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Convergence and Middle-Income Trap between Asian Country Members: New Findings

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This paper investigates the possibility of middle-income convergence among seven members of Southeast Asian nations (Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand, and Vietnam), with Malaysia being in upper-middle-income rank and other six countries in lower-middle-income rank. We apply unit root testing framework that allows for smooth nonlinearity, abrupt break, and cross-dependence in the income differences. Results show that these lower-middle-income countries are likely to converge among themselves and converge to the income level of Malaysia in the long run. Based on Add Asian cross-country policy recommendations, Economic policies capable of stimulating long-run economic growth of these lower-middle-income countries is therefore recommended, and the countries should be ready to take up the challenge of upper-income country, like Malaysia.

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Keywords: Southeast Asia region; cross-sectional dependency; fourier function; income convergence; seemingly unrelated regression.

1. INTRODUCTION

Solow [1] applies the neoclassical growth theory to prove that two countries with similar technological developments can have convergent GDP per capita income. On the other hand, Romer [2] applies the newer growth theory to prove that developing countries have no tendency to grow faster than developed countries. While several developing countries have achieved middle-income rank far back as the 1970s, only a few have crossed to high-income rank economies. The middle-income countries have failed to boost their productive capacities through technological advancements and education as noted in Otsuka et al. [3] and Lavopa and Szirmai [4], whereas, developing countries with good institutions are unlikely to remain as middle-income economies [5]. Countries are probable to be in the middle-income rank due to their economic slowdowns or because of the rapid growth of economically advanced nations, which causes a divergent gap between them and the lower-income countries.

Income convergence among countries has been increasingly investigated following the theory by Bernard and Durlauf [6]. The authors propounded that the log-differences of income values between the two countries is a series in stable equilibrium, that is, stationary. This implies homogeneity in growth. This theory was first applied in Greasley and Oxley [7] using the ADF unit root test with the structural break version of Zivot and Andrews [43] to investigate income convergence in four paired developed countries. These two papers are reference points to income convergence studies in most empirical literature.

Meanwhile, it is noteworthy that the effects of the middle-income trap cut the international community. One of the effects on the countries cut in the web is a long period of economic stagnation, and difficulty in attaining higher levels of income. By further implication, welfare will not be enhanced, and may even eventually fall. On the other hand, the global economy does not appear to be safe from the problems of the middle-income trap of certain countries. As rightly noted by Aiyar et al. [23] and Otsuka et al. [3], the effect of prolonged slowdowns in the growth of some prominent countries, especially those that fall in the cadre of large middle-income countries such as China is immense. Considering China, for instance, her share in world exports and technological advancement is huge. The majority of other countries that control a significant portion of the world's resources also fall in the middle-income group. Hence, the international community is also at the receiving end when these countries fall into the middle-income trap. Thus, empirical studies have been geared towards discovering the causes of the middle-income trap and its likely solutions.

Against this backdrop, this study intends to fill the empirical gap of examining the convergence among the South-East Asian countries, and the possibility of middle-income trap among them. To ensure the robustness of our results, we approach the analysis from two the angles, univariate and panel time series econometric methodologies. The univariate model involves a battery of unit root tests, starting with the first-generation unit root test, namely the Augmented Dickey-Fuller (ADF) test of Dickey and Fuller [8], and its structural breaks version (ADF-SB), proposed in Perron and Vogelsang [9]. We improve on these by considering more advanced techniques that can account for smooth breaks in the Fourier function. They are the Fourier ADF (FADF) test proposed by Enders and Lee [10] and its structural breaks variant (FADF-SB) that is due to Furuoka [11]. Unlike the majority of past studies, we further apply a solid panel unit root test recently developed by Furuoka [12]. This technique, referred to as the Seemingly Unrelated Regression Fourier ADF (SUR-FADF) test, has a very low-frequency Fourier function. Such feature makes it suitable to handle nonlinearity and multiple breaks in the deterministic component of the model as well as to consider cross-sectional dependence in the panel series [13] In short, our contributions are in two folds: (i) Evaluation of the possibility of the upper-middle-income country like Malaysia to converge with the remaining six lower-income countries; (ii) Investigates the possibility of those six lower-middle-income countries to converge among themselves (iii) Engagement of powerful techniques that can account for nonlinearities and structural breaks in the model. Also, the SUR-ADF and SUR-FADF (for panel models) produce fantastic results in the presence of dependence of cross-sections. This is unlike the majority of past studies that did not account for these, thus making them discover only a few countries with a middle-income trap [13].

