trend. Many factors may affect a country's rising GDP, and these factors can be derived from conditions within or outside the country. The global economic crisis in 2008 had quite an impact on the GDP of ASEAN countries, especially Malaysia. The crisis caused a significant decrease in GDP compared to the usual years; there were some ASEAN countries whose GDP declined in the year concerned, such as Malaysia. This phenomenon indicates that the global economy's condition is very influential for Malaysia and most other ASEAN countries.

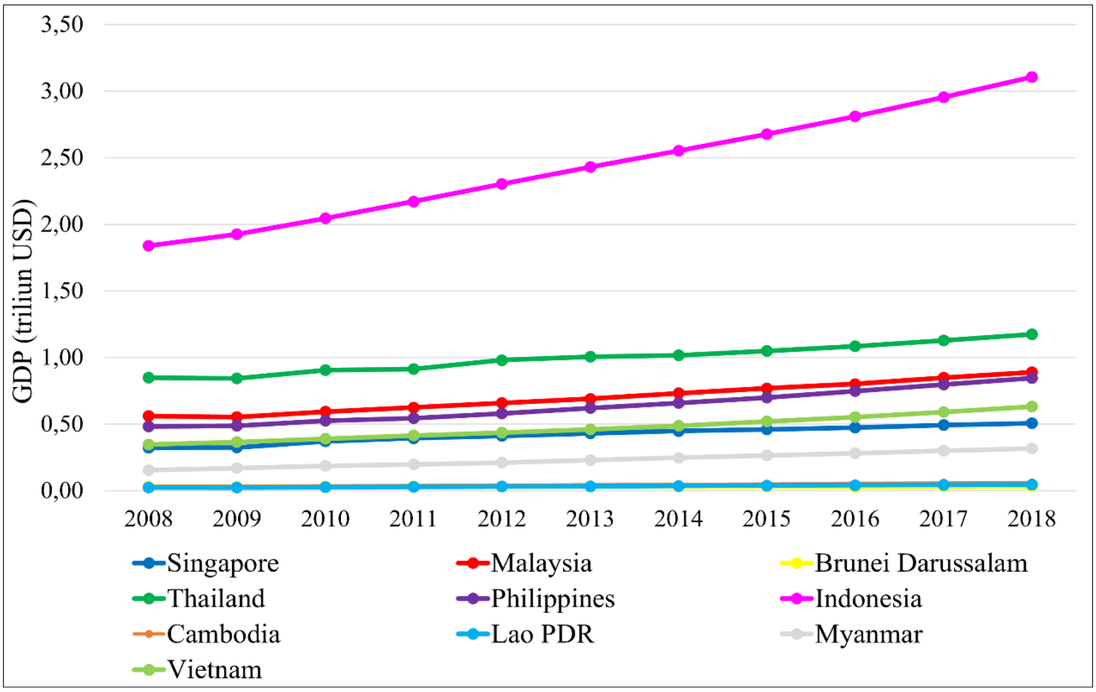

Figure 2. ASEAN's GDP 2008-2018
Source: Data Processed, 2022

Technology becomes an essential aspect to contemplate in the development of a country. The IDI issued by ITU (2018) can be a reference in describing information technology development and digital disparities between countries. IDI values in ASEAN have tended to increase in the last 11 years. In formingIn forming a country's IDI, ITU uses three subindex components: ICT access, ICT use, and ICT skills. Based on Figure 3, the increase in the value of IDI from 2008 to 2018 was due to an increase in the access subindex and usage subindex. When examined in more detail, the value of the expertise subindex tends to decrease. The skill subindex decline was caused by changes in the components forming the skill subindex in the last three years. From 2009 to 2015, the skill subindex was composed of literacy rates, secondary school participation rates, and tertiary school participation rates. After 2015, the literacy rate component is replaced by the average length of schooling, while the other components remained.

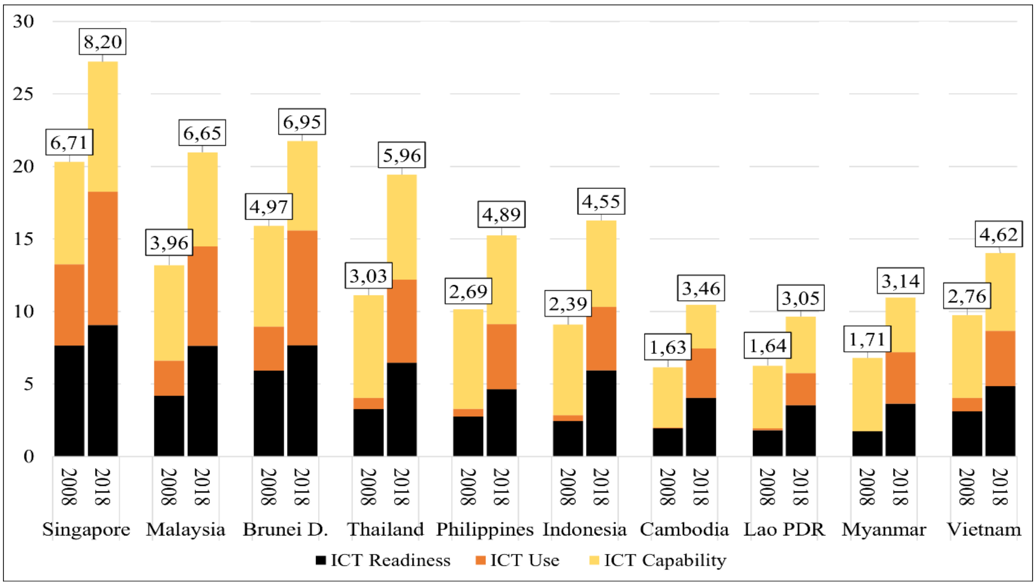

Figure 3. ASEAN's ICT Development Index by Sub-Index 2008-2018
Source: Data Processed, 2022

