



Structural Transformation and the Kuznets Hypothesis: Evidence from ASEAN Countries

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Abstract: According to the Kuznets hypothesis, economic development initially leads to higher income inequality, which then tends to decline as structural transformation and factor mobility increase. This dynamic remains particularly relevant for emerging ASEAN economies that are currently undergoing rapid structural changes in their production and employment structures. This study aims to analyze the relationship between economic greenness, economic sector structure, and income inequality in ASEAN countries, namely Indonesia, Malaysia, Singapore and Thailand. The data used is time series data, with the period adjusted based on the availability of each country. The analysis method used is descriptive analysis and Autoregressive Distributed Lag (ARDL). The results show that Kuznets hypothesis is proven in Indonesia and Singapore. In addition, service sector share has a positive and significant influence on income inequality (Gini ratio) in Indonesia in the long run. However, the growing share of the service sector tends to raise inequality in Indonesia, suggesting that structural transformation which is not inclusively directed may widen income gaps despite economic growth.

Keywords:

ARDL; Kuznets Hypothesis; Gini Ratio; Structural Transformation

Article History:

Received on 10 Aug 2025

Revised on 14 Oct 2025

Accepted on 27 Des 2025

Doi: 10.37479

Indexing:

Google Scholar; Portal Garuda; Crossref; SINTA 3 (Science And Technology Index)

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INTRODUCTION

Increased economic activity is economic growth, which leads to an increase in the number of goods and services produced by the community and an increase in the level of public welfare (Sukirno 2010). Economic growth is basically often used as a benchmark in describing the good and bad conditions of a country's economic progress. However, when economic progress continues to be pursued, new potential problems will arise, namely income inequality between communities. A study conducted by Rambey (2018) found a positive correlation between economic growth and income inequality in Indonesia. Income inequality occurs when there are large differences in the income received by members of a society, leading to marked differences between them (Todaro et al. 2003). Increasing economic progress and addressing income inequality must be pursued in order to achieve equitable economic development. Indicators of economic growth, changes in economic structure, and a decrease in the level of income inequality between individuals, regions, and sectors are ways that can be used to measure the success of economic development (Fattah et al.2022). This shows that to achieve equitable economic development, it is not enough to focus only on economic growth, which is described by the level of economic progress of a country. The problems of inequality and poverty must be addressed simultaneously. (Fawaz et al. 2014) in their study found that low income countries have a negative relationship between income inequality and economic progress. In contrast, high income countries have a positive relationship between income inequality and economic progress.

This research analysis will be conducted on the countries of Indonesia, Malaysia, Singapore and Thailand. This is because Indonesia, Malaysia, Singapore and Thailand have different income levels. Based on the four ASEAN countries included in this study, Singapore is considered a developed country (high income) based on its per capita income. The other countries are still included in the developing countries (upper middle income). According to the World Bank, countries with per capita income between US\$3,856 and US\$12,374 per year are categorized as upper

middle income countries. Figure 1 shows that these four countries consist of high income and upper middle income countries.

Table 1 GDP per capita of several ASEAN countries

Country	GDP Per capita 2023 (US\$)
Indonesia	4940,55
Malaysia	11648,67
Singapura	84734,26
Thailand	7171,81

Source : WITS (2024)

As mentioned earlier, equitable national development does not only focus on economic growth, which is illustrated by a country's economic progress, but must also be able to reduce income inequality. Although known as the most developed region, ASEAN still faces serious income inequality problems (Rulita and Sakti 2023). Gini ratio is one of the indicators used to measure the level of income inequality. A Gini ratio value close to one indicates extreme inequality. Conversely, a value close to zero indicates a very equal income distribution or perfect equality (Asrari 2019). Indonesia had the lowest income inequality trend among the three countries in 2000. Indonesia's Gini ratio was only 0.29 but this Gini ratio continued to increase and reached 0.388 in 2023. According to Wihardja (2016), one of the factors that caused the high inequality problem in Indonesia after 2000 was the occurrence of early deindustrialization conditions triggered by the symptoms of mini Dutch Disease due to the surge in commodity prices. In addition, Singapore, which has the highest GDP per capita, still has income inequality problems. From the graph, it can be seen that during the analysis period Singapore has never been in the lowest position of the Gini ratio. This means that income inequality in Singapore is not the best condition when compared to other countries with lower Gini ratio coefficients. The inequality data of several ASEAN countries explained through the Gini ratio can be seen in Figure 1.

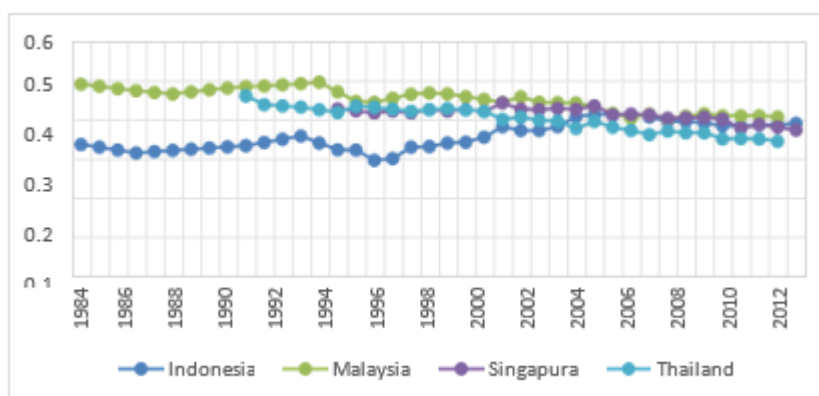


Figure 1 Gini ratio of Indonesia, Malaysia, Singapore, Thailand

Source : processed from BPS, DOSM, SingStat, NSO (2025)

