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The Impact of Tourism Demand, Government Expenditure on Education and Income on the Environment in ASEAN-5 Countries
(Kesan Permintaan Pelancongan, Perbelanjaan Kerajaan Ke Atas Pendidikan Dan Pendapatan Terhadap Alam Sekitar Di Negara-Negara ASEAN-5)

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ABSTRACT

ASEAN countries heavily rely on tourism and therefore are vulnerable towards environmental disruptions. Tourism demand (TD), government expenditure on education (GEE) and income (INC) are among the main factors that increase the total global carbon dioxide emissions which lead to climate change, hence making them the key focus areas in ASEAN-5 countries. This study analysed whether the environmental Kuznets curve (EKC) holds for all ASEAN countries from 1970 until 2014 using nonlinear autoregression distribution lag (NARDL) method. It also analyses whether all variables are asymmetric to the environment in the long-run. In the long-run, the carbon dioxide emission response could have a negative change in INC for Malaysia (MLY), India (IND), Singapore (SNG), and the Philippines (PHL). However, in Thailand (THL), the carbon dioxide emission response could lead to a positive change in INC. This study found an asymmetric long-run effect of the INC, GEE, and TD on the environment in ASEAN-5 countries. In conclusion, EKC does not hold in all cases, but is detected in some of the variables. In this case, legal regulations are needed to avoid environmental degradation due to inefficient economic mechanisms that are insufficient to reduce the total global carbon dioxide emissions.

Keywords: Environmental Kuznets curve (EKC); asymmetry; nonlinear autoregression distribution lag (NARDL); ASEAN-5 countries

ABSTRAK

Negara-negara ASEAN amat bergantung kepada sektor pelancongan dan ini menyebabkan Negara tersebut cenderung mengalami masalah berkaitan alam sekitar. Permintaan pelancongan (TD), perbelanjaan kerajaan terhadap pendidikan (GEE) dan pendapatan (INC) merupakan antara faktor utama peningkatan jumlah pelepasan karbon di peringkat global yang membawa kepada perubahan iklim dan seterusnya menjadikan isu ini tumpuan utama di negara-negara ASEAN-5. Kajian ini menganalisis sama ada Negara-negara ASEAN-5 menyokong hipotesis Keluk Alam Sekitar Kuznets (EKC) bagi tahun 1970 hingga 2014 dengan menggunakan kaedah ARDL bukan linear (NARDL). Kajian ini juga menganalisis hubungan simetri antara semua pembolehubah dalam jangka panjang. Dalam jangka panjang, tindak balas pelepasan karbon mempunyai perubahan negatif dalam INC bagi Malaysia (MLY), India (IND), Singapura (SNG) dan Filipina (PHL). Walau bagaimanapun di Thailand (THL), tindak balas pelepasan karbon boleh membawa kepada perubahan positif ke atas INC. Kajian ini mendapati terdapat hubungan asimetri di antara INC, GEE, dan TD terhadap alam sekitar dalam jangka masa panjang di negara-negara ASEAN-5. Kesimpulannya, hipotesis EKC tidak menyokong bagi semua kes, tetapi dikesan dalam beberapa pembolehubah. Dalam keadaan ini, peraturan perundangan diperlukan bagi mengelakkan kemusnahan alam sekitar memandangkan mekanisme ekonomi sedia ada adalah tidak cekap dan tidak mencukupi bagi mengurangkan pelepasan karbon global.

Kata kunci: Permintaan pelancongan, Keluk Alam Sekitar Kuznets (EKC), ARDL bukan linear (NARDL), negara-negara ASEAN-5

INTRODUCTION

Tourism is one of the fastest growing industries involving millions of people across the world. Statistics from the United Nation World Tourism Organisation (2017) estimated that international tourist arrivals in 2017 reached a total of 1,322 million, an increase of 7% compared to the year before. This reflects a strong momentum and the number is expected to

grow around 4-5% in 2018 (United Nation World Tourism Organization [UNWTO] World Tourism Barometer). Since the number of tourist arrivals is increasing from year to year, the rewards gained from this sector are immense from both financial and socioeconomic aspects. Ashley et al. (2007) stated that tourism can enhance economic opportunities especially in developing countries. It contributes significantly to the economic growth by providing millions of job, thus curbing the problem of poverty, especially in developing countries. In 2015, the contribution of the tourism sector was expected to grow by 3.8% to US$684.6 billion (3% of the global Gross Domestic Product (GDP)) by 2025 with surveys displaying the positive and strong relationship between tourism development in tourism demand and economic growth in income per capita (Antonakakis et al. 2015).

In ASEAN countries, tourism sector is one of the main sources of economy. Under the domain of service economy, it is perceived as a dynamic industry that thrives the national revenues and job opportunities (Ashley et al. 2007). In a bigger context, ASEAN is a melting pot for rapid growth within the tourism sector. This fact has been proven time and again by the number of tourist arrivals that keeps increasing in parallel with national revenues. Asian travellers accounted for 77.7% of all visitors in ASEAN-5 countries (ASEAN Tourism, 2016). In 2014, the major contribution of the tourism sector to the GDP was US$458.0 billion (2.6% of the global GDP). In the following year, 2015, the tourism sector grew by 3.0%, contributing a total of US$471.6 billion to the GDP. In 2016, the tourism industry generated US$7.2 trillion (9.8% of the global GDP) and offered 284 million jobs (ASEAN Council, 2016). The economic activities growing within the tourism domain were via tourism services such as hotels, transportation services, and travel agents.

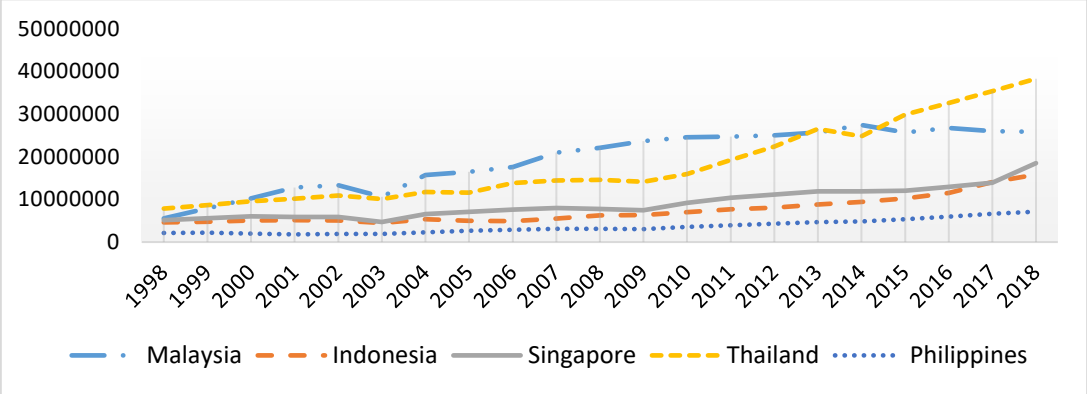


FIGURE 1. Tourist arrivals in ASEAN-5 countries
Source: World Development Indicator (2019)

Figure 1 shows the number of tourist arrivals across ASEAN countries from 1998 until 2018. Data show that Thailand and Malaysia have a prominent number of tourist arrivals in comparison to Singapore, Indonesia, and the Philippines. Thailand has the highest number of tourist arrivals in ASEAN-5 countries (38,277,300 tourists) in 2018. Meanwhile, Malaysia has the second highest number of tourist arrivals in ASEAN-5 countries (25,830,000 tourists) in 2018.

Despite its prominent contribution to the economy, the tourism sector is also a potential source of the climate change and carbon dioxide emissions globally. Holidaymakers and tourists are responsible for overcrowding, airplane emissions, foul beaches, and other environmental impacts related to the tourism activities. Furthermore, Knoema (2019) reported that, carbon dioxide emission was 8.53 metric tons in 2016. The carbon dioxide emission increased from 4.88 metrics tons in 1997 to the 8.53 metric tons in 2016 and is growing at an average annual rate at 3.09 percent. Lenzen et al. (2018) stated that global tourism is responsible for 8% of the greenhouse gas emissions, particularly the global carbon footprint was reported to increase from 3.9% to 4.5% GtCO2e which is four times higher than previously estimated. In this sense, tourism sector constitutes a growing part of the world's greenhouse gas emissions.

