INTERNATIONAL ACADEMIC RESEARCH JOURNAL

ISSN :2289-8441

International Academic Research Journal of Social Science

Journal homepage: www.iarjournal.com

# The Impact of Economic Activities on $Co_2$ Emission

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## Article Information

**Keywords**
$CO_2$ emission, energy consumption, trade openness, GDP, FDI

## Abstract

This paper attempts to investigate the impact of economic activities on $CO_2$ emission in Malaysia. This study gathers secondary annual balanced data over the period 1980–2011. Time series techniques Ordinary Least Squared (OLS) is applied to estimate the impact of GDP, energy consumption, trade openness and FDI towards the emission. According to the estimated results obtained from the analysis, separately only FDI has no significant relationship with $CO_2$ emission while the other three have significant relationship; GDP, energy consumption and trade openness. A joint effect of all variables towards $CO_2$ emission in Malaysia is also found to be significant. This study differs from others because it includes variable of foreign direct investment to measure the effect on $CO_2$ emission in Malaysia.

## INTRODUCTION

Being a country that strives to become a high income country by year 2020 has led to higher economic and social activities that also has spill-over effect on the environment. One may ask how economic activity; say for example trade, contribute to this? Trade at some point involves transportation and these vehicle need fuel to move from one place to another. Here is an example of what we call carbon footprint where greenhouse gas is emitted. It was not until the 90s where the environmental issue was taken seriously due to global issues like deforestation, climatic changes, and desertification and ozone depletion. A new perspective arised during this time; protection on the environment. $CO_2$ emission can be defined as carbon dioxide which is a clear gas composes of one atom of carbon and two atoms of oxygen. $CO_2$ is one of chemicals forms of carbon on earth. Carbon dioxide also can be said as the primary greenhouse gas emitted through human lifestyles (U.S Energy Information Administration, 2013). Another concept needs to be addressed is energy consumption. Energy consumption refers to the amount of energy consumed by an individual or organization, or to the process or system of such consumption.

In Malaysia, Department of Environment was set up in 1974 which is responsible to administer and enforce laws regarding environment and its preservation for the country's benefit in the present and future. This department also contributes in improving quality of life through their environmental program which creates awareness and motivates the people to maintain and enhance the quality of the place that they live in. The environmental issue has been around in Malaysia since 1970s but was given serious look in the 80s. This is due to the alarming problems of environmental degradation caused by pollution, global warming and greenhouse effect. Malaysia also experienced rapid economic growth for the past four decades and high growth rate of energy consumption. For example GDP on 2005 was constant price grew at an average of 6.3 percent between 1970 and 2012. Meanwhile, the annual growth rate of energy uses (kt of oil equivalent) was 6.6 percent between the periods (World Bank). Development and growth in in standard living, manufacturing sector, increase in income and increase in vehicles was results from the growth in energy consumption.

According to Ozturk and Acaravci (2010) the increasing global warming due to $CO_2$ emission for over 30 years has impacted the world economy in general. Throughout the globalization process, foreign trade also affects the level of $CO_2$ emission in many countries in the world. The relation between growth and $CO_2$ emission was mainly founded by the EKC hypothesis (Brock and Taylor, 2004). Kumbaroglu et al., (2008) postulated that growing volume of production, which also means raising the emission of $CO_2$, this would affect the environment negatively.

In recent years, it can be seen that many countries are started to act against global warming where they are building policies in order to combat this problem. Some have slapped charges on outflows of carbon dioxide, the principle a worldwide temperature alteration gas. Others have picked a framework that sets up a general point of confinement on carbon-dioxide discharges and afterward permits organizations to purchase and offer the privilege to pollute inside of that cut-off. Some believe that in order to expand economy, to harm the environment is a must. On the other hand it is also important to sustain the survival of people who live in it by having a balance between expanding the economy and harming the environment. While it is already known that development of a country contributes to the nature deterioration, the economic activities also play its part in this matter. In Malaysia, even though the issue is somewhat new, it has taken steps to reduce the impact. Therefore this study is conducted to investigate the impact of economic activities on $CO_2$ emission in Malaysia context. Thus, energy consumption, growth domestic product, trade openness and foreign direct investment are used as variables to trace the existence of this relationship. The Environmental Kuznets Curve (EKC) hypothesis is also tested to find a better understanding of this issue. This study differs from others because it includes variable of foreign direct investment to measure the effect on $CO_2$ emission in Malaysia.

