INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN ECONOMICS & MANAGEMENT SCIENCES

OPEN ACCESS JOURNAL

Vol 9, Issue 1, (2020) E-ISSN: 2226-3624

The Driving Prospects of Sustainable Environment in Malaysia

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To Link this Article: http://dx.doi.org/10.6007/IJAREMS/v9-i1/7317 DOI:10.6007/IJAREMS/v9-i1/7317

Published Online: 27 March 2020

Abstract

This paper investigates the relationship between Carbon Dioxide Emissions (CO2) and other factors such as Financial Development (FD), Energy Consumption (ENG), Economic Expansion (GDP) and Trade Openness (TO) in Malaysia. Annual time series data for the 1975 to 2014 period, the Autoregressive Distributed Lag (ARDL) and Unit Root Test such as Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) are used for the analysis. The results reveal that among the factors of GDP and TO have a positive significant impact on GDP growth. However, FD and ENG are the only variables that do not have significant bearings to CO_2 emissions in Malaysia. The study ultimately analyzes the short-run and long-run elasticities of the model of sustainable development. These findings could asists policymakers in planning urbanization development by emphasizing clean investment for limiting CO_2 emissions, which can save people from natural disasters.

Keywords: Kuznets Curve, CO2 Emissions, Economic Growth, Sustainable Environment.

Introductions

Carbon dioxide (CO_2) is known to be the main anthropogenic greenhouse gas that can change the radiative balance of the Earth. CO_2 is a synthesis of, mainly, the usage of fossil fuel and land-use changes. Nowadays, the danger of global warming is signaling a rise and the phenomenon is calling out for a better acknowledgment and a more thorough debate regarding the matters of the environment. The occurrence of escalating global average air and ocean temperatures, the meltdown of the ice caps and the rise of global average sea level are ultimately the supporting proofs to global warming.

Ever since independence in 1959, the outstanding upsurge in energy usage stimulates a simultaneous intensification in the emissions of pollutants in the current times. Referring to the United Nations Development Report, during the period ranging from 1990 to 2004 the CO_2 emissions in the country boosted by 221%, resulting Malaysia being listed as the 26th

among 30 countries to emit pollutants. If the CO_2 emissions continue to rise, the country is likely to gain a higher ranking on the abovementioned list. A good thing that the country participated in the Kyoto Protocol which is the international treaty which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC), that commits State Parties to reduce greenhouse gas emissions as it did influence in changing the movement of CO_2 emissions.

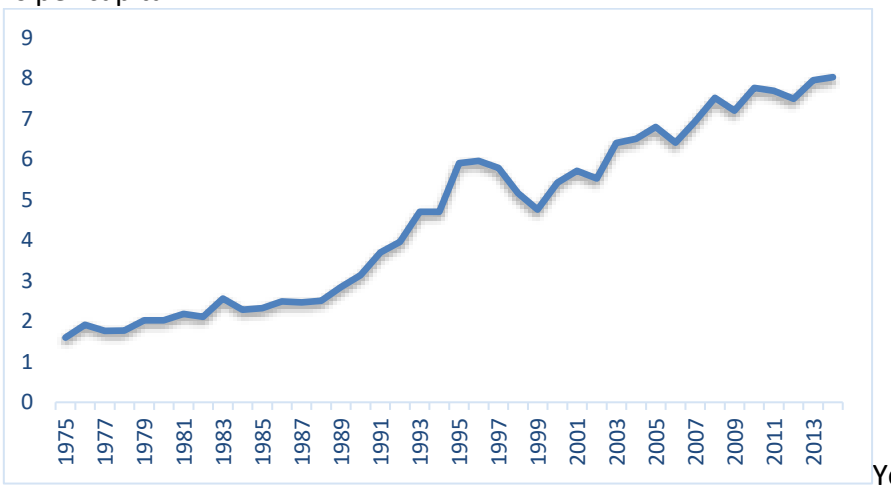

Figure 1: Trend of Malaysian CO2 Emission (metric tons per capita) from 1971 to 2014

The issue concerning environmental deterioration has opened a significant number of pairs of eyes in the last few decades and it is regarded as one of the most discussed matters. Malaysia has been dealing with difficulties with substantial carbon dioxide emissions (CO_2) especially from the burning of fossil fuels and the bearing it has on the climate which has become a significant matter for the environmentalists and economists in Malaysia. Carbon dioxide emissions are a remarkable matter where the value of emission moves along with activities such as business operations run by major organizations and government's infrastructural development, yet assumes a significant role in the environmental performance. The economic determinants of environmental performance movement are known to be one popular subject matter of study among some researchers. Preceding studies suggested that several investigations and analyses have been conducted regarding this case. The situation has given the study the notion to combined the factors in some studies that have been conducted, namely, financial development, energy consumption, economic expansion, and trade openness into this study to observe whether these macroeconomic factors have to bear the environmental performance in Malaysia.