This study mainly examined the impact of tourism demand on the environment in ASEAN countries from 1970 until 2014. Besides tourism demand, there are also other factors responsible for the environmental issues in developing countries like government expenditure on education and economic development. These however were less addressed in previous literature. Existing studies typically used the variable of economic development to measure the status of a country. The definition of economic development as GDP is the total goods and services provided by a country in a year (Lequiller and Blades 2006). Nevertheless, this study adopted income per capita (as a proxy of economic development) to analyse the relationship between income per capita and the environment across ASEAN-5 countries, followed by the EKC hypothesis.

On the one hand, Kuznet (1995) posited that the function of EKC is to develop the linkages between income inequality and the environment. In the beginning, the EKC theory refers to developing rural, agricultural areas into urban, industrial areas. The increase number of industries enhances the concentration of pollution. With higher income and development, technological and service-centralised production is made available, thus phasing out industrial-heavy production. The advanced technology in industrial production can minimise the concentration of pollution in industrial production. Dinda (2004) explained that the economic effects of more advanced technology include the reduced level of

pollution that can increase the demand and political interests in a clean environment. By defining various aspects of EKC hypothesis, this study posited that the mechanism behind the EKC shape is observable.

Government expenditure on education (GEE) is public spending on education that includes direct expenditure on education institutions and education-related public subsidies given to households administered by education institutions. Investment in education can propel an economy higher and accelerate the rate of economic growth. GEE and tourism industry are related through several factors, for instance human capital. When a person is highly educated especially in the areas of environment and tourism, the degree of pollution can be reduced. When pollution decreases, the level of tourism demand will increase, hence leading to an increase in the GDP. This shows positive impacts on a country visited by tourists. This study explored GEE to analyse the impact of education on the environment in ASEAN countries because human capital is an essential factor in measuring the strength of an economy (Mankiw et al. 1992).

On the other note, Bose et al. (2007) argued that education is strongly significant with the economic growth, whereas Gupta et al. (2002) assessed the efficiency and the impact of government budget on the environment across ASEAN countries. Zulkofli et al. (2018) assessed the long- and short-run causality of the priority of the Malaysian government spending on education and health care, and the effects of GDP on nominal values. The study revealed that government expenditure on education co-integrated with the escalating nominal GDP values, hence proving a significant bidirectional relationship between the variables. Thus, this study agreed that government should invest in education because of its strong impact on the nation.

This study also analysed the impacts of TD, GEE, INC on the environment by employing EKC hypothesis. EKC is an inverted u-shape where the x-axis represents gross domestic product and the y-axis represents level of environment. EKC curve has become a standard feature in the technical literature of environmental policy since 1991. It states that a country's environment tends to degrade as the country grows richer. EKC theory is also related to the income per capita on the environment. This study examined to what extent the income per capita is significant and related to the level of environment, which means that EKC hypothesis is either valid or invalid in the relationship between economic growth and environment. This study argued that the strength of EKC hypothesis depends on a country's economic development.

Furthermore, this study used the nonlinear autoregressive distribution lag (NARDL) model to identify the long- and short-run asymmetric relations between tourism demand, government expenditure on education and income per capita on the environment in ASEAN-5 countries. This study differed than previous studies because it devised a new specification or equation for EKC based on what Bradford et al. (2005) developed. It hinders from using nonlinear transformations of potentially non-stationary regressors in the panel estimation. Bradford et al. (2005) asserted that EKC theory is based on the average GDP per capita and the average growth rate of GDP per capita over the sample period. Their study assumed relationships between change in environment, income, and growth rate of income at a given point in time. Based on the potential role of each variable in shaping the asymmetric, the NARDL model captured both long- and short-run asymmetric relations between income per capita, government expenditure on education, and tourism demand on the environment (Shin and Greenwood-Nimmo 2011). This feature is integral to analyse and capture both long- and short-run asymmetries in the variables (Pesaran & Shin 1999; Pesaran et al. 2001). Meanwhile, Ibrahim (2015) also use NARDL model to analyse the effects of oil price and food price. The results showed that when the oil price increases, the food price will decrease, but when the oil price decreases, the food price will remain stagnant. This is similar to EKC hypothesis that explains the fluctuation of environment and income per capita. As of now, NARDL is the best approach for this study.

The remainder of this paper is structured as follows. Section 2 presents the literature review focusing on the factors affecting the environment. Next, section 3 describes the collection of data and research method used in this study. This is followed by section 4 that shows the results and discussion, and finally section 5 concludes this study.

LITERATURE REVIEW

Environmental Kuznets curve (EKC) theory suggests that economic growth will eventually limit environmental degradation. With low GDP, the environment suffers, and this relationship turns positive when economic growth improves, for example, in the 1960s, the air was more polluted than today in New York, London, and Tokyo. In this sense, many advanced countries also shared the same pattern. Thus, it is apparent that the relationship between economic growth and environment in the EKC was an inverted u-shape as shown in Figure 2 (relationship between the average of GDP and inequality).

Moreover, Kuznet (1995) stated that EKC serves to develop the linkages between INC inequality and the environment. When both INC and the environment are positively correlated, the EKC will have an inverted u-shape. Indirectly, the opposite relationship can be observed, followed by a change in trend. EKC theory is not only useful for sulphur dioxide concentration and urban areas, but also for general environmental degradation. Stern (2004) found that most studies in the past were criticised for their limited generalisation.

In the beginning, the EKC theory refers to developing rural, agricultural areas into urban, industrial areas. The increase number of industries enhances the concentration of pollution. With higher income and development, technological and service-centralised production is made available, thus phasing out industrial-heavy production. The advanced technology in industrial production can minimise the concentration of pollution in industrial production. Dinda (2004) explained that the economic effects of more advanced technology include the reduced level of pollution that can increase the demand and political interests in a clean environment.

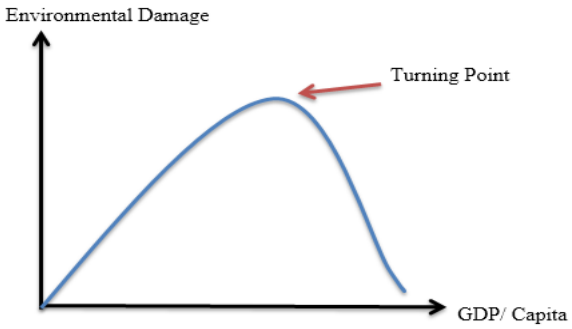


FIGURE 2. The environmental Kuznets curve (EKC)

The mechanism behind the EKC shape is observable via different definitions of aspects of the EKC hypothesis. The effect of scale is a term of the initial increase in environmental degradation when the economy grows. The increased growth of the economy will affect the level of pollution. With the increase in input and output, more natural resources will be used to indirectly increasing the pollution level (Grossman 1991). Based on the shape of the EKC, there is another variable offsetting the scale effect. This function, when added to the variable, will decrease the effects of environmental degradation while growing the economy. This mechanism can be described in many ways. For instance, the effects of technology, composition, international trade, and increased demand to clean the environment can strengthen regulations. Additionally, the effects of higher technology can cause more effective production. The benefit to the environment from the efficiency of production could motivate the development of new and more efficient technology.

Economic theory suggests that the competitive market is where firms sell their products and services at a low price. These firms must maximise their profit and reduce production costs by investing in technology. For example, research and development (R&D) and technology development support economic growth. Gardner (1996) explained the nexus of GDP and environmental degradation through the EKC theory. The study found that some cases in GDP affect the environment, in which the cases may or may not be consistent with the EKC hypothesis. Meanwhile, the different outcomes were produced due to differences in the incentives to preserve the environment. Gardner (1996) also suggested that EKC theory cannot be applied in the real world unless if it finds a strong support from policymakers and the public who want to reduce the environmental degradation.

Similar to Gardner (1996), this study explained that EKC is a hypothesised relationship between environmental quality and economic development. Various indicators of environmental degradation tend to worse off as the modern economic growth occurs until the average of INC reaches a certain point throughout the development. Changes that can be made to a country are when the development level increases and becomes parallel with technological improvement. In contrast with Cederborg and Snöbohm (2016), this study used Daly curve hypothesis to examine the relationship between INC and environment that emphasizes decreasing the environmental pollution especially in wealthier countries could be inadequate for the EKC hypothesis. This study preferred using panel data to identify factors affecting the environmental pollution while setting the environmental regulations.

Next, Selden and Song (1994) investigated the relationship between environment and GDP based on four airborne emissions. The results exhibited similar effects as that of EKC, where the INC level reduced the emission level. The study found that a turning point existed when the emission level began to decrease at a higher rate than the original. It was also argued that low-income economies take longer time to minimise the emission level.