**LITERATURE REVIEW**

Energy consumption refers to the amount of energy consumed by an individual or organization, or to the process or system of such consumption. Nearly every modern convenience increases the amount of energy consumed. There is a positive relationship found between $CO_2$ emissions, energy consumption, and economic growth (Dritsaki and Dritsaki, 2014). The result is concurred by few other studies like Akin (2014) on 85 countries, Akhmat, et, al (2014) in a study based on Australia and Halicioglu (2008) in the case of Turkey. In addition to that, using Environmental Kuznets curve (EKC), a long term relationship between with bidirectional causality between per capita $CO_2$ emission and per capita energy consumption are detected. Moreover, this study on South Asian Association for Regional Cooperation (SAARC) countries, namely, Bangladesh, India, Nepal, Pakistan, and Sri Lanka indicates that energy consumption acts as an important driver to increase environmental (Muhammad and Drake, 2012). Energy consumption per capita, both being unidirectional also causes environmental pollution through $CO_2$ emission in Tanzania (Baka, 2015). On the other hand, Yu (2015) points out that energy consumption keep increasing while the total $CO_2$ emissions fluctuated. Meanwhile a monotonically increasing curve between GDP and $CO_2$ emission has been found in Pakistan, rejecting the EKC relationship, implying that as per capita GDP increases a linear increase will be observed in per capita $CO_2$ emission. According to the results from Halicioglu (2008) based on Turkey, positive relationship is found between per capita incomes to $CO_2$ emissions. Akin (2014) also demonstrate the income from 85 countries have positive relationship with $CO_2$ emission. In a research by FarhaniChaibi and Rault (2014) for Tunisia, it suggests that GDP has positive Granger causality relationships to $CO_2$ emission. The research also reveals a unidirectional causality from GDP to $CO_2$ emission. Eteng (2012) in the study based on the UK has found an inverted U-shape relationship between $CO_2$ and GDP which concurs with the EKC hypothesis.

The impact of FDI on the growth of $CO_2$ emissions in 18 countries of the Middle East and North African region is found to be positive (Jalil, 2014). Similarly, according to Acharyya (2009), there has been a stable positive growth impact of FDI inflow in India on $CO_2$ emission. However, using data from 76 countries, Yildrim (2014) concludes that a rise in inward FDI (which leads to rise in energy use) does not guarantee the same pattern in pollution level. A different finding states that FDI does not contribute to $CO_2$ emissions since insignificant and negative relationship are found by Fereidouni (2013). According to Danladi and Akomolafe (2013), there is a unidirectional causality between the growth of FDI and the environmental pollution. Applying the same Granger causality test, FDI inflows is found to significantly not intensify the environment degradation within 12 Asian most populous Asian countries (Linh and Lin, 2015).

Moving on to trade openness, according to the Akin (2014), it can either has positive or negative relationship with $CO_2$ emissions because trade openness effect can vary so coefficient of trade can be positive or negative. In oppose to this, negative relationship between trade openness and $CO_2$ emission in Kenya is demonstrated (Zerbo, 2015). Halicioglu (2008) appears to support this result. Nevertheless, it was also found by Sahbi (2014) in his study that trade has positive Granger causality relationships to $CO_2$ emission for Tunisia. As found by Hossain (2012), Boopen (2012) and Saboori, Sulaiman and Mohd (2012), higher trade openness in Japan, Mauritus and Indonesia also gives rise to more $CO_2$ emissions respectively. Finding by Saboori, Sulaiman and Mohd (2012) indicates that foreign trade is the most significant variable in explaining $CO_2$ emissions in Indonesia.

