Energy Consumption and Economic Growth in Newly Industrialised Countries of Asia

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ABSTRACT

The relationship between energy consumption and economic growth has been analyzed by a number of previous studies. However, a consensus has not been reached to define the relationship between the variables. This paper aims to analyze the relationship between energy consumption and economic growth for six Asian countries viz. China, India, Indonesia, Malaysia, Philippines and Thailand by employing statistical and econometric techniques such as ARDL model, Johansen's Co integration test, VECM, VAR and Toda Yamamoto causality test. Results indicate that energy consumption and economic growth are co integrated in the long run in case of China, India and Indonesia however VECM indicates that both variables are unable to correct itself towards equilibrium after a shock when energy consumption is the independent variable and Real GDP the dependent variable. Co integration does not exist in case of Malaysia, Philippines and Thailand and VAR indicates that GDP is affect by its past values at lag 1 for Malaysia and Thailand and GDP is affected by its past values at lag 1 and 2 for Philippines. In case of India and Thailand there exists a uni-directional causal relationship running from GDP to energy consumption.

Keywords: Energy Consumption, Economic Growth, Co Integration, ARDL, Toda Yamamoto Causality
JEL Classifications: P18, Q43

1. INTRODUCTION

Sustainable growth and development of a country depends upon the availability of continuous supply of energy at a reasonable cost. Energy use leads to economic growth and economic growth necessitates the need to consume additional energy. According to (Bozyk, 2006) (Vithayasrichareon et al., 2012) (Mankiw, 2010) (Speier et al., 2018) the newly industrialized countries of Asia are China, India, Philippines, Malaysia, Indonesia and Thailand as the economic development of such countries falls between the classifications of First World and Developing.

The countries known as newly industrialized countries are identified by increasing exports, economic growth and migrations from rural to urban areas. Although great cultural, geographical and economic differences exist among the NIC, environmental impacts of modern civilization like air pollution, water pollution or improper waste management are being observed equally (Speier et al., 2018). The Newly Industrialized Countries of Asia being emerging countries is looking to accelerate economic growth which will in turn depend upon the availability of energy to sustain economic activities.

The share of industrial energy consumption as a percentage of total final energy consumption is increasing while residential energy consumption is showing a decreasing trend for all six countries viz. China, India, Indonesia, Malaysia, Philippines and Thailand (energyatlas.iea). This indicates that the industrial sector of newly industrialised countries is consuming energy at an increasing trend since 1971 in contrast to the energy consumption of the household sector.

There can be 4 forms of relationship between energy consumption and economic growth as advocated Kraft and Kraft (Banafea,

2014) through 4 hypothesis viz. Growth Hypothesis, Conservative Hypothesis, Feedback Hypothesis, Neutrality Hypothesis.

Unidirectional causality from energy consumption to economic growth (growth hypothesis) signals the economy is energy dependent in which case energy conservation policies may have a negative impact on economic growth. On the other hand, unidirectional causality from economic growth to energy consumption (conservation hypothesis) indicates that energy conservation policies may not have an impact on economic growth.

Bidirectional causality between energy consumption and economic growth (feedback hypothesis) reflect the interdependence association of energy consumption and economic growth. Absence of causality between energy consumption and economic growth supports the neutrality hypothesis.

2. REVIEW OF LITERATURE

Various studies have been conducted in the area of energy economics from a panel perspective as well as time series perspective. In case of china, (Cui, 2016) analyzed the relation between China's economic growth and energy consumption using ADF test, Johansen cointegration test and Granger causality test OLS estimation and concluded that there is a linear relationship between economic growth, energy consumption and carbon dioxide emissions. Similarly, Shahbaz et al. (2013) investigated the relationship between energy use and economic growth considering factors such as Real GDP, Energy use, Financial development, Real trade openness and Real capital use and concluded that all factors considered have a positive impact on economic growth and there exist a Unidirectional relationship running from energy use to real GDP. Another study conducted by (Yuan et al., 2008) on China, tested the existence and direction of causality between output growth and energy use in China at both aggregated total energy and disaggregated levels using variables such as total employment and real GDP, net value of fixed assets (capital stock), total energy consumption and as well as electricity as concluded that there exists long-run cointegration among output, labor, capital and energy use.