Meanwhile, economic freedom began to receive attention in the last few periods with The Economic Freedom Index introduced by The Heritage Foundation (2019). Figure 4 illustrates that the level of economic freedom in 2018 has increased compared to 2008 in ASEAN countries, except for Brunei Darussalam. In the span of 11 years, ASEAN countries experienced a rapid increase in economic freedom marked by many ASEAN countries experiencing the shift in the category of economic freedom and an increase in the ranking of world economic freedom.

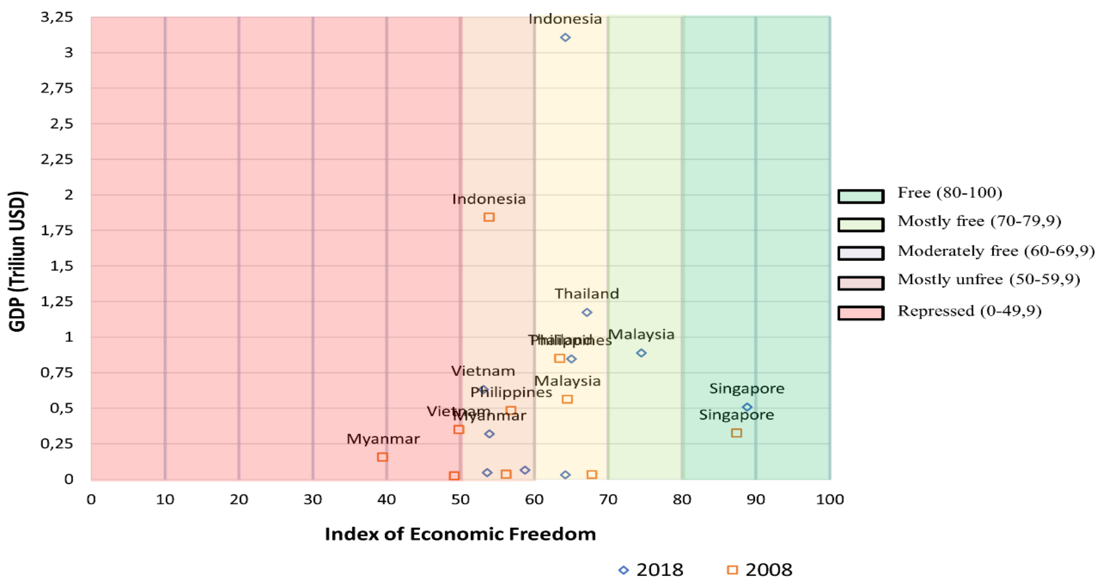

Figure 4. Scatter Plot Index of Economic Freedom and GDP of ASEAN Countries 2008 and 2018
Source: Data processed, 2022

Theoretically, economic openness promises benefit to all countries involved. The higher level of economic openness indicates that it is easier for a country to carry out economic activities with other countries. Figure 5 shows that trade openness in ASEAN countries generally shows a negative trend. The existence of the global economic crisis in 2008 had a significant influence reflected by the decline of trade openness in ASEAN countries, especially Singapore. Singapore is the country that has the highest level of trade openness compared to other ASEAN countries, followed by Malaysia and Vietnam. The global economic crisis caused Singapore's trade openness had (to experience) a drastic decline of 79.13 percent. This is one of the reasons why, when the global economic crisis occurred in 2008, Singapore's GDP experienced a significant negative impact.