## METHODOLOGY

*Scope of Study*

This study focuses on Malaysia context from the year 1980 to 2011 as yearly data. This period is chosen based on its availability. The program STATA is used to analyze data to get meaningful results. There are five variables used in this study; namely GDP, energy consumption, FDI, trade openness and $CO_2$ emission. All data are extracted as secondary data obtained from US Energy International Administration and World Bank. Energy consumption is measured in million Btu per person, trade openness proxied by trade percentage of GDP and both GDP and FDI are in monetary value. The objectives of this study are 1) to investigate relationship between GDP, energy consumption, trade openness, and FDI toward $CO_2$ emission in Malaysia and 2) to examine the effect of economic growth on environment deterioration.

*Multiple Linear Regression*

In order to determine the effect of selected variables on $CO_2$ emissions, Multiple Linear Regression is favoured. The model used in this study is adopted from previous research done by Akin (2014). The general model for this study is as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_t X_t + \in_t \quad (1)$$

Where $Y_t$ = dependant variable; α = constant, β = coefficient, X = the *i*th observation on explanatory variable X, *t* = time period and $\in_t$ = error term. Next is the model of this study:

$$CO_{2t} = \alpha + ln\beta_1 GDP_1 + \beta_2 EN_2 + \beta_3 TR_3 + ln\beta_4 FDI_4 + \in_t \quad (2)$$

Where $CO_2$ = carbon emission; GDP = Growth Domestic Product; EN = energy consumption; TR = trade openness; and FDI = foreign direct investment.

*Coefficient of Determination ($R^2$)*

The coefficient of determination in multiple regression indicates the percentage of variation in dependent variable; Y explained by the combination of all independent variables; X. The value of $R^2$ ranges from 0 to 1. $R^2$ value of 1 means that 100 percent of the variation in Y is explained by X. Now, R-square is calculated as below:

$$R^2 = \frac{ESS}{TSS} \quad (3)$$

*ANOVA, F-test*

The F-test is a test of joint hypothesis which is also called a test of overall significance of the observed or estimated regression line that is whether Y is clearly related to both $X_2$ and $X_3$. The consequence of p value under 5 percent would prompt dismissal of $H_0$. Formula underneath shows how F test is figured:

$$F = \frac{(\beta_2 \sum y_i x_{2i} + \beta_3 \sum \frac{y_i x_{3i}}{2}}{\frac{\sum u_i^2}{n-3}}$$

$$= \frac{ESS/df}{RSS/df} \quad (4)$$

$H_0$: There is no significant relationship between $CO_2$ emissions and its independent variables.
$H_1$: There is significant relationship between $CO_2$ emissions and its independent variables.

*Test of Significance, t-test*

A test of significance is a procedure by which sample results are used to verify the truth or falsify of a null hypothesis. The decision to accept or reject $H_0$ is made on the basis of the value of the test statistic obtained from the data at hand. The following equation depicts how t-test is calculated:

$$t = \frac{\beta_2 - \beta_1}{se(\beta_2)}$$

$$= \frac{\beta_2 - \beta_2 \sqrt{\sum x_t^2}}{\sigma} \quad (5)$$

It is said to be statistically significant if the value of the test statistic lies in the critical region. In this case the null hypothesis is rejected. On the other hand, it is statistically insignificant if the value of the test statistic lies in the acceptance region. For this case null hypothesis is not rejected.
$H_0$ = There is no significant relationship between $CO_2$ emission to GDP.
$H_1$ = There is significant relationship between $CO_2$ emission to GDP.

$H_0$ =There is no significant relationship between $CO_2$ emission to energy consumption.
$H_1$ = There is significant relationship between $CO_2$ emission to energy consumption.

$H_0$ = There is no significant relationship between $CO_2$ emission to trade openness.
$H_1$ = There is significant relationship between $CO_2$ emission to trade openness.

$H_0$ = There is no significant relationship between $CO_2$ emission to FDI.
$H_1$ = There is significant relationship between $CO_2$ emission to FDI

*Pearson Correlation Coefficient, r*

Pearson correlation coefficient is conducted to measure the quality of relationship between two variables. Fundamentally, Pearson item minute correlation endeavours to draw a line of best fit through the information of two variables, and the Pearson correlation coefficient demonstrates how far away all these information focuses are to this line of best fit. The test can take a scope of qualities from +1 to - 1. An estimation of 0 shows that there is no relationship between the two variables. A quality more prominent than 0 demonstrates a positive affiliation; that is, as the estimation of one variable builds, so does the estimation of the other variable. On the off chance that the quality is under zero it is demonstrates a negative affiliation. That is, as the estimation of one variable builds, the estimation of the other variable reductions. By utilizing this test, analyst can gauge which variables has solid, moderate and powerless relationship toward autonomous variables. Recipe underneath shows how Pearson correlation is computed.