Literature Review

A variety of earlier research on the relationship between carbon dioxide emissions and macroeconomic factors over the past half-century can be found worldwide. The economic and financial theory conceived that a possible and mixed association was found between emissions of carbon dioxide and certain variables. A strong financial system guarantees the positive economic growth and stability of a country in which could help to provide a positive impact towards reducing carbon dioxide emission in a country. Many previous studies have shown that good environmental quality is necessary for the economic growth of both developing and developed countries. There are several numbers of studies that have been

found related to the relationship between carbon dioxide emission and macroeconomic variables in this section. The result is either significant or insignificant influences of carbon dioxide emission.

As we all know, the primary greenhouse gas released from human activities is carbon dioxide (CO_2). Some of the major human activity emitting CO_2 is the combustion of fossil fuels (coal, natural gas, and oil) for energy and transport, although some industrial processes and changes in land use also emit CO_2. Across the year, the country has taken many actions to reduce the amount of annual carbon dioxide emissions. Numerous campaigns, policy options and many more have been intriguing parts of the initiatives. Most of these studies have come to the agreement that economic growth improves living standards but can also lead to increased carbon emissions (Wang, 2016).

Urbanization is shown to be positive in the early stage of urbanization, but at the higher stage of urbanization, it transforms into negative inelastic. In addition, the unidirectional causality from urbanization to short-term CO_2 emissions is significant at 1 percent, and the bidirectional causality between CO_2 emissions and urbanization is significant at 5 percent long-term. These findings could support policymakers in managing the development of urbanization and considering clean investment and other green aspects for sustainable urban development that can save many people from the natural disaster. Urbanization is a dynamic moderation of rural-to-urban social and economic capacity. Urbanization seems to be a dynamic moderation of rural-to-urban economic and social capacity. Nearly half of the world's population is currently living in urban areas; by 2050, about 64 percent of the population of developing countries will be urbanized (Shahbaz et al., 2016). This trend has contributed to greater energy consumption and CO_2 emissions from production and other economic activities as nearly all these activities occur in urban areas. In addition, most rural residents in the urbanization process have changed their lifestyles in some ways and improved their living standards.

Trade Openness refers to the outward or inward orientation of the economy of a given country in terms of trade openness. Outward orientation refers to economies that take advantage of other countries' opportunities to trade. Trade Openness is the sum of GDP standardized imports and exports. Lane and Milesi-Ferretti (2008) state that bilateral investment in equity is strongly correlated with underlying trade patterns. A hot topic is a connection between trade and CO_2 emissions. Most of the latest literature address either one of the two subjects. One is the emissions of CO_2 are incorporated in foreign trade. Shui and Harriss (2006) studied the impact of trade on national and global carbon dioxide emissions from 1997–2003 and found that over 7–14 percent of current CO2 emissions were the result of consumer exports. Lastly, most studies agree that export CO_2 emissions are enormous. It is therefore inferred that this country could become a pollution haven for the transfer of CO2 emissions from developed countries and that there is carbon leakage due to trade with developed countries.

Next, the Gross Domestic Product (GDP) is the broadest measure of the total economic activity of a nation. In particular, GDP is the monetary value of all goods and services produced within the geographical boundaries of a nation over a set period of time. Measuring the level and rate of growth of national income (Y) is important for keeping track of

- The economic growth rates
- Living standard changes
- Distribution changes

Yang et al. (2011) investigated the interaction between economic growth and pollution in Zhejiang's industrialization process, time-series data from three types of pollution indices from 1981 to 2006. Using the cointegration test and granger causality test, the investigation was carried out. The test results showed that, with the exception of solid waste, GDP per capita results in increased emissions from industrial waste.

