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Article

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International Journal of Energy Economics and Policy

Provided in Cooperation with:
International Journal of Energy Economics and Policy (IJEEP)

Reference: Chaisri Tarasawatpipat/Witthaya Mekhum (2021). Rethinking the reasons of greenhouse gases emission in ASEAN countries : finding reasons in urbanization, industrialization and population growth. In: International Journal of Energy Economics and Policy 11 (1), S. 544 - 550.
https://www.econjournals.com/index.php/ijeep/article/download/10688/5637.
doi:10.32479/ijeep.10688.

This Version is available at:
http://hdl.handle.net/11159/8150

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International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2021, 11(1), 544-550.

Rethinking the Reasons of Greenhouse Gases Emission in ASEAN Countries: Finding Reasons in Urbanization, Industrialization and Population Growth

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Received: 26 August 2020 **Accepted:** 08 November 2020 **DOI:** https://doi.org/10.32479/ijeep.10688

ABSTRACT

Recently, more of the greenhouse gases emission has been seen within ASEAN countries. Basically, there are different factors that can cause greenhouse gas emissions. Some of the reasons of greenhouse emission can be industrialization, urbanization, population growth, manufacturing processes, energy consumption etc. In this research paper, the impact of urbanization, industrialization, population growth on greenhouse gases emission has been analyzed. This analysis has been done in the context of Brunei, Laos, Cambodia, Indonesia, Myanmar, Malaysia, Philippines, Vietnam, Singapore and Thailand – the ASEAN countries. The methodology used for the analysis is the bootstrap panel causality test, LM panel test of co-integration, panel unit root test of Pesaran and Shin that permit cross-sectional dependency. The outcomes of the research have proposed that hypothesis of emission of greenhouse gases is valid in Vietnam, Indonesia and Laos. However, these factors play less significant role in greenhouse gas emission in Philippines, Malaysia and Myanmar. These factors have some impact over greenhouse gas emission in Brunei, Cambodia and Singapore too. Based on the overall analysis given in the research, it can be stated that urbanization, industrialization and population growth do have an impact over the greenhouse gas emission.

Keywords: Greenhouse Gas Emission, Gross Domestic Product, Urbanization, Industrialization, Population Growth
JEL Classifications: P25, O14

1. INTRODUCTION

During previous few years, the GDP of different ASEAN countries got increased from around 4 to 7%, as an outcome of the rapid transformation in the overall structure. As part of the given procedure, valued added through industry and services get developed 2 times than the agriculture rate. As an outcome, a drastic change is seen in the living standards of individuals, with a decrement in rates of poverty. This alteration in the living standards, in rates of urbanization and in movement which is made towards such economies driven through services and industries result into the emission of greenhouse gases in ASEAN countries. This kind of transformation also gets underpinned through exploiting natural resources within the ASEAN countries. Such emissions within the region are faster just like the development of economy. It increases to around 5% every year (Ahmad et al., 2018). The fastest regions having emission growth are transportation, manufacturing and electricity that are the sectors linked with the structural transformation of region. However, emissions' largest share gets driven through the use of land, which compromises 55% emissions of year 2010 (Baker, 2018). It is getting developed at a faster rate when referring to the emissions of carbon dioxide. Most of the given emissions get rise through degradation of land and deforestation in Indonesia. Outside Indonesia, the usage of land accounts for least amount of emissions, with use of energy driving more of the emission within Vietnam, Thailand and Philippines.