## RESULTS

*Multiple Linear Regression*

TABLE 1
REGRESSION COEFFICIENT

| $CO_2$ | Coefficient | Standard Error |
|---|---|---|
| Energy Consumption | 2.08107 | 0.17897 |
| GDP | 10.8866 | 4.71725 |
| Trade openness | -0.29038 | 0.059364 |
| FDI | 1.75078 | 1.55644 |
| Constant | -321.5717 | 106.7278 |

Based on Table 1, three variables are found to have positive relationship with $CO_2$ emission which is energy consumption, GDP and FDI. Meanwhile, negative relationship is found between trade openness and $CO_2$ emission. The increase of 1 percent of energy consumption, $CO_2$ emissionwill increase 2.081 btu. Next, for every increase of RM1 of GDP, $CO_2$ emission will increase by 10.887 btu and every increase of RM1 of FDI will increase $CO_2$ emission by 1.750785 btu. However for trade openness, the increase of 1 percent will reduce 0.2903802 btu of $CO_2$ emission. Therefore the model of this study is as follows:

$$CO_{2t} = 321.57 + 10.8866GDP_1 + 2.081EN_2 + 0.2903TR_3 + ln1.7507FDI_4 + \in_t \quad (7)$$

*Coefficient of Determination, $R^2$*

TABLE 2
MODEL SUMMARY

| | |
|---|---|
| Number of observations | 32 |
| F(4, 27) | 387.24 |
| Probabilty> F | 0 |
| R-squared | 0.9829 |
| Adjusted R-squared | 0.9803 |

Referring to table 2, the $R^2$ value of 0.9829 suggests that dependent variable $CO_2$ emission is explained by its independent by 98.29 percent whichare energy consumption, GDP, trade openness and FDI. The other 1.71% is explained by other unknown variables. The reliability of the model used for this study is confirmed.

*ANOVA, F-test*

According to table 2, the probability value for F-test is significant, 0.000 at 5 percent level. Therefore, the dependant variable $CO_2$ emission is explained by its dependent variables jointly. Hence, it fails to accept the null hypothesis. Besides, it also proves that EKC theory does apply in Malaysia case as supported by previous studies done by Saboori, Sulaiman and Mohd (2012). This complies with the theory that explains as early phases of economic development, contamination of the environment increments, however past some level of wage the pattern turns around, intending to say that high wage level monetary development prompts natural enhance to be better (Stern, 2003).

*Test of Significance, t-test*

TABLE 3
COFFICIENTS

| $CO_2$ | t | P>\|t\| |
|---|---|---|
| Energy Consumption | 11.63 | 0.000 |
| GDP | 2.31 | 0.029 |
| Trade openness | -4.89 | 0.000 |
| FDI | 1.12 | 0.271 |
| Constant | -3.01 | 0.006 |

Four independent variables have been regressed against $CO_2$ emission. The estimated result in table 3 shows that three of four variables convey significant relationship with $CO_2$ emission; energy consumption, trade openness and GDP where the values of significant for stand at 0.000, 0.029, and 0.000 respectively. In contrast, FDI is not statistically significant with $CO_2$ emission at 0.271. Thus, for the case of energy consumption, trade openness and GDP, it fails to accept null hypothesis that suggest there is significant relationship between the stated independent variable with $CO_2$ emission. Meanwhile for FDI, it fails to reject null hypothesis that suggests there is no significant relationship between FDI and $CO_2$ emission.