According to the Kuznets hypothesis (Todaro et al. 2011), inequality between regions will follow an inverted U-shaped pattern. This means that in the early stages of development, inequality tends to increase. However, inequality will gradually decrease with progress and increased mobility of capital and labor. In this study, the Kuznets Hypothesis will explain how people's per capita income relates to income inequality in a region. As explained earlier, besides success in promoting economic growth and reducing income inequality, another indicator of development success is also reflected in the structure of the economy (Fattah et al.2022). Economic structure refers to the arrangement of the roles played by each economic sector, either by business field or by sectoral groupings such as primary, secondary and tertiary sectors (Faried and Sembiring 2019). The shifting contribution of these sectors indicates a structural transformation in the economy. Structural transformation itself is a shift from traditional low-productivity economic structures to contemporary high-productivity economic structures (Szirmai et al. 2012). Deddy (2005), explains that during this structural transformation, production in industry and services will increase, contributing more to national income. Conversely, along with industrial growth and economic modernization, agriculture's contribution to national income will decline.

Based on a review of previous studies, there is no study that specifically combines the analysis of the relevance of Kuznets' hypothesis with the effect of structural transformation on income inequality in the ASEAN region, and uses the ARDL method approach in the analysis. This encourages the author to conduct such analysis in the ASEAN region. Therefore, this study has a novelty value that distinguishes it from previous studies. Based on the description above, this study aims to analyze the evidence of Kuznets curve theory and the effect of structural transformation on income inequality in several ASEAN countries.

METHODOLOGY

Data types and sources

This study uses secondary data obtained from the World Bank and the statistical center of each country. The data used are the gini ratio, total GDP value, GDP per capita, GDP per capita squared, value added as a percentage of GDP in the agricultural, service and industrial sectors of Indonesia, Malaysia, Thailand and Singapore. The selection of the four countries is based on the availability of adequate and consistent data during the time period needed in this study. The type of data used in this study is time series data, adjusted to the availability of data from each country. For Indonesia, the data used covers the period 1984 to 2023, Malaysia covers the period 1984 to 2022, Singapore covers the period 1998 to 2023 and Thailand covers the period 1993 to 2022. The limited time span of the data is one of the limitations in this study.

Operational Definition

Economic Growth and Development

Economic growth, according to Prof. Simon Kuznets, is defined as a long-term increase in a country's capacity to provide a variety of economic goods to its population. Economic development is a multidimensional process that involves fundamental changes in social structure, community behavior, and national institutions (Todaro et al. 2011).

Structural Transformation and Increasing Income Inequality

Structural transformation is a change in the economic structure from traditional sectors with low productivity to economic sectors with high productivity (Szirmai et al. 2012). According to Kuncoro (2010), structural transformation can run well if there is also equal distribution of employment opportunities, a decrease in population growth rate, and a decrease in urban-rural economic dualism. If this is fulfilled, then structural transformation will be followed by an increase in income and equal distribution of income that occurs simultaneously.

Kuznets Curve Theory of Growth and Income Inequality

The Kuznets Curve shows that while in the short run there is a positive correlation between economic growth and income distribution inequality, in the long run the relationship becomes negative (Todaro and Michael 2004). However, according to Todaro et al. (2003) an increase in economic growth will increase income inequality and vice versa.

Income Inequality

Income inequality is the difference in income generated by a society, resulting in stark differences in society (Todaro et al. 2003). According to Janah (2022), there will be a trade off between rapid economic growth and unequal income distribution, or vice versa. One measure of this income inequality problem is the gini ratio.

Data Analysis Methods

The analytical methods used in this research are descriptive analysis, and Autoregressive Distributed Lag (ARDL) analysis.

Descriptive Analysis

According to Sugiyono (2017) descriptive analysis methods are statistics used to analyze data by describing or describing the data that has been collected as it is without intending to make general conclusions or generalizations.

Autoregressive Distributed Lag (ARDL) Analysis

ARDL is a method designed to analyze time series data. The ARDL model is a regression model that combines the present and past values of the independent variables with the past values of the dependent variables. The AR (autoregressive) model is a model that utilizes one or more data from the past on the independent variable (Y) as part of the explanatory variable. Meanwhile, the DL (distribution lag) model is a regression model that involves both the current value and the past value (lag) of the independent variable (X) (Laloan et al. 2023). In using this ARDL analysis method, it must go through several testing stages first, namely:

1. Stationarity Test
2. Determination of Optimum Lag
3. Bound Test Cointegration Test
4. ARDL model estimation

To perform the cointegration test, the ARDL model is specified as follows:

$$Y_t = \alpha_0 + \sum_{j=1}^p \phi_j Y_{t-j} + \sum_{j=0}^q \beta_j X_{t-j} + \mu_t$$

If the cointegration test proves the existence of long-run convergence, it is necessary to estimate the Error Correction Model (ECM), which is expected to be different from zero and negative, indicating the speed of adjustment of the variables towards their long-run equilibrium. The cointegration specification can be seen as follows:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p-1} \phi_i \Delta Y_{t-i} + \sum_{j=0}^{q-1} \beta_j \Delta X_{t-j} + \lambda ECT_{t-1} + \mu_t$$

Model Fit Test

This model fit test is the final stage test on the model obtained. The data in the analysis output results can be said to be good if the model passes all classical assumption tests.