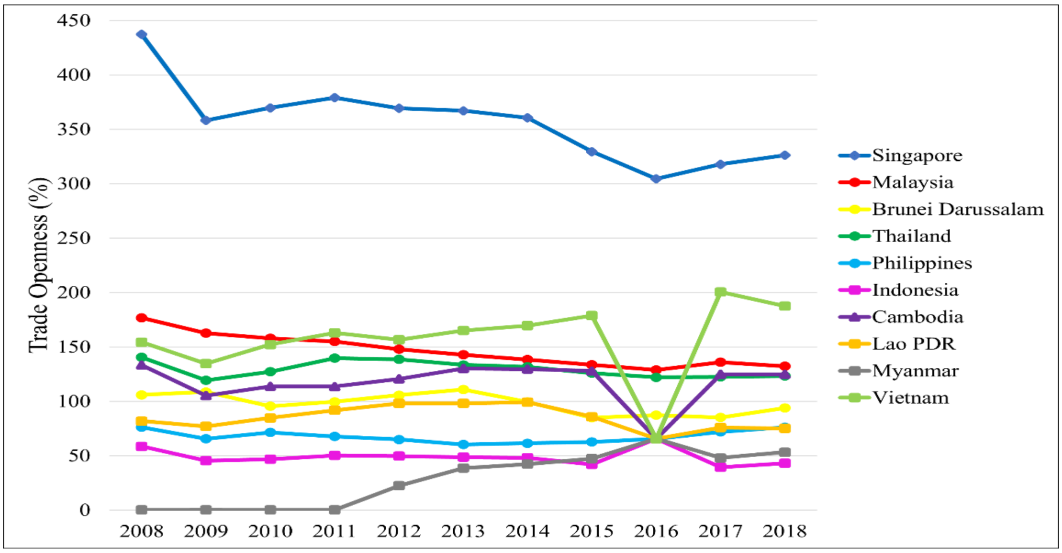

Figure 5. Trade Openness ASEAN Countries 2008-2018
Source: Data processed, 2022

Meanwhile, all ASEAN countries had an increase in financial openness, except Vietnam, Myanmar, Thailand, and Malaysia (Figure 6). The highest increase in financial openness occurred in Singapore, from 6.3 percent in 2008 to 22.5 percent in 2018. In addition, in the last ten years, Singapore had the highest level of financial openness compared to other ASEAN countries

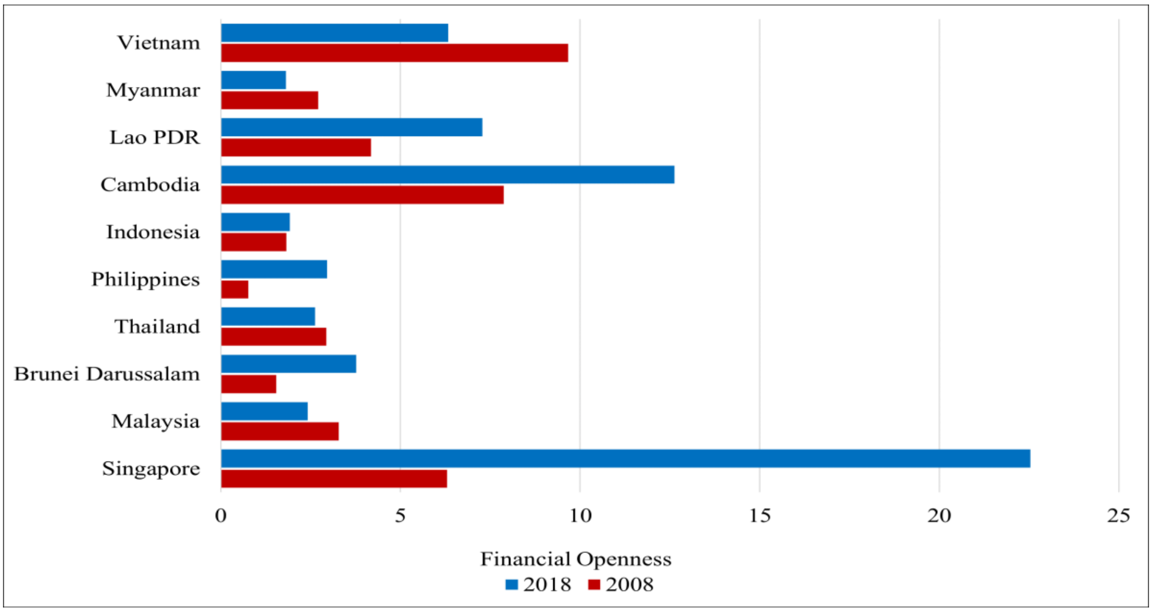

Figure 6. Financial Openness ASEAN Countries 2008 and 2018
Source: Data Processed, 2022

The first step is to look for cross-sectional dependencies in the panel data using a box plot. Boxplots by country show that average GDP, ICT, economic freedom, trade openness, and financial openness differ among ASEAN countries, indicating a dependence between cross-sections in the panel data. Reinforcing these allegations, a test was conducted to analyze cross-sectional dependence.

Table 2. Summary of Cross-Sectional Dependence Tests

Tests	Result	Decision	Result
Pesaran CD	6.0082** (0.0000)	Reject H_0	*cross-sectional dependence*
LM_{BP}	110.2400**(0.0000)	Reject H_0	*cross-sectional dependence*
CD_{LM}	6.8770** (0.0000)	Reject H_0	*cross-sectional dependence*
Corrected-bias CD_{LM}	6.3770** (0.0000)	Reject H_0	*cross-sectional dependence*

Source: Data Processed, 2022

Note: ** significance at the test level α (5%); *significance at the test level α (10%)

Based on Table 2, the scaled LM test, the Breusch-Pagan LM test, the Pesaran CD test, and the corrected-bias scaled LM test with the cross-section effect show that with a significance test of 5 percent (α=5%), there is enough evidence to state that the cross-section is dependent. Hence, there is a dependence between cross-sections in the panel data.

The next step is to carry out stationarity testing for all variables at the level. All variables tested are nonstationary at the level. Therefore, the stationarity test was carried out on all variables at the first difference. This test is carried out using the Hadri test on each variable shown in Table 3.

Table 3. Summary of Panel Unit Root Test Results

Variable	Test	Method	Result of Hadri's test	Stationarity
Ln GDP	Level	3	8.4581** (0.0000)	No
	First Diff	3	0.9678 (0.1666)	Yes
ICT	Level	3	2.8298** (0.0023)	No
	First Diff	2	-1.6839 (0.9539)	Yes
EF	Level	3	5.2652** (0.0000)	No
	First Diff	2	-0.3824 (0.6489)	Yes
TO	Level	3	4.6004** (0.0000)	No
	First Diff	2	-0.1189 (0.5437)	Yes
FDI	Level	3	3.4688** (0.0003)	No
	First Diff	2	-1.0687 (0.8574)	Yes

Source: Data Processed, 2022

Note: ** significance at the test level α (5%); *significance at the test level α (10%). Method 1 = intercept; method 2 is intercept; and method 3 is intercept and trend.

