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Government Expenditure, Manufacturing Growth and CO_2 Emission: A Causality Analysis in Malaysia

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ABSTRACT

The main objective of the study is to explore government expenditure, CO_2 emission and manufacturing output in one model. These comprehensive literature reviews related to this topic of interest prove evidence upon variations towards the causality relationship that exists between government expenditure, CO_2 emission and manufacturing output. Most of past literatures had studied on the relationship of these variables, however separately. This study is done in order to test the relationship between government expenditure. CO_2 emission and manufacturing output on pollution in Malaysia. The data is secondarily obtained from The World Bank, The Eurostat, The European Environment Agency (EEA) and the international Monetary Fund (IMF) on the basis of a 39 of data collection from 2005 to 2019. The amounts of government expenditure, CO_2 emission and manufactu1ing output are then valued from the data usable. The study aims to analyses to whether or not do the variables hold causal to each other. This study discusses on the impacts of economic sectors on pollution the government expenditure, CO_2 emission and manufacturing consumption as its variables. Upon examining the study, an annual time series data covering the period of 2005-2019 in Malaysia were used. Models such as augmented Dickey - Fuller (ADF) unit root test, Johansen and Juselius (1990) co- integration test, vector error correction model test and Granger causality test were employed, each its own purposes. The conclusion on the findings limitation of the studies and suggestion for future references will later on be discussed in this chapter.

Keywords: Environmental Pollution, Air Emission, CO_2 Emission, Economic Growth, Malaysia
JEL Classifications: E31, Q41, O11

1. INTRODUCTION

The general amount of Malaysian government final consumption expenditure within 15 years duration; that is from 2005 to 2019 (Figure 1). The data was extracted from the World Bank and are presented in a constant US$. It had seemed that throughout the years, the increment posed in forms of the curve showed fluctuations in the year 2005 to 2019. Government expenditure in the year 2010 rose by 5.6 which it increases as much as 506,837,244 US$ from the past amount of 8,918,023,666 US$. However, on the 2nd year of the observation, 2010, it is evident that due to certain reasons, government expenditure sunk by 8.9% from 9,424,860,910 US$ to 8,586,696,543 US$. On 2012 it seems, government expenditure rose tremendously by 17%. In coming lo the year 2014, it appears that there is no significant increment of government expenditure as it only decreased by 1.6%. The fluctuation seemed to have occurred only within the early 5 years where from the year 2013 onwards the curve sinking to the present date.

The total amount of carbon dioxide (CO_2) emission emitted by industries in Malaysia within the year 2005 to 2019 (Figure 2). It appears that CO_2 emission throughout the observation period is very

volatile. It had seemed that the first 4 years indicated a dramatic dip in the emitted amount of CO_2 by which from 2005 to 20006 the amount plummeted from 125,374.730kt to as low as I 07,934.478kt: a drop for 13.9%. However, from 2006 onwards, the graph showed a gradual increment, yet with few slip backs but only slightly.

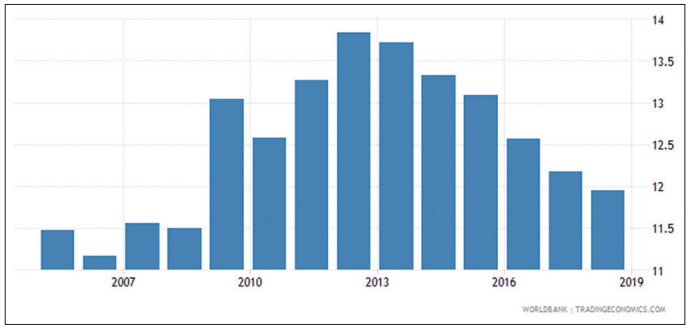
In the following years from 2008 to 2011, the amount of CO_2 emission rocketed by a significant 31.3% from 135, 128.950kt to 177,372.79kt and fell by 67,252.278kt on the following year. The amount of CO_2 emission experienced a sudden drop for as much as a slight 4.4% that is by 9.339.849 of 213,221.382. As from the year 20014 the CO_2 emission amount yet again surged till the year 2019. Nevertheless, in 2009 to 2010 the CO_2 emission amount increases from 203881.533 to 216804.041.

The trend for the last variable is showed in Figure 3 by which it addresses to the observation of manufacturing output for 15 consecutive years that is from 2005 to 2019 where the data is expressed in constant US$. Despite having few slumps in the recorded data, Malaysia's manufacturing output showed a consistent increase throughout the observation years. The first observation year of 2017 to 2018 shows an increase of 0.1% from 25,032,636,556 US$ to 27,565,110,988 USS followed by a marginal fall of 36,986,046 10 US$ that signifies for 13.4% in the year 2019. For the next 2 years, there seemed to be a spectacular increment of up to 2% that is an increase of 7,666,352,690 US$ from 2,386,650,637 USS to 31,532,859,061 US$ from the year 2013 to 2014. A considerable decline of 4.2% followed in the year 2015. However, the amount fell to 40, 175, 594,l 33 US$ which presented a 9.9°o reduction in 2009 yet folioed by an increment of a modest 11.9% in 2010.