1. Normality Test
2. Autocorrelation Test
3. Heteroscedasticity Test
4. Multicollinearity
5. Stability Test

Research Methods

This study uses the gini ratio variable as the dependent variable, while total GDP, GDP per capita, GDP per capita squared, service sector share (PS) as independent variables. The GDP per capita squared variable is used to examine the non-linear relationship between GDP per capita and the gini ratio. The cointegration model in this analysis can be seen as follows:

$$\Delta GR_t = \beta_0 + \sum_{i=1}^{p-1} \beta_i \Delta GR_{t-i} + \sum_{i=0}^{p-1} \alpha_i \Delta GDPPK_{t-i} + \sum_{i=0}^{p-1} \theta_i (\Delta GDPPK)_{t-i}^2 + \sum_{i=0}^{p-1} \gamma_i \Delta PS_{t-i} + V_1 GR_{t-1} + V_2 GDPPK_{t-1} + V_3 (GDPPK)_{t-1}^2 + V_4 PS_{t-1} + \mu_t$$

The model in this analysis if there is no cointegration can be seen as follows:

$$\Delta GR_t = \beta_0 + \sum_{i=1}^{p-1} \beta_i \Delta GR_{t-i} + \sum_{i=0}^{p-1} \alpha_i \Delta GDPPK_{t-i} + \sum_{i=0}^{p-1} \theta_i (\Delta GDPPK)_{t-i}^2 + \sum_{i=0}^{p-1} \gamma_i \Delta PS_{t-i} + \mu_t$$

RESULTS

Structural Transformation/Change in Economic Sector Composition

Indonesia

Based on Figure 2, in 1984-2010 the industrial sector was the main contributor to national income, surpassing the agricultural and service sectors. But from 2011 to 2023, the contribution structure changed, with the services sector equaling and even surpassing industry. In 2011, services contributed 42%, industry 41.8%, and agriculture 14.1%. The graph shows the structural transformation in Indonesia. The contribution of the agricultural sector continues to decline, from 23.3% in 1984 to 12.2% in 2023. In contrast, the services sector increased significantly from 34% to 45.8% over the same period. The industrial sector rose until 2002, but declined thereafter, contributing 37.6% in 2023. This change reflects deindustrialization in Indonesia.

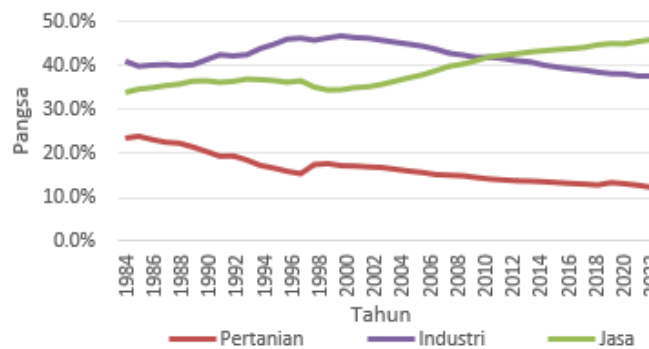


Figure 2 Share of agriculture (pertanian), services (jasa) and industry (industri) in Indonesia
Source : processed from WITS (2025)

Table 2 Correlation matrix of GDP shares of agriculture, industry, and services in Indonesia

Correlation	Share of Agriculture	Share of Industry	Share of Services
Share of Agriculture	1,000		
Share of Industry	0,137	1,000	
Share of Services	-0,810	-0,686	1,000

Source: processed from WITS (2025)

The agricultural sector share variable shows a positive correlation of 0.137 with the industrial sector share. This indicates a unidirectional relationship between the two, where an increase in the share of the industrial sector tends to be followed by an increase in the share of the agricultural sector, although the correlation is weak. In contrast, the correlation between the share of the agricultural sector and the services sector is negative at 0.810, reflecting an opposite relationship between the two sectors. That is, as the share of the service sector increases, the share of the agricultural sector tends to decrease significantly. A negative correlation was also found between the share of the services sector and the industrial sector, with a value of -0.686, indicating that an increase in the share of one sector is generally accompanied by a decrease in the share of the other.

Malaysia

Based on Figure 3, in 1984-2006 the industrial sector was the main contributor to Malaysia's national income, with a share of 50.7% in 1984 and 48.4% in 2006. However, since 2007, its contribution has declined to 36.29% in 2022. This decline was accompanied by a significant increase in the services sector, from 26.5% in 1984 to 46.8% in 2007, and continued to rise to 55.6% in 2022. The agricultural sector experienced a consistent decline, from 23.1% in 1984 to 6.6% in 2022. In 1986 and 1987, the contribution of the agricultural sector briefly surpassed services, but since 1988 the services sector has become dominant again. These developments reflect the ongoing structural transformation in Malaysia.