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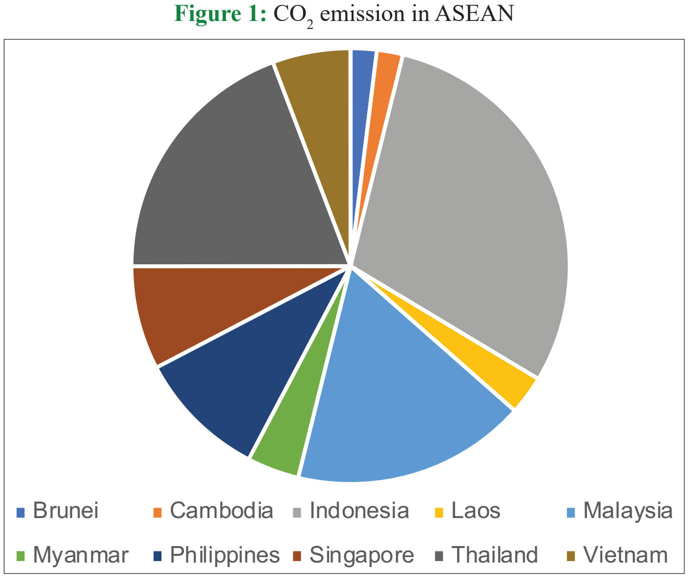
ASEAN countries are getting urbanized day by day. Today, around 41.8% of the total population of the region or around 245 million of the individuals lives within urban regions.

In year 1950, this grew up to around 15.4% (Carlson et al., 2017). An increment of around 49.7% will be made in the urban population of ASEAN countries in year 2025. However, there will be different levels of urbanization. The most advanced countries such as Singapore, Malaysia and Brunei have higher urbanization levels. Vietnam and Timor-Leste have lower level of urbanization. There is higher rate of growth of least urbanized countries. The Northeast Asia is getting industrialized and currently China has also got industrialized. ASEAN economies of Thailand, Singapore, Malaysia and Indonesia have developed more quickly as compared to the countries. In 1960s, with exception of Singapore, the start of industrialization has been seen. Within ASEAN countries, the annual rate of growth is around 8-10% (Fioramonti, 2016). A rapid growth is seen in the industry within ASEAN countries, exceeding the average of developing countries by around 50-100% in 1970s. In accordance with Green et al. (2017), across all ASEAN countries, the population is more than 622 million of individuals. ASEAN make up the largest economy. It will make up 4th largest world economy in year 2050. In addition to this, it also has largest forces of labor in the entire world, falling behind China and India only.

There have been several researches related to the impact of greenhouse emission within ASEAN countries. The CO_2 Emissions in ASEAN countries presented in Figure 1. In different researches, the researchers have explored different reasons why emission of greenhouse gases is done within ASEAN countries. However, some of the reasons are still unexplored for instance, population growth, industrialization and urbanization. Moreover, the analysis of these reasons of greenhouse Gas Emission in ASEAN countries has not been explored in detail. Therefore, in order to fill this gap in the literature, it was significant to do more research on the factors like population growth, industrialization and urbanization causing greenhouse gas emission. The objectives of this research are as follows:

1. To check the impact of urbanization of greenhouse gas emission in ASEAN countries
2. To analyse the role of industrialization in emission of greenhouse gases in ASEAN countries
3. To identify the impact of population growth in greenhouse gas emission within ASEAN countries.

Figure 1: CO_2 emission in ASEAN



There are different researches concerned with the greenhouse gas emission. These researches are helping the government of different countries to take considerable actions to reduce emission of such gases. However, there is lack of research for the ASEAN countries. Therefore, this research will be mainly beneficial for ASEAN countries.

The structure of this research is as follows: Introduction, Literature Survey, Methodology, Discussion and Conclusion.