The rest of the paper is structured as follows: Section 2 presents a theoretical and empirical review on the middle-income trap and income convergence among Asia countries. Section 3 presents the datasets and the time series econometric approach. Section 4 presents the empirical results, and Section 5 renders the concluding remarks.

2. REVIEW OF LITERATURES

2.1 What Exactly does the Middle-Income Trap Stand for?

It is better to start the review by noting the conceptual meaning of the middle-income trap. This is because, as the literature stands, there is yet to be a definition that is universally accepted, thus creating a significant limit to its use in economic discourse [14]. In other words, the basis upon which a country is said to be income-trapped yet seems a blur, thus making some researchers regard some countries to having to be in the trap, while others argue otherwise. For instance, while Woo et al. [15] argument reveals that Poland is income-trapped, other studies indicated otherwise (see Agenor & Canuto [16] Felipe et al. [17] Islam [18]. Berglof [19] believes that Poland ranks top in convergence after 25 years of drastic transition. Among other notable studies, Gill and Kharas [20] identify three broad areas in which middle-income trap can be interpreted, namely descriptive forms, empirical analysis through the identification of income bands, and empirical analysis through the inability to trace convergence to a benchmarked developed country. However, a recent study of Pruchnik and Zowczak [14] builds on the work of Gill and Kharas [22] to arrive at five interpretative definitions of middle-income trap based on conclusions of related studies. These are summarized below:

i. Descriptive (non-empirical) interpretations, e.g. Kharas & Kholi [21] Gill & Kharas [22].
ii. Time thresholds, e.g. Felipe et al. [17]
iii. Fixed income limits, (e.g. Ayiar et al. [23] Spence [24]
iv. Indices, (e.g. Woo et al. [15] Hawksworth [25].
v. Relative income benchmark, e.g. Robertson & Ye [26] Agenor & Canuto [16].

Notwithstanding the differences in the middle-income trap's definitions, the deduction is that it is a phenomenon in which there are slowdowns in the growth of developing countries. Put differently, it is an economic scenario in which countries tend to economically stagnate having initially got an impressive economic growth [27]. Hence, economic growth may be retarded or slowed down immediately the countries attain the middle-income status [23].

Garret [28], who appears to be the introducer of the concept in economic parlance, observes that, since the 1980s, certain middle-countries have experienced stagnation in growth rates. Although introduced by Garret [28], Pruchnik and Zowczak [14] note that it is Gill and Kharas [22] who offered the first definition for the concept.

2.2 Empirical Review

As a follow up to the study of Gill and Kharas [22], they disclose that there could be significant problems for East Asian countries in attaining impressive convergence pace having earlier recorded strong economic growth for decades. They tie the reason for the absence of economies of scale, thus informing their recommendations that the countries would have to accumulate productive factors in ensuring gradual deteriorating results strategically. Comparatively, they further give reference to the Middle East and Latin America as those that had overcome the middle-income trap for decades.

Since this pioneering study, researchers have drawn attention to establishing this tendency for other economic regions of the world using different methodologies, scope, and data measurements. For instance, Spence [24] highlights the difficulties often faced by middle-income countries in transitioning from middle-level income to higher levels of income. The author specifically notes that certain groups of countries are unable to exceed the benchmark per capita income of $10,000. These countries have consistently stagnated around a range of per capita income of $5,000 and $10,000. The author believes that the major cause of the stagnation is the loss of the global competitive strength of the industries in the countries in question due to wage increase. In a related study, Eichengreen et al. [29] and Eichengreen et al. [30] try to check the economic slow-down incidence in some middle-income countries that once experienced rapid growth using the Penn World data. While the former shows that growth slowdown occurred at levels of income between $15,000 and $16,000 (with the base year being 2005 purchasing power parity in dollars), the

latter study reveals inflection points in growth. The first one was between $10,000 and $11,000, while the second revolved around $15,000 and $16,000. The analyses of both studies were based on several countries with consecutive seven years of declining growth rates. With these, they discover that several countries were caught in the middle-income trap web. They also establish through their correlation analysis that slowdowns in growth have a high probability of occurring in countries with a high number of dependent populations, high rates of investments (which can result into decline in future capital returns), and undervalued real exchange rates (which tends to cause a slowdown in technological advancement). On the other hand, it is not likely to happen to countries that have sound education systems at the secondary and upper cadres, and countries with significantly high technological products in their export base.