Financial development involves some improvements in producing information on possible investment and capital allocation, monitoring firms and exercising corporate governance, trading, diversification, and risk management, mobilizing and pooling savings, facilitating the exchange of goods and services. There are studies that stated that financial development reduced carbon dioxide emission in the upper and middle-income countries while on low-income countries financial development will lead to an increase of carbon dioxide emission, as stated by Onanuga (2017). Financial development reduces carbon dioxide emissions when the financial markets provide financial assistance to domestic firms to acquire environment-friendly and clean technology for manufacturing purposes.

Consumption of energy is the amount of energy or electricity used. Controlling and reducing energy consumption is important because it allows cost reduction – this is becoming increasingly important because energy costs are rising and harmful to the environment itself at the same time. To understand better about electricity consumption, several previous studies have been reviewed and can be divided into two categories:

1. Relationship between the use of energy and economic growth.
2. The relationship between the use of energy, economic growth, and the production of carbon dioxide.

Model Specification

The purpose of this project paper is to examine the driving prospects of the CO_2 movement for Malaysia. Preceding studies had conducted numerous analyses exploring the case of CO_2 emissions, including economic expansion and energy usage as the determinants (Ang, 2007). Tamazian and Rao (2010) added financial development as a prospect driver of CO_2 emissions. Subsequent to the discussion above, a study conducted an analysis of the linkage between economic expansion, energy usage, financial development on CO_2 emissions by incorporating trade openness as the determinant while excluding the square of GDP and urbanization from the study (Shahbaz et al., 2013). The general form of the empirical model as introduced by the above study:

$CO_{2t} = f(+E_t + Y_t + F_t + TR_t)$

Now, we transform all the series into logarithms to attain direct elasticities. The empirical equation is modeled as follows:

$LNCO_{2t} = \alpha_0 + \beta_1 LNFD_t + \beta_2 LNENG_t + \beta_3 LNGDP_t + \beta_4 LNTO_t + \mu_i$

where CO_{2t} is carbon dioxide emissions measured by CO_2 emissions metric tons per capita, FD_t is financial development proxied by domestic credit to the private sector, ENG_t is energy consumption measured by kg of oil equivalent per capita, GDP_t per capita constant 2010 USD is used as a proxy for economic growth and TO_t which represents trade openness as a share of GDP. Finally, μ_i is the error term assumed to be normally distributed with zero mean and constant variance. The coefficient $\beta 1$ is expected to have a negative sign, while the other three coefficient $\beta 2$, $\beta 3$ and $\beta 4$ is expected to have a positive sign.

Annual data over 36 years starting from 1981 until 2017 were used in the empirical analysis. The data have been collected from various sources. The sources of each data are listed in the following Table 1.

Table 1
Sources of data

Model	Description	Sources
CO_2	CO2 emissions (metric tons per capita)	World Development Indicator
FD	Domestic Credit to Private Sector (% of GDP)	World Development Indicator
ENG	Energy Use (kg of oil equivalent per capita)	World Development Indicator
GDP	GDP per Capita (Constant 2010 USD)	World Development Indicator
TO	Trade (% of GDP)	World Development Indicator

Source: World Development Indicator 2018

Empirical Result and Discussion

This section focuses on the regression outcomes of the proposed model. The analysis begins with ADF and PP unit root test. From Table 2, it displays that at the first difference, almost all variable consisting both independent variables and the dependent variable are significant at 1% level and 99% confidence level for both ADF and PP test. Nevertheless, only one particular variable, which is LNFD (financial development) at the first difference is insignificant for intercept and trend and intercept for ADF test. Not putting aside the fact that for PP test, the variable (LNFD) shows significant at 1% level and 99% confidence level. Furthermore, note that the variable LNTO (trade openness) shows significant at 5% level and 95% confidence level for trend and intercept in PP test.