On the one hand, Acaravci and Ozturk (2010) investigated the linkages between GDP, environment, and energy consumption in European countries using co-integration test approach in 19 countries. No evidence existed for a positive, long-run relationship except in a few countries. Thus, studies in European countries concluded that EKC hypothesis cannot be seen as a valid result.

Selden and Song (1994) analysed the relationship between INC and the environment by utilising the panel data of 130 countries. Four results were obtained, in which the first result showed the diminishing propensity to emit environment as the economy develops, but this cannot be detected using only the cross-sectional data. The second result showed that the accumulative environment will increase at the annual rate because the level of marginal propensity to emit decreases with the level of economic growth. The third result showed that low-income economies have the highest marginal propensity to emit environment. Finally, a sensitivity analysis revealed that environmental level does not change dramatically with economic growth.

In the 21st century, the environment is constantly reviewed meticulously. Many studies focused on environmental degradation, global warming, and the understanding of relationship between tourism development and environmental degradation. The global tourism sector has developed rapidly in recent years. United Nation World Tourism Organisation (2013) reported that the recent forecast of tourism sector had an average growth of 3.8% between 2012 and 2018, while World Tourism Organisation (WTO) stated that tourism is a significant contributor to global warming and climate change. Several studies identified that tourism sector is a major source of pollution, especially coming from air transportation. Scott

et al. (2008) estimated that this contributed a total of 5% from the greenhouse gases. Ironically, this sector has also become one of the victims of climate change.

Examining the effect of tourism on the economy and environment was done by analysing the relationship between specific variables through direct observation or some parallel-based analyses. Zaman et al. (2016) argued that these approaches are unable to confirm and specify the nexus of tourism development and the environment. Previous studies also highlighted that INC influences the environment whereby INC increases the level of emissions, yet Amzath and Zhao (2014) proposed a positive relationship between economic growth and the environment.

This study is important because most empirical studies examined GEE using distinct theoretical approaches. The allocation of expenditure to an associated ministry from the researchers' view is too general since it was implied generally because of the increasing population. This does not reflect the effect of solving the problem of human capital in terms of cost inflation (McCarty 1993). According to World Data Bank (2017), the population in Malaysia in 1970 was 10,881,535 of whom only 0.07% enrolled university. This study assumed that tertiary institutions in Malaysia are heavily dependent on government funds due to high living costs, hence people consider education as a second choice. This situation is very different than universities in the United States and United Kingdom, in which some of the universities are self-funded.

In the context of subsidy cost, Mitchell (2005) found that government subsidies have adverse outcomes. For example, when the government subsidises consumer goods, people spend without saving because the price of goods is low. Their study stated that productivity, accumulation, education, and healthcare increase the return on investment and create sustainable economic growth through a more productive labour force (Ifere et al. 2014). Within the context of education, this is a limited issue because this indicator was given less attention in the past. The GEE was not much examined as it uses distinct theoretical approaches.

Meanwhile, Bose et al., (2007) discovered that education is strongly significant to the economic growth, whereas Gupta et al. (2002) assessed the efficiency and impact of government budget on the environment across ASEAN countries. Zulkofli et al. (2018) assessed the long- and short-run causality of the priority of the Malaysian government spending on education and healthcare, as well as the effects of GDP on nominal values using the ARDL method. They revealed that the government expenditure on education cointegrated with the escalating nominal GDP values, hence a significant bidirectional between the variables. This study agreed that the government should invest in education due to its strong impact on the nation.

INC, GEE, and TD lead to different growth impacts, expenditures, and GDP revenues with mixture of positive or negative relationships between the variables. This study addressed the econometric issues in INC, GEE, TD, and their effects on the environment in ASEAN-5 countries. This study analysed whether INC, GEE, and TD contribute to the environmental degradation based on the EKC hypothesis using data from Malaysia, Indonesia, Singapore, Thailand, and the Philippines.

METHODOLOGY

This study focused on the ASEAN-5 countries since they have significant INC, GEE, and TD. The main factors affecting the environment in these countries were analysed. Data were collected from the Statistics Tourism Malaysia, Ministry of Tourism, World Tourism Organisation, United Nations Statistics Division, and World Development Indicators for the period between 1970 and 2014. The dependent variable was the environment, whereas the independent variables comprised INC, GEE, and TD. This study used NARDL to evaluate if EKC holds the ASEAN-5 countries based on the variables in this study.

The nonlinear ARDL model was recently developed by Shin and Greenwood-Nimmo (2014) that has positive and negative partial sum decompositions, allowing researchers to detect the asymmetric effects in the long- and short-run. Compared to the classical cointegration models, NARDL model has its own advantages. First, NARDL performs better in determining cointegration relations in small samples (Romilly et al. 2001). Second, it can be applied irrespective of whether the regressors are stationary at the level or at the first difference, i.e. I (0) or I (1). NARDL cannot be applied, however, if the regressor is I (2). Therefore, the asymmetric NARDL framework of Shin et al. (2013) is particularly suitable for this study as it allows to not only gauge the short- and long-run asymmetries, but also to detect hidden cointegration. For example, a positive shock of oil prices may have a larger absolute effect in the short-run while a negative shock has a larger absolute effect in the long-run, or vice versa.

Furthermore, in order to fulfil the research objective of this study which is to study the asymmetric cointegration and long-run relationship between GDP and the level of environment, this study adopted what Ibrahim (2015) did, whereby he adopted NARDL model that was advanced by Shin et al. (2011). This is for the analysis that captured short- and long-run asymmetric relationships between oil and food prices in Malaysia. Abdlaziz et al. (2016) also used the same approaches in examining the oil price and food prices. They discovered the estimated NARDL for the oil price in domestic currency provides strong evidence of long- and short-run cointegration between food and oil prices when the latter increase, yet the relationship for oil price reduction is absent and insignificant. These relationship and concept are similar to this study, hence researchers had already highlighted EKC issues. When GDP increases, the level of environment will increase. When GDP increases the effects of higher technology, the level of environment is decreased. This study also employed NARDL model to evaluate the short- and long-run asymmetries in ASEAN countries using data from 1970 to 2014. The advanced NARDL

cointegration approach refers to the asymmetric extension to the well-known ARDL model (Shin and Greenwood-Nimmo 2011). This feature is integral to analyse and capture long- and short-run asymmetries in the variables (Pesaran & Shin 1999; Pesaran et al. 2001). This modelling approach had been applied and is one of the advantages in this study.

THE ECONOMETRIC APPROACH

This study mainly assessed the relationship and effects of INC, GEE, and TD on the environment in ASEAN countries from 1970 until 2014. This study built a new specification or equation for the EKC developed by Bradford et al. (2005) to avoid using nonlinear transformations of potentially non-stationary regressors in the panel estimation. Bradford et al. (2005) posited that EKC approach is based on the average GDP per capita and an average growth rate GDP per capita over a sample period. Their study also assumed a relationship between change in environment, INC, and growth rate of income at a given point in time.

$$ENV / P = \alpha(GDP / P) + (y^*)g \qquad (1)$$

Based on equation (1), ENV is environment, P is population, GDP is gross domestic product, y^* shows the turning point or whether the countries develop or not, and g is growth rate. Growth rate allows the effect of pollution dynamics that depend on the growth regime. Pollution normally increases when y* is reached and decreases after the turning point. This formulation describes the inverse u-shape relationship between income and environment when $\alpha<0$. Stern (2004) argued although the level of environment differs between countries at any particular income level, the income elasticity is the same for all countries at any particular income level. This study not only tested the long-run equation or the co-integrating equation, but also investigated whether the EKC holds or not for each ASEAN country. The model and turning point, $y*$, is a function of the GEE as follows:

$$y^* = \delta_1 + \delta_2 GEE \qquad (2)$$

This equation shows the average GEE over the sample period for each country. Based on the specification, not all countries have the same turning point. The higher the index, the higher the degree of GEE. IT means that $\delta_2>0$, higher GEE will result in higher income at the turning point.