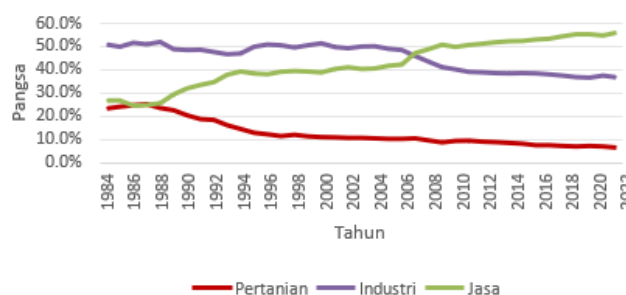


Figure 3 Share of agriculture, services and industry in Malaysia

Source : processed from WITS (2025)

Table 3 Correlation matrix of GDP shares of agriculture, industry, and services in Malaysia

Correlation	Share of Agriculture	Share of Industry	Share of Services
Share of Agriculture	1,000		
Share of Industry	0,934	1,000	
Share of Services	0,671	-0,887	1,000

Source : processed from WITS (2025)

The agricultural sector share variable shows a very strong positive correlation with the industrial sector share, with a coefficient of 0.934. This indicates a unidirectional relationship between the two sectors, where an increase in the share of the industrial sector tends to be followed by an increase in the share of the agricultural sector. In addition, the share of the agricultural sector also has a positive correlation with the services sector, with a value of 0.671. This indicates that an increase in the share of the services sector is also accompanied by an increase in the share of the agricultural sector, although the relationship between the two is not as strong as the relationship between the agricultural and industrial sectors. In contrast, the correlation between the share of the services sector and the industry sector shows a strong negative relationship, with a coefficient of -0.887. This means that an increase in the contribution of one sector tends to be followed by a decrease in the contribution of the other sector.

Singapore

Based on Figure 4, from 1998-2023, the services sector is the main contributor to Singapore's national income. All three sectors show stable contribution trends without significant fluctuations. The service sector increases from 65.52% in 1998 to 69.32% in 2023. The industrial sector fell slowly from 26.68% to 25.50%, while the agricultural sector was minimal, from 0.11% to 0.03%. This data shows that services and industry remain the dominant sectors, but without significant change, signaling stagnation in Singapore's structural transformation.

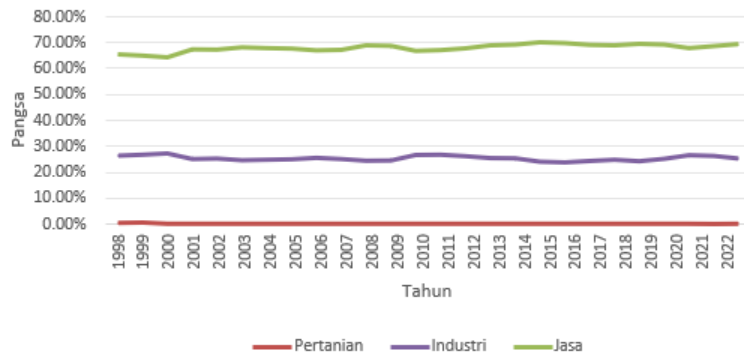


Figure 4 Share of agriculture, services and industry in Singapore
Source : processed from WITS (2025)

Table 4 Correlation matrix of GDP shares of agriculture, industry, and services in Singapore

Correlation	Share of Agriculture	Share of Industry	Share of Services
Share of Agriculture	1,000		
Share of Industry	0,427	1,000	
Share of Services	-0,809	-0,763	1,000

Source : processed from WITS (2025)

The agricultural sector share variable shows a positive correlation of 0.427 with the industrial sector share, which indicates a unidirectional relationship or linkage between the two sectors. This means that an increase in the share of the industrial sector tends to be followed by an increase in the share of the agricultural sector. In contrast, the correlation between the share of the agricultural sector and the services sector is negative at -0.809, indicating an opposite relationship between these two sectors. When the share of the service sector increases, the share of the agricultural sector tends to decrease, and vice versa. In addition, the correlation between the share of the services sector and the industrial sector is also negative at -0.763, indicating that an increase in the share of the services sector is generally accompanied by a decrease in the share of the industrial sector. This illustrates that Singapore's economic structure is dominated by the services sector, which is gradually replacing the roles of the other two sectors, namely agriculture and industry.

Thailand

Based on Figure 5, from 1993 to 2023 the service sector has consistently been the highest contributor to Thailand's national income. All three sectors show relatively stable trends without major fluctuations. The contribution of the service sector increased from 52.2% in 1993 to 57.3% in 2023, with more significant acceleration since 2011. The industrial sector declined from 36.2% to 34%, while the agricultural sector, always the lowest, fell from 12% to 8.7%. This data shows that services and industry remain the dominant sectors, but without significant change, signaling stagnation in Thailand's structural transformation.

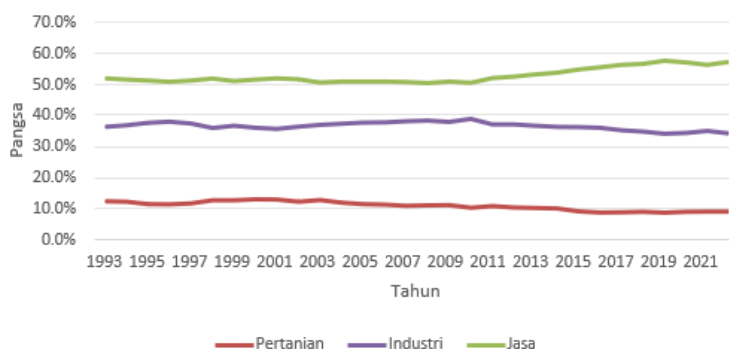


Figure 5 Share of agriculture, services and industry in Thailand
Source : processed from WITS (2025)

Table 5 Correlation matrix of GDP shares of agriculture, industry, and services in Thailand

Correlation	Share of Agriculture	Share of Industry	Share of Services
Share of Agriculture	1,000		

Share of Industry	0,457	1,000	
Share of Services	-0,827	-0,876	1,000

Source : processed from WITS (2025)

The agricultural sector share variable shows a positive correlation of 0.457 with the industrial sector share, indicating a unidirectional linear relationship between the two sectors. In contrast, the correlation between agriculture sector share and services sector share is negative at -0.827, reflecting an opposite relationship between the two sectors; an increase in services sector share implies a decrease in agriculture sector share, and vice versa. In addition, the correlation between service sector share and industry sector share is also negative at -0.876, indicating a similar inverse relationship between these two sectors, where an increase in service sector share is followed by a decrease in industry sector share, and vice versa. The role of the services sector in Thailand also tends to replace that of the agriculture and industry sectors.