The test results on the first difference show that all variables have a p-value greater than the significance level of 5%. Accordingly, the decision for all variables fails to reject H_0, which means that with a significance level of 5%, there is not enough evidence that the variable has a root unit. It indicates that at the first difference, all variables are stationary.

The Pedroni and Kao test can be used to check the long-term relationship between stationary variables on the first difference (Kao, 1999; Pedroni, 1999). The results of the panel cointegration test in this study are summarised in Table 4.

Table 4. Panel Cointegration Test Results

Test	Statistic	Probability	Cointegration
Pedroni Test			
Panel v-statistic	0.0002**	0.0000	Yes
Panel rho-statistic	-9.7810**	0.0000	Yes
Panel PP-statistic	-2.9346**	0.0000	Yes
Panel ADF-statistic	-4480.9580**	0.0000	Yes
Group rho-statistic	-4.0061**	0.0000	Yes
Group PP-statistic	-0.5875**	0.0000	Yes
Group ADF-Statistic	-1.2342**	0.0000	Yes
Kao Test			
Modified DF	0.0551	0.4780	No
DF	-1.3722*	0.0850	Yes
ADF	0.3004	0.3819	No
Unadjusted modified DF	-1.2533	0.1050	No
Unadjusted DF	-2.2325**	0.0128	Yes
Westerlund Test			
Variance ratio	1.0126	0.1556	No
Group variance ratio	2.4190**	0.0078	Yes

Source: Data Processed, 2022

Note: ** significance at the test level α (5%); *significance at the test level α (10%).

Based on Table 4, the seven statistics of the Pedroni test are statistically significant at the 5 percent level. Meanwhile, the Kao test showed that one of the five statistics is statistically significant at the same level as Pedroni's. The other is statistically significant at a higher, 10 percent test level, and three other statistics were insignificant. The last cointegration panel test is the Westerlund test or the Durbin-Hausman test. The Westerlund test shows that one of the two is statistically significant at the test level of 5 percent, and the other is not significant. As such, it can be concluded that there is cointegration between ln GDP, ICT, economic freedom, trade openness, and financial openness.

After various testing stages, the panel cointegration regression estimation model is obtained, namely, IM-OLS, D-OLS, and FM-OLS, to identify the impact of ICT, economic freedom, and economic openness on ln GDP in the long run. This model has fulfilled the assumptions of non-multicollinearity (Appendix 1) and error stationer at the level (Appendix 2-4). The assumption of non-multicollinearity is fulfilled if the correlation coefficient between independent variables in the model must not exceed the absolute sign of 0.9 (Farrar & Glauber, 1967). If the LLC decision test is to refuse the null hypothesis, then the error assumption at the level is met. Meanwhile, the panel cointegration model has overcome violations of normality, non-autocorrelation, and homoscedasticity assumptions. The following cointegration panel regression model formed below:

Table 5. The estimated results of the panel cointegration model

Variable	Coefficient	Standard error	t-statistic	p-value
		***Fully Modified OLS* (FM-OLS)**		
ICT	-2.6278**	0.4294	-6.1188	0.0000
EF	0.6547**	0.0273	23.9598	0.0000
TO	-0.0118	0.0085	-1.3855	0.1688
FDI	-0.2535**	0.1022	-2.4800	0.0147
		***Dynamic OLS* (D-OLS)**		
ICT	-3.5830**	1.1358	-3.1546	0.0021
EF	0.6889**	0.0597	11.5331	0.0000
TO	0.0319	0.0264	1.2073	0.2300
FDI	-0.8343**	0.3263	-2.5567	0.0120
		***Integrated Modified OLS* (IM-OLS)**		
ICT	-3.6088**	0.8374	-4.3093	0.0000
EF	0.6797**	0.0478	14.2063	0.0000
TO	0.0401**	0.0181	2.2177	0.0287
FDI	-0.8676**	0.2043	-4.2467	0.0000

Source: Data Processed, 2022

Note: ** significance at the test level α (5%); *significance at the test level α (10%).

The estimation results in Table 5 show that the Information and Communication Technology (ICT), economic freedom (EF), and financial openness (FDI) variables significantly influence the long-term growth of Gross Domestic Product (ln GDP) in ASEAN countries on the FM model -OLS, D-OLS, and IM-OLS. In all three models, economic freedom positively affects ASEAN's GDP growth in the long term. The interpretation of the FM-OLS model is that each increase in the index of economic freedom by one unit causes GDP to grow by 65.47 percent, assuming the other variables are constant (cateris paribus) in the long term. These results are consistent with The Heritage Foundation's statement that every aspect measured from economic freedom has a vital role in GDP and prosperity. Countries with higher economic freedom levels have a higher economic development as they utilize more individual capacity for innovation to live more prosperously when burdensome government regulations and taxation do not constrain them. The availability of a free-market system can encourage the more efficient allocation of resources resulting in a dynamic environment to maximize the choices available for employment and consumption.