2. LITERATURE REVIEW

2.1. Urbanization and Population Growth

Cities are identified as an organic type of government and these often show the aspirations to citizens in quicker way as compared to higher government levels. According to Jain (2017), with the articulation of rising voices, the global influence gets noticeable, as the worldwide population makes response to the changes. In ASEAN countries, 1017 cities have made an agreement to exceed or fulfill the targets of Kyoto Protocol to decrease the emissions of greenhouse gases (Wang et al., 2018). In crisis conditions, cities tend to be such responders who make response at first; these are the first ones who experience such trends. For instance, most of the local governments were acknowledged of the financial crisis in year 2008 6 months before warnings were given to the national governments as rates of generation of waste and recyclables values got decremented significantly. In addition to this, cities act as the basic agency to integrate the directives of national government. Urbanization and economic development are seen parallel, as emission of greenhouse gas and economic development have it for previous 100 years (Kaur et al., 2018). More of the economic activity is seen within the urban regions; cities have an important role in changing climate. Lifestyle and affluence choices hold an impact on emissions of greenhouse gases. The developed ASEAN countries have had more of GHG as compared to other developing countries. Now urbanization is seen at a quicker rate and under the usual scenario of business, there will also be dramatic increment in greenhouse gas emission. In accordance with Mahat et al. (2019) cities mainly contribute in GHG. Half of the population of world resides in cities, a share that will get incremented to around 70% in year 2050. Cities consume around 80% of production of energy and account for international GHG of equal share. With the proceeding of development, industrial activities will drive less GHG and will be led more energy services that are needed for cooling, heating and lighting purposes. The International Energy Agency (IEA) predicts that urban regions account for more than 67% of energy-associated GHG, which is expected to get incremented to around 74% by year 2030 (Maraseni et al., 2018). It is predicted that around 89% of increment in CO_2 from use of energy will be made from ASEAN developing countries. This developing out instead of developing up will result into an increment in requirements of energy and new infrastructure's cost. Cities that are managed in a poor way exacerbate more requirements for investment in infrastructure and energy. The given hypothesis has been generated through this.

H_1: There is a significant impact of urbanization on greenhouse gas emission in ASEAN countries.

2.2. Industrialization and Greenhouse Gas Emission

Industrialization has been defined as the procedure of change of human society in an economic or social way from the agrarian society into some kind of industry. It basically includes innovations in technology and is identified as part of broader process of modernization, where economic development and social change are seen linked with the innovations in technology. In accordance with Masud et al. (2015), industrialization is like organizing economy for manufacturing. Manufacturing includes altering natural resources and energy use from various pristine states. Industrialization mainly includes transformation in sociology, economy and innovation. Climate change can be identified as the alteration in patterns of weather. Global warming is the major driver of change in climate. In accordance with Maulidia et al. (2019), climate change and global warming results into an increment in average temperature globally. The climate change is the major subject that has been discussed by different researchers. There is a consensus that a change in climate is seen, but the causes are not still known. Both human activities and natural events are identified as making contribution to an increment in average temperature. Since the rise of Industrial Revolution in 1700s, however individuals have added more amounts of GHGs in surrounding through conducting different practices, cutting down forests and burning fuels. With the emission of GHGs in atmosphere, most of these remain to be there even for longer periods of time, like to millennia from decade. With the passage of time, emissions sinks or chemical reactions remove such gases from the surrounding, like vegetation and oceans, which results into absorbing GHGs from surrounding. However, as an outcome of human practices, there is quicker entrances of these gases as compared to their removal. Therefore, the concentration gets incremented. Nitrous oxide, methane and carbon dioxide get well mixed in the entire surrounding due to longer time periods and due to the transports done through winds. The measurement of these concentrations is done through GHG. The given hypothesis can be developed through this.

H_2: There is a significant impact of industrialization on greenhouse gas emission in ASEAN countries.

2.3. Population Growth and Greenhouse Gas Emission

The development of greenhouse gases within atmosphere has got driven mainly through the increasing consumption of various fossil fuels in the world that is more industrialized. However, when looking forward to the coming future, the development of greenhouse gas emission will get identified through various other factors, involving technology's spread, and patterns of land use and economic development. The growth of population of world will also be a major factor. The population of world has got doubled since year 1965 and is developing by around 80 million individuals every year. Demographers present at UN projecting this development continue for development and for the population of world, it will be in range to 10.8 billion from 7.8 billion by year 2050 (Russo, 2019). More of the growth is seen in the developing countries of ASEAN. As developing ASEAN countries continue to get more developed economically, their contribution towards the emissions of greenhouse gas continue to get increased. Because of the sheer volume of growth of world population, decrement in greenhouse gas emissions because of shifts in usage of energy and sequestration will get offset partially through an increment in activity of human that outcome from population growth (Stevens, 2015). While the link in between population growth and greenhouse gas emission is quite prominent. The intergovernmental Panel on Climate Change (IPCC) has identified that future population growth within ASEAN countries will play a significant role in emitting greenhouse gases. There are different assumptions related to technological change, economic growth and population growth. The scenario that outcomes in smallest increment in temperature actually incorporates the lowest project in growth of population. However, further analysis should be done to identify the contribution of growth of population as driver of change in climate. Based on this, the given hypothesis can be proposed.

