CHAPTER IV

RESULT AND DISCUSSION

4.1 Overview of Convergence in ASEAN

The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967 in Bangkok, Thailand. ASEAN originated from the initiative of five founding member states: Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Over time, its membership gradually expanded with the inclusion of Brunei Darussalam (1984), Vietnam (1995), Laos and Myanmar (1997), Cambodia (1999), and most recently Timor-Leste in 2022.

As a regional cooperation institution, ASEAN facilitates collaboration across various strategic sectors, including politics, security, socio-cultural affairs, as well as science, technology, and economic development. In the economic sector specifically, the organization serves as a driving force for regional integration aimed at achieving sustainable growth and improving the welfare of its population. Referring to the Bangkok Declaration, the main pillars of ASEAN's establishment focus on accelerating economic growth, social progress, and cultural development through cooperation among member states.

As part of efforts to deepen economic integration, ASEAN has introduced several strategic initiatives, one of the most important being the establishment of the ASEAN Free Trade Area (AFTA). This free trade framework is designed to minimize trade barriers and enhance economic efficiency in Southeast Asia. Through the implementation of AFTA, ASEAN aims to create a highly competitive market environment that ultimately facilitates the smoother movement of goods, services, and cross-border investment flows within the region.

Table 4. 1 ASEAN-6 GDP Per Capita 2001-2024 (in USD)

Year	Brunei Darussalam	Indonesia	Malaysia	Philippines	Singapore	Thailand
2000	100.323,44	6.056,38	18.532,91	4.740,44	68.314,54	11.622,53
2001	99.680,76	6.190,52	18.186,44	4.778,40	65.784,40	11.901,32
2002	101.571,58	6.381,95	18.708,87	4.856,50	67.744,27	12.512,18
2003	103.226,91	6.599,09	19.329,01	5.003,38	71.877,53	13.287,30
2004	101.497,75	6.843,55	20.168,51	5.229,45	78.039,02	13.997,00
2005	99.795,69	7.140,85	20.767,59	5.386,82	81.841,16	14.458,26
2006	102.248,51	7.434,49	21.444,49	5.578,57	86.463,83	15.051,06
2007	96.752,62	7.802,46	22.305,12	5.840,07	90.417,81	15.742,66
2008	91.275,50	8.165,06	22.898,00	5.987,04	87.329,59	15.891,78
2009	87.875,83	8.435,46	22.106,64	5.965,31	84.843,52	15.665,90
2010	88.586,51	8.848,22	23.307,97	6.273,04	95.456,19	16.730,37
2011	90.279,66	9.274,97	24.115,82	6.388,31	99.296,76	16.766,35
2012	89.718,46	9.708,61	25.006,36	6.697,56	101.187,83	17.869,64
2013	86.606,65	10.121,81	25.736,35	7.016,54	104.359,03	18.242,43
2014	83.310,62	10.504,39	26.818,43	7.340,36	107.066,86	18.324,61
2015	81.910,19	10.893,66	27.699,63	7.691,76	108.953,72	18.812,00
2016	78.880,62	11.319,66	28.425,37	8.131,83	111.579,74	19.370,61
2017	78.966,86	11.772,57	29.551,55	8.584,14	116.471,82	20.094,68
2018	78.099,05	12.262,23	30.459,97	9.016,29	119.927,77	20.879,90
2019	80.228,16	12.757,79	31.300,51	9.452,29	120.114,13	21.277,84
2020	80.280,90	12.388,54	29.200,45	8.455,18	115.893,04	19.957,26
2021	78.248,80	12.757,07	29.822,85	8.857,79	132.617,35	20.242,77
2022	76.357,83	13.334,27	32.129,22	9.457,10	133.571,96	20.762,80
2023	76.616,70	13.889,97	32.857,67	9.898,53	129.555,25	21.191,45
2024	79.071,73	14.470,44	34.116,23	10.375,94	132.569,53	21.740,54

Source: World Bank, 2024

In Table 4.1, the ASEAN-6 group represents countries with an income base that was generally already at a more established level at the beginning of the observation period. In 2001, high-income countries such as Singapore and Brunei Darussalam recorded GDP per capita of approximately USD 65,784.40 and USD 99,680.76, respectively. Other ASEAN-6 countries, such as Malaysia and Thailand, also showed relatively high positions at USD 18,186.44 and USD 11,901.32 in the same year.

Despite starting from a high-income base, the long-run growth of more advanced ASEAN-6 countries tends to be relatively moderate. Singapore, for instance, increased its GDP per capita to around USD 132,569.50 in 2024, representing approximately a twofold increase over two decades. Meanwhile, Brunei Darussalam exhibited a stagnation pattern in income without any significant upward surge.

Table 4. 2 GDP Per capita CLMV 2001-2024 (in USD)

Year	Cambodia	Lao PDR	Myanmar	Viet Nam
2000	1.922,03	2.899,02	1.359,93	4.349,22
2001	2.032,08	3.015,63	1.498,31	4.570,27
2002	2.126,34	3.143,22	1.661,74	4.809,62
2003	2.309,84	3.282,99	1.874,17	5.090,29
2004	2.491,31	3.441,17	2.110,24	5.421,10
2005	2.781,89	3.630,56	2.377,90	5.776,36
2006	3.041,10	3.881,54	2.669,33	6.098,24
2007	3.308,16	4.112,25	2.968,30	6.418,54
2008	3.501,93	4.367,16	3.254,74	6.659,14
2009	3.587,61	4.625,07	3.578,17	6.914,34
2010	3.711,54	4.946,11	3.893,79	7.274,73
2011	3.921,98	5.266,88	4.078,61	7.652,62
2012	4.159,16	5.608,97	4.341,00	7.979,87
2013	4.419,40	5.974,47	4.666,95	8.324,20
2014	4.702,73	6.341,21	5.006,51	8.751,88
2015	4.968,57	6.703,74	5.313,89	9.248,02
2016	5.283,73	7.063,26	5.580,99	9.743,19
2017	5.632,03	7.432,46	5.877,87	10.290,55
2018	6.050,59	7.775,09	6.201,26	10.936,89
2019	6.448,88	8.075,28	6.562,99	11.628,61
2020	6.128,78	7.995,60	5.926,83	11.851,40
2021	6.225,53	8.080,44	5.178,45	12.048,90
2022	6.458,37	8.183,03	5.350,48	12.979,76
2023	6.695,29	8.372,16	5.364,14	13.545,93
2024	7.008,89	8.600,32	5.276,29	14.415,22

