International Journal of Academic Research in Accounting, Finance and Management Sciences
Vol. 9, No.3, July 2019, pp. 329–335
E-ISSN: 2225-8329, P-ISSN: 2308-0337
© 2019 HRMARS
www.hrmars.com

To cite this article: @ Ramli, N. R., Hashim, A., Hashim, E., Jalil, N. A., Tha, G. P. (2019). *Does Energy Consumption Influence the CO_2 Emission?,* International Journal of Academic Research in Accounting, Finance and Management Sciences 9 (3): 329-335

http://dx.doi.org/10.6007/IJARAFMS/v9-i3/6526 (DOI: 10.6007/IJARAFMS/v9-i3/6526)

Does Energy Consumption Influence the CO_2 Emission?

Norimah Rambeli @ Ramli[1], Asmawi Hashim[2], Emilda Hashim[3], Norasibah Abdul Jalil[4], Gan Pei Tha[5]

[1]Economics Department, Faculty of Management and Economics, Universiti Pendidikan Sultan Idris (UPSI), Malaysia, [1]E-mail: norimah@fpe.upsi.edu.my (Corresponding author)

Abstract

The focal point of this study is to investigate the impact of total primary energy consumption, gross domestic product, index of industrial production and employment toward the total carbon (CO2) emission in Malaysia from 1986 to 2018. This study employs the Ordinary Least Square (OLS) model in developing the estimation model between dependent and independent variables. The diagnostic model consist autocorrelation, multicolinearity, heteroscedasticity and normality tests were employed in order to test the model whether is adequate or not. The empirical results showed that the total primary energy consumption is the significant factors that affecting the CO2 emissions while per capita real gross domestic product is the least impactful factor in Malaysia. There are positive relationships between the independent variables on CO2 emissions. Therefore, this study suggested that implementing policies are needed in order to developing economy in Malaysia. Adopt new technologies or install solar energy for industries also recommended to control the energy consumption and pollution in Malaysia.

Key words

Total Primary Energy Consumption, Per Capita Real Gross Domestic Product, Index of Industrial Production, Total Employment, Co_2 Emissions, Ordinary Least Square

Received: 29 Sep 2019
Revised: 30 Oct 2019
Accepted: 02 Oct 2019
Published Online: 04 Nov 2019

1. Introduction and Literature Review

A main threats created from the phenomenal changes is global warming (Ab-Rahim and Xin-Di, 2016). Global warming is caused by the increased of earth surface average temperature effects from over emitting of greenhouse gasses such as carbon dioxide (CO_2). The CO_2 in atmosphere increases as the increases in human activities such as burning of fossil fuels, petroleum and so on. The emission of CO_2 and other gasses will remain in the atmosphere for as long as many years it would takes and making the case to almost impossible for its elimination. If human are unable to control the increase of global warming activities, the future will witness the raise of sea levels due to The Arctic ice melting and even higher frequency of tropical storms hitting the earth.

There have been various types of studies focusing on the environmental issue and trying to restrain the growth in global warming as it may lead to even more serious matter. Malaysia is a country that consists of farmers who are depending on rice cultivation as their main source of income. However, the unstable climate changes might ruin the crops and the field since weather has been playing the vital role in determining level of rice productivity. This not only will affect the small group of farmers and their

household, at the same time it will leads to government's concern about the reduction in future national income.

In Malaysia, National Policy in climate change was formulated to provide a framework which could be used as a guide for entire government agencies, industry, community as well as other stakeholders in order to facing the climate change scenario. The policy was to ensure climate-resilient development to fulfill national aspiration for sustainability. The policy implementation is mainly to stream the climate changes through wise management of resources and enhanced environmental conservation resulting in strengthened economic competitiveness and improved quality of life. Moreover, by strengthening of institutional and implementation capacity will produce much better harness opportunities to reduce negative impacts of climate change.

Climate changes is a global threat and need a global solution to mitigate the greenhouse gasses emission therefore this have to be concern by entire countries. In Malaysia, an adaptation strategy including crop management, soil management and irrigation management was proposed to farmers in order to minimize the impact of climate change. However, the major concern is still get back to the CO2 emissions since this is the only issue that cannot be control by Malaysia alone.