The Relationship between Inequality and Income Levels

Indonesia

Figure 6 shows the relationship between the Gini ratio and income per capita in Indonesia. The Y-axis represents the level of inequality, while the X-axis shows GDP per capita. During 1984-2023, the scatterplot pattern reflects the Kuznets curve hypothesis. In the early stage (GDP per capita <2,000 USD), the Gini ratio tends to stabilize or decline. As GDP per capita increases to 2,000-3,000 USD, the Gini ratio rises and reaches a peak of 0.41 in 2012-2014. After GDP per capita passes 3,000 USD, the Gini ratio starts to decline, signaling the advanced phase of the Kuznets curve, where increasing income has the potential to reduce inequality.

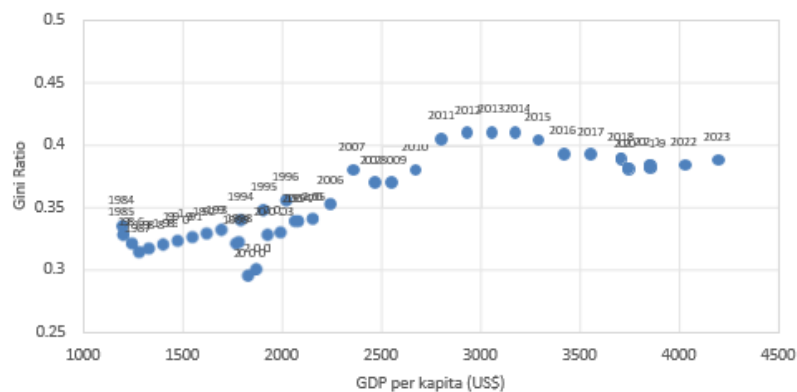


Figure 6 Scatterplot of GDP per capita and Gini ratio of Indonesia
Source : processed from WITS and BPS (2025)

Malaysia

Figure 7 shows the relationship between Gini ratio and income per capita in Malaysia. The Y-axis shows the level of inequality, and the X-axis shows GDP per capita. As GDP per capita increased from around USD 3,444 to more than USD 11,000, the Gini ratio tended to decrease gradually. In 1984-2010, the Gini ratio ranged from 0.44-0.48, indicating high inequality. However, after GDP per capita reached around 8,400 USD, the Gini ratio fell slowly to 0.404 in 2022. This pattern reflects the right phase of the Kuznets curve, where economic growth is accompanied by declining inequality. There is no initial phase of rising inequality, so the graph only reflects the decline in inequality as income rises.

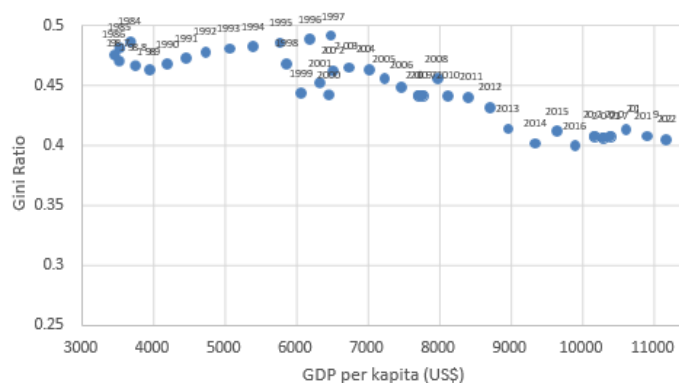


Figure 7 Scatterplot of GDP per capita and Gini ratio of Malaysia
Source : processed from WITS and DOSM (2025)



Singapore

Figure 8 shows the relationship between Gini ratio and per capita income in Singapore. Despite very high GDP per capita, income inequality remains stable and quite high. In 1998-2007, the Gini ratio was in the range of 0.41-0.43. Since 2008, the Gini ratio has gradually declined from 0.42 to 0.371 in 2023, although it has fluctuated. Overall, this trend shows a decline in inequality as GDP per capita increases, supporting the Kuznets curve hypothesis that long-term economic growth can reduce inequality.

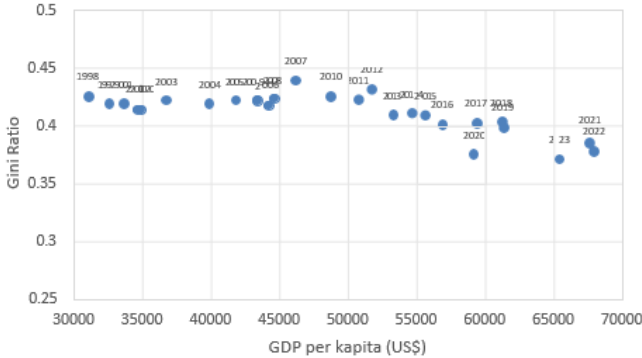


Figure 8 Scatterplot of GDP per capita and Gini ratio of Singapore
Source : processed from WITS and SingStat (2025)