Consequently, different innovations are witnessed in the literature as regards the growth slowdowns of middle-income countries. For instance, the study of Yusuf [31] focuses on the ways to identify middle-income countries that are already trapped. These four ways include the income per capita of the country, the income per capita of a country relative to the United States, the number of years the country's GDP falls below a threshold value, and the number of years the country suffers from the lower level of economic growth. In respect of this, Eichengreen et al. [32] note that there can be successive slowdowns in the growth of middle-income countries, rather than a one-time drop. This is because, according to Desai and Gkoulgkoustsika [40], there is no continuity in the catch-up process because of certain factors, including countries' heterogeneity and presence of breaks episodes of divergence in between paths. Furuoka et al. [13] analyze 14 countries selected across various regions of the world and reveal that there is a high tendency for ten countries to be caught in the middle-income trap, while only one country has meager chance of experiencing the problem. The authors obtain no conclusive evidence for the rest.

Another strand of literature intends to unravel the reason for the middle-income trap of developing countries. For Malaysia and Thailand, Sen and Tyce [33] find that political forces, particularly political settlements, are responsible for the slowdown in their growths. On the other hand, demographic factors are found to be responsible for the economic convergence of Asia to the United States. Specifically, the discovery of Ha and Lee [34] suggests that fertility and the share of the labor force in the total population are the determinant factors of the convergence speed of Asian countries to the GDP of the United States. Other factors, including schooling years, level of capital accumulation, and quality of labor, are essentially found to explain about 50% of the variation in the economic growth of some other developing countries in the long run [35].

The literature would appear incomplete without including studies that proffer solutions to the middle-income trap problem. The few studies in this line include Raiser et al. [36] and Otsuka et al. [3]. Otsuka et al. [3]. suggest a level of education, trade openness, research, and development, among others as solutions to the middle-income trap of East Asian countries. Raiser et al. [36] note that private entrepreneurship, viable economic institutions, and potent economic integrations have been of major support to Turkey and Poland.

3. DATA AND METHODS

The data set of GDP per capita in 2010 constant US dollar is extracted from the World Development Indicator (WDI) database of the World Bank.[1] Among 11 countries in Southeast Asia, seven countries are included in the analysis. Note that, among Southeast Asian countries, Singapore is a member of a high-income economy, as classified by the World Bank, and the per capita income of this country is higher than that of Malaysia or any other upper-middle-income countries. Also, with the fact that this country is likely to escape the middle-income trap according to Furuoka et al. [13], we have excluded it in the sample.[2] The countries considered are Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand, and Vietnam. The data, at annual frequency span from 1984 to 2016.

In studying income convergence, econometrics techniques rely on the interpretation of differences in logs of per capita income between two countries [6]. This difference is expected to be zero if the two countries' per capita incomes are the same in the long run. That is:

[1]There is yet to be a unified measurement of growth other than GDP per capita. Many authors have criticised this proxy variable by it facilitates country-country comparison.

[2] Brunei, Cambodia and Timor-Leste were not included in the analysis due to data unavailability.

$$E(x_{i,t+k} - x|I_t) = 0 \quad (1)$$

where E is the expectation function; I_t is the previous information set; $x_{j,t+k}$ is the time series of per capita income of a smaller country j while $x_{i,t+k}$ is the time series of per capita income of the bigger country i. The difference series $y_{t+k} = \left(x_{i,t+k} - x_{j,t+k}\right)$ is stationary if there is convergence, which means the null hypothesis of unit root tests should be rejected. If the unit root nulls are otherwise not rejected, there is a divergence of series, and the smaller country is unable to converge to the income level of the bigger economy.