Many literature has confirm that the global climate warning is thoroughly connected to carbon dioxide (CO_2) emissions that caused by human activities and also the presently significant environmental problem (Allali *et al.*, 2015: Rambeli *et al.*, 2018) among others. This study also has its limitations that the analysis of relationship between variables is at a disaggregated level and no such panel-based studies that are problematic to obtain disaggregated data. Besides, carbon dioxide is the one considered as the major cause for global warming while CO_2 emissions increase in term of energy consumption when occurring economic growth (Omri, 2013). The policy makers in Malaysia meet a major tight spot as the long-run environment degradation through CO_2 emissions would get worse the economy. Other than that, economic growth and industrial production growth in the long-run will affect the CO_2 emission in Malaysia. An increase in index of industrial production will increase the level of CO_2 emission in Malaysia. In addition, increase in total primary energy consumption that related to the fossil fuel caused an increase in CO_2 emissions which reached phenomenal levels (Al-mulali and Che Sab, 2018). Therefore, implementing the green energy by the government in the country is necessarily in order to reduce its fossil fuels consumption.

Therefore, the main objective of this paper is to develop the multiple regression estimation using the Ordinary Least Square (OLS) for CO_2 emission in Malaysia. Besides, this paper will tend to identify the most and the least important factors in influencing the CO_2 emission in Malaysia.

2. Methodology of Research

2.1. Model Specification

Inspired by Rambeli et al (2018), the model specification is developed as follows;

$$CO^2 = \beta_0 + \beta_1 ENE_t + \beta_2 RGDP_t + \beta_3 IIP_t + \beta_4 RMP_t + \varepsilon_t \quad (1)$$

Where,

$CO2_t$ =Total Carbon Emission in Malaysia

ENE_t =Total primary energy consumption for the year t

$RGDP_t$ =Per capita real gross domestic product for the year t

IIP_t =Index of industrial production for the year t

EMP_t =Total employment for the year t

t =Annual data from 1986 to 2016

2.2. Findings

The model is estimated from 1986 to 2018 as below:

$$CO2_t = 1.7395 + 0.6922 ENE_{1t} - 0.1197 RGDP_{2t} + 0.2729 IIP_{3t} - 0.2958 EMP_{4t} \quad (2)$$

$$SE = (1.0865) \quad (0.1590) \quad (0.06266) \quad (0.1197) \quad (0.1426)$$

$$t^* = (1.6010) \quad (4.3548)^{***} \quad (-1.9098)^{*} \quad (2.2794)^{**} \quad (-2.0749)^{**}$$

$F^* = 1345.433\,; R^2 = 0.995\,; \bar{R}^2 = 0.994$

Where,

$CO2_t$ =Total Carbon Emission in Malaysia

ENE_t =Total primary energy consumption for the year t

$RGDP_t$ =Per capita real gross domestic product for the year t

IIP_t =Index of industrial production for the year t

EMP_t =Total employment for the year t

t =Annual data from 1986 to 2016

Notation:

***:Important at the 99% level of confident

** :Important at the 95% level of confident

* :Important at the 90% level of confident

Referring to equation (2), the increase in ENEt will increase the CO_2 emission in Malaysia by 4.3548 percent at 99 percent significant level. The increase in RGDPt will reduce the CO_2 emissions in Malaysia by 1.9098 percent at 90 percent significant level. The increase of IIPt will increase the CO_2 emissions in Malaysia by 2.2794 percent at 95 percent significant level. The increase in EMPt will reduce the CO2 emissions in Malaysia by 2.0749 percent at 95 percent significant level.