Source: World Bank, 2024

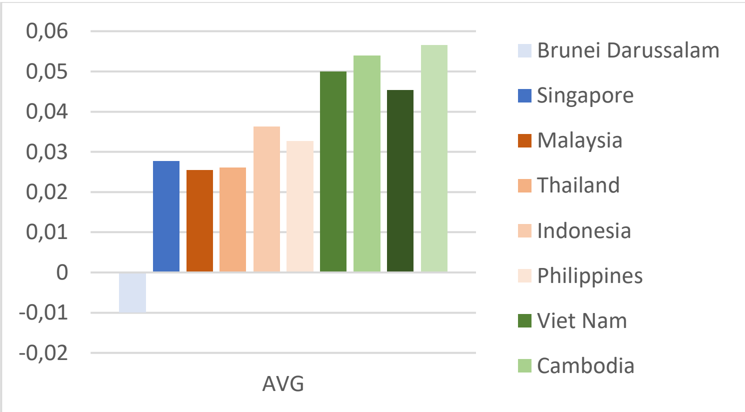
In contrast, Table 4.2 presents a very different trend in GDP per capita for the CLMV group of countries. At the beginning of 2001, this group experienced a substantial income gap compared to the ASEAN-6 countries. GDP per capita in CLMV countries at that time ranged from USD 1,498.31 (Myanmar) to a higher level within the group at USD 4,570.26 (Vietnam). Despite starting from a low base, the data up to 2024 confirms a sharp increase in GDP levels. Vietnam successfully raised its GDP per capita to USD 14,415.22, Laos reached USD 8,600.32, and Cambodia reached USD 7,008.88. This rapid increase in GDP per capita indicates a strong growth trajectory in the region.

This pattern suggests the presence of income convergence in the ASEAN region, where lower-income countries grow faster than higher-income countries. However, this convergence process does not occur uniformly, given differences in economic structures across countries, such as the dominance of the services sector in Singapore, reliance on natural resources in Brunei Darussalam, and more intensive industrialization processes in countries such as Vietnam. Therefore, this dynamic shows that convergence in ASEAN is not only determined by economic growth alone but is also strongly influenced by structural transformation in each country.

Based on Figure 4.2, the CLMV countries generally exhibit higher GDP per capita growth rates compared to the ASEAN-6 group. Myanmar and Cambodia recorded the highest average growth rates at around 5.5 percent and 5.3 percent per year, respectively, followed by Lao PDR and Vietnam at approximately 4.5 percent and 5.0 percent per year. In contrast, ASEAN-6 countries such as Singapore, Malaysia, and Thailand recorded more moderate growth rates in the range of 2.5–2.8 percent per year, while Brunei Darussalam even experienced a negative average growth rate of around -0.8 percent.

This pattern of higher growth in lower-income countries is consistent with the findings of Verico (2024), which confirm indications of a catch-up process in the ASEAN region, although external shocks such as the COVID-19 pandemic temporarily slowed this process. Overall, CLMV countries tend to exhibit stronger and more consistent growth trends compared to higher-income economies. This phenomenon reflects the potential for a catch-up effect, where countries with lower initial income levels have greater opportunities to grow at faster rates.

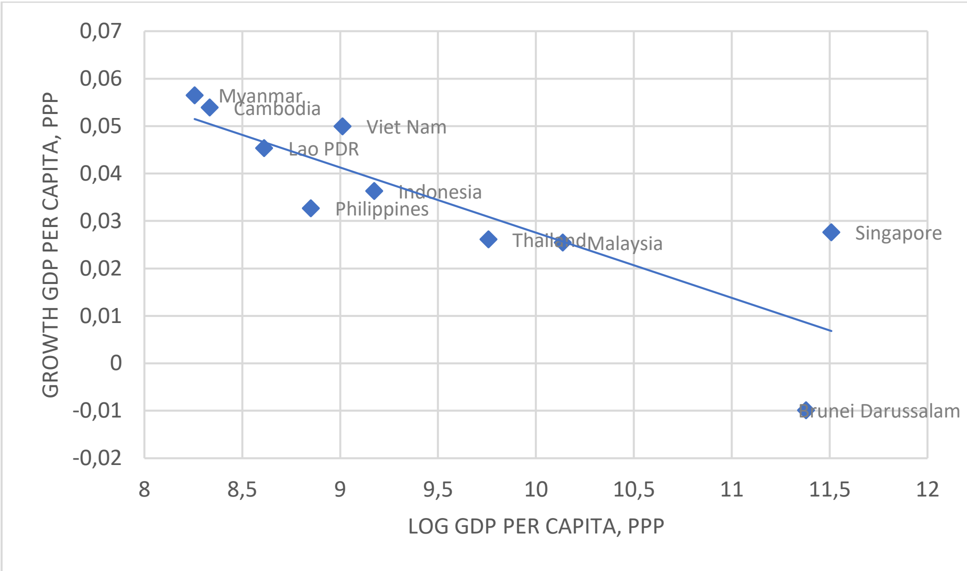
Figure 4. 1 Average GDP Per Capita Growth of ASEAN 2001-2024



Source: World Bank, 2024

The different growth patterns between the CLMV and ASEAN-6 groups described above provide an initial indication of an income convergence process. β-convergence is defined as the tendency of poorer economies to grow faster on average than richer economies, while σ-convergence refers to the tendency for the dispersion of per capita income across regions to decrease over time. This convergence can take two forms: absolute convergence, where all economies converge toward a single common steady-state level, and conditional convergence, where convergence occurs by accounting for differences in structural characteristics across countries such as capital accumulation, human capital, and institutional quality (Barro & Sala-i-Martin, 1992).