Following Eq. (1), we test the null and alternative hypotheses:

H_0: *There is a unit root in the time series of the income difference y_{t+k} between country i and country j, implying no income convergence between the two countries.* (2a)

H_1: *There is no unit root in the time series of the income difference y_{t+k} between country i and country j, implying income convergence between the two countries.* (2b)

The econometric analysis is approached in both univariate and panel settings. The univariate unit root tests are the ADF test of Dickey and Fuller [8] the FADF test of Enders and Lee (2012a, b); the ADF with structural break test of Perron and Vogelsang [9] and the FADF-SB test of Furuoka [11]. These unit root tests are based on the following regression models, respectively:

$$\Delta y_t = \mu + \beta t + \rho y_{t-1} + \sum_{i=1}^{p} c_i \Delta y_{t-i} + \varepsilon_t \Delta y_t = \mu + \beta t + \rho y_{t-1} + \sum_{i=1}^{p} c_i \Delta y_{t-i} + \varepsilon_t \quad (3)$$

$$\Delta y_t = \mu + \beta t + \gamma_1 sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 cos\left(\frac{2\pi kt}{T}\right) + \rho y_{t-1} + \sum_{i=1}^{p} c_i \Delta y_{t-i} + \varepsilon_t$$
$$\Delta y_t = \mu + \beta t + \gamma_1 sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 cos\left(\frac{2\pi kt}{T}\right) + \rho y_{t-1} + \sum_{i=1}^{p} c_i \Delta y_{t-i} + \varepsilon_t \quad (4)$$

$$\Delta y_t = \mu + \beta t + \delta DU_t + \theta D(T_B)_t + \rho y_{t-1} + \sum_{i=1}^{p} c_i \Delta y_{t-1} + \varepsilon_t$$
$$\Delta y_t = \mu + \beta t + \delta DU_t + \theta D(T_B)_t + \rho y_{t-1} + \sum_{i=1}^{p} c_i \Delta y_{t-1} + \varepsilon_t \quad (5)$$

$$\Delta y_t = \mu + \beta t + \gamma_1 sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 cos\left(\frac{2\pi kt}{T}\right) + \delta DU_t + \theta D(T_B)_t + \rho y_{t-1} + \sum_{i=1}^{p} c_i \Delta y_{t-i} + \varepsilon_t$$
$$\Delta y_t = \mu + \beta t + \gamma_1 sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 cos\left(\frac{2\pi kt}{T}\right) + \delta DU_t + \theta D(T_B)_t + \rho y_{t-1} + \sum_{i=1}^{p} c_i \Delta y_{t-i} + \varepsilon_t \quad (6)$$

where y_t is the income difference time series; μ is the model intercept; β is the slope coefficient for the linear t; T is the size of the time series, γ_1, and γ_2 in Eq. (4) and Eq. (6) are parameters measuring the amplitude displacement in the FADF and FADF-SB regression models, respectively; π equals 3.14159. In the two models, k is the frequency used in the trigonometric functions in sin and cosine. In the ADF-SB regression model, δ is the slope parameter in the structural break dummy. $DU_t = 1$ if $t > T_B$ and $DU_t = 0$ if otherwise. TB provides the break date and the point of the structural break in the series. θ is the parameter of the one-time break dummy such that $D(T_B)_t = 1$ if $t = T_B$ and $D(T_B)_t = 0$ if otherwise. The noise process is ε_t distributed with zero mean and variance 1. The ρ is the autoregressive parameter for the lagged series y_{t-1} so that the null of ρ implies accepting the null hypothesis in (2a), and the negativity of ρ implies rejecting the null hypothesis in (2a) against the alternative in (2b). Due to the small sample size of the income time series involved in the lag length p in the augmentation component of all the unit root regression models is fixed as 1.

Features of FADF and FADF-SB tests are shown in Furuoka [11] studying which the author finds competing performance of FADF-SB test with ADF-SB test in an F test.