2.3. Statistical criteria

Table 1. Test – t testing results

Variables	Hypothesis	Statistical Test (t*)	Critical Value(tα)	Result
ENEt	$H_0: \beta_1 = 0$ $H_1: \beta_1 \neq 0$	4.3548	2.056	$Reject$ H_0
RGDPt	$H_0: \beta_2 = 0$ $H_1: \beta_2 \neq 0$	-1.9098	2.056	$Accept$ H_0
IIPt	$H_0: \beta_3 = 0$ $H_1: \beta_3 \neq 0$	2.2794	2.056	$Reject$ H_0
EMPt	$H_0: \beta_4 = 0$ $H_1: \beta_4 \neq 0$	-2.0749	2.056	$Reject$ H_0

Table 1 simplify the t-test testing procedure results. The first results of significance tests were performed on β_1, the total primary energy consumption (ENEt) shows that the value of t*=4.3548 which is larger than tα =2.056, then the result will reject H_0. This means that ENEt is important variable in explaining the dependent variable, the CO_2 emission in Malaysia at 95 percent significance level. The second results of significance tests were performed on β_2, the per capita real gross domestic product (RGDPt) shows that the value of t*=-1.9098 which is smaller than tα =2.056 but larger than −2.056, then the result will accept H_0. This means that RGDPt is not important in explaining the dependent variable, the CO_2 emission in Malaysia at 95 percent significance level. The third results of significance tests were performed on β_3, the index of industrial production (IIPt) shows that the value of t*=2.2794 which is larger than tα =2.056, then the result will reject H_0. This means that IIPt is important in explaining the dependent variable, the CO_2 emission in Malaysia at 95 percent significance level. The last results of significance tests were performed on β_4, the total employment (EMPt) shows that the value of t*=-2.0749 which is smaller than tα =2.056, even smaller than −2.056, then the result will again reject H_0. This means that EMPt is important in explaining the dependent variable, the CO2 emission in Malaysia at 95 percent significance level.

Table 2. F-test Results

Model	Hypothesis	Statistical Test	Critical Value (Fv1,v2)	Results
General Model	$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ $H_1: \beta_1 \neq 0$	$F^* = \frac{\frac{ESS}{df}}{\frac{RSS}{df}}$ =1345.43	3.33	$F^* > F$, 1345.43 > 3.33 Reject H_0

Based on Table 2 above, it found that Fv1,v2=3.33 at the 95% confidence level while F*=1345.43. Since F* > Fv1,v2, therefore the result will reject H_0. In other words, all independent variables are good combination in explaining the dependent variable at a 95% confidence level.

2.4. Econometrics Criteria

Auto-Correlation (AC)

In examining the problem auto-correlation in the model, then the test will be carried out on the model. Among the tests that will be done is Durbin Watson.

Table 3. Durbin Watson Diagnostic Test for Autocorrelation

L	DW	N	K	DL	DU	4-DL	4-DU	Result
1%	1.764	31	5	0.960	1.509	3.04	2.491	Does not exist.
5%	1.764	31	5	1.160	1.735	2.84	2.265	Does not exist.

Table 3 represents the Durbin Watson test result. At the significance level of 0.01 (α=1%) and 0.05 (α=5%), the results of the Durbin Watson (DW) statistical test obtained from SPSS version 23 is 1.764. Based on the above test results, the auto-correlation problem doesn't exist 0.01 (α=1%) and 0.05 (α=5%) levels.

Multi-Collinearity (MC)

Multi-collinearity tests conducted to determine whether there has problem multi-collinearity serious or not serious between the dependent variable, by comparing the values of Correlation between independent variables (in pairs) and R^2.

Table 4. Multicolinearity testing

Relation	R^2	Arrow	Pearson Correlation	Results
ENEt & RGDPt	0.995	>	0.976	Imperfect MC
ENEt & IIPt	0.995	>	0.991	Imperfect MC
ENEt & EMPt	0.995	>	0.975	Imperfect MC
RGDPt & IIPt	0.995	>	0.978	Imperfect MC
RGDPt & EMPt	0.995	>	0.945	Imperfect MC
IIPt & EMPt	0.995		0.945	Imperfect MC