Figure 4. 2 GDP Per Capita VS GDP Per Capita Growth



Source: Data processed (2026)

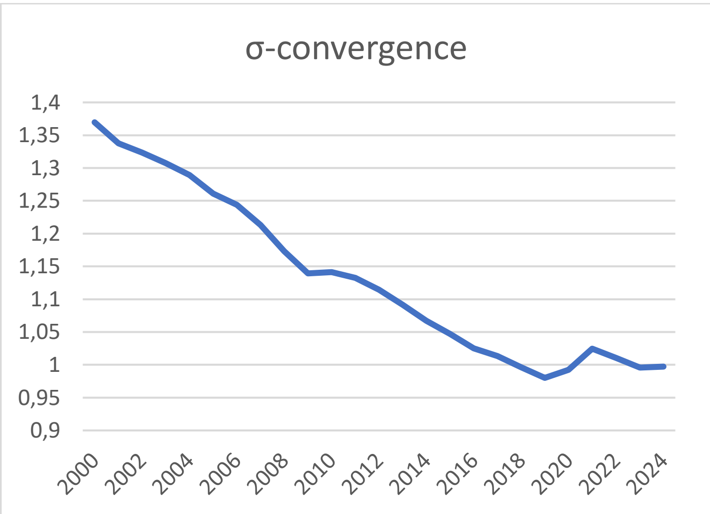
Initial indications of the convergence process in the ASEAN region can be observed through the scatter plot in Figure 4.3, which plots the relationship between the initial log GDP per capita in 2001 and the average GDP per capita growth over the period 2001–2024. The key question in convergence analysis is whether poorer countries grow faster than richer countries, a phenomenon known as β-convergence, and whether there is an automatic force that drives convergence in per capita income levels over time. Figure 4.3 shows a relatively clear negative relationship between the two variables, indicated by a downward-sloping trend line from the upper left to the lower right. Countries with low initial GDP per capita such as Myanmar, Cambodia, and Lao PDR recorded high average growth rates, while high-income countries such as Brunei Darussalam experienced negative growth, and Singapore grew at a relatively slower pace. This negative relationship pattern provides an initial indication of β-convergence in the ASEAN region, although further statistical confirmation is required through panel data regression estimation.

4.2 Result

4.2.1 Sigma Convergence

This test is applied to evaluate the level of static inequality among the ten ASEAN member countries. The analytical approach used is the coefficient of variation (CV). This coefficient is calculated by dividing the standard deviation by the average GDP per capita for each year. The computation of this metric is essential to validate the presence or absence of σ-convergence in the ASEAN region over the period 2001 to 2024. The results of this variation analysis are further visualized in Figure 4.4.

Figure 4. 3 Sigma Convergence



Source: Data processed (2026)

The σ-convergence graph indicates the presence of income convergence in the ASEAN region, as reflected by a decline in the sigma value from 1.36 at the beginning of the period to 0.99 in 2024. This decrease suggests that income disparities among countries have narrowed over time, leading to a more equal distribution of income across the region. Although there was a slight fluctuation after 2019, the overall trend remains downward. This implies that the convergence process has been taking place gradually, although it is not yet fully complete.

4.2.2 Absolute Beta Convergence

In estimating absolute convergence, the econometric analysis is based on panel data using three model approaches, namely the Common Effect Model, Fixed Effect Model, and Random Effect Model. The following are the estimation results of the Common Effect Model, Fixed Effect Model, and Random Effect Model using panel data, as presented in the table below.

Table 4. 3 Comparison of Absolute Convergence Estimation Models

Variable	**OLS**	**FE**	**RE**
	(1)	**(2)**	**(3)**
Initial per capita GDP (GDP t-1)	-0.013651***	-0.02365***	-0.01523***
	(0.015422)	(0.00618)	(0.00283)
Observations	240	240	240
R-squared	0.2284	0.30569	0.10402
Chow test	*p-value* = 0.0001		
Hausman test	*p-value* = 0.1257		
Breusch-Pagan LM test	*p-value* = 0.0000		

Statistically significant at ***1%, **5%. Source: Data processed (2026)

The sequence of model specification tests was conducted to identify the most optimal panel regression estimation approach. The first evaluation stage involved the Chow test, which was applied to assess whether the Fixed Effect Model (FEM) is more reliable than the Common Effect Model (CEM). Based on Table 4.3, a p-value of 0.0001 was obtained. Since this value is far below the 0.05 significance threshold, the null hypothesis is rejected. Thus, the Fixed Effect specification is proven to be more appropriate than the Common Effect model.

The next step is the Hausman test, which compares the reliability of the Fixed Effect Model (FEM) and the Random Effect Model (REM). The Hausman test result shows a p-value of 0.1257. Because this probability exceeds the 5% significance level (> 0.05), there is insufficient empirical evidence to reject the null hypothesis. This implies that the Random Effect Model is considered more consistent and efficient than the Fixed Effect Model.

