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THE IMPACT OF CARBON DIOXIDE EMISSION ON GROWTH IN MALAYSIA

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Abstract: *This paper attempts to establish a short run relationship between economic growth and carbon dioxide (CO2) emissions for Malaysia. To achieve this purpose, annual data were collected from the reports of the World Bank. It was tested by using Augmented Dickey Fuller (ADF) and Kwiatkowski –Phillips–Schmidt–Shin (KPSS) to test for stationarity using yearly data for the years from 1975 to 2016. The empirical results suggest the existence of a short run relationship between per capita CO2 emissions and real per capita Gross Domestic Product (GDP). According to the work of the analysis, unit root tests show that economic growth and carbon emission series become stationary when the first difference is considered. Results show that there is no cointegration exists between economic growth and carbon emission. Still, there exists two way relationship between economic growth and carbon emission during the short run period. These findings may be vital for future climate change policy. Following this development and new evidence, the government will be able to formulate the best method and encourage business sectors using high technology to reduce carbon dioxide emissions.*

Keywords: *Carbon Dioxide, Economic Growth, Kwiatkowski-Philips-Schmidt-Shin (KPSS), Short Run & Cointegration*

Introduction

The relationship between the economy and the quality of the environment is very close. What is the question of how GDP percapita allows many countries to produce greenhouse gases, especially carbon dioxide gas? According to data obtained from the World Bank, we can see that there is a positive correlation between GDP and carbon dioxide emissions. Continuing from the increase in national income, then it will be in line with the release of carbon dioxide gas into the atmosphere. As a result, the amount of fossil fuel spent will also increase. Previous research studies have found that there is indeed a link between carbon dioxide emissions and economic growth. However, a single study of a country can provides enlightenment and detail on the reactions or relationships that occur between carbon dioxide and economic development. It will also give an overview of the relations of a country. The deterioration of the environment as well as income relations has received high coverage and attention and emerged as one of the

exciting topics and has attracted several economists and policymakers so that the policies issued should be accurate. Policymakers need to think about the pattern of economic growth so that in the future, it does not provide severe pollution. Lately, the effects of urbanization on carbon emissions have been the focus of many researchers. However, the results are somewhat unconvincing. An analysis from Jones (1991) found that for a study of 59 countries concluded that there is a 10% increase in developing countries. Jones (1991) conducted a regression analysis of 59 developing countries for 1980 to study the overall impact of urbanization on energy consumption. He concluded that the 10% increase would increase energy consumption per capita by 4.5% to 4.8% assuming constant per capita income and industrialization. Analyzing the influence of urbanization on energy consumption and greenhouse gas emissions in developing countries based on panel estimates from 1965 to 1987 done by Parikh & Shukla, (1995), the result showed that a 10% increase in the urban population would allow a 0.3% increase in CO2 emissions per capita.

Literature Review

Ghosh (2010) study cointegration and causality between carbon emissions and economic growth for India using the ARDL method. The result obtained is the absence of a long-term equilibrium relationship and the long-term causal link between carbon emissions and economic development. However, there is a short-term two way relationship between the two. Efforts to reduce carbon dioxide emissions are seen to reduce national income. The results of the study also found that the lack of long-term relationships shows that there are things that need to be considered such as focusing on utilizing energy from clean sources to curb carbon emissions that will not affect the country's economic growth. Jaunky (2011) attempts to test the relationship for 36 high-income countries for the period 1980-2005. The method recommended by Narayan (2010) see the directions from GDP to carbon emission are not found in the short and long term. For the whole panel, we can see a 1% increase in GDP shows a 0.68% increase in co2 emissions in the short term while in the long run shows a 0.22% increase. The paper study by Acheampong (2018) uses vector panel autoregression (PVAR) together with the system generalized method of moment (System-GMM) to study the dynamic cause and effect relationship between economic growth, carbon emissions and energy consumption for 116 countries. The results of the study have had an impact or implications to the policy of a nation. The findings for the study have found that economic growth does not result in energy consumption globally and regionally. Second, except for American and Caribbean-Latin America, economic growth does not have a causal effect on carbon emissions. However, economic growth harms global carbon emissions and Caribbean-Latin America. Third, carbon emissions positively lead to economic growth. Fourth, energy consumption positively leads to economic growth in sub-Saharan Africa while negatively leads to economic growth in the global, Middle East and North Africa (MENA), Asia-Pacific and Caribbean-Latin America. Fifth, energy consumption positively results in carbon emissions in MENA but negative carbon emissions in sub-Saharan Africa and the Caribbean-Latin America. Nuryartono & Rifai (2017) study Economic growth and energy consumption in 4 ASEAN countries is dominated by fossil fuels which increases the carbon dioxide emission. This study examines the causality relationship between economic growth, energy consumption and carbon dioxide emissions in 4 ASEAN countries during the period of 1975-2013 and the analysis using granger causality and vector error correction model. The result shows that economic growth and energy consumption in Indonesia and Singapore are not interconnected. While in Malaysia and Thailand, there is a direct causal relationship. A one direction relationship between economic growth and carbon