Thailand

Figure 9 shows the relationship between Gini ratio and income per capita in Thailand. The Y-axis represents income inequality, and the X-axis shows GDP per capita. As GDP per capita increased from USD 3,187 to USD 6,272, the Gini ratio decreased slowly but consistently. In 1993, the Gini ratio reached a peak of 0.45. This scatterplot shows that an increase in per capita income is accompanied by a decrease in inequality. Therefore, this scatterplot only reflects the right part of the Kuznets curve, which is the phase where an increase in per capita income is accompanied by a decrease in inequality. The absence of a pattern of increasing Gini ratio in the early stage of economic growth suggests that the upward trend in per capita income in Thailand since the beginning of the period is not accompanied by a surge in inequality, unlike the pattern usually depicted by the full Kuznets curve.

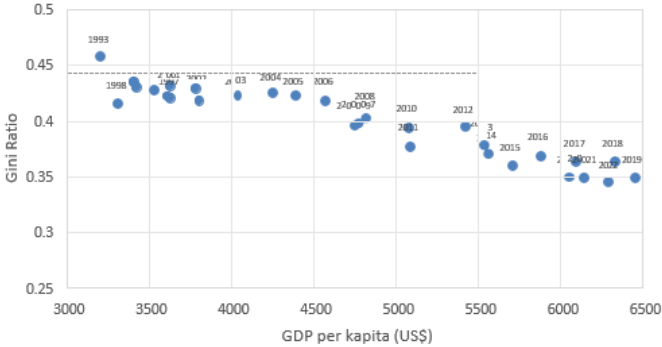


Figure 9 Scatterplot of GDP per capita and Gini ratio of Thailand
Source : processed from WITS and NSO (2025)

The Effect of Economic Sector Share and Income Level on Inequality

Stationarity Test of Indonesia, Malaysia, Singapore, and Thailand

Before applying the ARDL approach, a unit root test is conducted to determine whether the variables in the study are stationary or not. To avoid spurious regressions, it is essential to conduct a unit root test (Shrestha and Bhatta 2018).

The variables used in this process are Gini ratio, per capita income, per capita income squared, and services share. The share of agriculture is not used because it is the sector that contributes the least to national income. In addition, the correlation between service share and industry share is quite high in each country in this study. Therefore, to avoid multicollinearity problems, the services share variable was chosen to be included in the model, as it contributes the most to national income compared to the other two sectors.

Table 6 Stationarity Test Results of research variables in Indonesia, Malaysia, Singapore and Thailand

Country	Variable	ADF test <i>P-Value</i> at Level	ADF test <i>P-Value</i> at First Difference
Indonesia	GDP per capita	0,9357	0,0005
	GDP per capita ²	0,9630	0,0005
	Gini <i>Ratio</i>	0,7923	0,0004
	Share of services	0,9744	0,0127
Malaysia	GDP per capita	0,8172	0,0001
	GDP per capita ²	0,8526	0,0001
	Gini <i>Ratio</i>	0,8378	0,0002
	Share of services	0,8119	0,0009
Singapura	GDP per capita	0,7217	0,0002
	GDP per capita ²	0,7562	0,0001
	Gini <i>Ratio</i>	0,9905	0,0000
	Share of services	0,2374	0,0019
Thailand	GDP per capita	0,7643	0,0032
	GDP per capita ²	0,7838	0,0029
	Gini <i>Ratio</i>	0,9959	0,0000
	Share of services	0,9863	0,0010

Source : processed from WITS, BPS, DOSM, SingStat and NSO (2025)

Based on the stationarity test results of the model in Indonesia, Malaysia, Singapore and Thailand, all variables from each country are stationary at the same level, namely the first difference or I(1).

Bound Test for Indonesia, Malaysia, Singapore, and Thailand

Before estimating the overall ARDL model, the first step is to test for cointegration among the variables in the model. This test aims to determine whether there is a long-term relationship between the income inequality variable and the independent variables representing economic sector transformation and per capita income. The results of this test will be the basis for determining whether or not the ARDL model can proceed to the Error Correction Model (ECM) estimation stage. The cointegration test results for each country are presented in Table 8.

Table 7 Bound Test Cointegration Test Results of Indonesia, Malaysia, Singapore and Thailand

	Indonesia		Malaysia		Singapura		Thailand	
<i>F-statistic</i>	4,113		1,645		3,975		5,696	
<i>Bounds</i>	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
<i>Critical values for the bounds test</i>								
10%	2,37	3,2	2,37	3,2	2,37	3,2	2,37	3,2
5%	2,79	3,67	2,79	3,67	2,79	3,67	2,79	3,67
2,5%	3,15	4,08	3,15	4,08	3,15	4,08	3,15	4,08
1%	3,65	4,66	3,65	4,66	3,65	4,66	3,65	4,66

Source : processed from WITS, BPS, DOSM, SingStat and NSO (2025)

The Indonesian *F-statistic* value of the Bound Test above is 4.113 which is greater than the upper limit of I(1) at 5% significance level, which is 3.67, hence the null hypothesis is rejected which means that there is a long-run cointegration relationship between the variables in the model. This result explains that although the variables are not individually stationary, there is a stable long-run relationship between them.

Malaysia's *F-statistic* value from the Bound Test above is 1.645 which is less than the lower bound of I(0) at 5% significance level, which is 2.79, this means that the cointegration test result is not to reject H0 which means that there is no long-run cointegration relationship between the variables in the model. Therefore, the analysis for Malaysia will focus on the short run.