In case of India, (Shahbaz et al., 2017) investigated the asymmetric relationship between energy consumption and economic growth to find that negative shocks in energy consumption and financial development have impacts on economic growth while capital formation causes economic growth. (Benjamin, 1999) studied the causality between energy consumption and economic growth using PP unit root test, Johansens Cointegration test and Hsiao's Granger multivariate causality on variables such as GNP, energy consumption, gross fixed capital formation and population to conclude that causality runs from economic growth to energy consumption both in the short run and in the long run and causality flows from capital to economic growth in the short run. However (Sultan et al., 2019) concluded that there is a unidirectional relationship in the short run while in the long run there exists a bidirectional relationship between energy and economic prosperity.

In case of Indonesia, (Bimanatya and Widodo, 2018) investigate the causality relationship between fossil fuel consumption, carbon emission level, and output level using Johansen Co-integration and VECM Granger causality and advocated that in the short-run, there are unidirectional Granger causalities running from coal consumption to output and from output to oil consumption and in the long-run, unidirectional Granger causality running from oil consumption to output and carbon emissions whereas (Sriyana, 2019) investigate the dynamic effects of energy consumption on economic growth and the study resulted in Energy use having a positive impact on economic growth. A study conducted in Malaysia by (Tan and Tan, 2018) using variables such as energy use, economic growth and CO2 emissions concluded that there exists a unidirectional causality relationship from Energy consumption and CO2 emissions to economic growth in both short and long-run. (Farabi et al., 2019) examined the relationship between energy consumption, carbon emission and economic growth in the case of Indonesia and Malaysia and analysis indicated that an increase in aggregate consumption of energy will increase CO2 emission, while the increase in income also leads to the increase of CO2 emission.

Another study conducted by (Tang et al., 2016) where the relationship between energy consumption and economic growth was analysed for Vietnam resulted in a unidirectional causality running from energy consumption to economic growth while (Morelli and Mele, 2020) advocated that there exists a unidirectional causality running from economic growth to energy consumption after employing structural breaks, Toda-Yamamoto test and Johansen's cointegration test. A few studies were conducted in other countries such as Azerbaijan where (Mukhtarov et al., 2017) investigated the causal relationship between energy consumption and economic growth and Toda-Yamamoto causality test framework of vector autoregressive (VAR) model indicated that there is a bidirectional causality between energy consumption and economic growth. However in Sudan, (Elfaki et al., 2018) examines the dynamic relationship between energy consumption and economic using ARDL model and found that energy consumption has negative impact on economic growth. While in Mexico, (Gómez et al., 2018) analyze the causal link between aggregated and disaggregated levels of energy consumption and economic growth and concluded that there are linear causal links from total and disaggregated energy consumption to economic growth which supports growth hypothesis. (Comfort et al., 2018) examined the dynamic impact of energy consumption on the growth of Nigeria economy using symmetrical autoregressive distributed lag model approach on variables such as Aggregate real output, Stock of capital, Stock of labour and Technology and analysis indicated that electricity consumption and gas does not have a significant impact while petroleum consumption has a significant impact on economic growth. In addition a literature survey was conducted by (Ozturk, 2010) whose study concluded that most studies focus on examining the direction of causality between these two variables leading to conflicting results and suggested that there is a need to focus more on the new approaches and perspectives.

Various panel data studies have been conducted to investigate into the relationship between energy consumption and economic growth which include a study conducted by (Adhikari and Chen,

2013) on 80 developing countries using panel cointegration test and panel dynamic ordinary least squares (DOLS) and found out that energy consumption had a positive and statistically significant impact on economic growth in the long-run. Another study conducted by (Lee, 2006) with regard to 18 developing countries investigate the co-movement and the causality relationship between energy consumption and GDP and concluded that long-run and short-run causalities run from energy consumption to GDP, but not vice versa and energy conservation may harm economic growth in developing countries. (Bakirtas and Akpolat, 2018) investigated the causal relationship between energy consumption, urbanization and economic growth in new emerging market countries using Carrion-iSilvestre et al. panel unit root test and Dumitrescu-Hurlin panel Granger causality test and found various causalities between the variables.