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dioxide emissions happened in Indonesia and Thailand, while in Malaysia and Singapore did not exist. The causal relationship between energy consumption and carbon dioxide emissions occurs in Indonesia, whereas in other countries did not exist. The respond of every variable on the shock in other variables is different in each state. Given Malaysia's status as a fast-growing economy with accelerating carbon dioxide emissions, a better understanding of the relationship between economic growth and pollution is vital to the policymakers. This paper, therefore, Lau et al.,(2014) attempt to investigate the existence of long run relationship among carbon dioxide emission, institutional quality, exports, and economic growth and further examines the causal relationship among these variables in Malaysia for the period 1984 to 2008. From the bounds test, it is found that a long run relationship does exist among the variables, even using different conditioning information sets. A positive and significant interaction term between carbon dioxide emission and institutional quality indicator (i.e., law and order) implies that good institutional quality is vital in controlling carbon dioxide emission in the process of economic development. The results for Granger causality tests further confirm the importance of institutional frameworks in reducing carbon dioxide emissions since institutional quality is found affects economic growth not only directly but also indirectly via carbon dioxide emissions. This indicates that sound institutional frameworks are essential for Malaysia to achieve high economic growth without sacrificing its environment. The goal of this paper done by Alejandro & Anastacio (2017) looks at the validity of the environmental Kuznets curve hypothesis for North America countries (Canada, United States and Mexico) over the annual period 1980-2008. Pedroni cointegration tests are applied for a long-run testing relationship between the variables. Using the panel fully modified ordinary least squares (OLS) and the Panel dynamic OLSs determinate the elasticities of the long-run relationships. The results show that there is an inverted U-shape relationship. Finally, in the long run, the results of the causality test show that there is a unidirectional causal flow from energy consumption, electricity consumption and economic growth to CO2 emissions in North America.

Data and Methodology

This study uses annual time series data from 1975 to 2016, which were obtained from the World Bank. Such data include Gross Domestic Product (GDP*)* and Carbon Dioxide (CBON). All data are transformed into logarithmic form. For the analysis, this study applies the Engle-Granger two steps and unit root test to deal with stationary or non stationary problem. Unit root tests in this study are conducted by using Dickey-Fuller, DF or Augmented Dickey-Fuller, ADF (Dickey & Fuller, 1979), and KPSS test (Kwiatkowski et al., 1992). After determining the integration level for all the variables involved, a cointegration test can be made to test the existence of cointegration between LGDP and LCBON by using the Engle-Granger (Engle et al., 1987) methods. To support the hypothesis that LGDP and LCBON are cointegrated, the cointegration vector must be at level 1.

Engle-Granger 2-step Cointegration Test

Cointegration exist if $\mathcal{E}_t = Y_t = \beta_0 = \beta_1 X_t \sim I(0)$, better known as "disequilibrium error" rarely drift far from zero (i.e., residuals are stationary). Engle-Granger 2 step procedure can be applied to test for cointegration. If Y and X are not cointegrated, the estimated level regression is indeed invalid. The relationship between the two variables must then estimated at first differenced (Engle et al., 1987)

$$\Delta Y_t = \beta_0 + \beta_1 \Delta X_t + \varepsilon_t$$

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The equation represents the short-run relationship between Y and X.

$$\Delta GDP_t = \beta_0 + \beta_1 \Delta LCBON_t + \varepsilon_t$$

In case of no cointegration, VAR model also can be used. Then, one directly proceeds to Granger causality tests to establish causal links between the variables. The regression equation form for VAR is as follows:

$$\Delta GDPt = \propto_1 + \sum_{i=0}^{n} \beta_1 \, \Delta GDP_{\text{t-i}} + \sum_{i=0}^{n} \beta_2 \, \Delta LCBON_{\text{t-i}}$$

with $\varepsilon_{it} \sim iid(0, \sigma_{si}^2)$ and cov(e_y, e_z)=0

(1)

In VAR, the cointegration rank shows the number of cointegrating vectors. For instance, a rank of two indicates that two linearly independent combinations of the non-stationary variables will be stationary.

