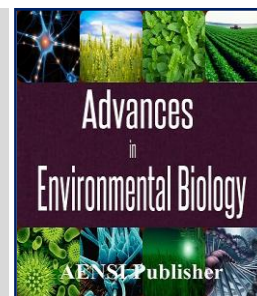




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## Relationship between CO<sub>2</sub>, Carbon Tax, Financial Development and Research and Development Expenditures in Malaysia: A proposed Study

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### ABSTRACT

The proposed study will analyze the relationship between Carbon dioxide and its determinants like a carbon tax, financial development and research and development expenditures for the time period 1980-2013. There exists theoretical and empirical contradiction in the literature on the relationship between the variables of the study, but these variables still have importance in determining the CO<sub>2</sub> emissions. The carbon tax and R&D expenditures which are not yet tested in the case of Malaysia and are supposed to improve the environmental quality by controlling the CO<sub>2</sub> emissions. The impact of these variables is controversial in different case scenarios therefore the study proposes further investigation about their relationship. It is suggested that the usage of the Vector error correction model (VECM) will be suitable to analyze the variable's relationship. The study also suggest the use of variance decomposition (VD) and impulse response function (IRF) to justify the results.

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## INTRODUCTION

The discovery of natural resources and their proper utilization has made it possible for the present world to be civilized. The high standard of living and life expectancy has become possible due to the industrialization which is fueled by the use of coal, gas and petroleum. However, the current pattern of consumption and production of fossil fuels is problematic, but the businesses ignore these externalities because they do not directly affect the individuals and businesses [1]. The concentration of greenhouse gases is increasing in the atmosphere and it is of great concern to both the national and international climate change policy makers and efforts are being made to reduce this concentration of GHG especially the abundance of carbon dioxide (CO<sub>2</sub>), which is the main cause of global warming [2]. There is a common scientific evidence that man-made greenhouse gases are the root cause of the global climate change. Policy and decision makers have attributed their concentration to this problem of climate change due to these emissions, and are trying to reduce or control such change in the earth's climate system [3].

To combat the problem of CO<sub>2</sub> emissions different researchers used different policy instruments including emission trading, carbon tax, emission standards and energy taxes. The most known of them is the emission trading and carbon tax. Beside the emissions reduction carbon tax can be helpful in improving the economic situation by paying down the deficit or by cutting down other tax rates like income tax or payroll tax [4]. Research and development expenditures play an unquestionable part in determining the pathway of the energy economy. The long-run achievement of the low emission paths can be determined in the near future by looking into the rate at which low emissions technologies are emerging and improving [3]. R&D public energy expenditures are considered as the base to adopt new technologies as well as it may increase the absorption capacity and may generate new knowledge. The R&D expenditures in energy by governments may be considered as the source to measure the upstream-technology push [3].

The role of the financial sector also cannot be neglected in the environmental perspective as it may increase manufacturing activities which will give rise to more CO<sub>2</sub> emissions, but it also may be helpful in reducing the

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CO<sub>2</sub> emissions by encouraging the technological progress [5]. The development of the financial sector may also help boost the R&D and economic activities, and thus may affect the environmental quality [6]. These streams of interconnection are more practicable in developing economies [7] and especially in the case of Malaysia [8].

The economy and the environment are both at risk due to the continuous and rising GHG emissions and scientists projected that this climate change will cause a rise of about 2oF to 11.5oF higher on an average by 2100 [9]. The topic of CO<sub>2</sub> emissions is discussed in the literature, but the results are inconclusive and there is a lot of contradiction in the arguments about the variable's relationships.

This study will try to investigate the relationship between carbon tax, financial development, R&D expenditures and CO<sub>2</sub> emissions. The proposed study will observe the role of increasing R&D expenditures in mitigating the CO<sub>2</sub> emissions in case of Malaysia. The study will look into the relationship of carbon tax and CO<sub>2</sub> emissions to look for the application of carbon tax in Malaysia. The study will also try to suggest the role of financial sector development in improving the environmental quality.

#### *Literature Review:*

There is a vast range of discussion on the determinants of CO<sub>2</sub> in different contexts. Some studies argue about the positive relationship of these determinants and some found that these determinants cause decrease in CO<sub>2</sub> emissions. There is a cluster of mix results about the relationships of these variables with the environmental quality.