As the final validation stage, the Breusch-Pagan Lagrange Multiplier (LM) test is conducted to compare the Random Effect Model with the Common Effect Model. The LM test results show a very small p-value of 0.0000 (< 0.05), which decisively rejects the null hypothesis. This condition strongly rules out the Common Effect specification. Based on the entire sequence of structural evaluation tests, the Random Effect Model (REM) is ultimately selected as the most appropriate and best-fitting estimation model for analyzing absolute convergence dynamics in the ASEAN region.

Table 4. 4 Absolute Convergence Regression Estimation with Random Effects

Dependent Variable: Growth per capita GDP

Variable	Coefficient	t-Statistic	Probability
Initial per capita GDP (GDP t-1)	-0.01523	0.00283	0.0000
Observations	240		
R-squared	0.10777		
Adjusted R-squared	0.10402		
Durbin-Watson stat	1.74026		
F-statistic	28.7482		
Prob(F-statistic)	0.0000		

Source: Data processed (2026)

Based on the estimation results of the Random Effect model, the coefficient of the initial income variable (lagged log GDP per capita) is negative and statistically significant at the 1 percent level, with a value of -0.01523. This finding indicates that countries with lower initial income levels tend to experience higher economic growth rates compared to countries with higher income levels.

4.2.3 Conditional Beta Convergence

Following the analysis of absolute convergence, the subsequent examination is conducted using the conditional convergence approach. Unlike absolute convergence, which assumes that all countries share identical economic characteristics, conditional convergence accounts for differences in structural factors across countries that may influence economic growth and each country's steady-state position. In this study, these structural factors are represented by Foreign Direct Investment (FDI), trade openness, human capital, and institutional quality measured through the World Governance Indicators (WGI). In addition, the AFTA variable is included as a policy variable to examine its relationship with economic growth dynamics in the ASEAN region.

4.2.3.1 Model Selection Test

As a further step, the model specification stage in the conditional convergence framework is conducted to identify the most precise estimation approach among the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). The selection procedure is systematically based on statistical evaluation tests, including the Chow test, Hausman test, and Breusch-Pagan Lagrange Multiplier (LM) test.

Table 4. 5 Comparison of Absolute Convergence Estimation Models

Dependent Variable: Growth per capita GDP

Variabel	**OLS**	**FE**	**RE**
	(1)	**(2)**	**(3)**
Initial per capita GDP	-0.22337***	-0.06064***	-0.02403***
	(0.0036)	(0.0122)	(0.00409)
FDI	0.001486***	0.00308***	0.00158***
	(0.00048)	(0.00066)	(0.00048)
Trade Oppennes	4.01E-05	0.00018**	3.49E-05
	(4.25E-05)	(8.54E-05)	(4.42E-05)
Human Capital	0.00183	0.01787*	0.00076
	(0.00806)	(0.0203)	(0.0085)
WGI	0.00351	0.024005**	0.00587
	(0.0062)	(0.0112)	(0.0065)
AFTA	0.001007	0.00904	0.00149
	(0.0042)	(0.0054)	(0.0041)
R-squared	0.3402	0.3835	0.2798
Observations	240	240	240
Chow test	*p-value = 0.0011*		
Hausman test	*p-value = 0.0060*		
Breusch-Pagan LM	*p-value* = 0.5974		

Statistically significant at ***1%, **5%. Sorce: Data processed (2026)

The first stage in the panel model specification evaluation is the Chow test, which aims to compare the reliability of the Common Effect Model (CEM) and the

Fixed Effect Model (FEM). Based on the test output in Table 4.5, the probability value (p-value) obtained is 0.0011. This value is far below the 5 percent significance level, meaning that the null hypothesis is rejected. Therefore, the Fixed Effect approach is statistically proven to be more appropriate for estimation than the Common Effect model.

The evaluation process then proceeds with the Hausman test to determine the suitability between the Fixed Effect Model (FEM) and the Random Effect Model (REM). The Hausman test results produce a probability value of 0.0060. Since this value is statistically significant at the 5 percent level (< 0.05), the null hypothesis is confidently rejected. Consequently, the Fixed Effect specification is once again confirmed as a more appropriate estimation approach compared to the Random Effect model.

Based on the sequence of selection procedures, both the Chow test and the Hausman test consistently lead to the same conclusion: the Fixed Effect Model (FEM) is the most optimal estimation framework for the regression equation in this study. Considering the definitive results from these two specification tests, the implementation of the Lagrange Multiplier (LM) test is no longer necessary, since the primary function of the LM test is to determine model selection only when the choice lies between the CEM and REM frameworks.

4.2.3.2 Classical Assumption Tests

The fulfillment of the Best Linear Unbiased Estimators (BLUE) criteria in panel model estimation requires the implementation of a series of classical assumption tests. Since not all assumption tests are methodologically relevant for panel data characteristics, the verification process in this study is focused on three main procedures, as follows:

1. Multicollinearity Test

The detection of strong linear relationships (multicollinearity) among explanatory (independent) variables is evaluated using the Variance Inflation Factor (VIF) instrument. Higher VIF values indicate the existence of serious multicollinearity problems, while lower values reflect a more acceptable level of correlation among predictor variables. A regression model is considered free from multicollinearity problems if all variables included in the model have VIF values below 5.

Table 4. 6 Multicollinearity Test

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
LN_YT_1	0.000151	5119.859	4.433715
D_AFTA	3.02E-05	6.032312	2.700741
FDI	4.42E-07	5.888591	1.176538
HC	0.000415	906.4805	3.826788
TO	7.29E-09	44.79425	1.072572
WGI	0.000126	2.636356	1.699156

Sorce: Data processed (2026)

Referring to the previous Variance Inflation Factor (VIF) calculation results, all predictor variables recorded values below the threshold of 5. This condition convincingly confirms that the model specification in this study is entirely free from multicollinearity problems.