When equations 1 and 2 were combined, this study obtained:

$$ENV/P = \alpha\,(GDP/P) + (\delta_1 + \delta_2 GEE)g \qquad (3)$$

Based on the integration in equation 3, the constants of the average income, the average growth rate and the average GEE, this study obtained:

$$ENV / P = \mu + \alpha(GDP / P) + (\delta_1 + \delta_2 GEE)g \qquad (4)$$

Based on equation 5, μ is constant in the integration. This equation is obtained from equation 4 by adding the unobserved country-specific effects (μ_i), a vector of additional explanatory variables (Z) and the stochastic error term (ε_{it}). This study also estimated this model using the natural logarithm of the environment as the dependent variable. This is similar to Bradford et al. (2005) who estimated the level of environment as a dependent variable in their model. This study has:

$$\ln ENV_{it} = \mu + \beta_0 \ln INC_{it} + \beta_1 (\ln GEE) g_{it} + \beta_2 \ln Z_{it} + \varepsilon_{\mathrm{it}} \qquad (5)$$

Where the countries were indexed by the first two terms on the right side intercepting parameters that varied across countries or region i and years t. ENV_{it} is CO_2 emissions per capita in the country i in period t, INC is the country-specific measure for the INC over the sample period. While g is the country-specific average growth rate of real GDP per capita over the sample period, GEE is the country-specific average of the GEE over the sample period, and ε is an error term, and *ln* indicates the natural logarithms. This formulation is unrelated to the unsolved problem arisen in the panel regression with a nonlinear transformation of the potential non-stationary regressors (Bradford et al. 2005). This is how g is calculated. First, the period must be determined, and measuring the GDP growth rate involves calculating the increase or decrease in GDP from one year to the next. Second, the value of GDP for two consecutive years is found, and third, the following formula for growth rate is used:

$$Growth\_rate = Final\_year - Initial\_year \,/\, Initial\_year * 100$$

Last, the result must be interpreted as a percentage. Equation 5 includes a vector of the additional explanatory variable (Z). Z refers to the GEE in each ASEAN country. It captures how GEE is expected to influence the environment. It also discusses whether the openness on education expenditure influences the national development with the decrease in pollution parallel with the increase in INC.

The hypothesis of an inverted u-shape relationship can be referred in equation 5 by testing the hypothesis $\alpha=\beta 0<0$. In addition, the hypothesis on the positive relationship between INC and the environment at the turning point can be checked by testing the hypothesis $\delta 2=-\beta 2/\alpha>0$. Therefore, this should expect $\beta 2>0$ (Leitao, 2010). Based on the nonlinear approach, equation 5 can be modified and extended to become an asymmetric long-run equation:

$$ENV_t = \alpha_0 + \alpha_1 INC^+_t + \alpha_2 INC^-_t + \alpha_3 GEE^+_t + \alpha_4 GEE^- + \alpha_5 TD^+_t + \alpha_6 TD^-_t + \varepsilon_t \qquad (6)$$

Where $\alpha=(\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4)$ is a symbol of co-integrating vector parameters to be estimated. The values of positive and negative for TD and INC are generated by computing this equation:

$$INC^+_t = \sum_{i-1}^{t} \Delta INC^+_i = \sum_{i-1}^{t} \max(\Delta INC_i, 0) \qquad (7)$$

$$INC^-_t = \sum_{i-1}^{t} \Delta INC^-_i = \sum_{i-1}^{t} \max(\Delta INC_i, 0) \qquad (8)$$

$$GEE^+_t = \sum_{i-1}^{t} \Delta GEE^+_i = \sum_{i-1}^{t} \max(\Delta GEE_i, 0) \qquad (9)$$

$$GEE^-_t = \sum_{i-1}^{t} \Delta GEE^-_i = \sum_{i-1}^{t} \max(\Delta GEE_i, 0) \qquad (10)$$

$$TD^+_t = \sum_{i-1}^{t} \Delta TD^+_i = \sum_{i-1}^{t} \max(\Delta TD_i, 0) \qquad (11)$$

$$TD^-_t = \sum_{i-1}^{t} \Delta TD^-_i = \sum_{i-1}^{t} \max(\Delta TD_i, 0) \qquad (12)$$

In equation 6, the long-run relation between ENV and INC, ENV and GEE and ENV and TD are α_1, α_3 and α_5 were expected to be positive, whereas in the long-run, the relationship was negative for the variables ENV and INC, ENV, GEE, ENV, and TD are α_2, α_4, and α_6. Both coefficients were expected to have a positive sign, but they were not anticipated to have the same magnitude, e.g. $TD^+ > TD^-$. In equation 6, positive and negative represent the element of asymmetry in the ARDL model which means that the long-run relationship represented in equation 6 is asymmetric in the long-run INC, GEE, and TD through the environment. Based on Shin & Greenwood-Nimmo (2011), equation 6 can be framed in an ARDL bound test as follows:

$$\Delta ENV = \alpha + \beta_0 ENV_{t-1} + \beta_1 INC^+_{t-1} + \beta_{21} INC^-_{t-1} + \beta_3 GEE^+_{t-1} + \beta_4 GEE^-_{t-1} + \beta_5 TD^+_{t-1} + \beta_5 TD^-_{t-1} + \sum_{i=1}^{n1} \varphi_i \Delta ENV_{t-1} +$$
$$\sum_{i=1}^{n2} (\theta^+_i \Delta INC^+_{t-i} + \theta^-_i \Delta INC^-_{t-i}) + \sum_{i=1}^{n3} (\theta^+_i \Delta GEE^+_{t-i} + \theta^-_i \Delta GEE^-_{t-i}) + \sum_{i=1}^{n4} (\theta^+_i \Delta TD^+_{t-i} + \theta^-_i \Delta TD^-_{t-i}) + \mu_t \qquad (13)$$

Where all variables defined above $\alpha_1 = -\beta_1/\beta_0,\ \alpha_2 = -\beta_2/\beta_0,\ \alpha_3 = -\beta_3/\beta_0,\ \alpha_4 = -\beta_4/\beta_0,$ were the long-run impacts of TD and INC increased or reduced in the environment. $\sum_{i=1}^{n2} \theta^+_i$ measured the short-run influences of increase INC on the environment while $\sum_{i=1}^{n2} \theta^-_i$ \ measured short-run influences of the decreased INC on the environment. Next, $\sum_{i=1}^{n3} \theta^+_i$ measured the value in the short-run influences of increase in GEE on the environment, whereas $\sum_{i=1}^{n3} \theta^-_i$ measured the short-run influences

of a decrease in GEE on the environment. $\sum_{i=1}^{n4}\theta^{+}_{i}$ measured the short-run influences with the increase in TD on the environment, whereas $\sum_{i=1}^{n4}\theta^{-}_{i}$ measured the short-run influences in the decrease of TD on the environment. In addition, the asymmetry in the long-run relation and the asymmetries in the short-run influence of INC, GEE, and TD changes on ENV were captured.

Based on Dinda (2004), the trend of the relationship between the environment and INC can be determined in some of the forms. First, when $\beta_1=\beta_2=0$, it indicates that there is no relationship between the environment and INC. Second, when $\beta_1>0$ *and* $\beta_2=0$, it represents the increasing relationship or a linear relationship between INC and the environment. Third, when $\beta_1<0$ *and* $\beta_2=0$, it refers to a decreasing relationship between INC and the environment. Fourth, when $\beta_1>0$ *and* $\beta_2<0$, it indicates the inverted u-shape relationship or EKC curve and when $\beta_1<0$ *and* $\beta_2>0$, it indicates a U-shaped relationship and the turning point can be calculated by $Y= (-\beta_1/2\beta_2)$.

This study adopted the NARDL approach. First, it determined the order of integration of the variables; this study employed the unit root. In this case, although the ARDL approach to cointegration was applicable (variables are *I (0)* or *I (1)*), this test was still necessary such that no *I (2)* variable was involved. Therefore, this study applied and used the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root test as it is essential for establishing the variable orders of integration. This study also chose the lag length based on the information criteria Akaike Information Criterion (AIC) or SIC. Second, a test for the presence of cointegration in the long-run and the short-run relation between the environment and its determinant was done using a bound test approach proposed by (Shin and Greenwood-Nimmo 2011). The calculated Wald test statistic was conducted by assuming the null hypothesis of joint significance where $H_0: \beta_1= \beta_2= \beta_3= \beta_4=0$. Pesaran et al. (2001) argued when the F-statistic is greater than the upper bound critical value, the result shows that there is a cointegration relationship between ENV and macroeconomic variables. Third, when the variable is cointegrated, equation 6 was estimated using the Stepwise Least Square (STEPLS) method. From the result of NARDL estimation, this study can estimate whether the EKC holds or not for each ASEAN country. Also, from the NARDL, this study can check the turning point by calculating the long-run equation.

THE DATA

This study employed four variables; CO_2 emission (ENV), tourism demand (TD), government expenditure on education (GEE) and income per capita (INC). All data were obtained from Statistic Tourism Malaysia, Ministry of Tourism, World Tourism Organisation, United Statistic Division, and World Bank Indicators from 1970 until 2014.

