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THE IMPACT OF MALAYSIAN ECONOMIC DEVELOPMENT ON CO2 EMISSION

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ABSTRACT

The manufacturing industry plays an important role as one of the main contributors to Malaysian economic growth. According to the Department of Statistics Malaysia (DOSM), the value of gross output rose 5.7 per cent per annum to RM1,275.8 billion in 2017 as compared to 2015 (RM1,142.0 billion). Even though a greater economic activities leads to greater economic production, unfortunately most forms of economic production generate pollution. Therefore, this study attempts to examine the relationship between economic development and CO2 emission in the context of Malaysia from year 1986 until 2016. The dependent variable used in this study is CO2 emission, while the dependent variables are economic growth, population, urbanization and industrialization. Using the Dynamic Ordinary Least Square (DOLS) method, the results revealed the existence of long run relationship between economic development and CO2 emission where economic growth and urbanization show positive significant impact towards CO2 emission.

Keywords: *CO2 Emission, Economic Growth, Population, Urbanization, Industrialization*

INTRODUCTION

Environment is a complex of many variables. Environment includes water, air, land and other living creatures such as plants, animals and micro-organisms. The importance of taking care the environment is so crucial that a simple element like a forest helps to remove carbon dioxide and other pollutants from the air which also helps to cool down the earth temperature. It is also worth noting that once emitted to air, carbon dioxide persists in the atmosphere for 50 to 200 years, which means emission released now will continue to warm the climate in the future, (Cairoli, 2017). Although, developments such as the adoption of new technologies, general improvement in living standard and the transition from agriculture-based to industry-based economy often enhance human welfare in terms of modernization and human-made environments, their impact on the natural environments has been a long way from benign (Alauddin,2002). This simply means that human activity often gives impact to the physical environment. With an increasing awareness of this issue, a substantial body of literature has shown strong linkage between economic development and carbon dioxide (CO2) emission. Thus, this study intends to investigate other variables such as population, urbanization and industrialization impacts on Malaysian eonomics.

In recent years, environment seems to lose its charm. This is because in this modern world, all human actions would directly impact the whole ecosystem which will result in many environmental problems. Having said that, it is not too much to say that the developing world is often seen as having a high percentage of heavily pollutant activities within various sectors such as industrial and services sector like tourism industry. In addition, in agricultural sector, it contributes to deforestation, where the erosion of the top soil led to extreme pressures on the environment.

The manufacturing industry plays an important role as one of the main contributors to Malaysian economic growth. According to the Department of Statistics Malaysia (DOSM), the value of gross output rose 5.7 per cent per annum to RM1,275.8 billion in 2017 as compared to 2015 (RM1,142.0 billion). Even though a greater economic activities lead to greater economic production, most forms of economic production generate pollution. As a result, environment is faced with a perfect storm of problems driven by

economic development and the deterioration of environment damages mother nature generally and its sustainability in the future. The development of an economy is good for the country but somehow they pose as threats to the environment. People might be living in an advanced economy but sadly not in a healthy environment. Therefore, this study attempts to examine the relationship between economic development and CO2 emission in the context of Malaysia from year 1986 until 2016. The dependent variable used in this study is CO2 emission, while the dependent variables are economic growth, population, urbanization and industrialization. Using the Dynamic Ordinary Least Square (DOLS) method, data collected were analyzed to get estimated results. The results revealed the existence of long run relationship between economic development and CO2 emission, where economic growth and urbanization show positive significant impact towards CO2 emission. Other than that, the theory of Environmental Kuznets Curve (EKC) appears to be irrelevant in this study.