*Pearson Correlation*

TABLE 4
CORRELATIONS

| | **$CO_2$ emission** | **Energy** | **GDP** | **Trade** | **FDI** |
|---|---|---|---|---|---|
| **$CO_2$ emission** | 1.0000 | | | | |
| **Energy consumption** | 0.9820<br>0.0000** | 1.0000 | | | |
| **GDP** | 0.9467<br>0.0000** | 0.9450<br>0.0000** | 1.0000 | | |
| **Trade** | 0.7329<br>0.0000*** | 0.8135<br>0.0000** | 0.7881<br>0.0000** | 1.0000 | |
| **FDI** | 0.5366<br>0.0015* | 0.5327<br>0.0017* | 0.5866<br>0.0004* | 0.5608<br>0.0008* | 1.0000 |

** Correlation is significant at 1 percent level.
* Correlation is significant at 5 percent.

Table 4 provides the value of correlation for the variables used in the study. The relationship are mixed between strong and moderate. Four strong positive relationship are found and they are 1) energy consumption with $CO_2$ (98.2 percent), 2) GDP with $CO_2$ ((94.7 percent), 3) GDP with energy consumption (94.5 percent) and 4) trade openness with energy consumption (81.4 percent). The rest shows moderate relationship between 53 to 74 percent.

## CONCLUSION

The purpose of this is to examine the impact of economic activities on $CO_2$ emission in Malaysia from year 1980 to 2011 based on yearly data. This study differs from others because it includes FDI as a variable to measure the effect on $CO_2$ emission in Malaysia. Using time series techniques OLS data collected are specifically used to estimate the impact of GDP, energy consumption, trade openness and FDI towards $CO_2$ emission.

Estimated results suggest that separately only FDI has no significant relationship with $CO_2$ emission while the other three have significant relationship; GDP, energy consumption and trade openness. The insignificant relationship result is supported by previous research done by Fereidouni (2013). A joint effect of all variables towards $CO_2$ emission in Malaysia is also found to be significant. Nevertheless, four strong positive relationships are recorded being two out of four are relationship amongst independent variables; GDP and energy consumption and trade openness and energy consumption. The EKC hypothesis also proved to be applied in Malaysia.

In conclusion, GDP, energy consumption, trade openness and FDI do affect the $CO_2$ emission in some way. Even the country has started to take note on the importance of the sustainability of the environment, little has been done to accelerate it. In some countries method of trade and cap are practiced to reduce amount of $CO_2$ emission while their economies are growing. It is the method where manufacturer or any individual who emit excess $CO_2$ will be charged. The introduction of green product and simple practice like recycling and reduction in electricity consumption also help. In the future, researchers can extend this study by taking into account newest data and other meaningful methods.

**REFERENCES**


Acharyya, J. (2009). FDI, growth and the environment: evidence from India on $CO_2$ emission during the last two decades. *Journal of Economic Development, 34*, (1), 43-58.

Akhmat, G., Zaman, K., Shukui, T., Irfan, D., & Khan, M. M. (2014). Does energy consumption contribute to environmental pollutants? Evidence from SAARC countries. *Environmental Science and Pollution Research, 21, 9,* 5940-5951.

Amadeh, H., &Kafi, P. (2015). The dynamic relationship among economic growth, energy consumption and environment in Iran. *International Letters of Social and Humanistic Sciences*, *50*, 118-128.

Anwar, S., &Nasreen, S. (2015). The impact of economic and financial development on environmental degradation. An empirical assessment of EKC hypothesis. *Studies in Economics and Finance, 32*, 4, 485-502

Boopen, S., & Harris, N. (2012). Energy use, Emissions, Economic growth and Trade: Evidence from Mauritius. *ICTI 2012, ISSN: 16941225*

Akin, C. S. (2014). The Impact of Foreign Trade, Energy Consumption and Income on $CO_2$ Emissions. *International Journal of Energy Economics*
*and Policy, 4, 3.*

Chen, J. H., & Huang, Y. F. (2013). The study of the relationship between carbon dioxide ($CO_2$) emission and economic growth. *Journal of International and Global Economic Studies, 6, 2,* 45-61.

Danladi, J. D., &Akomolafe, K.j (2013). Foreign direct investment, economic growth, and environmental concern: evidence from Nigeria. *Journal of Economics and Behavioral Studies, 5,7,* 460-468.