Table 2
Results of Unit Root tests

Model	Variable	ADF test statistic		PP test statistic	
		Intercept	Trend and ‘intercept	Intercept	Trend and Intercept
Malaysia					
Level	$LNCO2_t$	-1.213 (0)	-1.868 (0)	-1.213 (0)	-1.948 (3)
	$LNFD_t$	-2.774 (3)*	-2.609 (3)	-2.338 (3)	-1.579 (3)
	$LNENG_t$	-1.722 (0)	-2.220 (0)	-2.955 (14)*	-2.036 (3)
	$LNGDP_t$	-1.415 (0)	-2.240 (1)	-1.359 (1)	-2.242 (2)
	$LNTO_t$	-1.448 (4)	0.497 (0)	-1.702 (2)	0.279 (4)
First difference	$LNCO2_t$	-7.593 (0)***	-7.523 (0)***	-7.482 (2)***	-7.475 (1)***
	$LNFD_t$	-2.160 (2)	-2.482 (2)	-5.349 (4)***	-5.673 (3)***
	$LNENG_t$	-6.506 (0)***	-6.743 (0)***	-6.666 (6)***	-10.318 (13)***
	$LNGDP_t$	-5.221 (0)***	-5.193 (0)***	-5.221 (0)***	-5.193 (0)***
	$LNTO_t$	-3.769 (0)***	-4.343 (1)***	-3.765 (5)***	-4.179 (11)**

Note: 1. (***), (**) and (*) are 1%, 5% and 10% of significant levels, respectively. 2. The optimal lag length is selected automatically using the Akaike information criteria for ADF test and the bandwidth has been selected by using the Newey–West method for the PP test. 3. Number in parentheses is standard errors 4. Integration order information is based on trend and intercept.

Detecting the Long-Run Relationship

The next part is to verify whether the long-run relationships between the variables exist, the study carried on with the F-tests and the results are as shown in Table 3. The maximum lag of 4 was set in the model using Akaike Information Criterion (AIC). The F statistic (6.43) is greater than the upper I(1) critical value (significant at 1% level), thus confirming the existence of long-run relationships. The result is extracted from the Bound Test using E-views software.

Table 3
Result of ARDL co-integration

Model	Maximum lag	AIC (Lag order)	F Statistic
Model of Sustainable Development	4	(3,2,3,1,3)	6.438***
Critical Values for *F*-statistics#		Lower bound, I(0)	Upper bound, I(1)
k = 4	1%	3.74	5.06
	5%	2.86	4.01
	10%	2.45	3.52

Note: # The critical values are obtained automatically under Eviews 9, k is number of variables (IV), critical values for the bounds test: case III: unrestricted intercept and no trend. (*), (**), and (***) represent 10%, 5% and 1% level of significance, respectively.

Diagnostic tests are conducted for the model to make certain that the long run estimation may be able to derive reliable results. Table 4 has presented the result that contains the very much sought after econometric properties, in which to be precise, the model possesses no autocorrelation problem, not only possess a correct functional form but correspondingly a serially uncorrelated residual, and the model is unrestricted from the homoscedastic problem. Null hypothesis or H_0 reflects that the model is clear from the diagnostic problem and alternate hypothesis or H_1 reflects that the model is facing diagnostic problems. The model must pass all tests in order to produce non-biased results.

Table 4
Result of Diagnostic Tests for the Model of Sustainable Development

Diagnostic test	Null hypothesis	Statistics	Decision
Jarque-Bera test	H_o = Residual are normally distributed	0.771 [0.680]	Do not reject H_0
Breusch-Godfrey serial Correlation LM test	H_o = There is no autocorrelation	0.578 [0.570]	Do not reject H_0
Breusch-Pagan-Godfrey test	H_o = There is no heteroscedasticity	0.792 [0.678]	Do not reject H_0
Ramsey RESET test	H_o = The model is correctly specified	0.851 [0.367]	Do not reject H_0

Note. S signifies stable model. The graphs can be requested from author. The numbers in brackets [ ] are p-values. The tests run for diagnostic check are Jarque-Bera (normality), Ramsey RESET (functional form), Breusch Godfrey LM test (autocorrelation) and Breusch Pagan Godfrey (heteroscedasticity).

Both the stability tests were also conducted for this study and the findings are shown in Figure 2. The CUSUM test plot reveals that the residuals are at sense level across two polar boundaries. In comparison, the CUSUMSQ test plot holds at the 5 percent significance level between two polar tied. This confirms that the model selected for the time series is structurally stable.