Moreover, our consideration of the panel unit root test is motivated by the weakness of the conventional single-equation unit root tests in handling certain statistical properties inherent in economic series. To improve the power performance of the unit root test, therefore, the panel ADF-based unit root test is developed within the context of the Seemingly Unrelated Regression (SUR) framework [37]. In particular, this advanced unit root test, regarded as SUR-ADF unit root test, allows interdependencies among the panel members and further caters to a varying degree of inter-correlations in a simple version. However, Furuoka [11] finds the SUR-ADF to break down in the presence of nonlinearities in the series and hence, considers the nonlinear version of the panel unit root test using the Fourier form of low frequency. This new test is termed SUR-FADF test. This nonlinear panel unit root model possesses another outstanding feature. The inherent Fourier function in sine and cosine functions of time can conveniently capture smooth structural breaks of unknown forms see Enders & Lee [10] b) even in time series with small *T*. This is unlike the exponential functions as in Leybourne et al. [38] and Kapetanios et al. [39], which are only consistent with instantaneous break and large time series. Hence, the use of the nonlinear function is suitably overcoming the inclusion of dummy variables as proxies for inherent breaks along the time path of the series, regardless of whether the breaks are smooth or instantaneous.

The SURFADF framework thus caters for the inherent cross-sectional dependence of the panel members, while jointly testing for $\rho_i (i = 1,...,m)$ parameters in the system of *m* panels of time series income differences as,

$$\Delta y_{it} = \mu_i + \rho_i y_{i,t-1} + \gamma_{i,1}\sin\left(\frac{2\pi kt}{T}\right) + \gamma_{i,2}\cos\left(\frac{2\pi kt}{T}\right) + \sum_{j=1}^{p} c_{ij}\Delta y_{i,t-j} + \varepsilon_{it} \quad (7)$$

where $\varepsilon_{it} \approx iid\left(0, \sigma_i^2\right)$ for every *I*; y_{it} is the income differences series with m panels; μ_i is the model intercept; $\gamma_{i,1}$ and $\gamma_{i,2}$ are parameters measuring the amplitude and displacement in the Fourier form, as in Eq. (3)and Eq. (5) above; the coefficient of the augmentation component of the model is c_{ij}. The null hypothesis is then tested in the SUR panel setting as,

$$H_0 : \rho_i = 0 \quad \forall\, i \quad (8)$$

which is carried out using the t-test. With the non-significance of the Fourier parameters, $\gamma_{i,1}$ and $\gamma_{i,2}$, the model system in Eq. (7), the SURFADF model becomes the SURADF model of Breuer et al. [37]. The limitation of these tests is the fact that data specific critical values are obtained based on the bootstrap approach [40].

4. EMPERICAL RESULTS

The empirical analysis of this study appears to be unique following its objective of evaluating the growing convergence of the South-Eastern Asian countries among themselves. This is different from the majority of past studies as they use an advanced country as a growth benchmark for the countries under consideration. This motivates the manner of the presentation of our results in which South-Eastern countries are paired accordingly. For brevity, the results are distinctly presented and discussed based on the findings from our choices of techniques.

We begin with the results of the ADF and FADF tests, which are used to determine the rejection or the null hypothesis of unit root. Such hypothesis is further associated with the absence of income convergence between any two countries in the region being considered. As earlier explained, the FADF is the nonlinear version of the traditional ADF unit root test. The results of these two tests are presented in Table 1. Focusing first on the ADF test results, it is observed that the unit root null hypothesis of income differences cannot be rejected for virtually all pairs of countries. The few exemptions are the pairs of Thailand, Indonesia, and the Philippines with Myanmar, and the Philippines–Laos pair. This implies that only in these few country pairs does the ADF test identify the possibility of income convergence with each other. On the other hand, the results of the FADF largely support those of the ADF [41] However, the income differences between Thailand and Myanmar, and Indonesia and Myanmar are now found to be non-stationary, while those of Vietnam and Laos pair become stationary. Interestingly, the unit root null hypothesis is rejected still for the pair of Philippines with each of Laos and Myanmar. Hence, when nonlinearities are accounted for, only the incomes of the Philippines and Laos, Philippines and Myanmar, and Vietnam and Laos will likely converge [42,43].