The Singapore *F-statistic* value of the Bound Test above is 3.975 which is greater than the upper limit of I(1) at 5% significance level, which is 3.67, hence the null hypothesis is rejected which means that there is a long-run cointegration relationship between the variables in the model. This result explains that although the variables are not individually stationary, there is a stable long-run relationship between them.

The Thai *F-statistic* value of the Bound Test above is 5.696 which is greater than the upper bound of I(1) at 5% significance level, which is 3.67, hence the null hypothesis is rejected which means there is a long-run

cointegration relationship between the variables in the model. This result explains that, although the variables are not individually stationary, there is a stable long-run relationship between them.

Diagnostic Test: Normality, Autocorrelation, Heteroscedasticity, and Stability Tests

To ensure the validity and reliability of the ARDL model used in this study, a number of diagnostic tests have been conducted. The results of the residual normality test with the Jarque-Bera test show a normal distribution of residual data (p -value > 0.05). While the heteroscedasticity test with the Breusch Pagan Godfrey method shows that the model does not show symptoms of heteroscedasticity (p -value > 0.05). Furthermore, the autocorrelation test with the Breusch-Godfrey method also shows that the model residuals are free from autocorrelation (p -value > 0.05). In addition, the parameter stability test using the CUSUM and CUSUM of Squares (CUSUMQ) graph shows that the test line is within the tolerance limit at the 5% significance level, indicating that the model is structurally stable during the observation period. Thus, the ARDL model in this study meets the basic assumptions and is suitable for further analysis.

Long-Term and Short-Term Relationships

Based on the ECM estimation results, analysis is conducted for three ASEAN countries, namely Indonesia, Singapore, and Thailand to examine the dynamics of the relationship between GDPPK, service sector structure, and income inequality (measured by Gini ratio) in the short and long term.

Table 8 Processed Results of Error Correction Model (ECM) Indonesia, Singapore and Thailand and ARDL First Difference Malaysia

	Indonesia	Malaysia	Singapura	Thailand
ECT	-0,469***	0,128	-0,759***	-0,71***
Short run				
D_GDPPK	-2,782	0,641	2,483	0,251
D_GDPPK ²	0,186	-0,027	-0,109	-0,011
D_Share of Services	2,421	-0,281	0,262	-1,123
Constant	-12,331***	-0,013**	-53,23***	-20,913
Long run				
GDPPK	6,342***		13,09***	7,016
GDPPK ²	-0,427***		-0,613***	-0,435
Share of Services	4,642***		-0,872	0,003
R ²	0,942	0,245	0,879	0,966
Adjusted R ²	0,929	0,063	0,829	0,955
Number of obs.	39	37	25	29

Source : processed from WITS, BPS, DOSM, SingStat and NSO (2025)

Indonesia

The ECM model for Indonesia shows an Error Correction Term (ECT) coefficient value of -0.496 with high significance (p -value = 0.0006) indicating that there is a stable adjustment mechanism towards long-run equilibrium. About 49.63% of the imbalance that occurred in the previous period can be adjusted in the current period, signaling a relatively fast convergence.

In the short run, the variable GDP per capita (GDPPK) has a negative coefficient (-2.782) but is not significant (p -value = 0.535), while GDP per capita squared (GDPPK²) shows a positive coefficient (0.186) but is also not significant (p -value = 0.523). This finding indicates that there is no statistically significant relationship between GDPPK and income inequality in the short run. Thus, the inverted U-shape pattern of the relationship has not been established in the short run. In contrast, the service sector share variable shows a significant positive effect with a coefficient of (2.421) and (p -value = 0.052). This means that an increase in the contribution of the service sector to GDP has the potential to increase income inequality in the short run.

In the long run, the estimation results show that GDPPK has a positive and significant effect on the Gini ratio with a coefficient of (6.342) and (p -value = 0.0009). The GDPPK² variable has a negative and significant effect with a negative coefficient (-0.427) and (p -value = 0.0009). This combination indicates the formation of a Kuznets relationship pattern, where in the early stages of economic growth or an increase in per capita income leads to an increase in inequality, but after reaching a certain turning point, an increase in per capita income is assumed to reduce the level of income inequality. In addition, the services share variable continues to have a positive and significant effect with a coefficient of (4.645) and (p -value = 0.0001). The relevance of the Kuznets curve in the long run is also supported by the provisional conjecture depicted through Indonesia's scatterplot pattern which tends to form an inverted U pattern.

Malaysia

Bound test results for Malaysia show that there is no long-run cointegration relationship between the variables in the model. Therefore, first difference ARDL processing was carried out to focus on analyzing the short-term relationship between variables. The results show that the variables GDPPK, GDPPK², and Services Share have probability values above the 5% significance level. Based on the estimation results, it also shows that there is no significant short-term relationship between the variables.

Singapore

The results of the ECM modeling of Singapore country obtained a negative Error Correction Term (ECT) value (-0.759) and significant with a p-value of 0.0058. This indicates the existence of a stable adjustment mechanism towards long-term equilibrium. The ECT coefficient of (-0.759) indicates that about 75.91% of the imbalance that occurred in the previous period will be corrected or adjusted back to the equilibrium path in one period. This suggests that the process of convergence towards long-run equilibrium is fast and significant.

