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Article

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Inter-regional trade and economic growth of ASEAN low middle income: Are corruption control and HDI important?

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Abstract: The current study aims to analyze the factors influencing ASEAN economic growth and integration. Specifically, the variables of inter-regional trade, human resource development, and corruption were investigated in six lower-middle-income countries from 1996 to 2019 through Driscoll and Kraay's, Newey and West's, and Dumitrescu and Hurlin's as causal analysis. The study's results found that capital had an impact of 0.248%, labor had an impact of 0.467%, human development had 3.010%, intra-regional trade had an impact of 0.014%, and corruption control had 0.260%. Statistically, all variables have a significant effect except for inflation. Furthermore, a bidirectional found in economic growth from the capital, corruption control, and intra-trade. A unidirectional was found for economic growth between the labor force and human development. At the same time, a neutral relationship was found between inflation and economic growth. Based on these findings, strengthening the economy in the integration area needs to be done, even if it's only trading with fellow LMIs. Besides that, there is an increasing need to increase the allocation of education and health, which stimulates productivity. The government also needs to

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PUBLIC INTEREST STATEMENT

Integration is defined as the interconnection of several regions with the same goal of ensuring the economy's continued development. ASEAN is one of them. Each country has unique characteristics in terms of capital, labor, human development, trade performance, corruption control, and inflation. This study examines ASEAN integration from 1996 to 2020, with a focus on low-middle income countries. According to the study's findings, all research variables stimulate economic growth (except inflation), and there is a causal relationship between variables in both directions and one direction. The study's findings are expected to be helpful for policymakers in encouraging economic growth.

strengthen corruption control, which is detrimental to developing nations and economic growth.

Subjects: Economics and Development; Regional Development; Economics

Keywords: economic growth; inter-regional trade; human development; corruption

JEL Classification: C23; F14; F15; F62

1. Introduction

Integration is interconnection of numerous aspects for the simultaneous achievement of multiple goals among individuals and groups. For example, Association of Southeast Asian Nations or in short is ASEAN. Essentially, ASEAN focuses on the economic and trade sectors to resolve increasing liberalization challenges in interstate cooperation. The integration is anticipated to establish a stable, open, vibrant, and resilient regional economic community, which promotes economic growth in the ASEAN region.

ASEAN countries developed and adhered to the ASEAN Free Trade Agreement (AFTA) in 1993. Contemporarily, 10 ASEAN member countries, namely the Philippines, Vietnam, Myanmar, Cambodia, Laos, Malaysia, Singapore, Brunei Darussalam, Indonesia, and Thailand, continues economic cooperation to elevate economic growth and competitiveness in producing quality goods and services. Concurrently, ASEAN countries cooperate with other nations, such as China and India by forming ASEAN-Plus to further stimulate economic development.

Integration is become a hot topic of theoretical discourse regarding the economic community due to the positive economic benefits generated for each member country (Bong & Premaratne, 2018; Shah, 2021). One of the advantages is that each member country can trade with member countries without any obstacles to either the same economy or a higher economy. However, the consistency of this positive impact does not always occur. Obasaju et al. (2021) found that integration does not benefit state members because each member has a different character. These differences may include natural resources, human resources, skills, technology, bureaucratic quality, corruption control, etc. This difference greatly determines the country's ability to obtain high economic growth (Jahanger et al., 2022).

These characteristic differences exist in the ASEAN region dominated by developing countries. Most member developing countries, especially lower middle income, have low capability of human resources and technology that encourages inefficiency. Not only in terms of weakened productivity but also leading the use of natural resources (include non-renewable energy) to become wasteful (Chen et al., 2022; Rafei et al., 2022). In addition, often unstable political turbulence (in the control of corruption) causes economic performance not to be achieved. In the long term, more massive environmental damage is the most worrying (Wang et al., 2023; Wang et al., 2023) and gives causal to the economy (Jahanger et al., 2022; Li et al., 2021).

Based on above background analysis, this paper is dedicated to solving three problem as follows:

(1) Does intra trade between lower-middle-income countries drive economic growth during the integration period?

(2) Are human development and control of corruption important to boost economic growth during the integration period?

(3) Does the research variable have a causal relationship with economic growth during the integration period?

This study contributes to the literature about economic growth by presenting the case of ASEAN integration area, especially lower-middle income countries. To the best of the author's knowledge, this study pioneered the examination of the aforementioned issues and relevant impacts, as previous researchers investigated the issues without considering each ASEAN country status (see Bong & Premaratne, 2018; Masron, 2013; Nguyen & Bui, 2022; Okabe & Urata, 2014; Huang; 2016). Therefore, the present study bridged the economic literature gap on integration and the issues underlying human resource development and corruption control. Gründler and Potrafke (2019) explicated that corruption would significantly disrupt the national economy owing to production inefficiencies. Correspondingly, the present study employed Driscoll and Kraay's (1998) and Newey and West's (1987) panel as an analytical tool for controlling the linkage problem between investigation areas. Furthermore, this study incorporated the Granger panel method by Dumitrescu and Hurlin (2012) to reveal causal relationships.

The remainder of this paper is organized as follow. Section 1 describes an overview of the AFTA and lower-middle-income ASEAN nations. Section 2 conducts a reviews of the relevant literature and hypothesis. Section 3 describes econometric data and strategies. Section 4 reports and discusses the results. Finally, Section 5 draws conclusions and pertinent policy recommendations.