H_3: There is a significant impact of population growth on greenhouse gas emission in ASEAN countries.

3. METHODOLOGY

In this research, greenhouse gas emission, urbanization, industrialization, population growth and greenhouse gas emission data for ASEAN countries and their data of 26-27 years have been taken. The variables have been defined as UR, ID, PG, GDP, PCI and GHE. Variable UR stands for Urbanization, ID for industrialization, PG for population growth, GDP for gross domestic production, PCI for Per capita income and GHE for greenhouse gases emission. Greenhouse gases emission is a dependent variable. GDP and per capita income are controlled variables. Urbanization, industrialization and population growth are independent variables. Greenhouse gas emission data was taken through World Bank Data and Global Economy source. The 235 first three data were acquired through the Penn World Table. Table 1 depicts the AMG Estimation results of UR, IN, PG, GDP and PCI and also for panel. Dependent on GDP, Cambodia has highest GDP, followed by Vietnam, Laos, Thailand, Brunei, Indonesia, Singapore, Malaysia, Philippines and Myanmar. The urbanization degree has been measured using the arbitrary minimum limit of urban size and it does not involve the hierarchy of urban size. Two measurements have been used as alternatives, for instance the population concentration scale and urbanization scale. The urbanization degree is dependent over the minimum size limit, but it does not show the hierarchy of urban size. A measurement of concentration of population also shows the size hierarchy, but it involves all of the points of concentration of population. Industrialization has been measured through the economic activity, through the percentage of labor force in industry and manufacturing. Moreover, it has also been analyzed using the economic output.

Table 1: AMG estimation results

Countries	UR	IN	PG	GDP	PCI
Brunei	0.035	0.321**	0.388**	0.231**	0.064
Cambodia	0.381***	0.273*	0.354**	0.428***	0.023
Indonesia	0.138*	0.231*	0.294*	0.231**	0.133*
Laos	0.287*	0.242**	0.243**	.0.253**	0.124*
Malaysia	0.209***	0.095	0.046	0.183**	0.013
Myanmar	0.201*	0.486**	0.284**	0.031	0.153*
Philippines	0.043	0.027	0.212**	0.038	0.017
Singapore	0.276**	0.184**	0.104	0.201**	0.226**
Thailand	0.219**	0.218**	0.325**	0.238**	0.104
Vietnam	0.318**	0.129*	0.543***	0.313**	0.173*
Panel	0.149*	0.424***	0.562***	0.283**	0.243**

*, ** and *** show null hypothesis's rejection at the significance levels of 1%, 5 and 10% respectively

In the given case, GDP gross domestic production, per capita income PCI, urbanization UR, industrialization in and population growth PG have been taken as the determinants of greenhouse gases emission GHE, therefore the production function is described as:

$$GHE_{it} = (PCI_{it}, GDP_{it}, UR_{it}, IN_{it}, PG_{it}) \quad (1)$$

The model of equation 1 can be made as given below:

$$GHE_{it} = PCI_{it}^{\beta_{1i}} GDP_{it}^{\beta_{2i}} UR_{it}^{\beta_{3i}} IN_{it}^{\beta_{4i}} PG_{it}^{\beta_{15i}} e^{\mathcal{E}_{it}} \quad (2)$$

The transformation of equation 2 can be done into linear form through taking its log. The log of the equation is given below:

$$\ln GHE_{it} = \beta_{1i} lnPCI_{it} + \beta_{2i} lnGDP_{it} + \beta_{3i} lnUR_{it} + \beta_{4i} lnIN_{it} + \beta_{5i} lnPG_{it} + \mathcal{E}_{it}$$

Over here, β_{3i} β_{4i} β_{5i} are the coefficients of independent variables named as urbanization, industrialization and population growth. In addition, β_{1i} and β_{2i} are the coefficients of control variables, named as per capita income and gross domestic production.