2. RESEARCH METHODOLOGY

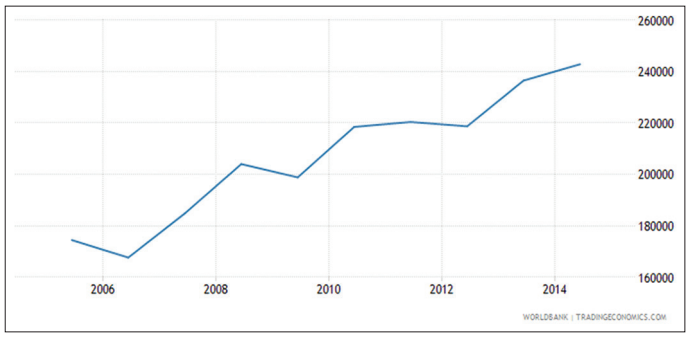
A study done by Poveda and Martinez (2013) using panel data co-integration techniques evaluated and compared the orientation of CO_2 emissions for manufacturing industries in three countries namely Sweden. Germany and Colombia. The two developed countries, Sweden and Germany had embarked upon several measures on promoting a shift towards a low carbon economy whereas Colombia. A developing country had shown considerable improvements of reducing CO_2 emissions. Although with different degree of emissions, the countries had shown promising efforts of producing more outputs less pollution. Relatively, the level of emission showed a trend of dependence on economic factors inclusive of investment levels and energy sources. As what Germany and Sweden evinced, the study signifies that it is possible to achieve both sustainable development and economic growth whilst reducing greenhouse gas emissions. As for Colombia, it is best to promulgate policies that combine both economic and technical instilments upon encouraging industries to reduce CO_2 emissions and start to subsidize the usage of new technologies that contribute to environmentally friendly and clean processes. A short run Vector Error Correction Model were then implied as so it could prove the relationship and to confirm the existence of a long run relationship among the variables. The finding revealed that the value of lagged error - correction terms is negative for manufacturing and positive for CO_2 emission and statistically significant when government expenditure is the dependent variable but when CO_2 emission and

Figure 1: Government spending



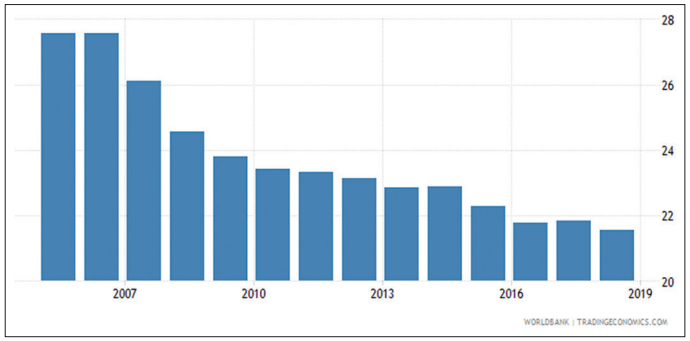
Source: Trading Economic Trading Economics (2020)

Figure 2: Malaysia CO_2 emission



Source: Trading Economic Trading Economics (2020)

Figure 3: Malaysia GDP from manufacturing sector



Source: Trading Economic Trading Economics (2020)

manufacturing is the variable, it contradicts the earlier result. Burnett et al. (2013) used vector error correction model and suggested that economic growth drove emission intensities instead of absolute emissions as \v. hat claimed in past studies. The study furthers when Granger causality test were performed to identify the direction the variable runs amongst each other. From this study, the result of Granger causality tests concluded that there are multiple directions causality that exists between economic growth and pollution in Malaysia. Depending on the variables, each has its own effects on the others. The result showed that the causality direction is running from manufacturing and CO_2 emission to government expenditure. This study proves that government expenditure is significantly affected by CO_2 emission and manufacturing, all in contributions to pollution. This test can be supported by Adom et al. (2012) which clearly stated that the variance decomposition analysis results revealed that economic growth contributes largely to changes in future carbon emission in Senegal and Morrocco. The result from the empirical studies showed that we had achieved the purpose