With regard to Asian countries, (Nasreen and Anwar, 2014) explored the causal relationship between economic growth, trade openness and energy consumption and concluded that there exist a positive impact of economic growth and trade openness on energy consumption and a bidirectional causality between economic growth and energy consumption, trade openness and energy consumption. Another study by (Lee and Chang, 2008) re-investigate the co-movement and the causal relationship between energy consumption and real GDP using variables such as Real GDP, energy use, labor force and real gross capital formation and concluded that there is a positive long-run cointegrated relationship between real GDP and EC as well as long-run unidirectional causality running from energy consumption and economic growth.

Another study conducted on BRICS countries by (Matei and Stamin, 2016) found a that an increase in real per capita GDP have a positive and statistically significant effect on per capita energy consumption and vice-versa while (Fatai et al., 2004) Modelled the causal relationship between energy consumption and GDP in New Zealand, Australia, India, Indonesia, Philippines and Thailand using Grangers Causality Test, Johansen's Maximum likelihood approach, TY approach and ARDL approach to find that Energy conservation policies may not have significant impacts on real GDP growth in industrialized countries such as New Zealand and Australia compared to some Asian economies.

(Ozturk et al., 2010) examined the relationship between energy consumption and GDP for a panel of 51 countries which were lower and middle income countries using techniques such as Pedroni panel cointegration and causality test method and results indicated that there is long-run Granger causality running from GDP to energy consumption for low income countries and there is bidirectional causality for middle income countries. Another study conducted by (Samawi et al., 2017) analysed the direct and indirect effects of energy supply on economic growth using quarterly data from 2000 to 2015 and concluded that energy supply is strongly correlated with economic growth. In addition (Kahia et al., 2017) examine the energy use – economic growth nexus by disaggregating energy use renewable and non-renewable energy use by employing Panel Granger causality test and results indicated that bidirectional causality exist between renewable energy use and economic growth, and non-renewable energy use and economic

growth. Similarly (Almozaini, 2019) investigate the causal relationship between economic growth and energy consumption in five countries with high consumption viz. China, India, Japan, the United States, and Saudi Arabia using Johansen Fisher Cointegration Test and Granger causality tests and concluded that Unidirectional, and bidirectional Granger causality exists between energy consumption and economic growth.

(Hassine and Harrathi, 2017) (Abul et al., 2019) conducted studies in the Gulf Cooperation Council Countries and concluded that renewable energy use and exports are able to increase the economic growth and economic growth increases energy consumption while Negative link between CO_2 emissions and economic growth resp. (Aali-Bujari et al., 2017) assess the impact of energy use on economic growth in the OECD using Granger causality analysis and generalized method of moments and results indicated that real GDP per capita is positively affected by the growth rate of energy use per capita. While with regard to G7 countries (Tugcu et al., 2012) investigated the long-run and causal relationships between renewable and non-renewable energy consumption and economic growth employing ARDL approach to cointegration and causality test by Hatemi-J and results indicated that Bidirectional causality is found for all countries in case of classical production function, mixed results are found for each country when the production function is augmented. (Ozturk and Acaravci, 2010) investigate the causal relationship between energy and economic growth in Albania, Bulgaria, Hungary and Romania by employing techniques such as ARDL bounds testing approach of cointegration and dynamic vector error correction (VEC) model. Results advocated that there is evidence of a long-run relationship however there exists bidirectional strong granger causality between these variables only in Hungary. On a different note, (Aydın and Esen, 2017) whether the effect of energy consumption on economic growth is dependent on the level of energy intensity using dynamic panel threshold technique and concluded that Energy consumption rate above the threshold energy intensity level adversely affects the economic growth, but this negative relationship becomes positive one when the energy consumption is below the threshold level.

This paper aims to examine the relationship between energy consumption and economic growth in six newly industrialised countries of Asia for a period of 48 years since 1971 till 2018.