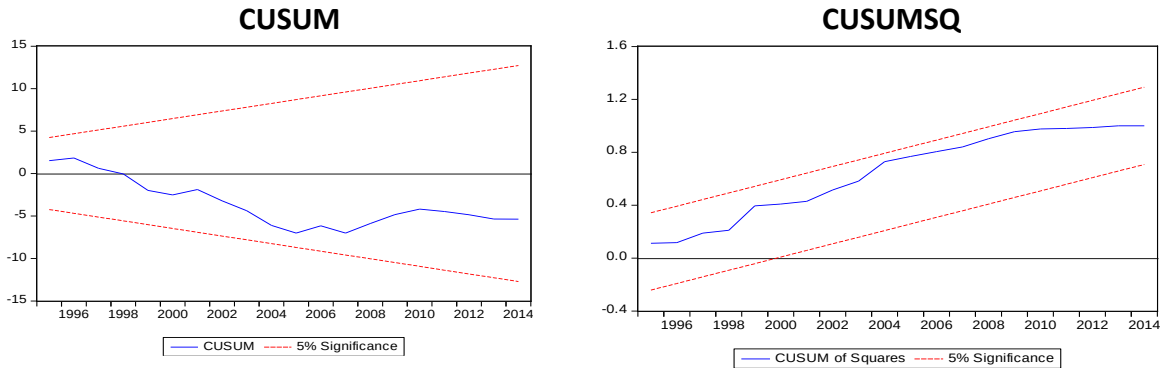

Figure 2: CUSUM of Square Test Stability Test for Model of Sustainable Development

Long-run and short-run elasticities

Based on the E-views result, the variable FD (Financial Development) has a negative relationship with the CO_2 (Carbon Dioxide Emissions) and not significant as its p-value is 0.6285 which is more than 1%, 5%, and 10% significance level. The variable ENG (Energy Consumption) showed that it has a positive relationship with CO_2 but simultaneously insignificant at a p-value of 0.3517, more than 1%, 5%, and 10% significance level. Next, GDP (Economic Expansion) is found to have a positive correlation on CO_2 (Carbon Dioxide Emissions) and significant as its p-value is 0.0048 which is less than 1%, 5%, and 10% significance level. The final variable that is TO (Trade Openness) also has a positive relationship with CO_2 and at the same time a significant with the p-value of 0.0035 which is relatively smaller than 1%, 5% and 10% significance level.

The first variable is domestic credit to the private sector, proxied by FD. From the E-views result, the financial development has a negative relationship with CO_2 emission. The variable has a coefficient of -0.025. Financial Development of Malaysia has p-value of 0.6285 which is higher than 1%, 5% and 10% significance level with the confidence level of 90% and 99%. Jalil and Feridun (2011) documented that findings suggested that financial development has no substantial bearing on CO_2 emissions for the long term. The discussion continued with the variable ENG, which is a proxy for energy use, showing a positive relationship with CO_2 emission. Even though the variable has a coefficient of +0.273. The variable has a p-value of 0.3517 which means it is lower than 1%, 5% and 10% of significance level with the confidence level of 99%. Jayanthakumaran et al. (2012) noted that findings suggest that CO_2 emissions in India, there is no causal link is identified between energy usage and CO_2 emissions. Next would be GDP being a proxy for economic expansion. This variable gives an indication from the result that GDP has a positive relationship with CO_2 emission. The coefficient for GDP is +0.909 indicating that if GDP increases by 1%, the CO_2 emission will increase by 0.909%. The p-value for GDP shows 0.0048, meaning that it is lower than 1%, 5% and 10% of significance level with the confidence level of 99%. Jalil and Mahmud (2009) give documented evidence that GDP has a significant bearing on CO_2 emissions for the long term. The paper Ang (2009) added that greater use of GDP would generate greater CO_2 emissions. These studies are

supported by Jayanthakumaran et al. (2012), suggest that economic expansion has a positive relationship with CO_2 emissions.

Finally is trade openness, proxied by TO, which result indicates that TO has a positive relationship with CO_2 emissions. The TO has a coefficient of +0.275, showing that when TO rises by 1%, the CO_2 emissions will simultaneously rise by 0.275%. With the p-value of 0.0035, it means that TO is lower than 1%, 5% and 10% of significance level with the confidence level of 99%. Ozturk and Acaravci (2013) demonstrate that a rise in trade openness prompts a rise in CO_2 emissions over a long period. The study Ang (2009) matched the above study by stating that trade openness has a positive relationship with CO_2 emissions.