Table 1. Findings from the ADF test and FADF test

Malaysia differences	ADF t-stat	FADF t-stat
Malaysia – Indonesia	-1.3472	-3.58151
Malaysia – Laos	-2.2064	-3.12411
Malaysia – Myanmar	-3.4213	-2.10571
Malaysia -Philippines	-0.7074	-2.57511
Malaysia -Thailand	-3.1225	-3.46792
Malaysia – Vietnam	-2.3931	-2.33701
Thailand differences		
Thailand – Indonesia	-1.6690	-2.33811
Thailand – Laos	-3.2388	-2.81672
Thailand – Myanmar	-4.2014***	-1.78121
Thailand -Philippines	-1.3275	-1.24872
Thailand – Vietnam	-3.4376	-3.03742
Indonesia differences		
Indonesia – Laos	-3.2996	-3.25682
Indonesia – Myanmar	-3.5950***	-1.55771
Indonesia -Philippines	-1.5874	-1.66182
Indonesia – Vietnam	-2.2622	-1.66181
Philippines differences		
Philippines – Laos	-4.0805***	-4.99131***
Philippines – Myanmar	-4.3804***	-4.84041***
Philippines – Vietnam	0.0175	-3.92471
Vietnam differences		
Vietnam – Laos	-1.1868	-4.78011***
Vietnam – Myanmar	-3.4339	-3.25231
Laos differences		
Laos - Myanmar	-3.1151	-2.41751

However, structural breaks are common features of economic time series, such as income levels considered in this study. Income levels are affected by many factors that could cause significant breaks, such as fluctuations in business cycles, financial market crises, and other exogenous factors, including technology. It is thus important to account for these significant breaks as both the ADF and FADF break down when they are present. Putting this into consideration, we extend our analysis by employing unit root techniques that are structural breaks-consistent. Basically, both the ADF and FADF are re-modified to capture breaks, and the new models are respectively called ADF-SB and FADF-SB. Interestingly, the results based on the ADF-SB and FADF-SB tests reported in Table 2 suggest significance for an increased number of countries, especially for the latter technique. In other words, we find evidence of rejection of the unit root null hypothesis for the income differences of most of the country pairs. Specifically, among the 21 country pairs, the null hypothesis is rejected for 11 pairs according to the ADF-SB test, while the FADF-SB suggests rejection for as high as 18 pairs. Out of the remaining three country pairs whose null hypothesis cannot be rejected using the FADF-SB test, the results for two of them (Thailand and Indonesia, and Thailand and Vietnam) are consistent with the conclusion from the ADF-SB test. By implication, the problem of income convergence among the South-Eastern Asian countries seems not to be critical, except for the two pairs of countries pointed out above.

In our final stage of analysis, cross-sectional dependencies are accounted in a panel SUR framework. The essence is still to determine the possibility of income convergence among the South-Eastern Asian countries while putting the interdependencies among the panel members into focus. Regardless of the tests, the null hypothesis of unit root associated with the absence of convergence is consistently rejected for all the country pairs (see Table 3). Therefore, there also seems to be no problem with income convergence among the countries.

Table 2. Findings from the ADF-SB and the FADF-SB test

Malaysia differences	ADF-SB t-stat	FADF-SB t-stat
Malaysia – Indonesia	-3.26332008,71.4	-5.66731998,42.9,1***
Malaysia – Laos	-3.50891990,20.0	-6.79171997,40.0,1***
Malaysia – Myanmar	-4.13042000,48.6***	-6.08231987,11.4,2***
Malaysia -Philippines	-4.81471990,20.0***	-4.70531997,40.0,1***
Malaysia -Thailand	-3.47581995,34.3	-4.95881996,37.1,1***
Malaysia – Vietnam	-3.19611987,11.4	-6.37681997,40.0,1***
Thailand differences		
Thailand – Indonesia	-2.60742007,68.6	-4.19021995,34.3,1
Thailand – Laos	-3.64611987,11.4***	-4.59111996,37.1,1
Thailand – Myanmar	-4.77851987,11.4***	-5.62631987,11.4,2***
Thailand -Philippines	-3.10701989,17.1	-4.99651996,37.1,1***
Thailand – Vietnam	-3.80551996,37.1	-4.45231996,37.1,1
Indonesia differences		
Indonesia – Laos	-4.12911990,20.0***	-8.31891997,40.0,1***
Indonesia – Myanmar	-6.10111997,40.0***	-4.94711997,40.0,2***
Indonesia -Philippines	-3.82251990,20.0	-5.43291997,40.0,1***
Indonesia – Vietnam	-10.84091997,40.0***	-9.09461997,40.0,2***
Philippines differences		
Philippines – Laos	-5.68742015,91.4***	-5.71922010,77.1,1***
Philippines – Myanmar	-5.28722001,51.4***	-6.52771987,11.4,1***
Philippines – Vietnam	-2.11071991,22.9	-4.74962008,71.4,1***
Vietnam differences		
Vietnam – Laos	-2.38922009,74.3	-5.45972004,60.0,1***
Vietnam – Myanmar	-4.16442001,51.4***	-6.90131987,11.4,2***
Laos differences		
Laos - Myanmar	-4.34721999,45.7***	-6.13891987,11.4,2***