3.1. Cross Sectional Dependence Test

As an outcome of the increasing per capita income and GDP of ASEAN countries, there is a link in between cross sections units present in the panel data models. In case when the links in between cross-sectional data are not considered, then it results into misleading calculations. Because of the reason that this research used ASEAN countries with economic cooperation, therefore cross-sectional dependence tests were conducted. Pesaran (2015) used the given panel data model in order to test cross-sectional dependence:

$$CD_{BP} = T \sum_{i=1}^{N-1} \sum_{j=j+1}^{N} \hat{p}_{2_{ij}}$$

The test of Breusch and Pagan (1980) has a drawback where there is large value of N, and its application is not possible where $N \to \infty$. Pesaran (2015) provided the given LM statistic in order to avoid the given issue:

$$CD_{I,M} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T\hat{p}_{ij}^{2} - 1)$$

In accordance with Pesaran (2015), the given test of statistics should be utilized in case when the cross-sectional size is larger as compared to the dimension of time (T) is (N>T):

$$CD_{I,M} = \sqrt{\frac{2T}{N(N-1)}} (\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{p}_{ij}^{2})$$

Where $\hat{p}_{ij}$ depicts the correlation in between different errors. The alternative and null hypotheses that has been used for the purpose of null hypotheses is given below:

H_0: Cov (u_{it}, u_{ij})=0, no cross-sectional dependence
H_0: Cov (u_{it}, u_{ij})=0, cross-sectional dependence.

Finally, the calculation of P-values is done for making the decision related to null hypothesis. In case when the measured values of probability are smaller as compared to the significance values, then in such cases, null hypothesis gets rejected. On contrast with this, the rejection cannot be made towards null hypothesis. Along with it, the heterogeneity of cross-sectional units was also investigated through the test of slop homogeneity, which was actually created through Pesaran (2015).

In this research, Δ and $\hat{\Delta}_{adj}$ were used that were developed through Pesaran (2015). A modified statistic of test was developed by Bailey et al. (2016). The statistics of test, named as $\hat{\Delta}$ is given below:

$$\widehat{\Delta = \sqrt{N}}((N^{-1}\check{S} - k) / \sqrt{2k}$$

Where $\overline{S}$ identifies the altered Swamy model. Correction can be made in $\hat{\Delta}$, small characteristics of sample under normal distributed errors are given below:

$$\hat{\Delta}_{adj} = \sqrt{N}((N^{-1}\check{S} - E\left(\breve{\tilde{z}}_{it}\right)) / \sqrt{\text{var}(\breve{\tilde{z}}_{it}))}$$

Where $E\left(\breve{\tilde{z}}_{it}\right)$ and $var\left(\breve{\tilde{z}}_{it}\right)$ are equivalent to k and 2k(T−k−1)/T+1.

The null hypothesis that shows the homogenous slopes of both of the test statistics gets tested in opposed to the alternative hypothesis that exist for the heterogeneous slopes.

3.2. Panel Unit Root Test

In the other part of empirical analysis, variables' stationary levels has been tested through making use of CIPS panel unit test given by Pesaran (2015) which takes the dependence of cross-sectional horizon into account. Pesaran made use of the given cross-sectional augmented DF.