LITERATURE REVIEW

A study done by Mikayilov et al. (2018) for Azerbaijan found that economic growth has a positive and significant impact on the carbon dioxide (CO2) emissions in the long-run from 1992-2013. Next, Raza and Shah (2018) examined the effects of economic growth, energy consumption and financial development on environmental degradation in Pakistan using the data from 1974 to 2014. The result showed all three variables have significant positive effect on environmental degradation. Besides, Ameer and Munir (2016) on their research about the impact of economic growth, urban population, trade openness, and technology on environment of Asian economies from 1980 to 2014 found a positive significant impact of growth and technology on carbon emissions. Furthermore, an analysis of the effect of economic growth and carbon taxation on carbon emissions done by Loganathan et al. (2014) from 1974 to 2010 in Malaysia found that economic growth in Malaysia affected carbon emissions significantly in positive manner. Another study by Govdeli (2019) on the long-term relationship between health expenditure, economic growth and CO2 emissions in 26 OECD countries from 1992 – 2014 has given positive and significant results between economic growth and CO2. On the other hand, using annual data from 1980 to 2010 for Laos, Phimphathavong (2013) indicated that economic growth and trade openness

have insignificant affect to the quality of environment.

Furthermore, a positive significant result was found by Zaman et al. (2011) from their studies to find relationship between population and environmental degradation in 1985 to 2009 for Sri Lanka and India. Another study also found an insignificant result for Pakistan from 1972 until 2001 by Ahmad et al. (2005), which examined the impact of demographic variables on environment. Besides, a study to investigate the nexus among CO2 emissions, economic growth, renewable energy and population growth across regions by Dong et al. (2017) postulated at both global and regional levels, economic growth and population size positively and significantly did influence CO2 emission. The period used in the study was from 1990 until 2014 and focused on 128 countries. From more recent study undertaken by Yu et al. (2018) in China using the period from 1990 to 2014 showed that population aging has a positive significant relationship with CO2 emission. In addition, a study to examine the impact of population size, aging population, energy intensity, per capita consumption and urbanization on CO2 emissions done by Wang et al. (2017) also in China from 1997 to 2002 found that population size has significant relationship on CO2 emissions.

Next, based on a study done by Zhang et al. (2015) which examines the impact of urbanization on CO2 emissions found that the effect of population urbanization is insignificant, while the impact of land urbanization is positively significant. This result is concurred by Wang et al. (2018), where urbanization was found to be positive and significant towards CO_2 emissions. The study was conducted in China from 1990 to 2013. Other than that, a research that explored the impact of urbanization has on carbon dioxide emissions in emerging economies indicated that urbanization has positive significant impact to CO_2 emissions. Sadorsky (2014) picked 16 countries in this study and time period from 1971 to 2009. Moreover, a study done by Fan et. al. (2020) investigated urbanization issue on the Co2 emission in South Asian region specifically Pakistan, India, Bangladesh, and Nepal from year 1974–2014. They exhibited a positive significant relationship between urbanization and economic growth on Co2 emission; as well as detected a long run relationship between these variables. The result from Wang and Zhao (2018) on the impacts of urbanization on CO2 emissions in China from 1997 to 2012 showed that the relationship between urbanization and CO2 are insignificant in urbanized part of China, but in under urbanized

part of China shows a positive significant relationship.

Following a research conducted by Xu and Lin (2015) which aim to examine the impacts of industrialization and urbanization on CO2 emissions in China from 1990 to 2011 showed that for the western region, the relationship of urbanization on CO2 emissions is insignificant. However, a study by Li and Lin (2015) based on 73 countries from year 1971 to 2010 found that industrialization and urbanization have negative significant impacts on CO2 emissions and energy consumption. In contrary, study to find out the relationship between urbanization, industrialization and CO2 emissions by Afawubo and Ntouko (2016) from 1960 to 2014 on 142 countries detected a positive significant relationship between industrialization, urbanization and CO2 emissions in long-run for low income countries. In addition, in upper-middle-income countries, both industrialization and urbanization have significant relationship with CO2 emissions. In lower-middle-income countries, only in industrialization has slightly significant impact with CO2 emissions in long-run. Shahbaz et al. (2014) conducted a study to investigate the relationship between CO2 emissions and industrialization from 1975 to 2010. The result suggested a positive significant relationship between industrialization and CO2 emission in Bangladesh.