Based on the Table above, $R^2 = 0.995$. It was found that the relationship between the independent variables namely, total of primary energy consumption with per capital real gross domestic product (ENEt & RGDPt), total of primary energy consumption with index of industrial production (ENEt & IIPt), total of primary energy consumption with total employment (ENEt & EMPt), per capital real gross domestic product with index of industrial production (RGDPt & IIPt), per capital real gross domestic product with total employment (RGDPt & EMPt), and index of industrial production with total employment (IIPt & EMPt) are having imperfect multi-collinearity problems. This is because $R^2 = 0.995$ is larger than all those six relation, which are $Corr(ENE_t, RGDP_t) = 0.976$, $Corr(ENE_t, IIP_t) = 0.991$, $Corr(ENE_t, EMP_t) = 0.975$, $Corr(RGDP_t, IPP_t) = 0.978$, $Corr(RGDP_t, EMP_t) = 0.945$, $Corr(IIP_t, EMP_t) = 0.945$. In that case, every variable are applicable in the model.

Heteroscedasticity

T-Test based on Park Test

$$\ln \widehat{\mu_t^2} = -75.643 - 16.523ENEt - 6.161RGDPt + 15.539IIPt + 13.872EMPt$$

Table 5. Park Test Results

Variables	Hypothesis	Statistical Test (T*)	Critical Value(T)	Result
ENEt	$H_0: \beta_1 = 0$ $H_1: \beta_1 \neq 0$	−1.277	2.056	$Accept$ H_0
RGDPt	$H_0: \beta_2 = 0$ $H_1: \beta_2 \neq 0$	−1.208	2.056	$Accept$ H_0
IIPt	$H_0: \beta_3 = 0$ $H_1: \beta_3 \neq 0$	1.594	2.056	$Accept$ H_0
EMPt	$H_0: \beta_4 = 0$ $H_1: \beta_4 \neq 0$	1.195	2.056	$Accept$ H_0

Based on the first result obtained from new model Park Test (t-Test), total primary energy consumption (ENEt) is $T^* = -1.277$ which is smaller than the value of $T = 2.056$. When $T^* < T = -1.277 < 2.056$, then the result suggested to accept H_0. The total primary energy consumption (ENEt) is not important in explaining the total carbon (CO2t) emission in Malaysia at the 95% significant level. The second result obtained from new model Park Test (t-Test), value of real gross domestic product per capita (RGDPt) is $T^* = -1.208$, which is also smaller than the value of $T = 2.056$. When $T^* < T = -1.208 < 2.056$, then the result will accept H_0. The value of real gross domestic product per capita (RGDPt) is not important in explaining the CO_2 t emission in Malaysia at the 95% significant level. Thirdly, the result obtained from new model Park Test (T-Test), the index of industrial production (IIPt) is $T^* = 1.594$ which is smaller than the value of $T = 2.056$. When $T^* < T = 1.594 < 2.056$, then the result will accept H_0. The index of industrial production (IIPt) is not important in explaining the CO_2 t emission in Malaysia at the 95% significant level.

Lastly, the fourth result obtained from new model Park Test (T-Test), the total employment (EMPt) is $T^* = 1.195$ which is also smaller than the value of $T = 2.056$. When$T^* < T = 1.195 < 2.056$, then the result should accept H_0. The total employment (EMPt) is not important in explaining the CO2t emission in Malaysia at the 95% confidence level. Therefore, based on all of the results obtained from the Park Test, there is no heteroscedasticity in the first model and it is applicable for the study.

T-Test on Glejser Test $|\mu_t^2| = 75.643 + 16.523ENEt + 6.161RGDPt - 15.539IIPt - 13.872EMPt$

Table 6. Glejser Test Results

Variables	Hypothesis	Statistical Test (T*)	Critical Value (T)	Result
ENEt	$H_0: \beta_1 = 0$ $H_1: \beta_1 \neq 0$	1.277	2.056	$Accept$ H_0
RGDPt	$H_0: \beta_2 = 0$ $H_1: \beta_2 \neq 0$	1.208	2.056	$Accept$ H_0
IIPt	$H_0: \beta_3 = 0$ $H_1: \beta_3 \neq 0$	−1.594	2.056	$Accept$ H_0
EMPt	$H_0: \beta_4 = 0$ $H_1: \beta_4 \neq 0$	−1.195	2.056	$Accept$ H_0