(CADF) regression:

$$\Delta Y_{ij} = a_i + b_i Y_{i,t-1} + c_i \overline{Y}_{t-1} + di\Delta\overline{Y}_t + \mathcal{E}_{i,t}$$

Over here $\overline{Y}_t = \frac{I}{N}\sum_{i=1}^{N} Y_{i,j}$ and $\varepsilon_{i,j}$ is the error term. Pesaran provided a cross-sectional augmented version of the test of IPS.

$$\text{CIPS} = \text{I / N}\sum_{i=1}^{N} CADF_i$$

Over here $CADF_i$ is the Dickey-Fuller statistic that is fully augmented in the equation above. For the panel unit root test, the testing of null hypothesis showing the unit root is done in opposed to the alternative hypothesis that shows stationarity. In case when the test statistic gets larger as compared to the critical values, then in this case, rejection is made to the null hypothesis. On contrast to this, no rejection can be made to null hypothesis.

3.3. Panel Co-integration Test

At the other stage of analysis, the co-integration test has been investigated between the variables through the study of Zoundi (2017) bootstrap test of co-integration, which does the consideration of cross-sectional dependence. The test statistics that were used are as follows:

$$LM_N^+ = I / NT^2 \sum_{i=1}^{N}\sum_{t=1}^{T} \hat{w}_i^{-2} s_{it}^2$$

Where s_{it}^2 depicts the sum of some of the error terms. The bootstrap's null hypothesis LM panel test of co-integration is that the model is cointegrated. On the other hand, the alternative hypothesis suggests that the model is not cointegrated. In case when the probability values get smaller as compared to the significance values, then it results into rejecting null hypothesis. In cross-section dependency, bootstrap calculated critical values are tested. AMG estimators estimated the long-run model's coefficients developed through Banerjee and Carrion-i-Silvestre (2017).

3.4. Panel Causality Test

At empirical analysis' last stage, the causality in between Urbanization, industrialization, population growth, per capita income and GDP; and greenhouse gas emission has been investigated through making use of panel causality test developed through Chang et al. (2015). In accordance with X. Zhang et al. (2016), it basically removes the requirement to perform preliminary tests before doing the actual analysis of causality. The panel causality test has different benefits over the other tests. For instance, as it uses critical values and estimator, therefore the assumption related to cross-sectional dependence does not get emerged. Moreover, according to Pan et al. (2015), causality analysis can be done between non-cointegrating series and unit-rooted series.

The equation system to be used for performing the panel causality test is given below:

$$GHE_{1,t} = \alpha_{2,1} + \sum\nolimits_{i=1}^{ly_2} \beta_{2,1,i} UR_{1,t-i} + \sum\nolimits_{i=1}^{lx_2} \delta_{2,1,i} GHE_{1,t-i} + \mathcal{E}_{2,1,t}$$

$$GHE_{1,t} = \alpha_{2,2} + \sum\nolimits_{i=1}^{ly_2} \beta_{2,2,i} UR_{2,t-i} + \sum\nolimits_{i=1}^{lx_2} \delta_{2,2,i} GHE_{2,t-i} + \mathcal{E}_{2,2,t}$$

… …

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$$GHE_{N,t} = \alpha_{2,N} + \sum\nolimits_{i=1}^{ly_2} \beta_{2,N,i} UR_{N,t-i} + \sum\nolimits_{i=1}^{lx_2} \delta_{2,N,i} GHE_{N,t-i} + \mathcal{E}_{2,N,t}$$

$$UR_{1,t} = \alpha_{1,1} + \sum\nolimits_{i=1}^{ly_1} \beta_{1,1,i} UR_{1,t-i} + \sum\nolimits_{i=1}^{lx_1} \delta_{1,1,i} GHE_{1,t-i} + \mathcal{E}_{1,1,t}$$

$$UR_{2,t} = \alpha_{1,2} + \sum\nolimits_{i=1}^{ly_1} \beta_{1,2,i} UR_{2,t-i} + \sum\nolimits_{i=1}^{lx_1} \delta_{1,12,i} GHE_{2,t-i} + \mathcal{E}_{1,2,t}$$

… …

… …

… …

$$UR_{N,t} = \alpha_{1,N} + \sum\nolimits_{i=1}^{ly_1} \beta_{1,N,i} UR_{N,t-i} + \sum\nolimits_{i=1}^{lx_1} \delta_{1,N,i} GHE_{N,t-i} + \mathcal{E}_{1,N,t}$$

Where l shows the lag length, N is the total number of cross-section units and *t* is the dimension of time. Similar equations have been followed for IR, PG, PCI and GDP replacing UR with the given variables.