Furthermore, ICT has a negative impact on ASEAN countries' economic growth in the long run. FM-OLS model shows that each increase in ICT by one unit results in GDP growth falling by 26.27 percent, assuming the other variables are constant (cateris paribus) in the long run. For developing countries, ICT diffusion can negatively affect GDP for a more extended period. At first, ICT would accelerate economic growth by spurring growth in the modern manufacturing and service sectors. However, over time, when ICT begins to penetrate other labor-intensive sectors, the paradox occurs. Human resources in developing countries are yet to be ready for ICT invasion. ICT negatively affects employment and the labor market by reducing or eliminating unskilled workers' positions, increasing unemployment, and decreasing GDP (Aghion & Howitt, 1998; Freeman & Soete, 1997; Amiri & Woodside, 2017; Plăcintă et al, 2022). In other words, an increase in ICT will not necessarily increase GDP. Therefore, the government needs to consider the long-term side effects of ICT diffusion so that these adverse effects do not occur in the economy.

Financial openness harms GDP growth in ASEAN countries in the long run. Using the FM-OLS model, each increase in financial openness by one percent causes GDP growth to decrease by 25.35 percent in the long run, assuming the other variables are constant (cateris paribus). FDI can reduce domestic capital accumulation when foreign investors claim scarce resources such as loan facilities, skilled labors, and import licenses, which hinder domestic investment. In addition, there is a spillover effect of knowledge as domestic companies that use underdeveloped production technology and unskilled workers cannot learn from multinational companies. Finally, global companies can attract demand from domestic companies because international companies generally have lower marginal costs. In the end, domestic companies have to reduce their production. Thus, paradoxically, competition for multinational companies can cause losses because it reduces domestic companies' productivity, which, if it continues, will reduce GDP (Aitken & Harrison, 1999; Kein, 2015).

The D-OLS model estimation results are not much different from the estimation results of the FM-OLS model. Meanwhile, the estimation produced by the IM-OLS method is slightly different, where only the IM-OLS method states that trade openness positively impacts the GDP growth of ASEAN countries after a considerable time. The IM-OLS is a new estimation method in panel cointegration regression developed from the D-OLS and FM-OLS methods. The IM-OLS method is uncomplicated since the model formation does not require estimating the long-term variance matrix and does not need to choose tuning parameters like kernel, bandwidth, and lag. IM-OLS estimation method performs relatively better than D-OLS and FM-OLS (Vogelsang & Wagner, 2014). With the IM-OLS method, each increase in trade openness by one percent causes GDP to grow by 4.01 percent in the long run, assuming other variables are constant (cateris paribus). The role of trade openness is significant in the economy as it encourages higher competition domestically and globally, accelerates knowledge transfers and promotes better efficient allocation of resources (Chang et al., 2005; Nwadike et al., 2020).

Table 6. Dumitrescu-Hurlin panel causality test

Direction of causality	Z-Statistic	P-value
ICT → ln GDP	5.5252**	0.0000
EF →ln GDP	-1.0853	0.2778
TO → ln GDP	4.8185**	0.0000
FDI → ln GDP	0.3147	0.7530

Source: Data Processed, 2022

Note: ** significance at the test level α (5%); *significance at the test level α (10%).

In addition to FM-OLS, D-OLS, and IM-OLS models, researchers also applied the Dumitrescu-Hurlin panel causality test to check for causality between GDP, ICT, economic freedom, trade, and financial openness in the short term. A summary of the Dumitrescu-Hurlin panel causality test is shown in Table 6. In the Dumitrescu-Hurlin test, verifying the presence of a short-term relationship between variables can be carried out by comparing z-statistics with z-tables with a 5 percent test level of 1.96. The estimation results in Table 6 show that the ICT and trade openness (TO) variables significantly influence the short-term GDP growth in ASEAN. Meanwhile, economic freedom (EF) and financial openness (FDI) do not significantly influence ASEAN's short-term GDP growth.

It takes time for the benefits of economic freedom to impact the economy due to many factors that must be met. The index of economic freedom comprises 12 qualitative and quantitative factors, and to increase economic freedom, those twelve factors must be improved. Meanwhile, financial openness also does not significantly affect GDP growth in the short term due to the preparations needed in investing, such as business infrastructure, a conducive business climate, and international trust (intangible aspect) that cannot be built in a short time. The way to increase the short-term in the era of economic globalization is to encourage ICT and trade openness.

In developing countries with low ICT, such as Laos, increasing ICT will negatively influence the country's GDP in the long term. Only countries prepared for an ICT invasion, like Singapore, can benefit from having ICT in the long term. On the other hand, in the short term, ICT has a positive influence on ASEAN's GDP growth. ICT as a catalyst in the economy can increase GDP in the short run. However, the government needs to consider using ICT wisely and in balance to overcome the side effects of ICT. Meanwhile, in terms of economic freedom, ASEAN countries are considered free countries even though some countries are still adopting unfree and moderately free economic. Increased economic freedom will positively influence the economy in ASEAN, even though not in the near future.

In terms of economic openness, ASEAN countries are open countries. The openness of trade impacts GDP in the short and long term. Trade openness has a positive influence on GDP growth in the long term. In general, in 2018, trade openness for each country in ASEAN was almost at the same level, exceeding the GDP value, especially Singapore, Vietnam, Malaysia, Cambodia, and Thailand. While in the long run, financial openness negatively affects GDP growth, especially for Vietnam and Cambodia.