Based on the first result obtained from new model Glejser Test (T-Test), total primary energy consumption (ENEt) is $T^* = 1.277$which is smaller than the value of $T = 2.056$. When $T^* < T = 1.277 < 2.056$, then the result should accept H_0. The total primary energy consumption (ENEt) is not important in explaining the total carbon (CO2t) emission in Malaysia at the 95% significant level. The second result obtained from new model Glejser Test (T-Test), the value of real gross domestic product per capita (RGDPt) is $T^* = 1.208$, which is also smaller than the value of $T = 2.056$. When $T^* < T = 1.208 < 2.056$, then the result will accept H_0. The value of real gross domestic product per capita (RGDPt) is not important in explaining the CO2t emission in Malaysia at the 95% significant level. Thirdly, the result obtained from new model Glejser Test (T-Test), the index of industrial production (IIPt) is $T^* = -1.594$ which is smaller than the value of

$T = 2.05$. When $T^* < T = -1.594 < 2.056$, then the result will accept H_0. The index of industrial production (IIPt) is not important in explaining the CO2t emission in Malaysia at the 95% significant level. Lastly, the fourth result obtained from new model Glejser Test (T-Test), the total employment (EMPt) is $T^* = -1.195$ which is also smaller than the value of $T = 2.05$. When $T^* < T = -1.195 < 2.056$, then the result should accept H_0. The total employment (EMPt) is not important in explaining the CO2t emission in Malaysia at the 95% significant level. Hence, the results are parallel with the Park Test result which there is no heteroscedasticity in the first model and it is applicable for the study.

3. Conclusions and Recommendations

Based on the findings, it is clear that energy consumption is a major factor in affecting the release of CO2 gas in the atmosphere for Malaysia case. Therefore a proper control is needed on energy consumption in Malaysia. Government should do enforcement under the ministry of the environment; this may be able to curb this problem before it becomes chronic in the future. Undeniably, economic growth is a contributing factor to this increase in gas in the atmosphere. Thus, the government should consider the best way to achieve positive growth as well as control the environment. This may be accomplished by adopt new technologies or install solar energy for industries or applying limit and trade procedure on polluted the environment (Rambeli *et al*., 2017) also recommended to control the energy consumption and pollution in Malaysia for the long term. In other words, in order to pollute the air, the stakeholder has to pay the amount of pollution.

References

1. Ab-Rahim, R., & Xin-Di, T. (2016). The determinants of CO_2 emissions in ASEAN+ 3 countries. *Journal of Entrepreneurship and Business*, *4*(1), 26-37.

2. Allali, M., Tamali, M., & Rahli, M. (2015). The Impact of CO2 Emission on Output in Algeria. *Energy Procedia*, *74*, 234-242.

3. Al-mulali, U., & Che Sab, C. N. B. (2018). Energy consumption, CO2 emissions, and development in the UAE. *Energy Sources, Part B: Economics, Planning, and Policy*, *13*(4), 231-236.

4. Anatasia, V. (2015). The causal relationship between GDP, exports, energy consumption, and CO2 in Thailand and Malaysia. *International Journal of Economic Perspectives*, *9*(4), 37.

5. Apergis, N., & Payne, J. E. (2015). Renewable energy, output, carbon dioxide emissions, and oil prices: evidence from South America. *Energy Sources, Part B: Economics, Planning, and Policy*, *10*(3), 281-287.

6. Bouznit, M., & Pablo-Romero, M. D. P. (2016). CO_2 emission and economic growth in Algeria. *Energy Policy*, *96*, 93-104.

7. Bruck, B. P., Incerti, V., Iori, M., & Vignoli, M. (2017). Minimizing CO_2 emissions in a practical daily carpooling problem. *Computers & Operations Research*, *81*, 40-50.

8. bt Muhyidin, H., Saifullah, M. K., & Fei, Y. S. (2015). CO2 Emission, Energy Consumption and Economic Development in Malaysia. *International Journal of Management Excellence*, *6*(1), 674-678.