2. Heteroskedasticity Test

The next stage of the classical assumption evaluation focuses on heteroskedasticity testing. This test is conducted to identify the existence of unequal residual variances across observations within the regression estimation model. The analytical approach applied in this study uses the Glejser test method.

The decision rule states that the null hypothesis (H0) cannot be rejected if the test probability exceeds the 5 percent significance level (0.05), indicating that the model residuals are homoskedastic (have constant variance). Conversely, H0 is rejected if the probability value is lower than the 5 percent significance threshold, indicating that the regression model is affected by heteroskedasticity problems.

Table 4. 7 Heteroskedasticity Test

Variable	Coefficient	t-statistic	Prob
LN_YT_1	0.020869	1.285819	0.0087
D_AFTA	-0.004472	-1.397189	0.2069
FDI	-0.000465	-0.634151	0.2778
HC	-0.007692	-0.484994	0.5578
TO	-6.22E-05	-0.706683	0.2585
WGI	-0.004497	-0.606673	0.5342

Sorce: Data processed (2026)

Based on the table above, the probability value of the variable LN_YT_1 is lower than the 5 percent significance level (0.05), indicating that the LN_YT_1 variable suffers from heteroskedasticity problems. Since at least one variable is affected by heteroskedasticity, the regression model consequently exhibits heteroskedastic residual variance problems.

3. Autocorrelation Test

Autocorrelation testing is used to determine whether there is a relationship between observations in the current period and those in the previous period within a regression model. In this study, autocorrelation testing is conducted using the Breusch-Godfrey Test (Serial Correlation LM Test) with a simple approach through residual regression on lagged residuals (resid(-1)).

This test aims to detect whether there is serial correlation in the error term of the model, which may affect the accuracy of the estimation results. The indication of autocorrelation is determined based on the significance of the lagged residual coefficient, where a statistically significant coefficient indicates the presence of autocorrelation problems in the model.

Table 4. 8 Autocorrelation Test

Variable	Prob
C	0.4767
RESID(-1)	0.0250

Sorce: Data processed (2026)

The autocorrelation test results indicate that the probability value of the variable RESID(-1) is 0.0250, which is lower than the 5 percent significance level. This confirms that the model suffers from autocorrelation problems.

The diagnostic test results further reveal the presence of heteroskedasticity and autocorrelation in the standard Fixed Effect Model. Nevertheless, violations of these two assumptions do not invalidate the estimation results; rather, they only cause the standard errors to become biased, thereby rendering statistical inference invalid (Wooldridge, 2010). Therefore, the final estimation is conducted using the Fixed Effect Model with White cross-section robust standard errors in order to produce consistent standard errors and valid statistical inference despite the presence of heteroskedasticity and autocorrelation problems.

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4.2.3.3 Regression Estimation Results

Based on the Chow Test and Hausman Test results, the most appropriate model specification for this study is the Fixed Effect Model (FEM). Furthermore, the use of robust standard errors allows the parameter estimates to remain consistent and ensures that the statistical tests are valid. Accordingly, the estimation results of the conditional convergence regression are presented below.

Table 4. 9 Conditional Convergence Estimation (FEM)

Dependent Variable: Growth per capita GDP

Variable	Coefficient	t-statistic	Prob
LN_YT_1	-0.060640	-2.525670	0.0189
D_AFTA	0.009045	1.168928	0.2544
FDI	0.003085	2.771864	0.0108
TO	0.017870	0.724122	0.4763
HC	0.000180	1.392292	0.1772
WGI	0.024005	2.193942	0.0386
Observations	240		
R-squared	0.422204		
Adjusted R-squared	0.383512		
Durbin-Watson stat	1.676454		
F-statistic	10.91200		
Prob(F-statistic)	0.000000		

Sorce: Data processed (2026)

The estimation results show that the lagged initial income variable (LN_YT_1) has a negative and statistically significant coefficient at the 5 percent level (prob = 0.0189), indicating the presence of a convergence tendency. This implies that countries with higher initial income levels tend to experience lower economic growth rates, after controlling for the variables D_AFTA, FDI, TO, HC, and WGI as predictive variables for GDP per capita as the dependent variable.

4.2.3.4 Statistical Tests

1. Coefficient of Determination (R^2)

The evaluation of the coefficient of determination is intended to measure the explanatory power of the regression specification, namely the extent to which the combination of predictor variables collectively explains the dynamics of the dependent variable. This performance is commonly represented by the Adjusted R-squared metric, where values closer to one indicate a stronger ability of the model to explain data variation.

Table 4. 10 R-squared Results

Category	Value
R-squared	0.422204

Sorce: Data processed (2026)

Based on the statistical summary results above, the R-squared value is recorded at 0.422204. This finding confirms that approximately 42.2 percent of the variation in regional economic growth can be explained by the explanatory variables included in the research model. The remaining proportion reflects the influence of other external factors operating outside the estimated model specification.