2. An overview of the AFTA and lower-middle-income ASEAN countries

The ASEAN Free Trade Agreement (AFTA) is an agreement between several ASEAN countries from 1993 until recently, which aims to boost ASEAN economic growth by expanding trade routes and networks to other member countries, eliminating tariffs, and increasing production efficiency (Okabe & Urata, 2014). In addition, AFTA removes barriers for member countries to obtain foreign investment (Masron, 2013). While the initial AFTA was developed based on the trading of goods, the agreement was proposed to be expanded to service trades in 2020 with a relevant consensus remaining in negotiation. Nevertheless, policymakers realize the AFTA benefits and instrumentality for future economic development, as demonstrated by the Singaporean share of exports in 1990 among ASEAN member countries being elevated to 39.8% currently. In 2010, the share was reduced to 23.2% due to the active Indonesian contribution in the export sector achieving 19% of the share (Okabe & Urata, 2014).

Cambodia, Indonesia, Laos, Myanmar, the Philippines, and Vietnam are developing lower-middle -income nations. Nevertheless, each country exhibits highly stable economic performance with an average of 5% annual growth (see Appendix A1), especially Laos, Vietnam, and Cambodia, while the remaining fluctuated in the first 10 years before stabilizing in the following years. These six countries compete with each other for market share (see Appendix A4). Although positive economic growth with increasing trade resulted from AFTA, the six countries possess different quality human resources (see Appendix A2) with varying development. Meanwhile, corruption control highly varies among the six nations within the negative range (see Appendix A3) owing to different political situations.

3. Literature review

3.1. Economic growth, capital, and labor

Economic growth denotes the output of an activity in a certain period, while the classical theory expounds economic output being determined by capital and labor formulated mathematically in equation (1) as follows:

$$Y = F(K, L) \tag{1}$$

Where Y, K, and L represent economic growth, capital, and labor respectively, which depicts the positive effect of the two variables on economic growth. Several previous studies corroborated the equation like Ahmed et al. (2016), Solarin (2020), Minh and Van (2023). Ahmed et al. (2016)

assessed capital and labor via the Bayer-Hanck cointegration approach in Iran between 1965 and 2011. The results demonstrated that capital and labor significantly and positively impact economic growth. Similarly, Solarin (2020) performed a relevant investigation in the United Stated through maximum likelihood analysis from the first quarter of 2002 to the fourth quarter of 2019, which revealed a similar positive impact of capital and labor on long-term economic growth. Recently, Minh and Van (2023) discovered that only capital significantly and positively influences long-term Vietnamese economic growth based on the ARDL method from 1995 to 2019. Accordingly, two relevant hypotheses were proposed:

H1: Capital positively influences economic growth.

H2: Labor positively impacts economic growth.

3.2. The human development index and economic growth

Human development is integral to increased workforce productivity and efficiency before positively impacting economic growth, in example, Čadil et al. (2014) examined human capital as a human development indicator in Europe from 2004 to 2008 via a robust regression model, which discovered a significant negative effect regionally and a significant positive influence in clusters. Concurrently, Fleisher et al. (2010) revealed through the fixed effect model that human capital significantly and positively influenced economic growth, wherein an increase in human capital in the surrounding area would encourage relevant economic growth. Colantonio et al. (2010) also studied African human capital via the matrix correlation method and corroborated that human capital in the healthcare and education sectors was correlated to economic growth by 85%.

Qadri and Waheed (2014) manifested that Pakistani human capital significantly and positively influenced economic growth through multiple regression. Nevertheless, Pelinescu (2015) through the Pooled Least Square approach disclosed that elevating human capital in 28 European regions from 2002 to 2012 significantly and negatively influenced economic growth. Fang and Chang (2016) discovered no positive effect of human capital on economic growth in the Asia-Pacific region through the Continuously Updated Fully Modified (CUP-FM) and Fully Modified Ordinary Least Square (FMOLS), as the finding revealed that human capital insignificantly impacted economic growth. Meanwhile, Sultana et al. (2022) discovered via the GMM System that human capital proxied by the average schooling length in 141 developing and developed countries produced a positive effect only in developing countries, while developed countries received an insignificant effect. Although previous literature demonstrated mixed findings, the current study proposed as follows:

H3: The Human Development Index positively influences economic growth.

3.3. The inter-regional trade and economic growth

Exports occur not only because of the requests from other countries but due to the cooperation agreement. Although each country possesses different productivity levels, positive competitiveness in producing quality goods is encouraged (Okoro et al., 2020). Although limited studies investigated the relationship between exports and economic growth, Bhattacharyya (2005) demonstrated a positive relationship between industrial sector exports and economic growth in South Korea through the Johansen cointegration. Similarly, Wooster et al. (2011) predicted a positive effect of exports on economic growth in 13 European countries from 1980 to 2003 via regression.

Tahernejad et al. (2017) revealed that certain countries, such as Iran, Indonesia, and Malaysia in the D-8 country integration area exhibited a significant positive impact of inter-regional trade on economic growth. Okoro et al. (2020) also manifested via the Generalized Methods of Moment (GMM) that the West African regional trade significantly and positively influenced economic growth. Contrarily, Miron et al. (2010) did not reveal a similarly significant relationship in Romania through the logistical approach. Meanwhile, Zahonogo (2017) demonstrated through the panel mean group method that inter-regional trade would only produce a significant positive impact on economic growth in active trade liberalization among 42 sub-Saharan African nations between 1998 and 2012. Summarily, despite past mixed results, a hypothesis was proposed as follows:

H4: Inter-regional trade positively impacts economic growth.