of this study where most of the result indicated that economic growth indeed had positive effects on pollution. Likewise, a study was made in China by Feng et al. (2013) implying a consumption based accounting of emissions. However this time, it focuses on CO_2 emission materialized in products traded internationally and within the Chinese territ1y. They had found out that more than half of China's emission are related to goods consumed outside the region they are manufactured. It is said that up to 80°o of the emissions are from consumed goods that are exported from a less developed provinces in both central and western China to a highly developed coastal territory. These less developed provinces produces goods of low -value - added yet the presence of carbon element is very much intense. The more developed provinces ' ill achieve their CO_2 emission intensity targets by simply outsourcing whilst the less developed provinces will struggle to meet their emission targets if no policy is enacted given the situation of inter provincial carbon leakage. Hence, it can be said that consumption - based accounting of emission is effective and a just climate policy within China. Another China - based research was done by Zheng and Bronsing (2013) to analyses few influences known as actors that includes enterprises, public sectors and other actors using actor analysis. This paper relates the Chinese political system and the actors as to which actors need more control. The political leader's interest, power, and approach towards the intensity target are described by further elaboration on their relations with each other and positions in the political system. The results indicated that of all actors, those from the public sector and ENGOs' are what pays an important role in stimulating CO_2 emission.

2.1. Model Specification

2.1.1. Simultaneous-equation model

The extended Cobb–Douglas production framework has helped to explore the links among the three variables: GS, CO_2 and MAN. They were considered simultaneously in a modelling framework. To evaluate the impacts of GS on CO_2 and MAN, and to investigate the causality relationships with CO_2 and GS, the study used the two-step system generalized method of moments (GMM) approach (Gujarati and Porter, 2009; Omri, 2014). This approach is appropriate when estimating systems of equations that are over-identified (Buckley et al, 2007, Ruxanda and Muraru, 2010; Greene, 2007; Adam and Balcerzak, 2011) and it has been the preferred choice in empirical studies with numerous systems of equations (Hsiao et al,1993, Ghatak and Halicioglu, 2006, Li, 2006). The links among these variables were empirically examined by using Equation [1], Equation [2] and Equation [3].

The simultaneous-equation model used the following three equations:

$$LogGS_{i,t}=\xi_0\ LogCO2_{i,t-1}+\xi LogMAN_{i,t}+\mu_{i,t}+\varepsilon_{i,t} \quad (1)$$

$$LogCO2_{i,t}=\psi_0\ LogGS_{i,t-1}+\varphi LogMAN_{i,t}+\varphi LogFDIT_{i,t}+\mu_{i,t}+\varepsilon_{i,t} \quad (2)$$

$$LogMAN_{i,t}=\alpha_0\ LogGS_{i,t-1}++\alpha LogCO2_{i,t}+\mu_{i,t}+\varepsilon_{i,t} \quad (3)$$

where:
GS = Goveremnt spending (%USD)
CO_2 = CO_2 emission (kt)
MAN = Manufacturing (constant USD)
i = Country;
t = Time period
α_1,α_2, β_1, β_2, β_3 and γ = coefficients of the independent variables
μ = is the error term.

3. FINDINGS

In the attempts of completing this study, the samples that have been used are based on a relative 15 years of data collection in a yearly basis from 2005 to 2019. The data collected were Malaysian general government final consumption expenditure measured by a constant US$ (Government expenditure) which indicates the amount of expenditure by the government each year and CO_2 emission within Malaysian industry measured by kilo tons (CO_2 emission) which implies the amount of CO_2 emitted by the existing industries in Malaysia. The last variable would be manufacturing, value added and are measured by a constant USS (Manufacturing) where it addresses to the amount of output produced by Malaysian manufacturing industry solely. The purpose of using the Unit Root Test is to determine the stationary trait of the time series data. The test is vital in representing the relationship of the variables: i.e. to determine whether or not it is in the same order of integration. Hence, the analysis is done by using Augmented Dickey-Fuller (ADF) Unit Root Test. Variables such as Manufacturing output. CO_2 Emission, and Government Expenditure in Malaysia were included in the test to determine their stationary properties. Table 1 presents the results of unit root test of augmented Dickey- Fuller. The results were distinguished into 2 parts that are: level and first difference under intercept while the other is level and first difference under intercept + trend.

Table 2 indicate VECM test. A VECM test is done as to confirm the existence of a long run relationship among the variables. The finding exposed that the value of lagged error-correction terms is negative for manufacturing and positive for CO_2 emission and statistically significant when government expenditure is the dependent variable. Thus it confirms that a long run relationship between government expenditure with CO_2 emission and manufacturing exists. However, it occurs in contradiction when CO_2 emission is the dependent variable with government expenditure and manufacturing as an independent variable: it appears to be insignificant. The same happens when manufacturing is the dependent variable along with CO_2 emission and government expenditure as its independent variable. In other words, for both CO_2 emission and manufacturing, as being the dependent variable, it does not seem to be affected by its independent variable.