2. t-test (Partial Significance Test)

The t-statistical test is conducted to identify the significance level of each macroeconomic indicator individually on the dependent variable. The basis for decision-making relies on comparing the probability value (p-value) with the 5 percent significance level ($\alpha = 0.05$). If the probability value is below 0.05, the corresponding variable is considered to have a statistically significant partial effect.

a. Initial GDP per Capita (LN_YT_1)

The estimation produces a coefficient of -0.060640 with a probability value of 0.0189. Since the p-value is lower than the 0.05 threshold, this indicator is proven to exert a negative and statistically significant effect on the growth trajectory. Consequently, the hypothesis regarding the existence of conditional β-convergence is empirically confirmed.

b. AFTA Dummy Variable (D_AFTA)

The variable representing the implementation of AFTA records a coefficient of 0.009045 with a probability value of 0.2544. Because the probability exceeds the 5 percent significance level, this dummy variable is concluded to have no significant partial effect on GDP per capita growth.

c. Foreign Direct Investment (FDI)

Foreign direct investment generates a coefficient of 0.003085 with a probability value of 0.0108. Since the p-value is below the α level of 0.05, the FDI variable is confirmed to contribute positively and significantly to economic growth.

d. Human Capital (HC)

The human capital parameter is estimated at 0.017870 with a relatively high p-value of 0.4763. As this probability is far above 0.05, human capital quality is not proven to have a significant partial effect on growth within this observation period.

e. Trade Openness (TO)

The trade openness indicator obtains a coefficient of 0.000180 accompanied by a p-value of 0.1772. In accordance with the statistical decision rule (p-value > 0.05), this variable is concluded to have no substantial effect on fluctuations in GDP per capita growth.

f. Institutional Quality (WGI)

The institutional governance indicator records a coefficient of 0.024005 with a probability value of 0.0386. Since this value is below the 5 percent significance threshold, the WGI variable is statistically confirmed to have a positive and significant effect in accelerating regional economic growth.

3. F-Test (Simultaneous Test)

The simultaneous evaluation using the F-test is conducted to verify whether all explanatory variables within the regression model collectively exert a significant influence on the dependent variable. The significance criterion is assessed by comparing the probability value of the F-statistic with the significance level of $\alpha = 0.05$.

Table 4. 11 F test

Category	**Value**
F-statistic	10.91200
Prob(F-statistic)	0.000000

Sorce: Data processed (2026)

The estimation results indicate an F-statistic value of 10.91200 with an absolute probability value of 0.000000. This probability value, which approaches zero, lies far below the tolerance threshold of 0.05, thereby leading to the rejection of the null hypothesis.

It can therefore be concluded that initial income (LN_YT_1), the AFTA policy (D_AFTA), foreign direct investment (FDI), human capital (HC), trade openness (TO), and institutional governance (WGI) collectively exert a highly significant influence on the growth rate of GDP per capita, even at the 1% significance level. This analytical finding confirms that the conditional convergence model specification employed is highly appropriate and statistically fit to explain variations in economic growth dynamics across the ten ASEAN countries during the 2001–2024 period.

4.2.4 Calculation of the Speed of Convergence

The speed of convergence, or convergence rate, is used to measure how rapidly the growth of GDP per capita approaches its steady-state condition. The calculation results are presented in the following table:

Table 4. 12Speed of Absolute and Conditional Convergence

Category	Absolute	Conditional
Speed of Convergence	1.54% per year	6.25% per year
half-life	45.1 years	11.1 years

Sorce: Data processed (2026)

Based on Table 4.11, the speed of conditional convergence at 6.25 percent per year is higher than the speed of absolute convergence at 1.54 percent per year. This difference indicates that controlling for structural factors contributes to accelerating the income convergence process within the ASEAN region. In contrast, the half-life of conditional convergence, estimated at 11.1 years, is shorter than that of absolute convergence at 45.1 years. This implies that, by accounting for structural factors, ASEAN countries are able to close half of their income gap within a relatively shorter period of time.

4.3 Discussion

4.3.1 Analyze Absolute Income Convergence

Based on the estimation results of the absolute convergence model, the first hypothesis of this study is accepted. The coefficient of the initial income variable, which is negative and statistically significant, confirms that there is a negative relationship between the initial level of GDP per capita and the growth rate of GDP per capita among ASEAN countries during the observation period. In other words, ASEAN countries with lower initial income levels tended to grow faster than countries with higher initial income levels, which empirically indicates the existence of absolute β-convergence within the ASEAN region. This finding is consistent with the fundamental predictions of the Neoclassical Growth Theory developed by Solow (1956) and Swan (1956), as well as the convergence hypothesis formulated by Barro & Sala-i-Martin (2004).

Theoretically, this result can be explained through the diminishing returns to capital mechanism in the Solow-Swan model. Countries with lower initial capital stocks possess higher marginal productivity of capital, allowing additional investment to generate relatively greater increases in output compared to countries that already have high capital stocks. In contrast, advanced economies that are closer to the steady-state condition tend to experience slower economic growth because the efficiency gains from additional capital gradually decline. The negative relationship between initial income and economic growth is evident in the CLMV group (Myanmar, Cambodia, Vietnam, and Laos), which recorded relatively low initial income levels but high growth rates. Myanmar and Cambodia were positioned on the far-left side with the highest average growth rates of 5.65% and 5.39% per year, respectively, followed by Vietnam and Laos with average growth rates of 4.99% and 4.53% per year. This pattern is directly consistent with the diminishing returns to capital mechanism in the Solow-Swan framework: the lower the initial capital stock of a country, the greater the growth potential generated from each additional unit of investment, thereby providing CLMV countries with substantially larger catch-up opportunities compared to the ASEAN-6 economies.

Conversely, the ASEAN-6 countries were positioned in the right quadrant, characterized by higher initial income levels but more moderate economic growth. Indonesia and the Philippines occupied an intermediate position with average growth rates of 3.63% and 3.36% per year, while Thailand and Malaysia recorded average growth rates of 2.61% and 2.54%, respectively. Singapore, which appeared on the far-right side of the graph with the highest log GDP per capita, recorded an average growth rate of approximately 2.76% per year, lower than the CLMV group but still positive. This reflects the characteristics of advanced economies whose growth can no longer be easily stimulated through physical capital expansion and instead depends more heavily on innovation and productivity improvements. The most extreme case was Brunei Darussalam, which appeared in the lower-right corner of the graph and experienced negative average growth throughout the observation period due to its strong dependence on the oil and gas sector, which underwent prolonged stagnation. The case of Brunei further strengthens the convergence argument from the upper-income side.