3.4. Corruption control and economic growth

Developing countries are ineffective in controlling corruption, which aggravates the issues of inflation and poverty before negatively impacting economic growth. Although relevant studies are limited, Farooq et al. (2013) disclosed through the Autoregressive Distributed Lag (ARDL) that corruption control positively impacted long-term Pakistani economic growth from 1987 to 2009. Cieślik and Goczek (2018) studied 141 countries from 1994–2012 using the GMM method. Contrastingly, Nguyen and Bui (2022) revealed via the GMM that corruption control negatively influenced economic growth in 16 emerging countries from 2000 to 2019. Nevertheless, Sharma and Mitra (2019) tested the relationship globally by employing the same analysis method, which demonstrated that corruption control significantly and positively influences economic growth. Contrarily, another global study by Uberti (2022) discovered the significant negative effect of corruption control on economic growth from the historical data analyzed through regression. Although previous studies manifested mixed findings, the current study hypothesized as follows:

H5: Corruption control positively influences economic growth.

3.5. Literature gap

After summarizing the relevant literature studies, the literature gaps include the following: (1). The literature on independent variables on economic growth has different findings between studies, so it is inconsistent. (2) It can be seen that integration studies are rarely discussed, especially ASEAN with sub-status state income. (3) Most of the previous studies used dynamic panels and time series models as analytical tools. Based on these gaps, this study examines this relationship using Driscoll and Kraay's (1998) and Newey and West's (1987) approaches and the Dumitrescu and Hurlin (2012) causality panel from 1996–2020. This method uses specific criteria to obtain important information about the current economy.

4. Data and econometric strategy

4.1. Data analysis

The current study analyzed actual economic growth in six lower-middle-income ASEAN countries, namely Cambodia, Indonesia, Laos, Myanmar, Philippines, and Vietnam, from 1996 to 2019 based on the available observational data illustrating the AFTA period. The selected countries based on the World Bank classification (2021) were appraised on capital, labor, human resource development, inter-regional trade, corruption control, and inflation with relevant details on definitions and data sources presented in Table 1.

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Table 1. Descriptive variables and data sources

Variable	Symbol	Definition	Expected Sign	Source
Economic Growth	Y	Constant Gross Domestic Product 2015 in the US dollars		WDI
Capital	K	Gross fixed capital formation	+	WDI
Labor	L	The workforce aged between 15 and 64 years old	+	WDI
Human Resource Development	HDI	The Human Development Index according to UNDP method	+	UNDP
Inter-regional Trade	ITR	Total shares of ASEAN exports across countries in percentage	+	IMF (Author's Calculation)
Corruption Control	CC	Estimated corruption control between −2.5 to 2.5 (bad to good)	+	WGI
Inflation	INF	Annual percentage of consumer prices	-	WDI

Notes: WDI = World Development Indicator, WGI = World Governance Indicator, UNDP = United Nations Development Program.

4.2. Econometric strategies

The present study was initiated with the neoclassical production function, which describes *A* as a constant technology, with *K* and *L* being changed by assuming a constant return to the scale as follows:

$$Y_{it} = A_{it}K_{it}^{\alpha}L_{it}^{\beta} \tag{2}$$

Equation (2) is extended via several variables to be examined, namely human resource development, inter-regional trade, corruption control, and inflation, as delineated in equation (3). Given that equation (3) is non-linear, the researcher transformed the equation into a natural logarithm (ln) as equation (4):

$$Y_{it} = A_{it}K_{it}^{\alpha}L_{it}^{\beta}HDI_{it}^{\varphi}ITR_{it}^{\gamma}CC_{it}^{\delta}INF_{it}^{\theta} \tag{3}$$

$$lnY_{it} = lnA_{it} + \alpha lnK_{it} + \beta lnL_{it} + \varphi lnHDI_{it} + \gamma lnITR_{it} + \delta lnCC_{it} + \theta lnINF_{it} \tag{4}$$

lnA_{it} is considered a constant coefficient(β_0), with $\beta, \varphi, \gamma, \delta,$ andθ as the coefficient of each variable. *i* represents 10 countries and *t* portrays the period from 1996 to 2019, with all coefficients interpreted in percentage. Countries in the same groups generally possess linkages with other countries (Fachrurrozi et al., 2022), although each country reflects different economic structures. Thus, several stages of testing are required to ensure zero errors in estimations, in which several procedures, such as the cross-sectional dependence test, stationarity panel testing, cointegration panels, long-term estimation methods, and causality panel testing were performed before estimating equation (4).

4.2.1. Cross-sectional dependence tests

Regarding the panel data, economic relations between countries would likely occur, especially among countries with inter-regional cooperation agreements (Fachrurrozi et al., 2022; Ozcan & Ozturk, 2019). The conventional method assumes no relationship between regions, which leads to unreliable estimation findings in panel data model (Wang et al., 2023), especially in the long term (Wang et al., 2022). Hence, the cross-sectional dependence test was conducted through two approaches, namely the Lagrange Multiplier (LM) test (Breusch & Pagan, 1980) and the statistical CD test (Pesaran, 2021) with the following computations:

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^{2} \tag{5}$$

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \tag{6}$$

Equations (5) and (6) elucidate that N is the number of countries, T is the time, and $\hat{\rho}_{ij}$ is the residual correlation between regions i and j. The null hypothesis of the tests is that no correlation exists between regions, while the alternative hypothesis postulates a significant correlation between each region.