Table 3 indicates the result of causality between all variables. A modified Wald (MWALD) causality test was employed to determine the causality direction between variables. The results imply that the causality direction is running from manufacturing and CO_2 emission to government expenditure, although there is no significant evidence that shows a reversed causality from both variables. This result is consistent with the long run causality evidence proved by the significance of the lagged error-correction term when the DV (Government Expenditure) is the dependent variable in the VECM. The empirical evidence of this study has

Table 1: Augmented Dickey-Fuller (ADF) Unit Root Test

Dependent variable	Intercept		Intercept + Trend	
	Level	First difference	Level	First difference
Manufac	1.166880 (0.9974)	–6.079170* (0.0000)	–1.940115 (0.6146)	–6.509754* (0.0000)
CO_2 Emission	1.268518 (0.9980)	–6.598920* (0.0000)	–1.763355 (0.7031)	–7.210459* (0.0000)
Government expend	4.313274 (1.0000)	–4.257902* (0.0018)	0.734864 (0.9995)	–6.005741* (0.0001)

*Indicates significance of the variables at five percent levels

Table 2: Vector correction model

Model 1 government expenditure			
DV (government expenditure)	Coefficient	t-statistic	Prob.
A CO_2 Emission(–)	28979.71	3.904629	0.0004
A Manufacturing(–)	–0.177776	–4.068775	0.0003
ECM	–0.000996	–5.901488	0.0000
Model 2 CO_2 emission			
DV (CO_2 emission)	Coefficient	t-statistic	Prob.
A government expenditure(–)	4.23E-06	1.237277	0.2247
A Manufacturing(–)	1.41E-06	1.322705	0.1950
ECM	–0.170915	–1.154353	0.2566
Model 3 Manufacturing			
DV (manufacturing)	Coefficient	t-statistic	Prob.
A CO_2 emission(–)	–8427.869	–0.213263	0.8324
A government expenditure (–)	0.764146	1.025187	0.3127
ECM	–0.008931	–0.054816	0.9566

Table 3: Modified Wald (MWALD) causality test

Dependent variable	x2 - statistics		
	Manufacturing	CO_2 emission	Government expenditure
Manufacturing	.	0.045481	1.051008
CO_2 Emission	1.749549	.	1.530855
Government Expenditure	16.55493•	15.24613.	.

Null hypothesis of non-causality: x2 statistics, Probability values in parenthesis;
*rejection of the null of no causality

proved that government expenditure is significantly affected by CO_2 emission and manufacturing. As such, the result implied that a causality direction from manufacturing output and CO_2 emission towards government expenditure exists.

4. CONCLUSION

The main objective of the study is to explore government expenditure, CO_2 emission and manufacturing output in one model. These comprehensive literature reviews related to this topic of interest prove evidence upon variations towards the causality relationship that exists between government expenditure, CO_2 emission and manufacturing output. Most of past literatures had studied on the relationship of these variables, however separately (Alola, 2019). Most studies employed the unit root test, co - integration test and granger causality test in their approach of examining the relationship between the three variables in various nations including the Asian countries, European counties, OECD countries and Africa n countries (Kinoshita and Campos, 2006). This study, on the other hand will focus on these three variables specifically and simultaneously (Alfaro, 2003, Aizenman, 2005, Rashid and Razak, 2017). The methodology utilized in this research is the Unit Root Test. Johansen co-integration. Vector error correction model (VECM) and Granger Causality as these mentioned methods were frequently used by previous studies. To conclude, the results in Malaysia found that government expenditure is significantly influenced by CO_2 emission and manufacturing output and vice versa by which the unit root test indicated a stationary state to all variables under intercept at first difference: the same goes under intercept and trend too. It had seemed that the VECM result exposed a long run relationship between all variables exists when government expenditure is put as the variable (Garbaccio, et al, 2000). As such, the result implied that a causality direction from manufacturing output and CO_2 emission towards government expenditure exists. This study and its findings would significantly aid in implementing policy.

The government should consider all relevant factors that would cause more pollution in Malaysia. The target is to produce more outputs and at the same time reduces pollution (Andersson and Karpestam, 2013, Boachie et al, 2014, Yavas, and Malladi, 2020). In the study by Poveda and Martinez (2013), the trends in the countries within their study showed that the countries' CO_2 emission depends on investment level, energy sources and economic factors. Precedent to that. Anderson and Karpestam (2013) suggested that climate policy is more likely to affect emission over the long - terms rather than in short - terms. It is said that the long run capital accumulation is the main driver of emissions and that a global carbon tax is an important policy tool to reduce emission. However. It should not be a single mean of reducing pollution and to put all focus on it to decouple emission from economic growth would be insufficient (Reinhart and Reinhart, 2001). Again Anderson and Karpestam (2013) claimed that it would require a structural transformation of the economy lo overcome the plight. The economy may be a root to pollution but there should be more than one way to reduce the pollution intensity.

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