9. Conversion of 1 USD to MYR on 01 January 1986. (2018). [online] Available at: http://fxtop.com/en/historical-exchange-rates.php?A=1&C1=USD&C2=MYR&YA=1&DD1=01&MM1=01&YYYY1=1986&B=1&P=&I=1&DD2=20&MM2=03&YYYY2=2018&btnOK=Go%21.

10.Department Statistics of Malaysia. (2018). Employment. [online] Available at: https://www.dosm.gov.my/v1/uploads/files/3_Time%20Series/Malaysia_Time_Series_2016/21_Guna_Tenaga.pdf

11.Department Statistics of Malaysia. (2018). Index of Industrial Production. [online] Available at: https://www.dosm.gov.my/v1/uploads/files/3_Time%20Series/Malaysia_Time_Series_2016/07_Indeks_Pengeluaran_Perindustrian.pdf

12.Li, P., & Jones, S. (2015). Vehicle restrictions and CO2 emissions in Beijing–A simple projection using available data. *Transportation Research Part D: Transport and Environment*, *41*, 467-476.

13.Malaysia Primary energy consumption, 1986-2016 (2018). Available at: https://knoema.com/atlas/Malaysia/CO2-emissions-per-capita

14.Malaysia Real GDP Per Capita by Year. (2018). Retrieved from http://www.multpl.com/malaysia-real-gdp-per-capita/table/by-year

15.Rambeli, N., Hashim, E., Jalil, N. A., & Zakariya, Z. (2017). The Mechanism Design of Homogeneous Carbon Permit Auction: A National Model. Advanced Science Letters. Volume 23(7) 6153-6156 (4) Available at: https://doi.org/10.1166/asl.2017.9226

16.Rambeli. N., Jalil, A. N.,Hashim E., Mahdinezhad M., Hashim A., Belee, & Bakri, M. S., (2018). The Impact of Selected Macroeconomic Variables on Carbon Dioxide (Co2) Emission in Malaysia. *International Journal of Engineering & Technology, 7* (4.15), 204-208 Available at: https://docs.wixstatic.com/ugd/7b8359_55c40e00d987490c9838e6fa0543bdbe.pdf

17.Omri, A. (2013). CO2 emissions, energy consumption and economic growth nexus in MENA countries: Evidence from simultaneous equations models. *Energy economics*, *40*, 657-664.

18.Ozturk, I., & Acaravci, A. (2016). Energy consumption, CO2 emissions, economic growth, and foreign trade relationship in Cyprus and Malta. *Energy Sources, Part B: Economics, Planning, and Policy*, *11*(4), 321-327.

19.Pereira, A., & Pereira, R. (2017). On the Optimal Use of Revenues from a CO2 Tax and the Importance of Labor Market Conditions. *Journal of Economics and Public Finance, 3*(4), 481-506

20.Saidi, K., & Mbarek, M. B. (2017). The impact of income, trade, urbanization, and financial development on CO_2 emissions in 19 emerging economies. *Environmental Science and Pollution Research*, *24*(14), 12748-12757.

21.Shahbaz, M., Bhattacharya, M., & Ahmed, K. (2015). Growth-globalisation-emissions nexus: the role of population in Australia. *Monash Business School Discussion Paper*, (23/15), p1-33.

22.Sikdar, C., & Mukhopadhyay, K. (2018). The Nexus between Carbon Emission, Energy Consumption, Economic Growth and Changing Economic Structure In India: A Multivariate Cointegration Approach. *The Journal of Developing Areas*, *52*(4), 67-83.

23.Soheilakhoshnevis, Y., & Bahram, S. (2014). The Econometric Model For Co2 Emissions, Energy Consumption, Economic Growth, Foreign Trade, Financial Development And Urbanization Of Iran. *Journal of Environmental Research and Development*, *8*(3A), 828-840.

24.Vardopoulos, I., & Konstantinou, Z. I. (2017). Study of the Possible Links Between Co2 Emissions And Employment Status. *Journal "Sustaibable Development, Culture, Traditions", 1b*.

25.World Bank. (2018). CO_2 emissions (metric tons per capita). Retrieved from https://data.worldbank.org/indicator/EN.ATM.CO2E.PC?end=2014&locations=MY&start=1984.