4.2.2. Panel unit root tests

Stationarity testing on data is highly necessary before assessing the model, although stationarity tests, such as Levin-Lin-Chu (LLC) and Im-Pesaran-Shin (IPS) could not be performed to determine the correlation between regions. Therefore, Pesaran (2007) recommended employing Cross-sectional Augmented Dickey-Fuller (CADF) and Cross-sectional IPS (CIPS) stationarity tests, which address both regional correlations and heteroscedasticity. The null hypothesis of the tests is data non-stationary, whereas the alternative hypothesis is data stationary. The CADF statistical computation is conducted as per the following equation:

$$\Delta Y_{it} = a_i + b_i Y_{i,t-1} + c_i \bar{Y}_{t-1} + c_i \Delta \bar{Y}_t + \omega_{it} \tag{7}$$

Where Δ is the difference, Y is the dependent variable, and ω_{it} are residuals. Based on the CADF computation, the CIPS calculation is expressed as follows:

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} CADF_i \tag{8}$$

4.2.3. Panel cointegration tests

Cointegration testing is employed when all variables possess the same integration level (first difference). Wang, et al. (2023) explained that cointegration can occur in the same order of integration so that a long-term relationship is possible. Numerous researchers, such as Pedroni (2004), Kao (1999), and Johansen (1991), conducted cointegration as a test tool. Nevertheless, the test results would be unreliable when a correlation exists between regions, which requires Westerlund's (2007) method as a solution. The Westerlund cointegration calculation is performed in the ECM model as follows:

$$\Delta Y_t = \delta_i' d_t + \alpha_i Y_{i,t-1} + \lambda_i' X_{i,t-1} + \sum_{j=1}^{pi}\alpha_{ij}\Delta Y_{i,t-1} + \sum_{j=-qi}^{pi}\gamma_{ij}\Delta X_{i,t-1} + u_{it} \tag{9}$$

Where *Y* is the dependent variable, *X* is the independent variable, *i* is the region, *t* is the time, and α_i is the speed of error correction. The Westerlund cointegration method consists of two components, namely statistical groups (*Gt* and *Ga*) and statistical panels (*Pt* and *Pa*). The null hypothesis proposes no cointegration exists while the alternative hypothesis posits a cointegration relationship across all panels. Resultantly, the cointegration test exists although one of the four statistics is insignificant. The group calculations and statistical panels are expressed as follows:

$$G_t = \frac{1}{N}\sum_{i=1}^{N}\frac{\widehat{\alpha_t}}{SE_{\widehat{\alpha_t}}} \tag{10}$$

$$G_\alpha = \frac{1}{N}\sum_{i=1}^{N}\frac{T\widehat{\alpha_t}}{\widehat{\alpha_t}(1)} \tag{11}$$

$$P_t = \frac{\widehat{\alpha_t}}{SE_{\widehat{\alpha_t}}} \tag{12}$$

$$P_\alpha = T\hat{a} \tag{13}$$

4.2.4. Long-term estimation methods

To achieve the first and second objectives, we use Driscoll and Kraay's (1998) and Newey and West's (1987). This method was employed to perform the long-term estimation, which discusses panel estimation with issues involving autocorrelation, heteroscedasticity, and cross-sectional dependence (Rahman et al., 2022). In addition, the method could resolve missing and imbalanced data (Chandio et al., 2022) that are irresolvable by previous panel methods, including pooled ordinary least squares (OLS), fixed effects, and random effects (Djoukouo, 2021). The equation is illustrated as follows:

$$y_{it} = x_{it}'\beta + \varepsilon_{it}, i = 1, \ldots, N; t = 1, \ldots, T \tag{14}$$

Where *y* is the dependent variable (Economic Growth), *x* represents the independent variables (*K*, *L*, *HDI*, *ITR*, *CC*, *INF*) with the vector of (*K* +1) times the first element (1), and β corresponds to the vector of (*K* +1) times (1) as the estimated coefficient. The regressors x_{it} and ε_{it} are assumed for all uncorrelated i and t (assumed to be exogenous). Meanwhile, ε_{it} possesses autocorrelation, heteroscedasticity, and cross-sectional dependence. Based on the OLS estimation consistency, β could be derived as follows (Hoechle, 2007):

$$\widehat{\beta} = \left(\mathbf{X}'\mathbf{X}\right)^{-1}\mathbf{X}'\mathrm{y} \tag{15}$$

The estimated coefficients fromDriscoll and Kraay's (1998) standard errors are derived from the "square root $\left(\hat{S}_T\right)$ of the diagonal elements of the asymptotic covariance matrix" (Hoechle, 2007: 287) expressed as follows:

$$V(\widehat{\beta}) = \left(\mathbf{X}'\mathbf{X}\right)^{-1}\widehat{\mathbf{S}}_{\mathrm{T}}\left(\mathbf{X}'\mathbf{X}\right)^{-1} \tag{16}$$

The fixed effect estimators, namely the weighted least squares (WLS) estimators, could be calculated upon applying the transformation (the WLS transformation) to all model variables estimated by the OLS pool with Driscoll-Kraay's standard errors (Djoukouo, 2021). The temporary $\widehat{S}_T$ was defined byNewey and West (1987) as follows:

$$\widehat{\boldsymbol{S}}_T = \widehat{\Omega}_0 + \sum_{j=1}^{m(T)} w(j,m)\left[\widehat{\Omega}_j + \widehat{\Omega}_j'\right] \tag{17}$$

4.2.5. Dumitrescu-Hurlin causality test

Last objective, cointegration indicates a long-term relationship between variables without signifying the direction of each variable However, there may be several directions in the variable that is important in policy (Li et al., 2021). Thus, directional testing, namely the Dumitrescu-Hurlin (Dumitrescu & Hurlin, 2012) panel causality, was conducted to appraise the panel data applicable to both $N > T$ and $T > N$ cases (Haseeb et al., 2018; Wang et al., 2022) as follows:

$$Y_{it} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} Y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} X_{i,t-k} + \varepsilon_{i,t} \tag{18}$$