TABLE 1. Description and unit of data

Variable	Data Description	Unit of Measurement (Sources)
ENV	Carbon Dioxide Emission	Value of Metric Tonnes
TD	Tourism Demand	Total of Tourist Arrivals
GEE	Government Expenditure on Education	Percentage of GEE
INC	Income per capita	Gross Domestic Product

Source: World Development Indicator (2017)

In this study, carbon dioxide (CO_2) emission is used as a proxy for environment, which refers to the rate of reaction between hydrochloric acid and calcium carbonate. It is calculated from the total concentration of CO_2 emissions (metric tonnes) divided by the population of each country (Stern 2004). Solomon et al. (2009) stated that one of the contributors to global warming and local environmental degradation is CO_2. Their study stated that the relationship between the environment with TD and INC was negative. The income per capita was calculated based on the GDP divided by the population of each country. The increase in INC encourages higher environmental degradation to occur because the function of INC is to measure the status of economics in environmental economics. The government expenditure on education is calculated using GEE in each ASEAN-5 country. The value of GEE was multiplied with the growth rate to get the value of GEE. The growth rate is calculated as follows: Final year minus the initial year and divide by the initial year. Next, that value must be multiplied by 100 to get the value in percentage. The total of tourism demand is calculated using the total TD in each ASEAN-5 country. It is expected that the rapid increase in tourism demand will be accompanied by an increase in CO2 emissions.

RESULTS AND DISCUSSION

This study employed the annual data from 1970 until 2014 and focused on ASEAN-5 countries, i.e. Malaysia (MLY), Indonesia (IND), Singapore (SNG), Thailand (THL), and the Philippines (PHL). The main factors affecting the environment (EKC hypothesis) in these countries were analysed. Data were collected from Statistics Tourism Malaysia, Ministry of Tourism, World Tourism Organisation, United Nations Statistics Division, and World Development Indicators for the period between 1970 and 2014. The dependent variable was environment, whereas the independent variables comprised INC, GEE, and TD.

The advanced of NARDL is an asymmetric extension to the ARDL model (Shin and Greenwood-Nimmo 2011). This feature is important to analyse and capture the long- and short-run asymmetries in the variables (Pesaran & Shin 1999; Pesaran et al. 2001). This study adopted this modelling approach and initially applied the unit root tests.

UNIT ROOT TEST

An analysis was conducted by employing the unit root test for the variables, including constant at first difference using ADF and PP tests. The ADF and PP tests proposed by Phillips and Perron (1988) was utilised to test the null hypothesis that a time series was integrated of order 1. The unit root test and the selected model were necessary as they were performed on the time series. The results of unit root test are illustrated in Table 2 and shows that the series is a mixture of *I (0)* and *I (1).*

TABLE 2: Results from unit root tests

Variables/Country	MLY	IND	SNG	THL	PHL
Augmented Dickey-Fuller (Level)					
ENV	-2.0405	-3.6200**	-2.8222	-1.4910	-3.2668*
INC	-1.4489	-2.2783	-1.8244	-1.0330	-1.5365
GEE	-5.9789	-1.5058	-5.2764***	-5.3247***	-4.7716***
TD	-3.8302**	-1.2969	-2.9411	-2.4988	-2.1698
Augmented Dickey-Fuller (First-difference)					
ENV	-7.9867***	-6.0821***	-6.6019***	-4.7931***	-6.0051***
INC	-5.8208***	-4.7057***	-5.5518***	-4.0462**	-3.2164***
GEE	-5.7175***	-8.0348***	-3.8659**	-5.4134***	-3.9997**
TD	-6.5505***	-4.9874***	-5.9970***	-1.144702***	-5.1985***
Phillips-Perron (Level)					
ENV	-2.0365	-2.5139	-2.6582	-1.2317	-1.7334
INC	-1.5135	-20253	-1.8244	-0.6772	-1.5044
GEE	-5.9472***	-4.1479**	-5.2544	-5.5147***	4.5873***
TD	-4.3201***	-1.4123	-2.9411	2.3176	1.9383
Phillips-Perron (First-difference)					
ENV	-7.9774***	-6.9461***	-8.5527***	-4.7991***	-6.0634***
INC	-5.8208***	-4.7649***	-5.5749***	-4.0549**	-3.6361**
GEE	-35.8111***	-13.6186***	-20.3031***	-23.2034***	-24.8010***
TD	-8.3462***	-5.0760***	-6.0053***	-7.4826***	-4.5469***

Note: ***, **, * significant at 1%, 5%, and 10% level respectively

This study included constant and trend terms and employed the AIC with the function of the optimal lag order in testing the ADF equation. This study used AIC since it is a good model. According to Akaike (1974), AIC is the technique to estimate the likelihood model to predict future values. It also estimates the quality of each model relative to another and provides a means for the model selection. Both the ADF and PP tests were in agreement that the ENV, GDP, GEE, and TD were integrated of order 1. Based on the result, the ADF test indicated a stationary level while the PP test showed that the result was stationary after first differencing. This study continued to the next step, which was a bound testing procedure after this test indicated that none of the variables in this study was *I (2).*

BOUND TEST

Before any conclusions were described, checking whether the variables were cointegrated or not was important; the coefficients were spurious if the variables were not cointegrated. Cointegration under NARDL was tested using joint null hypothesis of the level (non-difference) variables before the critical values of bound testing were compared (Shin and Greenwood-Nimmo 2011; Pesaran et al. 2001). This study assumed that cointegration exists when F-statistic is greater than the critical value. Otherwise, cointegration is absent if F-statistic is lower than the critical value.

TABLE 3. Results of the bound tests

(ENV, INC, GEE, TD)	F-statistic		Outcome
MLY	22.0363***		
IND	13.5515***		
SNG	10.7290***		Cointegration
THL	13.3908**		
PHL	11.5006***		
Critical values (percent)	Lower I (0)	Upper I (1)	
1	4.29	5.61	
5	3.23	4.35	
10	2.72	3.77	

Note: ***, **, * significant at 0.01, 0.05, and 0.10 level respectively

The results showed that the calculated F-statistics were 22.0363 (MLY), 13.5515 (IND), 10.7290 (SNG), 13.3908 (THL) and 11.5006 (PHL). This study used case III because it represents the environmental model as a constant in NARDL (the intercept was not restricted). k is the number of long-run regressors, and the k lies between 1 to 6. This study had six independent variables in the long-run equation of the environment model: INC_P, INC_N, GEE_P, GEE_N, TD_P, and TD_N, and this study chose k=3. k=3 was chosen because it had three variables. Shin and Greenwood-Nimmo (2011) stated that if the null hypothesis of the cointegration is rejected by a smaller critical value, it means that there is a strong evidence of cointegration in the result. In the ENV model, this study chose k=3, but for a large number of variables, set k was equal to the number of regressors before decomposition. Based on the bound test result, the calculated F-statistics of 22.0363 (MLY), 13.5515 (IND), 10.7290 (SNG), 13.3908 (THL), and 11.5006 (PHL) were larger than the critical value 5.61 at 1% significance level. There was a strong evidence of cointegration at 1%. This finding is parallel with Wang et al. (2011) and Han and Lu (2009).

LONG- AND SHORT-RUN ESTIMATION COEFFICIENT

Based on the nonlinear ARDL estimation, this study evaluated the adequacy of the dynamic specification from several diagnostic statistics which include LM test statistic for autocorrelation. ARCH test statistic finds the autoregressive conditional heteroscedasticity while *Jarque-Bera* statistic finds the error normality. Both of LM test and the ARCH test was up to order 2. This study also included the graph of CUSUM and CUSUM square statistic to test the stability of the model. The results showed that all variables passed all of the diagnostic tests that show the error normality absence of autocorrelation, ARCH effect, and parameter stability.