METHODOLOGY

Data Collection

This study used secondary data annually for 30 years from 1986 until 2016. It focuses on Malaysia. The proxy used for carbon dioxide (CO2) emission was measured in metric tonnes. Then, for the economic growth (GRW), the data obtained used Gross Domestic Product (GDP) per capita at constant price and measured in Ringgit Malaysia. Meanwhile, population (POP) used annual percentage growth, while urbanization (URB) used the number of employment in both manufacturing and construction as its proxy. Lastly, industrialization (IND) used annual growth of the industrialization yearly in percentage. The data used were retrieved from Our World in Data and World Bank.

Hypothesis

H1 : There is no significant relationship between economic growth and CO2 emission.
H2 : There is no significant relationship between population and CO2 emission.
H3 : There is no significant relationship between urbanization and CO2 emission.
H4 : There is no significant relationship between industrialization and CO2 emission.

Model Employed

In this study, CO2 emission acts as dependent variable while the independent variables are population, economic growth, urbanization and industrialization. The model of this study is as follows:

$$lnCO_2 = \propto + \beta_1 lnGRW_t + \beta_2 POP_t + \beta_3 lnURB_t + \beta_4 IND_t + \varepsilon_t \quad (1)$$

where α is coefficient, β represents constant and ε is error term.

Data Analysis

The data analysis started with some preliminary steps before intended results could be gained. A correlation test was conducted to evaluate the association between two or more variables. It measures the degree of (linear) association (and not causation) between the dependent variable Y and the single explanatory variable X. If all data were free from multicollinearity problem, then unit root test would be conducted. This is a test for stationarity in a time series and should the variables are proved to be stationary, it allows for cointegration to take place. Cointegration test would detect existence of long run relationship among variables in the model. Next, for the purpose of proving the validity of Environmental Kuznets Curve (EKC) theory, F-test would help achieve it by running the Granger Causality test.

RESULTS AND DISCUSSIONS

Correlation Test

Table 1 shows the result of correlation test for all variables which are carbon dioxide (CO2) emission, economic growth (GRW), population (POP), urbanization (URB) and industrialization (IND). The result shows that values of correlation coefficient for all independent variables are less than 0.5 except for URB and GDP which is slightly over at 0.586829. It can be concluded that there is no multicollinearity problem due to weak correlation amongst the variables.

Table 1. Correlation Matrix

	CO2	GRW	POP	URB	IND
CO2	1.00000				
GRW	0.86792	1.00000			
POP	-0.06497	-0.09454	1.00000		
URB	0.78012	0.58682	-0.00542	1.00000	
IND	-0.15967	-0.13465	-0.18578	0.04188	1.00000

(Source: Author)

Unit Root Test

Table 2 shows the result of unit root test. The ADF test was conducted at level and first difference level. CO2 emission and GRW are-non stationary at level, implying that those variables computed t-statistics are smaller than any critical values at 1 percent, 5 percent and 10 percent. Thus, null hypothesis, Ho is failed to be rejected. Both CO2 emission and GRW are significant at 1 percent in first difference while the other variable such as POP, URB and IND are significant at 1 percent but at a level. Meanwhile, in order to get the robustness and consistency of unit root test, this study performed another test which is Philips-Perron (PP) test. It is also conducted at level and first difference due to different results from all variables. CO2 emission, GRW, URB are-non stationary at level and are significant at 1 percent at first difference, while POP and IND are stationary at level and significant also at 1 percent.

Table 2. Unit Root Test

Series	Level		First Difference	
	ADF	PP	ADF	PP
CO2	-1.73	-1.74	-5.61***	-5.62***
GDP	-2.85	-2.63	-5.82***	-12.60***
POP	-6.67***	-17.09***	-9.33	-29.04
URB	-4.31***	-4.29	-6.15	-19.17***
IND	-6.72***	-6.98***	-5.98	-20.84

(Source: Author)
Notes: The asterisks ***, ** and * denote significant at 1%, 5% and 10% level respectively.