Nevertheless, the existence of absolute β-convergence does not necessarily imply that all ASEAN countries are moving toward fully equal levels of welfare. As emphasized by Barro & Sala-i-Martin (2004), absolute convergence merely indicates the existence of a catch-up growth process in which developing economies grow faster, but not necessarily fast enough to substantially close income disparities in the short run. This occurs because each country's capacity to achieve catch-up growth is highly dependent on its structural characteristics. These structural differences explain why the speed of convergence among ASEAN countries remains heterogeneous, even though absolute convergence is confirmed at the aggregate level. This issue is examined further in the discussion of conditional β-convergence.

Furthermore, the estimated speed of absolute convergence at 1.54% per year, with a half-life convergence period of approximately 45 years, can be considered relatively slow. This indicates that narrowing income disparities within ASEAN would require a very long period if relying solely on market mechanisms and natural growth processes. This finding is consistent with Kwan & Malki (2025), who found that the ASEAN convergence process does occur but progresses slowly and forms a two-tier ASEAN pattern, as well as Feeny (2025), who emphasized that structural heterogeneity remains the primary obstacle to reducing regional income disparities.

The existence of σ-convergence is further confirmed by the decline in the standard deviation of log GDP per capita from 1.36 in 2001 to 0.99 in 2024, indicating that the aggregate wealth gap between ASEAN-6 economies and CLMV countries has systematically narrowed (Yasin, 2023). σ-convergence reinforces the conclusion that the process of income disparity reduction in ASEAN is both real and systemic. Nevertheless, the temporary increase in income dispersion observed around 2020 is consistent with the argument of D'Aloia & Gugler (2024), who argued that global shocks, particularly the COVID-19 pandemic, increased income dispersion among ASEAN countries and temporarily disrupted the ongoing convergence process. This phenomenon also demonstrates that ASEAN countries possess differing levels of economic resilience.

Overall, the estimation results of the absolute convergence model confirm that the process of narrowing income disparities within the ASEAN region has occurred in a real and systemic manner, as reflected by the simultaneous confirmation of both β-convergence and σ-convergence. Nevertheless, the relatively slow convergence speed and the disruption caused by global shocks suggest that market mechanisms alone are insufficient to generate a more substantial reduction in regional income inequality.

4.3.2 Analyze Absolute Income Convergence

Based on the estimation results of the conditional convergence model, the second hypothesis of this study is partially supported. The coefficient of the initial income variable remains negative and statistically significant after the inclusion of control variables in the model, confirming that the process of income convergence in ASEAN is conditional in nature. Among the structural variables examined, Foreign Direct Investment (FDI) and institutional quality (WGI) are proven to have positive and significant effects on GDP per capita growth as variable Y, while the AFTA dummy variable, trade openness, and human capital do not show statistically significant effects in the short run.

The increase in the convergence coefficient from $\beta = -0.01523$ in the absolute model to $\beta = -0.06064$ in the conditional model carries important theoretical implications. The acceleration in the speed of convergence from 1.54% to 6.25% per year, along with the reduction in the half-life period from 45.1 to 11.1 years, indicates that structural heterogeneity within ASEAN economies is not merely statistical noise, but rather a substantive determinant of how quickly each economy approaches its respective steady state. In other words, the process of income convergence in ASEAN does not occur automatically, but is highly influenced by the structural characteristics of each country. Every country possesses a different long-term growth capacity depending on institutional quality, level of industrialization, ability to attract investment, quality of human capital, and overall economic structure. This finding is consistent with Islam (1995), who demonstrated that panel-based conditional convergence estimations consistently produce higher convergence speeds compared to absolute cross-sectional estimations. Theoretically, these findings support the concept of conditional convergence in the neoclassical growth model, which argues that differences in structural conditions cause each country to follow distinct growth paths and possess different long-run equilibrium points. Once variables such as FDI, institutional quality, trade openness, and human capital are controlled for in the model, the catch-up process among countries appears to proceed more rapidly, indicating that development disparities in ASEAN are driven not only by differences in initial income levels, but also by disparities in development capacity across countries.

Regarding the role of regional trade integration, the estimation results indicate that the AFTA dummy variable has a positive but statistically insignificant effect on GDP per capita growth. This empirical finding validates the theoretical proposition of Balassa (1961), which argues that a free trade area represents only the initial stage of economic integration, whose benefits depend heavily on the structural readiness of member countries. Within Balassa's framework, the establishment of a free trade area should enhance economic efficiency through tariff reductions, market expansion, and increased intra-regional trade. However, countries with stronger industrial bases, better infrastructure quality, and more developed institutional capacity tend to gain greater benefits from integration compared to countries with more limited economic capacities, as argued by Gammadigbe (2021) and Kyophilavong & Hayakawa (2023). The insignificance of the AFTA variable also suggests that ASEAN economic integration remains largely characterized as shallow integration. Although AFTA has succeeded in reducing tariff barriers, regional integration has not yet fully addressed deeper structural dimensions such as regulatory harmonization, labor market integration, logistics efficiency, and the equal distribution of regional production chains. Several CLMV countries still face limitations in productivity, human capital quality, technology, and institutional capacity, preventing them from fully benefiting from trade liberalization. Eum & Maliphol (2023) further emphasized that the catch-up process in Southeast Asia depends on the convergence of actual trade structures and industrial upgrading, rather than merely the signing of trade agreements.