Where α_i is constant, $\gamma_i^{(k)}$ is the lag coefficient of Y, k is the optimal lag, and $\beta_i^{(k)}$ is the X coefficient. $\gamma_i^{(k)}$ and $\beta_i^{(k)}$ delineate the differences between each region, with the null and alternative hypotheses presented as follows:

$$H_0 : \beta_i = 0, \qquad \forall i = 1, 2, \ldots, N$$

$$H_1 : \begin{cases} \beta i = 0 & \forall i = 1, 2, \ldots, N_1 \\ \beta i \neq 0 & \forall i = N_{1+1}, \ldots, N \end{cases}$$

The null hypothesis propounds that no causal relationship exists in the panel data, whereas the alternative proposes causality between the panel data for at least one region. The Wald statistic is recommended calculating the DH panel causality by determining the average Wald statistic value for each region. $W_{N,T}^{Hnc}$ is employed if $N > T$ [equation (19)] is temporary and $Z_{N,T}^{Hnc}$ (the corresponding standard statistic) is performed with $T > N$ [equation (20)] as follows:

$$W_{N,T}^{Hnc} = \frac{1}{N}\sum_{i=1}^{N} W_{i,T} \tag{19}$$

$$Z_{N,T}^{Hnc} = \sqrt{\frac{N}{2K}}\left(W_{N,T}^{Hnc} - K\right) \xrightarrow[T,N \to \infty]{d} N(0,1) \tag{20}$$

Table 2 presents a summary of the research data and correlation matrix between variables. Standard deviation values explain data fluctuations, which highlight that inter-regional inflation is more turbulent than the variables of economic growth, capital, labor, human resource development, and corruption. Nonetheless, all variables are not normally distributed where the Jarque-Berra (JB) probability value is below 1% significance. Table 2 also demonstrates the correlation matrix between interrelated variables, except for inflation which is correlated with economic growth and human resource development.

Table 2. Descriptive statistics and the correlation matrix

Variable	*Y*	*K*	*L*	*HDI*	*ITR*	*CC*	*INF*
Mean	24.789	23.477	16.859	− 0.558	16.666	− 0.877	9.537
Standard Deviation	1.642	1.728	1.221	0.163	18.167	0.360	15.368
Minimun	22.094	19.979	14.618	− 0.949	0.227	− 1.673	− 1.710
Maximum	27.679	26.578	18.729	− 0.331	59.921	− 0.249	125.272
Skewness	0.003	− 0.230	− 0.365	− 0.654	1.123	− 0.364	4.707
Kurtosis	1.684	2.142	1.972	2.501	2.957	2.179	30.178
Jarque-Berra (JB)	10.390	5.694	9.54	11.770	30.300	7.229	4964
JB Probability	0.005 *	0.058	0.008 *	0.002 *	0.000 *	0.026 **	0.000 *
Correlation Matrix							
Y	1.000						
K	0.949* (0.000)	1.000					
L	0.929* (0.000)	0.940* (0.000)	1.000				
HDI	0.825* (0.000)	0.691* (0.000)	0.607* (0.000)	1.000			
ITR	0.853* (0.000)	0.818* (0.000)	0.815* (0.000)	0.583* (0.000)	1.000		
CC	0.601* (0.000)	0.428* (0.000)	0.452* (0.000)	0.691* (0.000)	0.426* (0.000)	1.000	
INF	− 0.228* (0.000)	− 0.148 (0.075)	− 0.152 (0.067)	− 0.358* (0.000)	− 0.074 (0.376)	− 0.152 (0.068)	1.000

Notes. () is p-value; * and ** signify significance at 1% and 5% respectively.

Table 3. Autocorrelation dan heteroscedasticity tests

Preliminary Test	Test Statistic	p-value
The Modified Wald test for groupwise heteroscedasticity	193.31 *	.000
The Wooldridge test for autocorrelation in the panel data	33.042 *	.002

Notes: * Significance at 1%.

5. Results and discussion

5.1. Results

5.1.1. Preliminary results

The pre-analytical stages, namely autocorrelation and heteroscedasticity, were conducted before analyzing the panel data to ensure the selected analysis tools would be appropriate while avoiding any potential analysis errors. Moreover, both tests of assumptions are crucial to the panel data (Djoukouo, 2021; Rahman & Alam, 2022). At a 1% significance level, the Woolridge test approach for autocorrelation discovered a statistical lift of 33,042, while the Modified Wald test for heteroscedasticity revealed a statistic of 193.31, which suggested the existence of autocorrelation and heteroscedasticity issues (see Table 3). Thus, conventional panel analysis methods would not be performed in the present study.

Table 4. Cross-sectional dependence tests

Variable	LM Test	p-value	CD Test	p-value
Y	88.206*	.000	18.74*	.000
K	48.074*	.000	15.73*	.000
L	29.374**	.014	18.55*	.000
HDI	78.782*	.000	18.75*	.000
ITR	45.674*	.000	−2.64*	.008
CC	82.187*	.000	5.31*	.000
INF	44.004*	.000	7.48*	.000

Notes: * and ** signify significance at 1% and 5% respectively.

Table 5. Panel unit root tests

Variable	CADF		CIPS		Conclusion
	Level	First Difference	Level	First Difference	
Y	− 2.192	− 3.434 *	− 0.303	− 3.305 *	I (1)
K	− 2.837	− 4.040 *	− 1.504	− 4.474 *	I (1)
L	− 1.531	− 2.542 **	− 1.494	− 3.209 *	I (1)
HDI	− 1.989	− 2.933 *	− 2.461	− 4.299 *	I (1)
ITR	− 1.238	− 3.302 *	− 2.558	− 4.778 *	I (1)
CC	− 1.532	− 4.487 *	− 1.812	− 5.211 *	I (1)
INF	− 2.274	− 4.101 *	− 2.203	− 5.605 *	I (1)

Notes: * and ** signify significance at 1% and 5% respectively.