This study improves previous research for several reasons. First, this study focuses on deeply analyzing the impact of economic globalization on the GDP in the short and long term, considering the process of economic globalization in improving the economy takes time. Second, the research period (from 2008 to 2018) is suitable for economic globalization research due to the rapid development of ICT. Third, the focus of this study is developing countries (ASEAN). Using panel cointegration analysis and the Dumitrescu-Hurlin causality test, this study shows that GDP growth is significantly influenced by ICT, financial openness, and economic freedom in the long term. This study reveals that economic freedom affects GDP growth positively in the long term; conversely, ICT and financial openness have drawbacks in the long run. Meanwhile, in the short term, only ICT and trade openness significantly influence GDP growth.

CONCLUSION

The GDP of ASEAN countries has generally increased since 2008. ASEAN countries which majority are developing countries, still have low ICT Development Index (IDI) levels. Overall, economic freedom in ASEAN is still in the category of mostly unfree and moderately free. However, the increase in the economic freedom index has been very rapid in the past eleven years. In addition, ASEAN also has a reasonably high level of economic openness. In the long term, economic freedom positively affects ASEAN GDP growth, while ICT and financial openness negatively affect ASEAN GDP growth on the IM-OLS, D-OLS, and FM-OLS models. Furthermore, trade openness also positively influences ASEAN GDP growth on the IM-OLS model in the long run. In the short term, ICT and trade openness significantly affect ASEAN GDP growth.

This study recommends that the Singapore government, categorized as free, can provide knowledge transfer to the other ASEAN countries, to which the majority are mostly classified as unfree and moderately free in terms of economic freedom. Moreover, the governments of ASEAN countries need to encourage the use of ICT and trade openness to increase GDP in the short run. However, in the long run, the government needs to pay attention and think of appropriate solutions to mitigate the drawbacks of ICT on the economy and persistently promote a conducive business climate.

REFERENCES

Aghion, P., & Howitt, P. (1998). *Endogenous growth theory*. MIT press.

Aitken, B. J., & Harrison, A. E. (1999). Do domestic firms benefit from direct foreign investment? Evidence from Venezuela. *American Economic Review*, *89*(3), 605–618. https://doi.org/10.1257/aer.89.3.605

Alesina, A. (1998). The political economy of high and low growth. In *Annual World Bank Conference on Development Economics 1997* (pp. 1–324). World Bank. https://openknowledge.worldbank.org/handle/10986/2158

Amiri, S. & Woodside, J. M. (2017). Emerging markets: the impact of ICT on the economy and society. *Info (Cambridge, England)*, *19*(5), 383–396. https://doi.org/10.1108/DPRG-04-2017-0013

ASEAN. (2019). *ASEAN integration report 2019*. ASEAN. https://asean.org/book/asean-integration-report-2019/

ASEAN. (2021). *ASEAN Key Figures 2021*. The ASEAN Secretariat.

ASEAN. (2022). *Flows of Outward Foreign Direct Investment (FDI), by Destination Country (in million US$).* https://data.aseanstats.org/fdi-by-hosts-and-sources-flow-outward

Barro, R. (1994). Democracy and growth. In *National Bureau of Economic Research* (Issue 4909). https://doi.org/10.3386/w4909

Bengoa, M., & Sanchez-robles, B. (2003). Foreign direct investment, economic freedom and growth: New evidence from Latin America. *European Journal of Political Economy*, *19*, 529–545. https://doi.org/10.1016/S0176-2680(03)00011-9

Bibi, S., Ahmad, S. T., & Rashid, H. (2014). Impact of trade openness, FDI, exchange rate and inflation on economic growth: A case study of Pakistan. *International Journal of Accounting and Financial Reporting*, *4*(2), 236–257. https://doi.org/10.5296/ijafr.v4i2.6482

Carlsson, F., & Lundström, S. (2002). Economic freedom and growth: Decomposing the effects. *Public Choice*, *112*(3–4), 335–344. https://doi.org/10.1023/A:1019968525415

Chang, R., Kaltani, L., & Loayza, N. (2005). Openness can be good for growth: The role of policy complementarities. In *NBER Working Paper No. 11787*. https://econpapers.repec.org/paper/nbrnberwo/11787.htm

Chaudhury, S., Nanda, N., & Tyagi, B. (2020). Impact of FDI on economic growth in South Asia: Does nature of FDI matters? *Review of Market Integration*, *12*(1–2), 51–69. https://doi.org/10.1177/0974929220969679

De Haan, J., & Siermann, C. L. J. (1998). Further evidence on the relationship between economic freedom and economic growth. *Public Choice*, *95*(3–4), 363–380. https://doi.org/10.1023/a:1005072108159

de Vanssay, X., & Spindler, Z. A. (1994). Freedom and growth: Do constitutions matter? *Public Choice*, *78*(3–4), 359–372. https://doi.org/10.1007/BF01047764

Doucouliagos, C., & Ulubasoglu, M. A. (2006). Economic freedom and economic growth: Does specification make a difference? *European Journal of Political Economy*, *22*, 60–81. https://doi.org/10.1016/j.ejpoleco.2005.06.003

Farrar, D. E., & Glauber, R. R. (1967). Multicollinearity in regression analysis: The problem revisited. *The Review of Economics and Statistics*, *49*(1), 92–107. https://doi.org/10.2307/1937887

Foundation, T. H. (2019). *About the index*. http://www.heritage.org

Freeman, C., & Soete, L. (1997). *The economics of industrial innovation*. London and Washington Printer. https://doi.org/10.4324/978020337637

Gilling, E. J. (1975). *Telecommunications and economic development: Inter-country comparisons of the catalytic effect of telephone services on development*. McGill University.