Table 4 summarizes the findings from the various unit root tests employed. Comparing the results based on the unit root tests, we observe some differences depending on the need to account for nonlinearities, structural breaks, and cross-sectional dependencies in the models. As more of these statistical features are accounted for, the higher the number of cases in which the unit root null hypothesis that subsequently indicates an absence of income convergence between each pair of countries is rejected. For instance, when structural breaks and cross-sectional dependencies are not put into consideration, there is an absence of income convergence in most cases. However, contrary evidence seems to be established when structural breaks are regarded in the model. The FADF-SB test that accommodates both nonlinearities and structural breaks suggests that only in three scenarios (two of which are similar to the results of the ADF-SB test) is income convergence not established. Combining cross-sectional dependencies with the linear and nonlinear unit root models, income convergence is interestingly established for all the pairs, thus implying that income differentials would likely not occur among the South-Eastern Asia countries in the long-run.

Chart 1 shows Bootstrap Critical Values at 1, 5 and 10% levels of significance.

Chart 1. SUR-ADF and SUR-FADF tests

SURADF test			SURFADF test		
1%	5%	10%	1%	5%	10%
-3.5091	-3.2203	-3.1094	-5.8520	-5.5284	-5.3715

Critical values are obtained based on 1000 replications of bootstrap samples.

Table 3. Findings from the SUR-ADF test and SUR-FADF test

Malaysia differences	SURADF t-stat	SURFADF t-stat
Malaysia – Indonesia	-8.6788***	-10.8908***
Malaysia – Laos	-6.6832***	-7.9789***
Malaysia – Myanmar	-6.7983***	-8.2348***
Malaysia -Philippines	-5.7579***	-8.0278***
Malaysia -Thailand	-3.7338***	-7.5659***
Malaysia – Vietnam	-4.1847***	-7.1319***
Thailand differences		
Thailand – Indonesia	-4.4445***	-7.3863***
Thailand – Laos	-5.3524***	-8.4567***
Thailand – Myanmar	-5.3356***	-6.7148***
Thailand -Philippines	-5.3769***	-8.5841***
Thailand – Vietnam	-5.7940***	-9.1064***
Indonesia differences		
Indonesia – Laos	-5.6945***	-7.8681***
Indonesia – Myanmar	-6.2049***	-10.4015***
Indonesia -Philippines	-6.2442***	-9.0218***
Indonesia – Vietnam	-5.9562***	-7.8083***
Philippines differences		
Philippines – Laos	-6.3515***	-9.1410***
Philippines – Myanmar	-6.2818***	-9.0194***
Philippines – Vietnam	-6.4029***	-7.9609***
Vietnam differences		
Vietnam – Laos	-6.2725***	-8.0292***
Vietnam – Myanmar	-6.4809***	-9.0088***
Laos differences		
Laos - Myanmar	-8.4097***	-10.7080***