Co-integration Test

This test aims to determine whether there was a long run relationship between the variables. If the long run does exists in the model, than the dependent and independent variables are tied together in the long run. Table 3 shows that the Lc statistics is 0.440160, which is greater than 0.2, therefore, it is decided that null hypothesis is failed to be rejected and this indicates the existence of cointegration. As a result, there existed a long run relationship between CO2 emission and its determinants.

Table 3. Cointegration Test

	Stochastic	Deterministic	Excluded	
Lc statistics	Trends (m)	Trends (k)	Trends (p2)	Prob *
0.440160	4	0	0	>0.0589

(Source: Author)

Long Run Estimation

Based on Table 4, independent variable GRW and URB are found to be significant at 1 percent level at 0.0002 and 0.0007 respectively. Thus, null hypothesis for both variables are rejected which means GRW and URB contributes to the CO2 emission. For variable GRW, this is supported by past researches such as Gövdeli (2019), Mikayilov et al. (2018), Raza and Shah (2018), Ameer and Munir (2016) and Loganathan et al. (2014), which obtained similar result. Meanwhile, Fan et al., Wang et al. (2018) and Sadorsky (2014) supported the result of positive and significant relationship between URB and CO2 emission. However, the other two variables which are POP and IND are found to be insignificant. Thus, the null hypothesis

failed to be rejected which explains these variables have no impact on CO2 emission. The research done by Ahmad et al. (2005) supported this study finding on POP where they also found that population had an insignificant impact on CO2 emission. As for IND, finding from Xu and Lin (2015) also found insignificant result between IND and CO2 emission.

Table 4. Long-run Coefficient

Dependent Variable				
CO2	Coefficients	Std. errors	t-Statistics	p-values
Intercept	-4.789035	0.781999	-6.124093	0.0022
GDP	0.282129***	0.066786	4.224400	0.0002
POP	-0.060473	0.132874	-0.455117	0.6598
URB	0.232940***	0.046535	5.005688	0.0007
IND	-0.094848	0.078956	-1.201268	0.2603
Lag & lead	(2,2)			
R2	0.80			

(Source: Author)
Notes: The asterisks ***, ** and * denote significant at 1%, 5% and 10% level, respectively.

Moreover, according to Table 4, the result shows that GRW is positively related with CO2 emission. This means that every 1 percent increase in GRW, the CO2 emission will increase by 0.282129 percent. To further explain, when GRW increases, it will affect the environment because as Gross Domestic Product (GDP) per capita increases, it shows the increase in economic activity such as more production and spending causes the CO2 emission to be higher. Next, the result from URB indicates a positive significant affect towards CO2 emission where for every 1 percent increase in URB, this will increase CO2 emission by 0.232940 percent. This suggests that when urbanization increases, it will affect the environment as those who live in urban area are more exposed to the use of modern technology in their everyday life. For example, the use of air conditioner and higher number of cars which emit higher amount of CO2 compared to those who live in rural area resulted in higher CO2 emission. Other than that, the R-Squared value recorded at 0.80 indicates that the balance 80 percent was dependent variable; CO2 emission was explained by the independent variables used in this study, while the other 20 percent were explained by other unknown factors.

To conclude, due to the detection of long run relationship, therefore the result for long run equilibrium is written as follows:

$$lnCO_2 = \underset{(4.2244)}{-4.79} + \underset{(0.4551)}{0.28lnGRW_t} * \underset{(5.0056)}{-0.06POP_t} + \underset{(1.2012)}{0.23lnURB_t} * -0.09IND_t + \varepsilon_t \quad (2)$$

From the equation above, it can be seen that GRW and URB are positively significant in explaining CO2 emission and both of the variables are significant at 1 percent (*) significant level.