TABLE 4. Nonlinear ARDL estimation results

Variables/ Country	MLY (3,3,4,4)	IND (3,3,4,4)	SNG (3,3,3,3)	THL (2,2,2,1)	PHL (1,3,2,1)
Long-Run Estimation					
C	0.0293	-2.1737***	0.7419***	-0.2791***	-0.1838***
ENV(-1)	-2.3584***	-6.0912***	-0.9241***	-0.7090***	-0.6717***
INC_P(-1)	3.6701***	14.8913***	1.0239***	1.3922***	-0.4440***
INC_N(-1)	-19.1296***	-31.3847***	31.4145***	-1.0185	1.4086**
GEE_P(-1)	-2.5598***	-1.1185***	-1.1274***	-0.0850***	-0.0477
GEE_N(-1)	-1.5686***	0.5355***	-1.4662***	-0.0192	-0.1753***
TD_P(-1)	0.8644***	-3.3924***	-1.1224***	-0.4520***	-0.0101
TD_N(-1)	2.1203***	6.7940***	3.3531***	0.6824	1.2038***
Short-Run Estimation					
DENV(-1)	-	4.4664***	-	0.3090	-
DENV(-2)	3.4396***	0.5466	-	-0.0947	-
DENV(-3)	1.6718***	-0.9237***	-		-
DINC _P	12.4311***	14.9579***	-	1.7872***	3.5196***
DINC _P(-1)	19.5301***	-21.1915***	-4.7162**	-1.1315	1.2423**
DINC_P(-2)	-7.2791***	-27.2081***		1.2869**	1.0547*
DINC_P(-3)	-4.0200***	23.4945***	5.9756**	-	-
DINC_N	-16.4861***	-12.6251***	31.3690	0.7447	-
DINC_N(-1)	-	10.6808***		-1.2652**	-
DINC_N(-2)	17.3928***		-23.4942	-0.5283	-
DINC_N(-3)	-	-38.6081***	-23.1666**	-	-
DGEE_P	-1.1434***	-1.4833***		-	-0.0616**
DGEE_P(-1)	0.0837**	-	0.9458	0.0780*	
DGEE_P(-2)	-	1.0695***	0.2465**	0.0409	-0.0144
DGEE_P(-3)	0.1324***	-	-	-	-
DGEE_P(-4)	0.1072***	0.2443***	-	-	-
DGEE_N	0.3367***	0.6742	-0.2240	-0.0565	-0.1085***
DGEE_N(-1)	0.5558	1.3457***	1.3814	-	0.0441
DGEE_N(-2)	0.0911**	2.5512***	1.4600	-	-
DGEE_N(-3)	-	0.8186	0.6713	-	-
DGEE_N(-4)	0.0417**	-	-	-	-
DTD_P	2.4671***	-1.2057***	1.3690	-	-0.1901
DTD_P(-1)	0.3659**		-	0.3524**	-
DTD_P(-2)	1.6403	-0.8978***	-	-	-
DTD_P(-3)	-0.4296***		-	-	-
DTD_P(-4)	1.5149***	0.5528***	-	-	-

DTD_N	1.2468***	-	-	-0.8396*	0.9803*
DTD_N(-1)	-	-	-	-0.8768	-0.5892
DTD_N(-2)	0.7026**	-1.9092**	-	-	-
DTD_N(-3)	3.2670***	-6.8399***	-1.8778**	-	-
DTD_N(-4)	1.8616***	-3.9052***		-	-
R^2	0.9805	0.9643	0.8525	0.8754	0.8063
LM (1)	1.0806	0.0616	0.1338	1.5169	0.5589
LM (2)	1.3463	0.5972	2.3897	1.6304	1.4597
J-B	16.5427	4.7920	2.9396	0.5608	12.1554
ARCH (1)	1.8560	1.9246	6.8635	1.8095	0.0185
ARCH(2)	2.9226	0.9166	4.4382	1.0569	0.7296

Note: ***, **, * significant at 1%, 5%, and 10% level respectively.

When applying the general-to-specific procedure, the nonlinear model was estimated based on equation 6, with the results shown in Table 4. This model enabled the assessment of the environment and its response to positive and negative changes in INC, GEE, and TD. As presented in Table 4, this result showed that all variables were important factors affecting the environment in ASEAN countries. This finding was in accordance with the nonlinear approach that showed whether all variables hold the EKC hypothesis or not in ASEAN countries. From the results, this study showed that both in the long- and short-run support the EKC hypothesis in Malaysia. In Malaysia, the finding further indicated that a 1% increase in INC_P was related to the increase in the environment by 3.67%. Different from the INC_N, the 1% increase in the variable of INC was related to a decrease in the environment by 19.13%. The results for INC_P and INC_N showed it was significant on the environment in Malaysia, while for GEE_P and GEE_N, the results showed it was negative and significant to the environment by 2.56% and 1.57%. For TD_P and TD_N, the results show that there was a positive and significant relationship with the environment by 0.86% and 2.12%. More specifically, the long-run NARDL estimation for Malaysia showed that all variables were significant to the environment. The result also showed that INC_N, GEE_P, and GEE_N lead to the decrease in the environment while INC_P, TD_P, and TD_N lead to the increase in the environment. In Malaysia, the results showed that INC_N had a higher value with the decrease of the environment by 19.13%, while TD_N showed a higher value with the increase of the environment by 2.12%. These results were in line with Saboori et al. (2012) which stated that Malaysia supports the EKC hypothesis with an inverted u-shape in the relationship between environment and GDP in both long- and short-run.

Malaysia's results were parallel with Indonesia's results. Indonesia has a significant relationship between economic performance and the environment. This means that the results of all variables in Indonesia were significant to the environment. In Indonesia, this finding indicated that a 1% increase in INC_P increased the environment by 14.89%. In contrast, a 1% increase in INC_N decreased the environment by 31.38%. While for GEE, the result shows that a 1% increase in GEE_P decreased the environment by 1.12%, and a 1% increase in the GEE_N decreased the environment by 0.54%. Normally, tourists travel to certain destinations and affect the environment. However, in Indonesia, the 1% increase in TD_P decreased the environment by 3.39%. Meanwhile, for the negative changes in TD, the 1% increase in TD_N increased the environment by 6.79%.

For the short-run, results in Indonesia showed only INC_P, INC_N, GEE_P, and TD_P were significant to the environment. INC_N had a higher value with the decrease in the environment by 31.38%, while INC_P increased the environment by 14.89%. This value was relatively higher compared to other countries. Johnson (2014) believed that Indonesia is already a significant global emitter yet still at a very low point on the EKC in terms of GDP per capita. As this is still at an early stage, the relevant authorities must concentrate and focus on the Indonesia's environment to avoid further potentially irreversible environmental degradation. Wijayanti and Sugiyanto (2018) stated from 1995 until 2014, the GDP and environment did not prove the Kuznets hypothesis in Indonesia.

On the one hand, Singapore's results showed all variables were significant to the environment. Singapore is physically a small country but its national revenue is the highest of all ASEAN countries. It is a big economy with a modern city. In Singapore, a 1% increase in INC_P and INC_N increased the environment by 1.02% and 31.41%. Different from the GEE result, this result showed that the 1% increase in GEE_P and GEE_N decreased the environment by 1.13% and 1.47%. While for TD in positive and negative changes, the results showed that the 1% increase in TD_P decreased the environment by 1.12%, and 1% increase in TD_N increased the environment by 3.35%. GEE_N had the largest decrease in the environment with 1.47%, while INC_N had the largest increase in the environment with 31.41%. This study is significant for Singapore in the long-run. These results also Sam (2016) which is the Granger causality flows from GDP to the environment, and that the EKC only exists in the long-run.

Next, Thailand's results showed only INC_P, GEE_P, and TD_P were significant to the environment. A 1% increase in INC_P was related to an increased environment by 1.39%, while for GEE, the result showed that a 1% increase in GEE_P decreased the environment by 0.09%. Only TD had a positive and significant effect on the environment. A 1% increase in TD_P decreased the environment by 0.45%. In the short-run, these showed that only INC_P and TD_N were significant to the environment in Thailand. In the long-run, TD_P showed the highest decrease in the environment by 0.45%, while INC_P showed the highest increase in the environment by 1.39%. These results supported Arouri et al. (2013) who found significant cointegration among the economic growth in the presence of EKC hypothesis in Thailand.

Finally, the Philippines' results showed only INC_P, INC_N, GEE_N, and TD_N were significant to the environment, having 1% increase in the INC_P will decreased the environment by 0.44%. Meanwhile for INC in negative change, the result showed that the 1% increase in INC_N increased the environment by 1.41%. The GEE in negative changes had a negative effect on the environment. It showed that the 1% increase in GEE_N decreased the environment by 0.18%. For TD in the negative change, the 1% increase in TD_N increased the environment by 1.20%. In the long-run, the result showed the variable of INC_P had caused the highest decrease in the environment by 0.44%, while INC_N had caused the highest increase in the environment by 1.41%. For the short-run, the results showed that INC_P, GEE_P, GEE_N, and TD_N were significant to the environment in the Philippines. This is different from Chung et al. (2017) who examined the linkages between EKC and GDP by sector (agriculture, manufacture, and service) in ASEAN-5 countries. Only the GDP in manufacturing and agriculture sectors were proven to have a positive, bi-directional causal relationship in the short-run. However, there was no significant result to explain the relationship between all three sectors in the long-run. Table 4 shows the results for all variables in each country which were significant to the environment, but in Thailand, the INC_N, GEE_N, and TD_N were not significant to the environment. This situation is similar to the Philippines, whereby GEE_P and TD_P were not significant to the environment.