4. EMPIRICAL RESULTS

The outcomes of cross-sectional dependence and tests of slope homogeneity are given in Table 2. In accordance with the CD, CD_{LM} and CD_{BP} tests, the rejection of cross-sectional independence's null hypothesis is done. Therefore, in the given research there is cross-sectional dependency in all of the variables. In accordance with the outcomes of tests of Delta, homogeneity assumption gets rejected, and units' coefficient becomes heterogeneous.

Table 3 gives results of CIPs panel unit root rest. The results of panel unit root test depict all of the series have root for constant-trend and constant models. On contrast to this, there are stationary series seen at first differences. The integration of series is done to be at first order.

Table 2: Cross-section dependence and slope homogeneity tests results

Variable	CD_{BP}	CD_{LM}	CD
UR	121.13*	67.53*	32.63*
ID	194.12**	57.43*	23.32*
PG	193.42*	86.54**	24.87**
GDP	131.25**	45.34*	25.36*
PCI	193.13*	68.35*	25.53*
GHE	128.23*	86.35*	21.53*
Slope homogeneity tests results			
Tests	**LM statistics**	**t-value**	**P-value**
Delta	37.27	3.28	0.000
Adj Delta	41.21	5.03	0.000

* and ** identify null hypothesis rejection at the significance levels of 1% and 5%. Delta and Adj Delta (also termed as show the Delta tests.

Table 4 shows the results of panel co-integration test. In case when the value of bootstrap is lesser as compared to the significance values, then rejection is made towards the null hypothesis. The null hypothesis of the given test is basically the co-integration seen in between various variables. In accordance with the bootstrap LM panel co-integration test, there is long-term link in between UR, IN, PG, GDP and PCI. Basically, it can be stated that there exists co-integration between greenhouse gas emission and urbanization, industrialization, population growth, per capita income and growth domestic product.

AMG estimator is used in order to calculate the long-term link, considering the cross-sectional dependence and parameter heterogeneity. Table 1 illustrates the AMG estimation results.

In accordance with Table 1, the relationship between greenhouse gas emission, GDP and PG is more significant. The information provided in Table 5 helps in the further analysis of coefficients and significance of urbanization, industrialization, population growth, per capita income and GDP on greenhouse gas emission. In accordance with this, GDP, which is significant for all of the countries except for Myanmar and Philippines, has positive influence over greenhouse gas emission. An increment in GDP causes an increment in greenhouse gas emission. Urbanization that has more significance for all of the countries except for Brunei and Philippines mainly influences the greenhouse gas emission. F-statistics and Probability have been used in order to do Konya Panel Causality Test Results as given in Table 5.

Table 3: CIPS panel unit root test results

Variable	At level	First difference
UR	−4.4352*	−5.3992**
ID	−2.7466	−6.8453**
PG	−6.6852*	−12.3821***
GDP	−3.6335*	−4.8436***
PCI	−2.8643*	−3.6354**
GHE	−2.8853*	−5.4424**

*, ** and *** show null hypothesis' rejection at the significance levels of 1%, 5% and 10%. CIPS statistics of test are basically the average of the individual statistics of CADF

Table 4: LM bootstrap panel co-integration test results

Conditions	LM statistics	Bootstrap P-value
Constant	-2.184	0.887
Constant + Trend	3.104	0.964

The bootstrap is dependent over around 1000 replications

Table 5: Kónya panel causality test results

Null hypothesis	F-statistic	Prob.
UR does not Granger Cause GHE	3.33915	0.0408
GHE does not Granger Cause UR	0.93518	0.3970
	5.79076	0.0046
GHE does not Granger Cause IN	4.72063	0.0117
PG does not Granger Cause GHE	10.1266	0.0001
GHE does not Granger Cause PG	1.46661	0.2372
IN does not Granger Cause UR	0.03705	0.9636
UR does not Granger Cause IN	0.83105	0.4396
PG does not Granger Cause UR	0.66308	0.5183
UR does not Granger Cause PG	0.26349	0.7691
PG does not Granger Cause IN	1.05701	0.3526
IN does not Granger Cause PG	1.19665	0.3079