Dellachiesa, A., & Yu, T.H.E. (2009). The long-run impact of energy use, income and trade on carbon dioxide emissions in Mercosur member states: A panel cointegration analysis.

Dritsaki, C., &Dritsaki, M. (2014) . Causal relationship between energy consumption, economic growth and $CO_2$ emissions: A dynamic panel data approach. *International Journal of Energy Economics and Policy,4, 2,* 125-136 .

Eteng, E. I. (2012). What is the relationship between $CO_2$ emissions and economic growth in the UK? *Centre for Energy, Petroleum and Mineral Law and Policy Gateway Annual Review, 17.*

Farhani, S., Chaibi, A. &Rault, C. (2014). A study of $CO_2$ emissions, output,energy consumption, and trade. *Journal Economic Modelling, 38,* 426-434.

Fereidouni, H. G. (20013). Foreign direct investments in real estate sector and $CO_2$ emission: Evidence from emerging economies.*Management of Environmental Quality An International Journal, 24, 4.*

Halicioglu, F. (2008). An econometric study of $CO_2$ emissions, energy consumption, income and foreign trade in Turkey.31st IAEE Annual International Conference Istanbul-Turkey paper no. 11457.

Hussain, M. (2012). An econometric study of carbon dioxide ($CO_2$) emissions, energy consumption, and economic growth of Pakistan. 1st International Conference on Emerging Research Paradigms in Business and Social Science, Dubai vol 1.

Hossain, S. (2012). An econometric analysis for $CO_2$ emissions, energy consumption, economic growth, foreign trade and urbanization of Japan, *Low Carbon Economy, 3, 3A*, 92-105.

Jalil, S.A. (2014). Carbon Dioxide Emission in the Middle East and North African (MENA) region: A dynamic panel data study. *Journal of Emerging Economies and Islamic Research, 2, 3.*

Kashyna, O. (2011). Investigating the Environmental Kuznets Curve hypothesis using Environmental Performance Indices. School of Management and Economics,Lund University, Master thesis.

Kerr, D. (2012). Energy, population and the environment: exploring Canada's record on $CO_2$ emissions and energy use relative to other OECD countries. *Journal of Population and Environment*December *2012, 34, 2,* 257-278.

Kohler, M. (2013). $CO_2$ Emissions, energy consumption, income and foreign trade: A South African perspective. ERSA working paper 356.

Liddle, B. (2014). Impact of population, age structure, and urbanization on carbon emissions/energy consumption: Evidence from macro-level, cross-country analyses. *Journal of Population and Environment, 35, 3,* 286-304.

Linh, D.H., & Lin, S.M. (2015). Dynamic causal relationships among $CO_2$ emissions, energy consumption, economic growth and FDI in the most populous Asian countries. *Advances in Management & Applied Economics, 5, 1,* 69-88.

Linh, D. H., & Lin, S. M. (2014). $CO_2$ emissions, energy consumption, economic growth and FDI in Vietnam. *Managing Global Transitions, 12, 3.*

Moghadam, H. E., &Lotfalipour, M. R. (2014). Impact of financial development on the environmental quality in Iran. *Chinese Business Review, September 2014, 13, 9,* 537-551.

Saboori, B., &Sulaiman, J., &Mohd, S. (2012). An empirical analysis of the Environmental Kuznets Curve for $CO_2$ emissions in Indonesia: The role of energy consumption and foreign trade. *International Journal of Economics and Finance, 4, 2,* 243-251.

Saidi, K. (2014). The impact of $CO_2$ emissions and economic growth on energy consumption in 58 countries. *Energy Reports, 1,* 62–70.

Salahuddin, M., & Khan, S. (2013). Empirical link between economic growth, energy consumption and $CO_2$ emission in Australia. *The Journal of Developing Areas, 47, 2.*

Stern, D.I. (2003). The Environmental Kutznetz Curve. *International Society for Ecological Economics.*

Yildirim, E. (2014). Energy use, $CO_2$ emission and foreign direct investment: Is there any inconsistence between causal relations? *Frontiers in Energy, 8, 3,* 269-278.

Zerbo, E. (2015). $CO_2$ emissions, growth, energy consumption and foreign trade in Sub-Sahara African countries. Working paper hal-01110769