LONG-RUN EQUATION IN ASEAN-5 COUNTRIES

This section presents the long-run coefficient calculation, whereby the coefficient was calculated based on β_n/Y for all regression models. Each coefficient value was divided by the negative value of the coefficient for INC_P, INC_N, GEE_P, GEE_N, TD_P, and TD_N using the coefficient of ENV (-1). The long-run equations or the co-integrating equations for ASEAN-5 countries are as follows:

Malaysia

$$Y = \alpha + INC\_P\ (1.5562) + INC\_N\ (8.1113) + GEE\_P\ (1.0854) + GEE\_N\ (0.6651) + TD\_P\ (0.3665) + TD\_N\ (0.8990)$$

Indonesia

$$Y = \alpha + INC\_P\ (2.4447) + INC\_N\ (5.1524) + GEE\_P\ (0.1836) + GEE\_N\ (0.0879) + TD\_P\ (0.5569) + TD\_N\ (1.1154)$$

Singapore

$$Y = \alpha + INC\_P\ (1.1080) + INC\_N\ (33.9947) + GEE\_P\ (1.2199) + GEE\_N\ (1.5866) + TD\_P\ (1.2146) + TD\_N\ (3.6285)$$

Thailand

$$Y = \alpha + INC\_P\ (1.9636) + INC\_N\ (1.4365) + GEE\_P\ (0.1199) + GEE\_N\ (0.0271) + DA\_P\ (0.6375) + TD\_N\ (0.9625)$$

Philippines

$$Y = \alpha + INC\_P\ (0.6610) + INC\_N\ (2.0971) + GEE\_P\ (0.0710) + GEE\_N\ (0.2610) + TD\_P\ (0.0150) + TD\_N\ (1.7922)$$

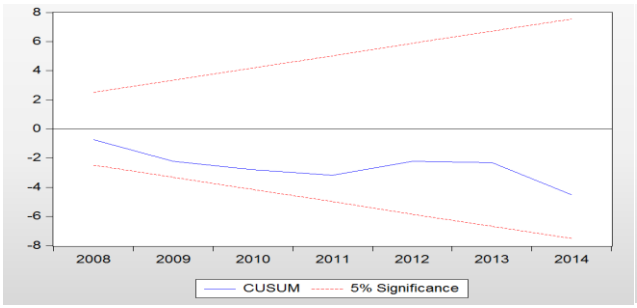
The equations can be explained as follows:

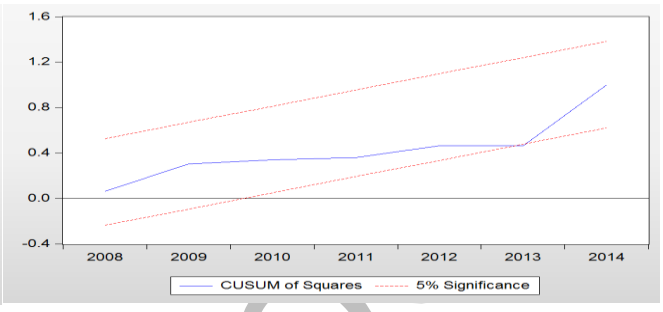
For Malaysia, 1% increase in INC led to 1.56% increase in the environment (+ve relationship), and 1% decrease in INC led to 8.11% increase in the environment (-ve relationship). On the other note, a 1% increase in GEE led to 1.09% increase in the environment (+ve relationship) and 1% decrease in GEE led to 0.67% decrease in the environment (-ve relationship). The 1% increase in TD leads to a 0.37 percent increase in the environment (+ve relationship), and a 1 percent decrease in TD leads to 0.90 percent decrease in the environment (-ve relationship). The interpretation of the equation for other countries was similar with Malaysia except for the coefficient values.

Based on the results, for all countries, the environment response had a negative effect on the change in INC for MLY, IND, SNG, and PHL. In THL, the environment response had a positive change in INC. The percentage value of INC_N was higher than the values of other variables which means that the degrees of INC decreased the environment by 8.11% (MLY), 5.15% (IND), 33.99% (SNG) and 2.10% (PHL). In THL, the percentage value of INC_P was higher than the value of other variables which means that the degrees of INC increased the environment by 1.96%. In other words, INC_P and INC_P are generally more applicable in the long-run in ASEAN countries.

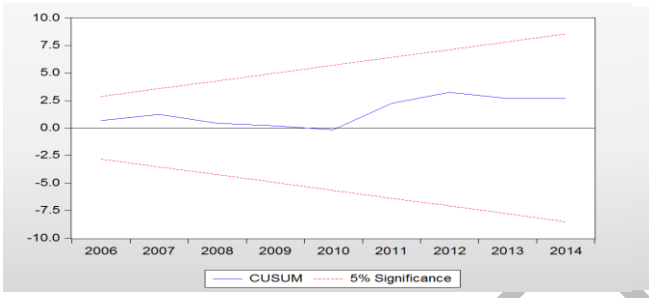
This study performed several diagnostic tests to assess the adequacy of the dynamic model. The results of this study showed the values of R^2 were 0.98 (MLY), 0.96 (IND), 0.85 (SNG), 0.87 (THL), and 0.80 (PHL). MLY and IND performed better than other countries because MLY and IND explained more than 90% by the explanatory variables for INC, GEE, and TD. The power of independent variables to explain the changes in the dependent variable was one of the functions of R^2. The results for serial correlation LM test also showed the absence of autocorrelation in the residuals. Likewise, autoregressive conditional heteroscedasticity ARCH demonstrated that the residuals in this test had constant variance over time. Meanwhile, Jarque-Bera and Ramsey RESET test results showed that the model was correctly specified with the error following the normal distribution.