F-statistics show that PG does not granger causes GHE. In addition to this, industrialization does not granger cause Greenhouse gas emission. Greenhouse gas emission does not mainly granger cause industrialization. Moreover, urbanization does not granger cause Greenhouse gas emission. There is more probability that industrialization does not granger cause urbanization. Moreover, there is more probability that urbanization does not granger cause population growth. There is 0.0408 probability that UR does not granger cause GHE. There is around 0.3970% probability that GHE does not granger cause UR. There is very little probability like of 0.0001% that PG does not granger causes GHE. Same like this, the probability of IN not granger causing GHE is around 0.0046%.

5. DISCUSSION

Greenhouse gas emissions are based on climate change (Heck et al., 2018). The demand for energy has been increased in the ASEAN countries over the past four decades due to high economic growth, industrialization and increased urbanization. The main purpose of this research is to understand and re-think the reasons for greenhouse gas emissions and their relationship with population growth, industrialization, and urbanization. The ASEAN region is known as the most dynamic region in the world and has contrasting energy demand profiles. Despite the increase in population growth, the energy consumption per capita in the region has been reduced (Salahuddin et al., 2018). The results and findings analyzed with the help of the AMG model indicated the significant and insignificant impact of control variables on greenhouse gas emissions. Moreover, population growth has an insignificant impact on Malaysia and Singapore. In this case, some researchers have also indicated that the increase in population is coupled with the increase of industrialization and urbanization, due to which energy demand is expected to increase substantially. Due to increase in urbanization and industrialization, the greenhouse gas emission has also been increased unless there are some fundamental changes in the patterns of economic production or fuel-mix (Wang et al., 2018). The results derived from the tables also indicated that the control variables such as GDP growth and per capita income also have an insignificant impact on emissions in Malaysia, Singapore, Myanmar, and Philippines. The reason is that the majority of people in these countries live within the middle-income ranges and only 17% of the population lives within the upper-middle-income. With the review, it has now become apparent that the majority of studies have been agreed on the finding that greenhouse gas emissions increase with urbanization, population growth, and urbanization. However, some of the studies explained a positive connection, while some of the studies indicated the negative of insignificant relationships. However, it has also been depicted from the results that per capita income has a negative or insignificant impact on Malaysia, Thailand, and the Philippines.

6. CONCLUSION

The main objective of this study was to analyze the reasons for greenhouse gas emission in ASEAN countries and its relationship with urbanization, industrialization and population growth. The results and findings have been concluded with the help of AMG model which showed that urbanization and industrialization have an insignificant impact on Philippines and Malaysia. For the results, CIPS panel unit root test has also been done along with the slope homogeneity tests. On the other hand, the control variables such as per capita income and GDP growth have also shown insignificant impact on Malaysia, Singapore, Myanmar, Philippines, and Thailand.

6.1. Implications

This research study has likely to have implications for the development of regional climate policies. However, the region is not currently bounded by any international agreement, but pressure can arise soon. Therefore, it is essential for the ASEAN countries to reduce the gas emissions by reducing the per capita income that has already been exceeded to the target level. At the same time, the findings designated that urbanization have an insignificant impact on greenhouse gas emission in Philippines. Similarly, industrialization has an insignificant impact on the emission in Malaysia and Philippines.

6.2. Limitations

Every study has its own limitations. In this study, the main focus is on the greenhouse gas emissions in ASEAN countries and its relationship with urbanization, industrialization and population growth. However, some other variables have been ignored in this study, which should be focused by future researchers, such as the effect of changes in carbon-coefficient; therefore, no meaningful conclusion has been drawn from this factor. Future researchers can also focus on variables other than urbanization and industrialization.

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