Table 5
Results of Estimation of Long-Run Elasticities

Regressor	Coefficient	Standard Error	t-Statistic	P-value
LNFD	-0.025617	0.052136	-0.491349	0.6285
LNENG	0.273757	0.287105	0.953508	0.3517
LNGDP	0.909360***	0.286689	3.171944	0.0048
LNTO	0.275267***	0.083045	3.314688	0.0035
C	-9.739842***	0.648515	-15.01873	0.0000

Note: (*),(**),(***) indicate significant at 10%,5% and 1% significance level respectively. Number in parentheses is standard errors.

Finally, Table 6 clarifies the result of short-run elasticities and error correction terms (ECT). The short-run elasticities elaboration is only based on zero lag. In the short term, the LNFD had an insignificant but positive relationship with $LNCO_2$ in Malaysia. Next, it is shown that LNENG had a significant and positive relationship with $LNCO_2$. Moreover, this country indicated a positive relationship between LNGDP and $LNCO_2$ but it is not significant. Lastly, the variable tested namely LNTO, showed a significant and positive relationship with $LNCO_2$.

The long-run linkage based on the ECM model is backup by the negative and significant values of error correction term (ECT). ECT represents the speed of adjustment for the model and the negative value reflects that the variables in the model will converge in a long period. Provided that the ECT value in Malaysia is -1.231, it indicates that the adjustment speed is very rapid from the short run to the long-run equilibrium. Specifically, if the actual equilibrium value is too high, the error correction term will reduce it, while if it is too low; the error correction term will raise it. In addition, if it performs well going by the relevant coefficient, all of which fall within the acceptable region. The ECT result indicated that when CO_2 deviates from its long-run equilibrium level, it adjusts around 123% within the first year. The explanatory variables explain well over at least 99 percent of the variations in the models.

Table 6
Results of Estimation of Short Run Restricted Error Correction Model (ECM)

Regressor	Coefficient	Standard Error	t-Statistic	P-value
$\Delta LNCO2_{t-1}$	0.532136**	0.193130	2.755322	0.0122
$\Delta LNCO2_{t-2}$	0.374116**	0.154190	2.426332	0.0248
$\Delta LNFD_t$	0.151816	0.103551	1.466094	0.1582
$\Delta LNFD_{t-1}$	0.361496***	0.111636	3.238179	0.0041
Δ $LNENG_t$	0.780816***	0.269752	2.894570	0.0090
$\Delta LNENG_{t-1}$	-0.000002	0.272527	-0.000008	1.0000
$\Delta LNENG_{t-2}$	-0.324112	0.237929	-1.362225	0.1883
$\Delta LNGDP_t$	0.502259	0.436311	1.151149	0.2632
$\Delta LNTO_t$	0.612474**	0.248130	2.468360	0.0227
$\Delta LNTO_{t-1}$	0.657780*	0.340005	1.934619	0.0673
$\Delta LNTO_{t-2}$	-0.398108	0.246013	-1.618239	0.1213
CointEq(-1)	-1.231461***	0.247323	-4.979168	0.0001
R square	0.993332			
Adj. R square	0.987997			

Note: Δ refer to first difference. Dependent variable is LNCO2. (*),(**),(***) indicate significance at 10%,5% and 1% levels. Adj. R square is referring to adjusted R square.

Conclusion & Recommendation

Based on the result, only trade openness and economic growth are significant in the long-run elasticities while in short-term elasticities, economic growth, trade openness and energy consumptions are significant. It is important to obtain results from the long and short-run elasticities test since it could help policymakers or the government to initiate what would be the best plan to reduce this carbon dioxide emission before it is too late.

We propose several legislative steps to improve the state of carbon dioxide emissions in Malaysia based on the above empirical results. Investors and policymakers may make an action from these findings.

Trade Openness

For TO, the relationship toward CO_2 emission is positive according to the test results earlier. This means that higher TO will trigger higher CO_2 emission here in Malaysia. The most effective recommendation can be suggested by this paper is for Ministry of International Trade Malaysia (MITI) to plan new policy or regulation in order to achieve freer trade and also higher income level in the country can provide environmental improvement at a higher level of development.

Economic Growth

Lastly, for economic growth in which the result showing a positive relationship with CO_2 emissions. Economic development is not doing well toward CO_2 emission is due to high pressure in the market and it is happening in all developing countries right now including Malaysia. Therefore, the Malaysian government needs to come out with a more suitable policy to reduce the pressure to help improve environmental quality in Malaysia.

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