5.1.2. The cross-sectional dependence results

The subsequent pre-analysis test was the cross-sectional dependence test through the LM and CD approaches with relevant findings presented in Table 4. The findings manifested that all variables were significant, which provided concrete evidence of cross-sectional dependence on each variable in the panel data. This shows that each country is interconnected.

5.1.3. Panel unit root results

Table 5 depicts the results of CADF and CIPS stationarity testing to avoid estimation errors (Fachrurrozi et al., 2022; Ikhsan et al., 2022). Specifically, the findings suggested rejecting the null or stationary hypothesis at the first difference level, which indicates that the variables of economic growth, capital, labor, human resource development, inter-regional trade, corruption control, and inflation are integrated at the first level.

Table 6. The Westerlund cointegration test

Statistic	Cointegration Value	z-value	p-value
Gt	− 2.900	− 1.660	.040**
Ga	− 93.217	− 29.945	.000*
Pt	− 14.472	− 10.828	.000*
Pa	− 86.848	− 31.943	.000*

Notes: * and ** signify significance at 1% and 5% respectively.

Table 7. Results of Driscoll-Kraay's and Newey-West's standard error estimations

Variable	Coefficient	D-K Std. error	Coefficient	N-W Std. error
K	0.248 **	0.062	0.248 *	0.057
L	0.467 *	0.028	0.467 *	0.060
HDI	3.010 *	0.215	3.010 *	0.342
ITR	0.014 **	0.003	0.014 *	0.002
CC	0.260 **	0.064	0.260 *	0.079
INF	− 0.001	0.001	− 0.001	0.001
Constant	12.756 *	1.187	12.756 *	0.770
F-statistic	156844 *		1855.12 *	
Prob. F-statistic	0.000		0.000	
R-Squared	0.988			
RSME	0.183			
Num. Obs	144		144	
Num. Groups	6			

Notes: * and ** mean significance at 1% and 5% respectively. K: Capital, L: Labor, HDI: Human Development Index, ITR: Intra-Regional Trade, CC: Control of Corruption, INF: Inflation. D-K: Driscoll-Kraay's, N-W: Newey-West's.

5.1.4. Cointegration results

Due to the cross-sectional dependence issues, cointegration testing was performed subsequently to observe the estimation through the Westerlund cointegration test, as portrayed in Table 6. The findings demonstrated that the *Ga*, *Gt*, *Pa*, and *Pt* statistics rejected the null hypothesis at the 1% significance level, which confirms the existence of cointegration at least once in the research area.

5.1.5. Long-term panel estimation

To answer research objectives one and two, Driscoll-Kraay's method and Newey-West's test were conducted for long-term panel estimation, as illustrated in Table 7. Particularly, the Driscoll-Kraay estimation revealed that the capital variable produced a positive and significant influence at the 1% significance level, wherein a 1% increase in capital would lead to a 0.24% increase in economic growth by assuming ceteris paribus. Meanwhile, labor demonstrated a significant positive effect at the 1% significance level, which propounded that a 1% increase in labor productivity would result in a 0.46% increase in economic growth with the ceteris paribus assumption.

Furthermore, HDI reflected a higher positive effect compared to other variables, in which a 1% increase in HDI would contribute to a 3.01% increase in economic growth by assuming ceteris paribus. The finding is concurrent with Fleisher et al. (2010) and Sultana et al. (2022) while contrasting with Fang and Chang (2016). Summarily, human resources are pivotal to the six countries (Cambodia, Indonesia, Laos, Myanmar, the Philippines, and Vietnam) due to the highly significant impact on economic growth, which could be elevated through sufficient education and healthcare in driving labor productivity (Ogundari & Awokuse, 2018).

The variable of inter-regional trade demonstrated a significant positive effect on economic growth at the 5% significance level, wherein economic growth would increase by 0.014% with a 1% increase in inter-regional trade. The findings correspond to Bhattacharyya (2005), Wooster et al. (2008), Tahernejad et al. (2017), and Okoro et al. (2020) but contradicted Miron et al. (2010). These findings show that integration provides benefits for lower middle income countries. However, the resulting impact is shallow when compared to other variables. One of the reasons is that these member countries have the same status and thus show similar selling power of raw goods and production, even though all the related transactions that complement the increasing domestic demand for certain goods.

Table 8. The panel causality test results

Dependent Variable	Independent Variable						
	Y	***K***	***L***	***HDI***	***ITR***	***CC***	***INF***
Y		12.126 * (0.000)	19.919 * (0.000)	47.482 * (0.000)	5.394 * (0.000)	1.832 *** (0.066)	1.908 (0.556)
K	38.267 * (0.000)		20.383 * (0.000)	43.060 * (0.000)	0.984 (0.325)	0.831 (0.405)	3.607 * (0.000)
L	0.989 (0.322)	3.236 * (0.001)		0.346 (0.729)	−1.818 *** (0.069)	5.986 * (0.000)	−0.084 (0.933)
HDI	1.103 (0.269)	3.029 * (0.002)	3.992 * (0.000)		−0.170 (0.864)	0.700 (0.483)	3.440 * (0.000)
ITR	15.058 * (0.000)	4.024 * (0.000)	2.575 ** (0.010)	3.635 * (0.000)		1.233 (0.217)	1.358 (0.174)
CC	6.841 * (0.000)	1.066 (0.286)	2.621 * (0.008)	5.082 * (0.000)	0.711 (0.476)		0.366 (0.713)
INF	0.238 (0.110)	4.217 * (0.000)	9.503 * (0.000)	9.232 * (0.000)	2.715 * (0.000)	0.982 (0.325)	