F-test

Granger Causality test is conducted to validate the Environmental Kuznets Curve (EKC) theory. The result in Table 5 shows insignificant result at 0.4720 which is more than 10 percent significance level and does not conform to the 1 percent and 5 percent significant level.

Table 5. Granger Causality Test

Null hypothesis	F-Statistic	Prob.
GRW does not Granger Cause CO2	0.77474	0.4720

(Source: Author)

Therefore, null hypothesis failed to be rejected, where increase in income does not necessarily degrade the environment quality; for this study GRW did not affect CO2 emission, while, the EKC theory suggests that higher income of a country leads to a higher environmental degradation. But at a turning point, higher income leads to less environmental degradation, this is not valid for Malaysia. According to Grimies and Roberts (1997, as cited by Gill et al., 2017), most of the times the EKC theory is applied for advanced countries due to their history of colonizing in the past. During this time, they would use cheap price for primary goods produced by their colonies for their own country's' rapid industrialization. Consequently, this contributed to the market exploitation of their colonies. Cole (2004) supported the claim, which states that the same current developing countries might not face the same international and domestic environment of growth that were available to developed countries. Therefore, this supports the results found in this study.

CONCLUSION

The purpose of this paper is to examine the relationship between economic development; economic growth, population, urbanization and industrialization towards carbon dioxide (CO2) emission in Malaysia using annual data from 1986 to 2016. Based on the estimated results, both the economic growth and urbanization are found to have positive and significant relationship with CO2 emission. Other than that, the result also detects a long run relationship for the model of this study. Furthermore, this study failed to prove the theory of Environmental Kuznets Curve (EKC). The findings of this study will contribute insight and knowledge as far as economic development and environment is concerned. This helps to increase awareness regarding environmental degradation and a guide for the policy maker in the process of making a better policy for the environment and start taking action because the world needs to accept the fact that tomorrow is today.

It is known that economic growth is undeniably important as much as the earth people are living in. Since it is impossible to stop the economic growth, it is plausible for the policymaker to find an alternative development path that is sustainable and less destructive to the environment. This is not just the policymaker who is responsible in not harming the environment, but it should be the entire population because if the world now cannot prevent themselves from harming the earth, what would the economic growth means when the earth is not habitable to live in and the future generation has to pay for the price. This is also worth to note that the availability of data concerning this subject is limited especially for smaller country like Malaysia. For further study, a different variable such as Ocean Health Index could be used to measure the degradation of environmental if enough data are accumulated.

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REFERENCES

Afawubo, K., & Ntouko, C. N. (2016). *Are Urbanization, Industrialization and CO2 emissions Cointegrated*? Retrieved from https://afse2016.sciencesconf.org/98849/document.

Ahmad, M. H., Azhar, U., Wasti, S. A., & Inam, Z. (2005). *Interaction between Population and Environmental Degradation*. The Pakistan Development Review.

Alauddin, M. (2002). Environmentalising Economic Development: A South East Asian Perspective. *Ecological Econmics, 51*(3-4):251-270.

Ameer, A., & Munir, K. (2016). Effect of Economic Growth, Trade Openness, Urbanization, and Technology on Environment of Selected Asian Countries.

Cole, M.A. (2004). Trade, the Pollution Haven Hypothesis and the Environmental Kuznets Curve: Examining the Linkages. *Ecology Economics, 48*(1), 71–81.

Dong, K., Hochman, G., Zhang, Y., Sun, R., Li, H., & Liao, H. (2018). CO2 Emissions, Economic and Population Growth, and Renewable Energy: Empirical Evidence Across Regions. Energy Economics.

Fan, H. Hashmi, S. H., Habib, Y., Ali, M. (2020). How Do Urbanization and Urban Agglomeration Affect CO2 Emissions in South Asia? Testing Non-Linearity Puzzle with Dynamic STIRPAT Model. *Chinese Journal of Urban & Environmental Studies, 8*(1), 37.