3. DATA AND METHODOLOGY

This paper follows a bivariate model where primary energy consumption in Gigajoules per capita is used to represent energy consumption and economic growth is represented by GDP in 2010 USD per capita. Before applying any technique to analyse the relationship between energy consumption and economic growth it is necessary to verify the stationarity properties of the variables. The Augmented Dickey Fuller (ADF) test and Philip Perron (PP) test is employed to test for stationarity of variables. If Variables have a mixed order of integration, we employ the ARDL model to test for cointegration while Johansens Cointegration test is applied if variables are found to be intergrated of order 1. If variables are integrated, Vector Error Correction Model (VECM) is employed to check how quickly variables return to long run equilibrium

Table 1: Results for Unit root tests

Country	Variable	ADF unit	Root test	PP unit	Root test
		Test statistic Level	Test statistic 1st difference	Test statistic level	Test statistic 1st difference
China	LEC	−2.4613	−3.1503*	−1.7813	−3.1868*
	LGDP	−3.237*	-	−3.838**	-
India	LEC	−2.0940	−7.388**	−2.2436	−7.3732**
	LGDP	−1.5668	−8.651**	−1.7122	−15.050**
Philippines	LEC	−1.2383	−6.448**	−1.6021	−6.5397**
	LGDP	−0.7293	−3.5012*	−0.1394	−3.6951**
Malaysia	LEC	−0.5896	−6.116**	−0.5767	−6.1676**
	LGDP	−2.4374	−6.000**	−2.5678	−5.9993**
Indonesia	LEC	−1.1587	−7.733**	−1.0498	−7.6679**
	LGDP	−2.6451	−5.032**	−2.2849	−4.9982**
Thailand	LEC	−1.0370	−4.698**	−0.9404	−4.873**
	LGDP	−1.7574	−4.2827*	−1.2831	−4.3230*

*Indicates significance at 10% significance level. **Indicates significance at 5% significance level

Table 2: Results of ARDL Bound testing approach to cointegration

K	Critical value bounds					
	90%	Level	95%	Level	99%	Level
1	2.496	3.346	2.962	3.910	4.068	5.250
Country	China					
F statistic	4.347656*					
	Reject H_0					

*Represents significance at the 5% level

after a deviation. In case variables are not found to be integrated we employ a VAR model to check if a variable is affected by its own lags or the past values of another variable.

Finally to identify if there exist a causal relationship between energy consumption and economic growth, we employ the Toda Yamamoto causality test which can be applied irrespective of the order of integration of variables.

4. ANALYSIS

4.1. Stationarity Tests
H_0: Variable is not stationery (Has a unit root)
H_1: Variable is stationery (Does not have a unit root)

Table 1 indicates the stationarity tests conducted to find our whether the mean, variance and auto- covariance of variables are the same in different lags i.e. time invariant/independent. This is necessary to ensure results that are not spurious. According to the Augmented Dickey Fuller (ADF) unit root test and Philip Perrons (PP) unit root test, energy consumption and Real GDP of India, Indonesia, Malaysia, Philippines and Thailand are stationery at first difference. However in case of China, energy consumption is stationery at levels and Real GDP is stationery at first difference. Both stationery tests indicate similar results for all countries under study.

The lag selection criteria help under to understand how many lags should be considered with the help of various criterion. According to Akaike information criterion (AIC) and Schwarz criterion (SC), this paper considers 2 lags are in case of China and 1 lag in case of India, Indonesia, Malaysia, Philippines and Thailand. The least

number of lags is preferable for analysis and in case of majority country both criteria suggest the same number of lags.

4.2. Cointegration Tests
4.2.1. ARDL bounds testing approach
H_0 - No existence of long run co-integrating relation
H_1- Existance of long run co-integrating relation

Since the order of integration for is mixed, we cannot apply OLS method nor can we apply Johansens cointegration test. This is because in order to apply OLS, all variables should be stationery at level and in case of Johansens Cointegration test, all variables should stationery at first difference.

Therefore we adopt ARDL bound test to find out if there exists long run relationship between energy consumption and Real GDP in case of China because energy consumption of China is integrated of order1 and Real GDP is integrated at levels i.e. mixed integration.