Table 4. Summary of empirical findings

Malaysia differences	ADF	FADF	ADF-SB	FADF-SB	SURADF	SURFADF
Malaysia – Indonesia	NC	NC	NC	C	C	C
Malaysia – Laos	NC	NC	NC	C	C	C
Malaysia – Myanmar	NC	NC	C	C	C	C
Malaysia -Philippines	NC	NC	C	C	C	C
Malaysia -Thailand	NC	NC	NC	C	C	C
Malaysia – Vietnam	NC	NC	NC	C	C	C
Thailand differences						
Thailand - Indonesia	NC	NC	NC	NC	C	C
Thailand - Laos	NC	NC	C	NC	C	C
Thailand - Myanmar	C	NC	C	C	C	C
Thailand -Philippines	NC	NC	NC	C	C	C
Thailand - Vietnam	NC	NC	NC	NC	C	C
Indonesia differences						
Indonesia - Laos	NC	NC	C	C	C	C
Indonesia - Myanmar	C	NC	C	C	C	C
Indonesia -Philippines	NC	NC	NC	C	C	C
Indonesia - Vietnam	NC	NC	C	C	C	C
Philippines differences						
Philippines - Laos	C	C	C	C	C	C
Philippines - Myanmar	C	C	C	C	C	C
Philippines - Vietnam	NC	NC	NC	C	C	C
Vietnam differences						
Vietnam – Laos	NC	C	NC	C	C	C

Malaysia differences	ADF	FADF	ADF-SB	FADF-SB	SURADF	SURFADF
Vietnam - Myanmar	NC	NC	C	C	C	C
Laos differences						
Laos - Myanmar	NC	NC	C	C	C	C

C means income convergence exists between the pair, while NC means convergence does not exist.

5. CONCLUSION AND RECOMMENDATION

One of the fastest-growing continents in the world is Asia although its countries are largely developing. However, the South-Eastern region of the continent is characterized by relative income differentials as most of the countries are categorized as lower-middle-income, and very few as upper-middle-income. The bothering question of this study, therefore, is whether the income levels of the upper-middle-income countries will converge with those of the lower-middle-income countries and whether convergence will hold among the latter. Premised on this, we take Malaysia as the yardstick for an upper-middle-income country and then determine the possibility of convergence between her and each of six lower-middle-income countries in the region, namely Indonesia, Laos, Myanmar, Philippines, Thailand, and Vietnam. For the sake of robustness, and to account for the inherent statistical properties of most economic series, we apply a battery of unit root tests, including the recently developed ones. In addition to the ADF and Fourier ADF (FADF) tests, which respectively handle linearity and nonlinearities in the model, the new tests are able to incorporate structural breaks (ADF-SB and FADF-SB tests) and cross-sectional dependencies (SUR-ADF and SUR-FADF tests).

Our findings show that when structural breaks and interdependencies among the cross-sections are not focused on, the null hypothesis of unit root is not rejected in virtually all the country pairs. This suggests that income convergence will likely not hold among most of the countries. However, contrary findings are found as these inherent properties are accounted. For instance, accounting for structural breaks improves the results as more evidence are found to favor rejection of the null hypothesis. For the sake of emphasis, the FADF-SB, which combines both nonlinearities and smooth breaks in its modeling, shows that only in three pairs of countries, namely Thailand and Indonesia, Thailand and Laos, and Thailand and Vietnam, will there be no convergence. Similar conclusions are also found for two of these pairs (Thailand and Indonesia, and Thailand and Vietnam) by the ADF-SB, which only accounts for structural breaks. The last case scenario involves accounting for cross-sectional dependence in which case the unit root null hypothesis is rejected in all the 21 pairs of countries. Therefore, if we are to rely on the conclusion of these new tests, which are more powerful than the previous ones, the income levels of the South Eastern Asian countries will eventually converge. In other words, with the present economic trend, income differentials would not be feasible among the countries in the long-run. Since Malaysia is a high-middle income country, it is distinctly compared with each of the remaining six lower-middle-income countries under consideration. These lower-middle-income countries must formulate economic policies capable of stimulating long-run economic growth. They include investment in research and development, the building of infrastructures, and the establishment of other innovative activities capable of enhancing long-run growth. Such policies must be stronger in economic effects than those of Malaysia if growth convergence will eventually be achieved; otherwise, such possibility will only be a daydream. This also implies the countries not to fall victim to the Middle-income trap. Only when the growths of the six countries can converge with those of their neighboring high-middle income countries, such as Malaysia, will it be possible to take up the challenge of the next level of convergence with the high-income countries of the world.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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