Gill, A. R., Viswanathan, K. K., & Hassan, S. (2018). The Environmental Kuznets Curve (EKC) and the Environmental Problem of the Day. *Renewable and Sustainable Energy Reviews*, 81, 1636-1642.

Gövdeli, T. (2019). Health Expenditure, Economic Growth and CO2 Emissions: Evidence from the OECD Countries. *Journal of Social Sciences*, 31, 488-516.

Gujarati, D. N. (2004). *Basic Econometrics*, Fourth Edition. The McGraw-Hill Companies.

Grimies, P.E., & Roberts J. (1997) Carbon Intensity and Economic Development 1962–1991: A Brief Exploration of the Environmental Kuznets Curve. *World Development, 25*(2), 191-198.

Li, K., & Lin, B. (2015). Impacts of Urbanization and Industrialization on Energy Consumption/CO2 Emissions: Does the Level of Development Matter? *Renewable and Sustainable Energy Reviews, 52*(C), 1107-1122.

Loganathan, N., Shahbaz, M., & Taha, R. (2014). The Link Between Green Taxation and Economic Growth on CO2 Emissions: Fresh Evidence from Malaysia. *Renewable and Sustainable Energy Reviews,* 38, 1083-1091.

Mikayilov, J. I., Galeotti, M., & Hasanov, F. J. (2018). The Impact Of Economic Growth On CO2 Emissions In Azerbaijan. *Journal of Cleaner Production, 167*(1), 1558-1572.

Phimphanthavong, H. (2013). The Impacts of Economic Growth on Environmental Conditions in Laos. *International Journal of Bussiness, Management and.Economics.Research, 4*(5), 766-774.

Raza, S. A., & Shah, N. (2018). *Impact of Financial Development, Economic Growth and Energy Consumption On Environmental Degradation*: Evidence from Pakistan. Munich Personal RePEc Archive (87095). Munich: University Library of Munich.

Sadorsky, P. (2014). The Effect Of Urbanization On CO2 Emissions in Emerging Economies. *Energy Economics, 41*(C), 147-153.

Shahbaz, M., Uddin, G. S., Rehman, I. U., & Imran, K. (2014). Industrialization, Electricity Consumption and CO2 Emissions in Bangladesh. *Renewable and Sustainable Energy Reviews, 31*(C), 575-586.

Wang, S., Zeng, J., Huang, Y., Shi, C., & Zhan, P. (2018). The Effects of Urbanization on CO2 Emissions in the Pearl River Delta: A Comprehensive Assessment and Panel Data Analysis. *Applied Energy, 228*(C), 1693-1706.

Wang, Y., & Zhao, T. (2018). Impacts Of Urbanization-Related Factors On CO2 Emissions: Evidence From China's Three Regions With Varied

Urbanization Levels. *Atmospheric Pollution Research, 9*(1), 15-26.

Wang, Y., Kang, Y., Wang, J., & Xu, L. (2017). Panel Estimation For the Impacts of Population-Related Factors on CO2 Emissions: A Regional Analysis in China. *Ecological Indicators*, 78, 322-330.

Xu, B., & Lin, B. (2015). How Industrialization and Urbanization Process Impacts on CO2 Emissions in China: Evidence From Nonparametric Additive Regression Models . *Energy Economics, 48*(C), 188-202.

Yu, Y., Deng, Y. R., & Chen, F.F. (2018). Impact of Population Aging and Industrial Structure on CO2 Emissions and Emissions Trend Prediction in China. *Atmospheric Pollution Research, 9*(3), 446-454.

Zaman, K., Khan, H., Khan, M. M., Saleem, Z., & Nawaz, M. (2011). The Impact Of Population On Environmental Degradation In South Asia: Application of Seemingly Unrelated Regression Equation Model. *Environmental Economics, 2*(2), 80-88.

Zhang, G., Zhang, N., & Liao, W. (2012). How Do Population and Land Urbanization Affect CO2 Emissions Under Gravity Center Change? A Spatial Econometric Analysis. *Journal of Cleaner Production*, 202, 510-523.