Granger Causality Test

Granger causality is a statistical hypothesis of causal influence based on prediction via vector autoregression. According to Granger causality, if *X*1 "Granger-causes" (or "G-causes") *X*2, then past values of *X*1 should contain information that helps predict *X*2 above and beyond the information contained in the past values of *X*2 alone. In other words, a time series *X*1 is said to Granger-cause Y if it can be shown, usually through a series of t-tests and F-tests on lagged values of *X*1 (and with lagged values of *X*2 also included), that those *X*1 values provide statistically significant information about future values of *X*2. A critical issue in testing for Granger causality is the specification of the data generating process underlying the observed time series. The standard Granger test is valid only if the variables are stationary and do not share a common stochastic trend. In a setting where the variables are non-stationary, as is the case with most economic time series, Engle et al. (1987) argue that conventional Granger causality tests could provide misleading results. One must, therefore, investigate the stationarity properties of the data before applying tests for causality in the Granger's sense. If our time series is stationary, the test is performed using the level values. If the variables are non-stationary, then the test is done using first (or higher) differences. The number of lags to be included is chosen using an information criterion, the Schwarz information criterion.

$$GDP_t = \sum_{i=1}^{n} \propto_i GDP_{t-i} + \sum_{j=1}^{n} \beta_j \, CBON_{t-j} + u_{1t} \quad (2)$$

If causality (or causation) runs from GDP to CARBON, it takes the form:

$$CBON_t = \sum_{i=1}^{n} \gamma_i \, CBON_{t-i} + \sum_{j=1}^{n} \delta_j \, GDP_{t-j} + u_{2t}$$

(3)

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Empirical Results

The results of the unit root tests based on ADF and KPSS are shown in Table 1. Based on the ADF and KPSS tests, both variables, LGDP and LCBON are stationary at first difference. We can specify that the order of integration is I (1) after taking the first difference.

Table 1: Unit Root Test

Variable	ADF			KPSS		
	LOG			LOG		
	Level	1st Difference		Level	1st Difference	
GDP	-1.343	-5.391	**	0.810	0.148	**
CARBON	-1.388	-7.475	**	0.776	0.189	**

Note: The ** Denotes Significance At The 5% Level

Table 2: Engle Granger Cointegration Test

Dependent	tau-statistic	Prob.	z-statistic	Prob.
LGDP	-2.474	0.308	-13.146	0.162
LCBON	-2.558	0.273	-13.493	0.149

Null Hypothesis: Series Are Not Cointegrated

Table 2 shows the result of the cointegration test based on the Engle-Granger approach. Based on the outcome, there is no cointegration for the series. The second cointegration test using the Johansen approach shows in Table 3 which shows a similar result with the Engle-Granger cointegration test. The results show that there is no long run cointegration relationship between GDP and CARBON. This empirical decision proposes that GDP and CARBON could not be cointegrated in the long run (Johansen, 1988). Both statistic tests which are Trace-eigen and Maximum-eigen statistic have produced similar results. Both eigenvalue and Trace statistics lower than the critical value. The results give the conclusion that in the long run there is no tendency that GDP moves together with CARBON towards equilibrium.

Table 3: Johansen Cointegration Test

Ho	Maximum Eigenvalue	Critical value (95% level)	trace statistic	Critical Value (95% level)
r=0	2.831	14.265	3.593	15.495

Note: r Indicates The Number Of Cointegrating Vectors.

The absence of a long run cointegration relationship needs eqs. (2) and (3) without error correction term, we decide to be used difference variable using OLS Test to find causality or significant relationship between these two variables between GDP and Carbon. As there is no cointegration using Engle granger and Johansen Test, the best method to find a significant relationship, following the right procedure will be Ordinary Least Square Method (OLS) method (see Table 4).