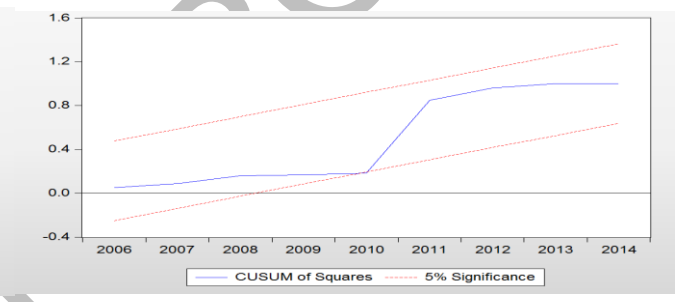
CUSUM AND CUSUM SQUARE



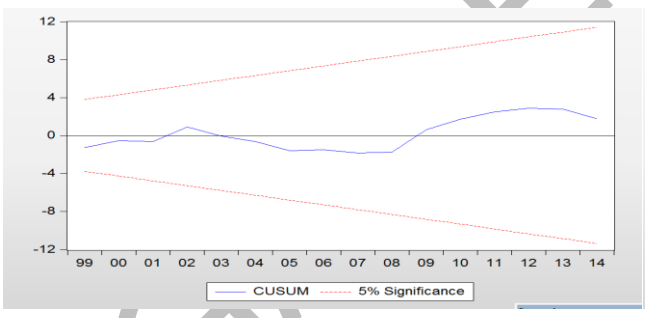


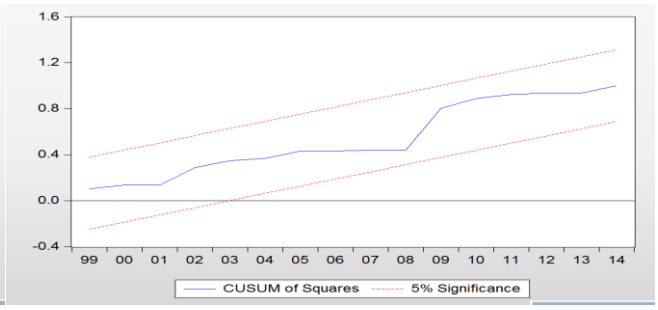
Malaysia



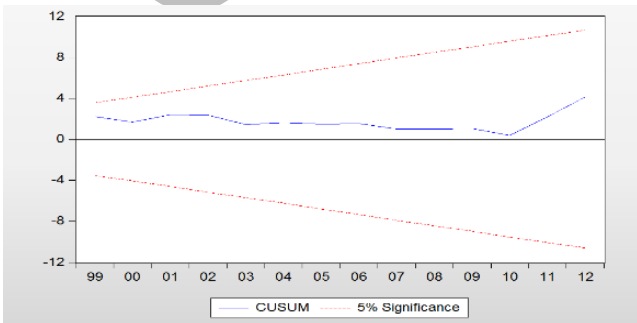


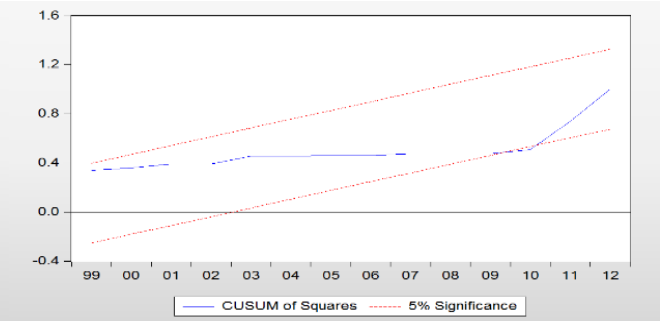
Indonesia



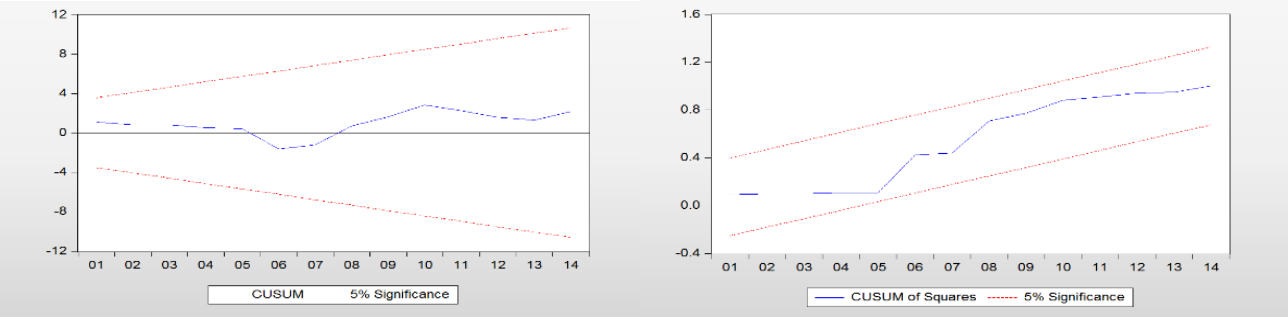


Singapore





Thailand



Philippine

This results were reinforced by the CUSUM and CUSUM square test. CUSUM test served to stabilise the model. In this case, the tests revealed the existence of stability in the model because the coefficients' estimated model laid within 5% significant line for the CUSUM and CUSUM square tests. This results were similar with findings from Lacheheb (2016).

TURNING POINT

Table 5 illustrates the results of the turning point obtained from NARDL estimation results in Table 4. Here, the EKC did not hold for all cases. This study detected the u-shape and another variable with the increasing trend without any turning point in certain variables.

TABLE 5. Turning point

Variables/ Country	MLY	IND	SNG	THL	PHL
INC	0.0959[c]	0.2372[c]	---------[b]	0.6835[c]	0.1576[a]
GEE	---------[b]	1.0444[a]	---------[b]	---------[b]	---------[b]
TD	---------[b]	0.2497[a]	0.1674[a]	0.3312[a]	0.0042[a]

a Represent the u-shape
b Increasing trend, no turning point
c Represent the inverted u-shape

Based on Table 5, the turning point in Thailand was higher than in other countries. Thailand's variable of INC had a higher turning point of an inverted u-shape, while in Malaysia the INC had the lowest turning point of an inverted u-shape. Arouri et al. (2013) found that the results for EKC existed and the graph showed that economic growth increased in the environment initially. After that, the graph of the environment began to decline once the threshold INC level had been achieved. Their study analysed causality testing and bidirectional between energy consumption, trade openness, urbanisation, and environment. The presence of EKC in Thailand occurred because of the economic growth within Granger-causes environment.

ASYMMETRIC COINTEGRATION TEST

Based on the result, both positive and negative changes had a long-run positive effect on ENV. This study tested for asymmetry in the case if either the coefficients were equal or not. There was no asymmetry if the value was equal, vice versa. This study calculated the long-run coefficient for INC_P, INC_N, GEE_P, GEE_N, TD_P and TD_N by -c (3) /c (2) =-c (4) /c (2) =-c (5) /c (2) =-c (6) /c (2) =-c (7) /c (2) =-c (8) /c (2), respectively.

TABLE 6: Results of the asymmetry test

(ENV, INC, GEE, TD)	F-statistic
MLY	210.05***
IND	874.03***
SNG	24.98***
THL	41.24***
PHL	22.13***

Note: ***, **, * significant at 0.01, 0.05, and 0.10 level respectively

Table 6 demonstrates the calculated F-statistic for all ASEAN-5 countries which were positive and significant. This means that the null hypothesis of equality was rejected and the p-value was less than 0.01. This test indicated that the results were asymmetry for the long-run impacts for INC, GEE, and TD on the environment in ASEAN-5 countries.

CONCLUSION

This study examined the effects of INC, GEE, and TD on the environment in ASEAN-5 countries from 1970 until 2014 using NARDL method. Based on the potential roles of each variable in shaping asymmetry, the nonlinear ARDL model was used to analyse and capture both long- and short-run asymmetric relationships between TD and INC on the environment. This study also analysed whether the EKC hypothesis holds the ASEAN countries using different variables. Next, it compared the results between ASEAN countries and examined which countries affect the environment more, and finally this study analysed whether all variable have asymmetry for the environment in the long-run in ASEAN countries.

In the long-run, the environment responded more to a negative change in the variable of INC for MLY, IND, SNG, and PHL. However, in THL, the environment response had a positive change in INC. Meanwhile, this study also performed a diagnostic test to assess the adequacy of the dynamic model. This study showed that the MLY and IND are better than other countries because based on the R^2 results, MLY and IND were explained more than 90% by the explanatory variables for INC, GEE, and TD. On the other note, the results of LM test, ARCH test, and the Jarque-Bera test showed that the condition for each test is good. For CUSUM test, the tests showed stability in the model coefficients as the estimated model lies within the 5% significant range for the CUSUM and CUSUM square test. These results supported findings by Shahbaz et al. (2015).

This study also analysed if the EKC holds or not in all cases. The results showed that EKC does not hold for all cases. This study detected u-shape and other variables with the increasing trend without any turning point in certain variables. It was found that Thailand's INC has the highest turning point than other ASEAN countries with an inverted u-shape, while Malaysia's INC has the lowest turning point with an inverted u-shaped. Mazzanti et al. (2007) found different shapes of EKC for different sectors. Service sector tends to present an inverted N-shape. From the results and analysis, this study found evidence of the presence of asymmetries in the long run. The asymmetry test examined if the value of the coefficient is equal or not. The null hypothesis of equality from this result is rejected and the p-value is less than 0.01, indicating that there is asymmetry in terms of the long-run impact for INC, GEE, and TD on the environment in ASEAN-5 countries.

The level of environmental degradation increases on a daily basis across ASEAN-5 countries. Hence, each country should begin addressing this alarming problem. Several years ago, a few approaches were adopted by the Malaysia government to address the rising level of environmental degradation which include systematic planning and waste management, law enforcement and technology advancement to reduce the use of insecticides and air conditioners.

Other than the environmental issues, this study showed that all ASEAN-5 countries have their unique ways of determining the effect of INC on the level of environmental degradation. By using the NARDL model by Pesaran et al. (2001), this study also proved either or not all ASEAN-5 countries hold the EKC theory. In this case, each country can improve towards balancing the factors of INC and the environmental degradation until all ASEAN-5 countries become developed nations.

At the same time, this study observed the approaches that need further attention. From the policy perspective, attention should be given on systematic planning, waste management, and law enforcement. The responsible parties should be alert about any environmental issues because market economy mechanism is inadequate to prevent environmental degradation. This calls for stringent regulations. As for the implications of government policies, the ASEAN-5 governments should cooperate to enhance their services and quality standards. Finally, policymakers must closely monitor all environmental services by formulating effective policies on tourism safety and security in order to cope well with the increasing tourism demand.

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