Notes: () is p-value; *, **, and *** signify significance at 1%, 5%, and 10% respectively

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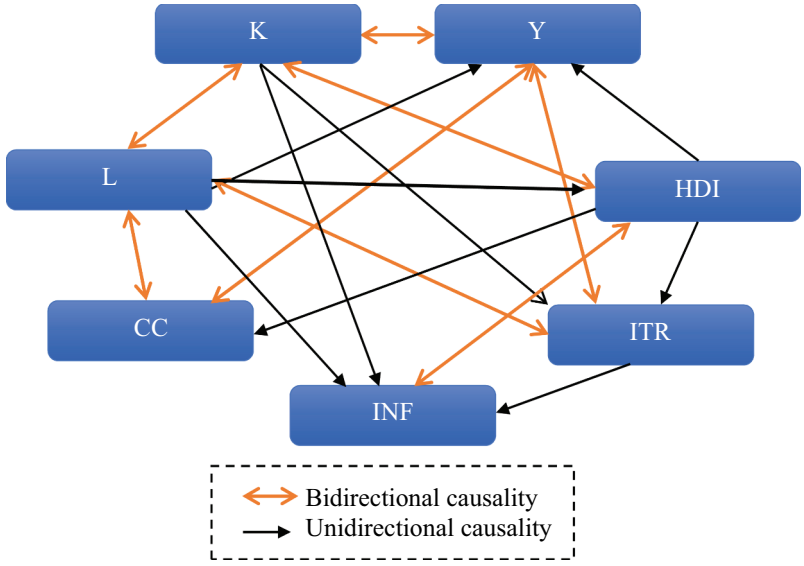
Figure 1. Summary panel causality ASEAN low middle income.



Meanwhile, corruption control produced a significant positive impact at the 1% significance level, in which economic growth would be elevated by 0.26% with a 1% increase in corruption control by assuming ceteris paribus. The finding is in line with Farooq et al. (2013) and Cieślik and Goczek (2018), although contrary to Nguyen and Bui (2022). Controlling corruption is a crucial element in economic development. The variable reflects how the economy works. If control is low, market stability will be directly disrupted due to rising prices, scarcity of goods, and loss of opportunities for cooperation with fellow members and other countries that can help boost economic growth. Nonetheless, the control variable, namely inflation, generated an insignificant effect on economic growth. Summarily, the Newey-West estimation results explicated all variables through the consistent findings discovered via the Driscoll-Kraay method. Although controlling corruption and human capital is a challenge for the six countries, adequate efforts would generate positive impacts on the economy.

5.1.6. Panel causality results

In this sub-chapter, we analyze the third goal, namely the relationship between research variables with the Dumitrescu-Hurlin (DH) causality approach. The aim is to provide information and strategies for policymakers. The estimation results are presented in Table 8 where there is a bidirectional between Y and K, Y and ITR, Y and CC, K and HDI, L and K, L and CC, L and ITR, and INF and HDI. Meanwhile, a unidirectional was found from L to Y, L to INF, L to HDI, K to INF, HDI to Y, HDI to ITR, and ITR to INF. Neutral relationships were found between INF and Y, CC and ITR, as well as INF and CC. The relationship between economic growth and trade is in line with the study by Wooster et al. (2011) but different from Li et al. (2021) on the LMI study. Meanwhile, the relationship between corruption control and economic growth is in line with Farooq et al. (2013) and Song et al. (2021).

Visualization of this causality relationship is presented in Figure Figure 1. Indirectly, economic integration in ASEAN has a different relationship from other integration areas by Bong and Premaratne (2018) and Shah (2021). The impetus for economic growth in the LMI case can occur directly or indirectly. It can be seen that economic growth and intra-trade are interrelated, and when this happens, the absorption of labor will have an impact on economic growth. However, the consequence is inflation because people have high purchasing power. On the other hand, economic growth can weaken if corruption control is low. The indications explained are the reduced availability of jobs due to corruption and causing unemployment. Fewer workers drive trade not to run and affect workers in getting skills.

6. Conclusion and policy implications

The present study investigated the influences of inter-regional trade and corruption control on real economic growth in six lower-middle-income ASEAN countries. This study also discovered the latest findings for the economic integration literature through Driscoll and Kraay's (1998) and Newey and West's (1987) approaches with several econometric tests on cross-sectional dependence. Specifically, the fundamental criteria stipulated by each test were fulfilled before employing the analytical model to resolve the violation of autocorrelation and heteroscedasticity assumptions. Meanwhile, the linkages between regions were integrated at the first level until a cointegration existed between the studied variables.

The empirical results demonstrated that capital, labor, the HDI, inter-regional trade, and corruption control significantly and positively impacted real economic growth, whereas inflation as a controlling indicator produced a significant negative effect on economic growth. The study's results found that capital had an impact of 0.248%, labor had an impact of 0.467%, human development had 3.010%, intra-trade had an impact of 0.014%, and corruption control had 0.260%. In addition, the DH test revealed causality in the relationships between capital and economic growth, inter-regional trade and economic growth, corruption control and economic growth, and inflation and economic growth. Resultantly, lower-middle-income countries could continue the AFTA benefits although the effect was minimal. Nonetheless, the national economy would be boosted, which requires the government to further enhance cooperation with ASEAN member nations. Concurrently, the government should improve human resource development by increasing allocated budgets on education and healthcare to encourage higher labor productivity, while strengthening corruption control to prevent relevant detrimental effects on economic growth, especially in developing countries.