According to bounds cointegration test, if the F statistic is more than the upper bound critical value, then Null hypothesis is to be rejected as there is cointegration. However, if the F statistic is less than the lower bound critical value then we accept the Alternate hypothesis as there is no cointegration and if the F statistic is between the lower bound and upper bound, the test results are inconclusive.

According to (Narayan, 2005) the existing critical values in (Pesaran et al., 2001) which is meant for large sample size cannot be applied for small sample sizes. Hence, (Narayan, 2005) provides a set of critical values for sample sizes which are small which are 2.496 - 3.346, 2.962 – 3.910, and 4.068 – 5.250 at 90%, 95%, and 99%, respectively.

In Table 2 Since 4.347656 is more than 3.910 which is the higher bound at 5% level of significance, we reject the null hypothesis where we can conclude that there is cointegration between energy consumption and GDP for China.

4.3. Johansen Cointegration Test
H_0: There is no co-integration among the variables
H_1: There is co-integration among the variables

Table 3: Results of Johansen's cointegration test

Country	Hypothesised no. of cointegrating equations	Eigen value	Trace statistic	Critical value at 5% (P value)	Max. Eigen statistic	Critical value at 5% (P value)
India	None	0.31466	17.7171	15.49471 (0.0228)	17.3808	14.26460 (0.0156)
	At most 1	0.00729	0.33632	3.841466 (0.5620)	0.33632	3.841466 (0.5620)
Indonesia	None	0.30166	16.9551	15.49471 (0.0299)	16.5161	14.26260 (0.0217)
	At most 1	0.00950	0.43905	3.841466 (90.5075)	0.43905	3.841466 (0.5076)
Malaysia	None	0.13505	7.11943	15.49471 (0.5638)	6.67389	14.26460 (0.5284)
	At most 1	0.00964	0.44554	3.841466 (0.5045)	0.44554	3.841466 (0.5045)
Philippines	None	0.07053	3.47070	15.49471 (0.9415)	3.36440	14.26460 (0.9196)
	At most 1	0.00231	0.10630	3.841466 (0.7444)	0.10630	3.841466 (0.7444)
Thailand	None	0.16553	10.5262	15.49471 (0.2424)	8.32430	14.26260 (0.3467)
	At most 1	0.04674	2020190	3.841466 (0.1378)	2.20189	3.841466 (0.1378)

Source: Researcher's compilation

Table 4: Results of vector error correction model

	ECT coefficient	Std. Error	t-statistic	Prob.
China	−0.023634	0.04885	−0.48378	0.6312
India	0.077954	0.018787	4.149334	0.0002
Indonesia	−0.007373	0.025505	−0.289066	0.7741

Source: Researcher's compilation

As the variable are stationery at first difference for India, Indonesia, Malaysia, Philippines and Thailand, we can test for long term relationship using Johansens Contegration test.

The results of Johansens cointegration test in Table 3 indicates a strong cointegration between energy consumption and economic growth for India and Indonesia as the P value is less than 0.05 which is supported by Trace test and Max Eigen values, Therefore the null hypothesis of no cointegration can be rejected for India and Indonesia 5% level of significance.

However in case of Malaysia, Philippines and Thailand, the Null hypothesis cannot be rejected at 5% level significance as the P-value is more than 0.05, therefore it can be concluded that energy consumption and economic growth is not cointegrated i.e., we accept H_0.

4.4. Vector Error Correction Model (VECM)
H_0: There is no long run relationship
H_1: There is a long run relationship

Since China, India and Indonesia are cointegrated according to Johansen Cointegration test and China by ARDL, we can run VECM to test how quickly variables correct itself towards equilibrium after a shock where energy consumption is the independent variable and Real GDP the dependent variable. The coefficient should be negative and significant to reject H_0. In Table 4 The coefficient of the error term of India is positive and significant and the coefficient error term of China and Indonesia is negative but not significant and hence it could be concluded that there is no long term relationship between the variables.