Hardy, A. P. (1980). The role of the telephone in economic development. *Telecommunications Policy*, *4*(4), 278–286. https://doi.org/10.1016/0308-5961(80)90044-0

Heckelman, J. C. (2000). Economic freedom and economic growth: A short-run causal investigation. *Journal of Applied Economics*, *3*(1), 71–91. https://doi.org/10.1080/15140326.2000.12040546

Hussin, F., & Saidin, N. (2012). Economic growth in ASEAN-4 countries : A panel data analysis. *International Journal of Economics and Finance*, *4*(9), 119–129. https://doi.org/10.5539/ijef.v4n9p119

Hye, Q. M. A., & Lau, W. Y. (2015). Trade openness and economic growth: Empirical evidence from India. *Journal of Business Economics and Management*, *16*(1), 188–205. https://doi.org/10.3846/16111699.2012.720587

IMF. (2019). *World economic outlook: Global manufacturing downturn, rissing trade barriers 2019*. IMF. https://www.imf.org/en/Publications/WEO/Issues/2019/10/01/world-economic-outlook-october-2019

Ishida, H. (2014). The effect of ICT development on economic growth and energy consumption in Japan. *Telematics and Informatics*, *32*(1), 79–88. https://doi.org/10.1016/j.tele.2014.04.003

ITU. (2018). *Measuring the information society report 2018* (Vol. 1). ITU. https://www.itu.int/en/ITU-D/Statistics/Pages/publications/misr2018.aspx

Jipp, A. (1963). Wealth of nations and telephone density. *Telecommunications Journal*, *30*(1), 199–201.

Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics*, *90*(1), 1–44. https://doi.org/10.1016/S0304-4076(98)00023-2

Kein. (2015). The Impact Of Fdi Inflows On Real Gdp In Estonia: Evidence From A Cointegration Approach And Causality Test. The Journal of Developing Areas, 49(4), 25–40. https://doi.org/10.1353/jda.2015.0127

Kirikkaleli, D., Sokri, A., Candemir, M., & Ertugrul, H. M. (2018). Panel cointegration: Long-run relationship between internet, electricity consumption and economic growth. Evidence from OECD countries. *Investigacion Economica*, *77*(303), 161–176. https://doi.org/10.22201/fe.01851667p.2018.303.64158

Lauridsen, J. T., Zeren, F., & Ari, A. (2013). A spatial panel data analysis of crime rates in EU. *Discussion Papers on Business and Economics*, *2*, 1–24. https://www.econbiz.de/Record/a-spatial-panel-data-analysis-of-crime-rates-in-eu-lauridsen-jørgen/10009688397

Makki, S. S., & Somwaru, A. (2004). Impact of foreign direct investment and trade on economic growth: Evidence from developing countries. *Journal of International Money and Finance*, *22*(1), 48–56.

Nabi, A. A., Tunio, F. H., Azhar, M., Syed, M. S., & Ullah, Z. (2022). Impact of information and communication technology, financial development, and trade on economic growth: Empirical analysis on N11 Countries. *Journal of the Knowledge Economy*. https://doi.org/10.1007/s13132-022-00890-6

Nelson, M. A., & Singh, R. D. (1998). Democracy, economic freedom, fiscal policy, and growth in LDCs: A fresh look. *Economic Development and Cultural Change*, *46*(4), 677–696. https://doi.org/10.1086/452369

Nwadike, Johnmary, A. K., & Alamba, C. S. (2020). Impact of Trade Openness on Nigerian Economic Growth: An Empirical Investigation, 1970–2011. Foreign Trade Review (New Delhi), 55(2), 239–247. https://doi.org/10.1177/0015732519894153

Octavianingrum, D. (2015). [*Analisis pengaruh investasi, tenaga kerja, dan tingkat pendidikan terhadap pertumbuhan ekonomi di Daerah Istimewa Yogyakarta: Studi 5 kabupaten/kot*a. In *Universitas Negeri Yogyakarta*.] http://eprints.uny.ac.id/14901/

Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics*, 653–670. https://doi.org/10.1111/1468-0084.61.s1.14

Pernia, E. M., & Quising, P. F. (2003). Economic openness and regional development in the Philippines. In *ERD Working Paper Series* (Issue 34). https://think-asia.org/handle/11540/1520?show=full

Phillips, P. C. B., & Hansen, B. E. (1990). Statistical inference in instrumental variables regression with I(1) processes. *Review of Economic Studies*, *57*, 99–125. https://doi.org/10.2307/2297545

Phillips, P. C. B., & Loretan, M. (1991). Estimating long-run economic equilibria. *Review of Economic Studies*, *58*, 407–436. https://econpapers.repec.org/article/ouprestud/v_3a58_3ay_3a1991_3ai_3a3_3ap_3a407-436..htm