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Table 4: Ordinary Least Square Test

DEPENDENT VARIABLE	INDEPENDENT VARIABLE	
	D(LGDP)	D(LCBON)
D(LGDP)		0.177*
D(LCBON)	1.063*	

Note: The *, ** Denote Significance At 1%

Based on the result from the Ordinary Least Square result by differencing the variable, we can identify that there is two way relationship between GDP and Carbon. GDP will cause Carbon and Carbon will cause GDP during the short run period.

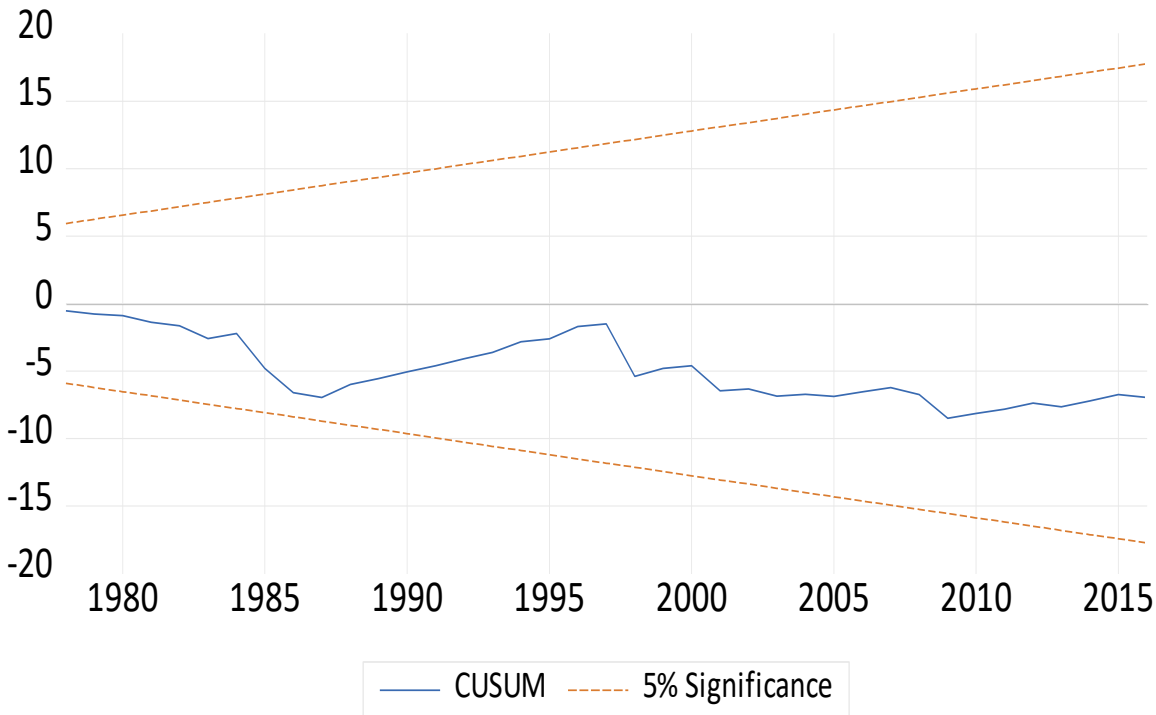

Figure 1: Cusum Test Result

Result from Cusum Test shows that the model is stable because it is within critical bound value.

Conclusion

The study investigates the relationship between CO2 emissions and GDP by using aggregate data for Malaysia. Based on this study, there is a significant relationship between economic growth and carbon dioxide emission, and it supports evidence from Saboori et al.,(2012) applying concept environmental Kuznets Curve Hypothesis. In particular, Nuryartono & Rifai, (2017) produce the same result showing there is economic growth which has a significant effect on Carbon Dioxide emission. Based on the result, the government should imply a policy to have a restriction on the industry that exceeds a certain level of emissions For future research its quite crucial if we could add other explanatory variables like International trade and use a more sophisticated technique which could contribute to increasing in environmental degradation To

decrease the CO2 emissions in the urban area, the government could limit the releases of CO2 emissions in that particular state. Every business industry should help in reducing the CO2 emissions, and solar energy can be recycled and easy to be obtained by everyone, especially the business sector.

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