The findings of this study show that intra-trade, corruption control and human development can increase economic growth, especially for low-income countries in the ASEAN integration region. However, there are several limitations. First, this study only uses intra-trade, corruption control, and human development. Researchers can review institutional quality, foreign direct investment, and political stability for the next study. These variables are very important in driving economic growth. Second, future researchers can develop analytical methods such as asymmetric and threshold panels to get new perspectives in filling the literature on economic growth. Third, the next researcher can add several ASEAN members as comparison study.

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Appendix

Figure 1 Economic Growth of the ASEAN LMI from 1996 to 2019.

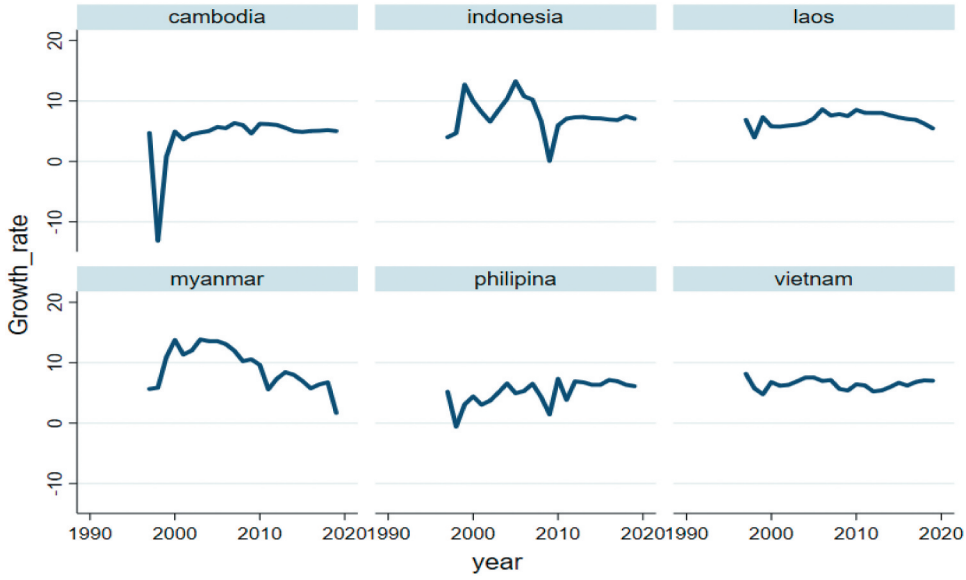

Figure 2 Human Development Index of the ASEAN LMI from (1996 to 2019).

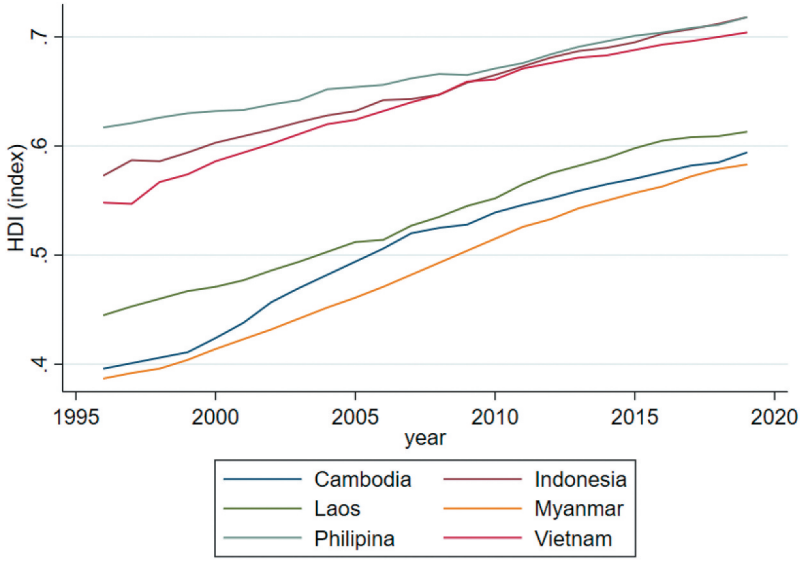

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Figure 3 Corruption Control of the ASEAN LMI from (1996 to 2019).

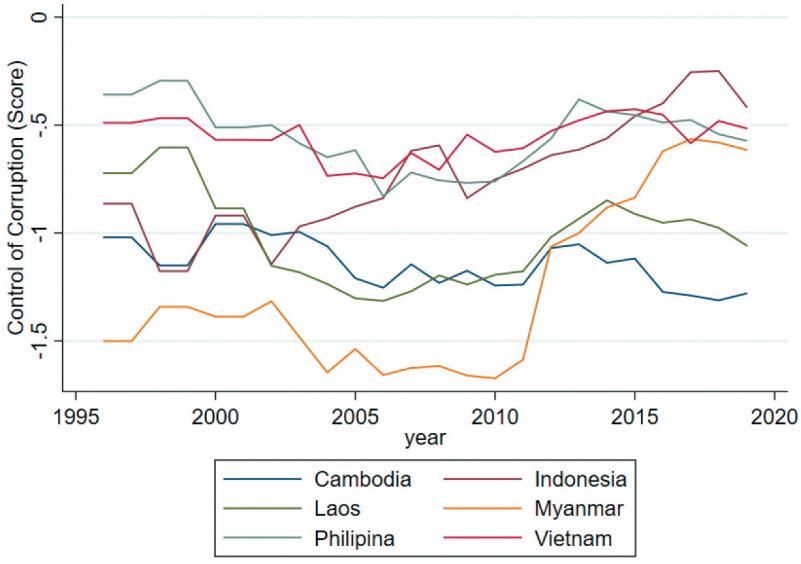

Figure 4 Inter-regional trade of the ASEAN LMI from 1996 to 2019.