Plăcintă, Grigorescu, E.-A., Posedaru, B.-Ş., Pantelimon, F.-V., Mirea, C.-M., & Bobocea, A. (2022). The Impact of ICT Investments on GDP in Central and South-East Europe. *Informatica Economica*, *26*(2), 20–28. https://doi.org/10.24818/issn14531305/26.2.2022.02

Saba, Charles Shaaba & Ngepah, Nicholas (2022). ICT Diffusion, Industrialisation and Economic Growth Nexus: an International Cross-country Analysis. Journal of the Knowledge Economy, 13(3), 2030–2069. https://doi.org/10.1007/s13132-021-00795-w

Safitriani, S. (2014). Perdagangan internasional dan foreign direct investment di Indonesia. *Buletin Ilmiah Litbang Perdagangan*, *8*(1), 93–116. https://doi.org/10.30908/bilp.v8i1.89

Saikkonen, P. (1991). Asymptotically efficient estimation of cointegration regressions. *Econometric Theory*, *7*(1), 1–21. https://doi.org/10.1017/S0266466600004217

Saunders, R. J., Warford, J. J., & Wellenius, B. (1983). Telecommunications and economic development. Published for the World Bank by Johns Hopkins University Press. *Baltimore*.

Scully, G. W., & Slottje, D. J. (1991). Ranking economic liberty across countries. *Public Choice*, *69*(2), 121–152. https://ideas.repec.org/a/kap/pubcho/v69y1991i2p121-52.html#more

Shangquan, G. (2000). Economic globalization : Trends, risks and risk prevention. *CDP Background Paper*, *1*, 1–10. https://www.un.org/development/desa/dpad/publication/cdp-background-paper-no-01/

Stock, J. H., & Watson, M. W. (1993). A simple estimator of cointegrating vectors in higher order integrated systems. *Econometrica*, *61*(4), 783–820. https://doi.org/10.2307/2951763

Toader, E., Firtescu, B. N., & Roman, A. (2018). Impact of information and communication technology infrastructure on economic growth : An empirical assessment for the EU countries. *Journal of MDPI*, 1–22. https://doi.org/10.3390/su10103750

Todaro, M. P., & Smith, S. C. (2012). Economic development. In *Pearson* (11th ed.). Addison-Wesley. http://eco.eco.basu.ac.ir/BasuContentFiles/57/57304a77-1269-4081-bd5b-4c66b84b06a4.pdf

Torstensson, J. (1994). Property rights and economic growth: An empirical study. *Kyklos*, *47*(2), 231–247. https://doi.org/10.1111/j.1467-6435.1994.tb02257.x

Economic freedom and conflict reduction: Evidence from the 1970s, 1980s, and 1990s, 22 Cato Journal 533 (2003). e

UN, U. (2004). *Globalization and the state: Challenges for economic growth and human development*. United Nations. https://digitallibrary.un.org/record/745104?ln=en

UNCTAD. (2021). *Key Statistics and Trends in International Trade 2021*. United Nati.

UNDP. (1999). Globalization with a human face. In *Human Development Report 1999* (pp. 1–130). Oxford University Press. http://www.hdr.undp.org/en/content/human-development-report-1999

Venturini, F. (2009). The long-run impact of ICT. *Quaderno Di Ricerca n. 254*, 1–42.

http://docs.dises.univpm.it/web/quaderni/pdf/254.pdf

Vogelsang, T. J., & Wagner, M. (2014). Integrated modified OLS estimation and fixed- b inference for cointegrating regressions. *Journal of Econometrics*, *178*(2), 741–760. https://doi.org/10.1016/j.jeconom.2013.10.015

Vogiatzoglou, K., Nhung, P., & Nguyen, T. (2016). Economic openness and economic growth: A cointegration analysis for ASEAN-5 countries. *The European Journal of Applied Economics*, *13*(2), 10–20. https://doi.org/10.5937/ejae13-11311

World Bank. (2022). *World Development Indicators*. https://databank.worldbank.org/source/world-development-indicators#

APPENDIX

Appendix 1. Correlation matrix

```
cor(dataku)

##         ln_gdp   ICT    EF    TO    FDI
## ln_gdp  1,00     0,24   0,16  0,07  -0,18
## ICT     0,24     1,00   0,90  0,71  0,40
## EF      0,16     0,90   1,00  0,78  0,52
## TO      0,07     0,71   0,78  1,00  0,73
## FDI    -0,18     0,40   0,52  0,73  1,00
```

Appendix 2. Panel unit root test for error FM-OLS model

Null Hypothesis: Unit root (common unit root process)
Series: RESID_FMOLS
Date: 07/06/20 Time: 16:59
Sample: 2008 2018
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 89
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-1.75908	0.0393

** Probabilities are computed assuming asympotic normality

Appendix 3. Panel unit root test for error D-OLS model

Null Hypothesis: Unit root (common unit root process)
Series: RESID_DOLS
Date: 07/06/20 Time: 17:30
Sample: 2008 2018
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 81
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-2.83388	0.0023

** Probabilities are computed assuming asympotic normality

Appendix 4. Panel unit root test for error IM-OLS model

Null Hypothesis: Unit root (common unit root process)
Series: RESID_IMOLS
Date: 07/06/20 Time: 17:48
Sample: 2008 2018
Exogenous variables: None
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 89
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-2.76815	0.0028

** Probabilities are computed assuming asympotic normality