4.5. Vector Autoregression Model (VAR)
Hypothesis 1 (Malaysia):
H_0: Energy consumption (Lag 1 and Lag 2) is not significant to explain GDP
H_1: Energy consumption (Lag 1 and Lag 2) is significant to explain GDP

Hypothesis 2 (Philippines):
Energy consumption (Lag 1 and Lag 2) is not significant to explain GDP
H_1: Energy consumption (Lag 1 and Lag 2) is significant to explain GDP
Hypothesis 3 (Thailand):
H_0: Energy consumption (Lag 1 and Lag 2) is not significant to explain GDP
H_1: Energy consumption (Lag 1 and Lag 2) is not significant to explain GDP

Equation 1:
MALAYSIA_GDP_LOG = (0.028560)*MALAYSIA_EC_LOG(−1) + 0.031177*MALAYSIA_EC_LOG(−2) + 1.098324*MALAYSIA_GDP_LOG(−1) + (0.115736)*MALAYSIA_GDP_LOG(−2) + 0.075203

Equation 2:
PHILIPPINES_GDP_LOG = (0.031534)*PHILIPPINES_EC_LOG(−1) + 0.064926)*PHILIPPINES_EC_LOG(−2) + 1.549045*PHILIPPINES_GDP_LOG(−1) + (0.554025)*PHILIPPINES_GDP_LOG(−2) + (0.015873)

Equation 3:
THAILAND_GDP_LOG = 0.052580*THAILAND_EC_LOG(−1) + (0.074158) *THAILAND_EC_

Table 5: Results of vector autoregressive model

Malaysia	Prob.	Philippines	Prob.	Thailand	Prob.
C(1) −0.028560	0.7774	C(1) −0.031534	0.7545	C(1) 0.052580	0.6981
C(2) 0.031177	0.7702	C(2) 0.064926	0.5183	C(2) −0.074158	0.5613
C(3) 1.098324	0.0000*	C(3) 1.549045	0.0000*	C(3) 1.349571	0.0000*
C(4) −0.115736	0.5280	C(4) −0.554025	0.0016*	C(4) −0.332145	0.0854
C(5) 0.075203	0.6343	C(5) −0.015873	0.8539	C(5) −0.018269	0.9226

*Significance at 5% level

Table 6: Results of Toda Yamamoto causality test

Country	EC causes GDP	GDP causes EC	Direction of causality
India	0.4416	0.0601*	GDP-> EC
China	0.7289	0.3192	No causality
Indonesia	0.5862	0.7003	No causality
Malaysia	0.2880	0.7760	No causality
Philippines	0.1303	0.7529	No causality
Thailand	0.6961	0.0263**	GDP -> EC

** and * Indicate significance at the 5% and 10% level, respectively

$$LOG(-2) + 1.349571*THAILAND\_GDP\_LOG(-1) + (0.332145)*THAILAND\_GDP\_LOG(-2) + (0.018269)$$

In case of Malaysia, Philippines and Thailand there is no long run relationship between energy consumption and GDP. Therefore we can run a VAR model to check if GDP is affect by the past values of energy consumption and GDP itself at different lags. Table 5 indicates the results of VAR model.

In Equation 1 for Malaysia, the Coefficients associated with energy consumption Lag (1) and Lag (2) are C (1) and C (2) for which probability values are 0.7774 and 0.7702 respectively. Since the P-values are more than 5%, the null hypothesis that energy consumption lag (1) and lag (2) are not significant to influence GDP could be accepted. This proves that GDP are not being affected by the past values of energy consumption.

Further, the coefficient associated with lag (1) of Real GDP is 0.000 which is less than 0.05 we reject the null hypothesis, which proves that GDP is affect by its past values at lag 1. The P-value associated with lag (2) of C(4) is 0.5280 which is more than 0.05. Therefore we accept H_0 and GDP is not significant to explain its past values at lag 2.

In equation 2 for Philippines, the Coefficients associated with energy consumption Lag (1) and Lag (2) are C (1) and C (2) for which probability values are 0.7545 and 0.5183 respectively. Since the P-values are more than 5%, the null hypothesis that energy consumption lag (1) and lag (2) are not significant to influence GDP could be accepted. This proves that GDP are not being affected by the past values of energy consumption.

Further, the coefficient associated with lag (1) of Real GDP is 0.000 which is less than 0.05 we reject the null hypothesis, which proves that GDP is affect by its past values at lag 1. The P-value associated with lag (2) of C(4) is 0.0016 which is also less than 0.05. Therefore we reject H_0 and GDP is significant to explain its past values at lag 2.