Foreign Direct Investment (FDI) exhibits a positive and statistically significant coefficient, confirming its role as one of the main structural drivers of economic growth within the ASEAN region. Drawing from the endogenous growth theory framework developed by Romer (1990) and Lucas (1988), FDI is not merely a transfer of physical capital, but also a channel for transmitting technology, managerial know-how, and more efficient organizational practices from developed to developing economies. This mechanism operates through several channels simultaneously: FDI encourages physical capital formation that expands domestic production capacity, facilitates technological spillovers to local firms through imitation and skilled labor mobility, and broadens export market access for domestic firms integrated into multinational production networks. For CLMV countries, which remain in the early stages of industrialization, FDI inflows become a vital instrument capable of accelerating structural transformation from subsistence agriculture toward higher value-added manufacturing and service sectors, consistent with the argument of Borensztein et al. (1998), who emphasized that FDI is superior to domestic investment in promoting long-run growth because it contains a technology transfer component that cannot be obtained solely through domestic capital accumulation. Within the context of conditional convergence, the role of FDI becomes even more relevant because the spillover mechanism it generates is asymmetric, meaning that countries with lower initial income levels tend to gain greater benefits from each additional unit of FDI compared to more advanced economies, thereby supporting the catch-up process whereby CLMV countries are able to grow more rapidly by utilizing technologies brought by foreign investors without having to undertake innovation processes from scratch. This finding is consistent with Chizema (2025), who emphasized that foreign capital inflows in ASEAN facilitate the expansion of industrial capacity crucial for developing economies to accelerate their growth trajectories, as well as Magazzino et al. (2022), who demonstrated that FDI contributes to conditional convergence in developing Asian regions by narrowing the technological gap between advanced and lagging economies.

Equally important is the role of institutional quality (WGI), which also displays a positive and statistically significant coefficient. This finding is grounded in the institutionalist theory proposed by Acemoglu et al. (2005), which explicitly argues that differences in institutional quality represent the fundamental cause of long-run differences in prosperity across countries, even more fundamental than differences in physical capital or trade policies. High-quality institutions create legal certainty, guarantee property rights, minimize transaction costs, and reduce rent-seeking behavior that hampers efficient resource allocation. In the ASEAN context, institutional maturity determines the absorptive capacity of an economy, namely its ability to absorb and productively utilize incoming investment flows, technology, and the benefits of trade integration. Furthermore, institutional quality plays a dual role in the convergence process: on the one hand, it directly promotes growth by improving domestic economic efficiency, while on the other hand, it enhances a country's attractiveness to foreign investors, thereby strengthening the positive effect of FDI on growth. In other words, institutions function as a complementary engine determining the extent to which benefits from trade openness and foreign capital inflows can be realized. Institutional quality differences between Singapore and the CLMV countries convincingly explain why the benefits of regional integration are not distributed evenly across these groups of economies, consistent with the argument of Lee (2020), who argued that strong institutions help developing economies escape the middle-income trap by transforming trade policies and capital inflows into sustainable productivity growth.

On the other hand, trade openness is not found to significantly affect GDP per capita growth. The most fundamental explanation stems from the threshold effect concept within the trade-growth nexus, where the benefits of trade openness are not automatic but instead depend on a country's capacity to absorb and transform trade flows into productivity gains. Seti et al. (2025) specifically demonstrated that trade openness only promotes growth significantly once a minimum threshold of institutional quality has been achieved, a condition that was not fully satisfied by most CLMV economies during the study period. In addition, there exists a partial multicollinearity issue between the trade openness variable and institutional quality, both of which were separately included in the model. These variables are structurally correlated because countries with stronger institutions also tend to have higher trade openness and are more capable of exploiting it effectively, causing part of the independent marginal effect of trade openness to be absorbed by the institutional quality variable. This does not imply that trade openness is irrelevant, but rather that its effect operates indirectly through institutional quality, as confirmed by Nam & Ryu (2024), who found that trade openness does encourage growth in ASEAN but its effects are uneven across countries and highly dependent on accompanying structural capacities.

Similarly, human capital does not exhibit a statistically significant effect on GDP per capita growth within the annual panel estimation. From the perspective of Lucas's (1988) endogenous growth theory, the effect of human capital on growth operates through transmission mechanisms characterized by long time lags. Investments in education and health today do not immediately generate increases in output within the same year, but instead become reflected in economic productivity several years or even decades later. In the context of annual panel estimation such as this study, these long-run effects cannot be adequately captured because the observation intervals are too short. Furthermore, most commonly used proxies, including average years of schooling, reflect the quantity of education rather than the actual quality of human resources produced. Hanushek & Woessmann (2008) demonstrated that what truly drives economic growth is not the length of formal education itself, but the cognitive quality generated by the educational system. Suprayitno & Gitaharie (2025) specifically noted that the returns to human capital accumulation in ASEAN materialize over a much longer time horizon than can be captured by annual growth cycles, consistent with Mankiw et al. (1992), who showed that the effects of human capital on convergence are more observable in long-run cross-country data than in high-frequency panel data. Overall, the pattern of findings from these variables forms a coherent narrative: the conditional income convergence process in ASEAN is real but uneven, and is fundamentally determined by each country's structural capacity to attract, absorb, and transform capital and trade flows into sustainable productivity growth. FDI and institutional quality emerge as the two primary pillars that most strongly determine the speed of conditional convergence in the region, while AFTA, trade openness, and human capital appear to operate through more indirect channels and require supporting structural conditions as well as longer time horizons to fully manifest within the data.