Based on the estimation results of the ECM model, it is found that in the short term, GDP per capita (GDPPK) has a positive but insignificant effect on the growth of the Gini ratio. The value of GDP per capita squared (GDPPK²) has a negative and insignificant effect on the Gini ratio. This indicates that in the short term there is no inverted U-shape or Kuznets curve relationship pattern. In addition, the services share variable shows a positive effect on the Gini ratio but does not have a significant effect on the Gini ratio in the short term.

In the long term GDP per capita (GDPPK) has a significant positive effect on the Gini ratio. The square value of GDP per capita (GDPPK²) has a significant negative effect. This indicates an inverted U-shape or Kuznets curve in the long run in Singapore. In the early stages, an increase in per capita income pushes up the Gini ratio, but after passing a certain point, an increase in per capita income actually reduces the Gini ratio. Meanwhile, the share of the service sector has a negative and insignificant effect on the Gini ratio in the long run. The relevance of the Kuznets curve in the long run is also supported by the provisional conjecture depicted through Singapore's scatterplot pattern which tends to form an inverted U pattern.

Thailand

The results of ECM modeling of Thailand obtained the Error Correction Term (ECT) value in this model, which is reflected in the coefficient of the Gini ratio variable (-1), is negative (-0.717) and significant with a p-value of 0.0001. This indicates the existence of a stable adjustment mechanism towards the long-run equilibrium. The ECT coefficient value of -0.717 indicates that about 71.75% of the imbalance that occurred in the previous period will be corrected or adjusted back to the equilibrium path in one period. This indicates that the convergence process towards the long-run equilibrium is fast and significant.

Based on the estimation results of the ECM model, it is found that in the short term, GDP per capita (GDPPK) has a positive but insignificant effect on the growth of the Gini ratio. The value of GDP per capita squared (GDPPK²) has a negative but insignificant effect on the Gini ratio. This indicates that in the short term there is no inverted U-shape or Kuznets curve relationship pattern. In addition, the services share variable shows a negative effect on the Gini ratio although it is not significant to the Gini ratio in the short term.

In the long run, GDP per capita (GDPPK) also has a positive and insignificant effect on the Gini ratio. GDP per capita squared (GDPPK²) also has a negative but insignificant effect. This indicates that there is no inverted U-shape or Kuznets curve in the long run in Thailand. In addition, the services share variable contributes positively but insignificantly to the Gini ratio in the long run.

DISCUSSION

The analysis of the four countries shows that the structural transformation process in the ASEAN region takes place with different dynamics, but is generally characterized by relatively uniform sectoral correlation patterns in most countries. Indonesia, Singapore, and Thailand show a negative correlation pattern between the service sector and the agricultural and industrial sectors, as well as a positive correlation between the agricultural and industrial sectors. This pattern indicates that the growth of the services sector tends to be substitutive, replacing the role of other sectors instead of growing synergistically.

The ECM analysis in Indonesia, which shows that services share has a positive and significant effect on inequality, supports the statement made by Romli et al. (2016) that income inequality will be higher as the contribution of the agricultural sector decreases and the modern economic sector such as the services sector develops. This indicates that the shift in economic structure in Indonesia is taking place by reducing the role of labor-intensive oriented sectors such as agriculture, and shifting to the service sector, which although more modern, does not always guarantee equitable income distribution. This indicates that the structural transformation taking place in Indonesia has not been inclusive and tends to widen the gap of inequality. Thus, the success of structural transformation in reducing inequality depends on the extent to which economic sectors can support each other and create growth that absorbs labor widely and equitably. This is supported by research conducted by Andersson and Chaverra (2016) who analyzed the effect of productivity gaps between economic sectors on income inequality. This study states that the service sector is the main labor absorber, but the agricultural sector still plays an important role in income distribution. The finding of this study is that the productivity gap between sectors is positively correlated with income inequality in countries with a budding dualist economic structure.

The pattern of the relationship between per capita income and income inequality as reflected by the Gini ratio in Indonesia, Malaysia, and Thailand shows a similar trend. Based on the visualization results in the form of scatterplots, it appears that the Gini ratio in the three countries decreases after per capita income (GDPPK) reaches a certain threshold, which is around US\$3,000. The turning point results that occur in Indonesia, Malaysia and Thailand when GDPPK reaches around 3,000 USD are also supported by the analysis conducted by Ali et al. (2024) which discusses the Kuznets curve hypothesis in South Asia. Aggregately, the results of this study found that the turning point for all countries in the analysis occurred when GDPPK reached 3,827 USD. However, when viewed from the results of each country, the turning point occurs at different GDPPK values.

CONCLUSION

Based on the results of the analysis that has been carried out, the following conclusions are obtained:

1. Indonesia and Malaysia experienced structural transformation with a shift in economic contribution from the industrial sector to the service sector, which also indicates symptoms of deindustrialization. In contrast, Singapore and Thailand show a stagnant structural transformation, with a stable dominance of the service sector.
2. The pattern of relationship between per capita income and income inequality in Indonesia and Singapore supports the Kuznets hypothesis. This pattern does not apply to Malaysia and Thailand, which only show the right-hand side of the Kuznets curve.
3. In the short run, the Kuznets curve hypothesis does not hold in every country. This is because income level does not significantly affect income inequality (Gini ratio). In the long run, the Kuznets hypothesis holds in Indonesia and Singapore. In addition, Indonesia's service sector has a positive and significant effect on income inequality, while Singapore's service sector has no significant effect. The Kuznets hypothesis does not hold for Malaysia and Thailand. In addition, the service sector also does not have a significant effect on income inequality in Malaysia and Thailand.

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