Equation 3 for Thailand the Coefficients associated with energy consumption Lag (1) and Lag (2) are C (1) and C (2) for which probability values are 0.6981 and 0.5613 respectively. Since the P-values are more than 5%, the null hypothesis that energy consumption lag (1) and lag (2) are not significant to influence GDP could be accepted. This proves that GDP are not being affected by the past values of energy consumption.

Further, the coefficient associated with lag (1) of Real GDP is 0.000 which is less than 0.05 we reject the null hypothesis, which proves that GDP is affect by its past values at lag 1. The P-value associated with lag (2) of C(4) is 0.0854 which is more than 0.05. Therefore we accept H_0 and GDP is not significant to explain its past values at lag 2.

4.6. Toda Yamamoto Causality Test
In the above Table 6 the P-values of China, Indonesia, Malaysia and Philippines are more than 5% significance level which indicates that there is no causality between energy consumption and GDP supporting the neutrality hypothesis.

However in case of India and Thailand there is a uni- directional causality running from GDP to energy consumption at 10% and 5% significance level resp. supporting the conservation hypothesis. This indicates that energy conservation will not be a hindrance to economic growth in these countries.

5. CONCLUSION

In case of China both variables i.e. energy consumption and GDP were found to have mixed integration. Therefore, in order to find out long term relationship we employed ARDL Bounds testing approach where both variables were concluded to have long term relationship however VECM indicated that variables are unable to adjust to equilibrium after a shock. Toda Yamamoto causality test indicated that there exist no causality between energy consumption and economic growth for China.

Energy consumption and GDP for India were found to be stationery at first difference. Therefore we applied Johansens Cointegration test to identify long term cointegrating relationship. Results indicated that there exists a long term cointegrating relationship between the variables which allowed us to run a VECM modal. However, VECM indicated that energy consumption does not have a long run relationship on GDP of the country. In Addition there exist a causal relationship running from GDP to Energy consumption supporting the conservation hypothesis which is in line with (Benjamin, 1999). Therefore the economic growth of India is not dependent on energy consumption.

Energy consumption and GDP of Indonesia were found to be stationery at first difference through ADF and PP unit root test. Therefore Johansen's cointegration test could be applied to find out if there exists a long run relationship. Results indicated that there exists a long run cointegration between the variables. VECM was employed where results indicated that there does not exist a long run relationship between energy consumption and GDP. Toda Yamamoto causality test indicated that there is no causal relationship between the variables supporting neutrality hypothesis.

In case of Malaysia, energy consumption and GDP were found to be stationery at first difference therefore Johansen's cointegration test was employed to test long run cointegrating relationship between the variables. Results indicated that there is no cointegrating relationship. There VAR was employed to find out if GDP is affected by energy consumption and its past values as well as its own past values. It was found that GDP was affected by its own past values at lag 1. Toda Yamamoto causality test indicates that there exist no causal relationship between energy consumption and GDP.

Energy consumption and GDP of Philippines were found to be stationery at first difference according to ADF and PP unit root test. Therefore we employed Johansen's cointegration test to understand if there is a long term cointegrating relationship between the variables. Results indicated that there is no long run cointegrating relationship. VAR model was applied where GDP was found to impact itself at lag 1 and lag 2. Toda Yamamoto causality test indicates that there is no causal relationship between energy consumption and GDP.

Unit root tests for Thailand indicate that both variables viz. energy consumption and GDP are stationery at first difference. Therefore we apply Johansen's cointegration test to check if there is a long run cointegrating relationship. Results indicate that there is no long run cointegrating relationship between the two variables. VAR indicates that GDP is affected by itself at lag 1. Toda Yamamoto causality test indicates that there exist a unidirectional causality running from GDP to energy consumption.

Economic growth for India and Thailand leads to energy consumption which is a cost to the economy and environment of both countries. In addition energy conservation policies will not have an adverse impact on economic growth. Efforts should be made to encourage consumption of clean energy through suitable policy formulation and implementation.

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