#### *Carbon Tax and CO<sub>2</sub> Emissions:*

The Pigovian tax postulates that the market activity which produce negative externalities should be taxed [10]. It is concluded that the intensity of carbon was significantly reduced regardless of the overall increase in the CO<sub>2</sub> emissions in Norway during 1990-2000. There occur changes in the energy structure and the intensity of carbon was decreased and a total of 2% decrease in CO<sub>2</sub> emissions was attributed to carbon tax of the total 14% reduction in the CO<sub>2</sub> emissions [11]. The study argued that the CO<sub>2</sub> emissions can be reduced by 17.6% relative to the 1998 level if a carbon tax of \$50 is applied on the carbon emissions from manufacturing industries, having no independent electricity restructuring [12]. The study that include 21 OECD countries and 9 energy-intensive industries concluded that the competitiveness of the energy-intensive industries are affected negatively on international basis due to the imposition of carbon tax [13]. A study of British Columbia found that GHG emissions are decreased by 9.9% in the Province by the imposition of carbon tax as compared to the 4.6% in the absence of carbon taxes [14]. It is concluded from the summary of different countries that there will be a loss of GDP from 0.1-1.2% if the countries decrease their carbon emissions from 15-25% by 2010 [15]. It is estimated that a carbon tax may affect net revenue from broader taxes for the year 2015 in a range of 0.5% to 0.8% by imposing a carbon tax of \$15 [16] and \$31 [17] respectively and intermediate estimates of [18] and [19].

It is postulated that the economic distortions due to carbon tax may be more than the generic tax on capital or labor [20]. There may be negative effects of carbon tax on investment, consumption and economic activities and the lost revenues due to limited economic activities cannot meet with net revenue from a carbon tax. It is concluded that a carbon tax will give rise to energy prices and it will make the economy suffer because if a tax of \$20 per ton is imposed and raised at a constant rate of 4% annually it will reduce the economy by \$97 billion by 2023 and will reduce the CO<sub>2</sub> emissions only by 30% by 2053, which is less than 80% reduction that is generally aimed [21]. It is also found that there is no effect of the increase in tax expenditures on renewable energy to replace coal by tax expenditure nor the expenditures on coal has some effect on the CO<sub>2</sub> emissions [22]. It is concluded that the carbon tax can be exempted by adopting the CGE models in different scenarios as it affect the GDP and energy intensive industries negatively but still it have good mitigation effects [23].

#### *Financial Development and CO<sub>2</sub> Emissions:*

A group of studies like [24], [25], and [26] argued that the eco-friendly programs can be conferred with lower cost by developing the financial sector which will result in a reduction of energy pollutants. The results of the study on South Africa concluded that energy emissions are increased due to economic growth, while the case with financial development is reversed, i.e. the financial development controls the emissions [27].

It is concluded that in the case of Turkey, financial development plays no role in controlling the CO<sub>2</sub> emissions [28]. The study of Portugal reported causality running from financial development and economic growth towards CO<sub>2</sub> emissions [29]. It is concluded that the CO<sub>2</sub> emissions can be mitigated by developing the financial sector to a certain stage but not in general [26].

#### *R&D Expenditures and CO<sub>2</sub> Emissions:*

The study concluded that the economic growth, technological change and abatement costs are affected by the research and development expenditures. The study also concluded empirically that the CO<sub>2</sub> emissions are

reduced in the post-IFRS adoption of R&D expenditures and also there occur an increase in the CO<sub>2</sub> abatement [30].

It is stated that if there occur a dramatic increase in the public expenditures on energy R&D it may come at the expense of very high cost, and it may be on the cost of reduced funding to other sectors of the economy which is not desirable [31], [32] and [33].

The findings provide support for existing criticism of energy subsidies on the grounds that the costs exceed the benefits [34], and that the subsidy policy currently in place cannot be justified using economic theory [35], and particularly in the case of traditional fuels [36].

#### *Study Objectives:*

The objectives of the proposed study are:

1. To suggest the measure of the relationship between carbon tax on the CO<sub>2</sub> emissions.
2. To suggest the role of an increasing energy R&D expenditures in mitigating the CO<sub>2</sub> emissions.
3. To suggest the relationship of financial development with the CO<sub>2</sub> emissions.

#### *Research Questions:*

1. What is the relationship between a carbon tax and CO<sub>2</sub> emissions?
2. What is the role of an increase in energy R&D expenditures in CO<sub>2</sub> mitigation?
3. What is the relationship between financial development and CO<sub>2</sub> emissions in Malaysia?

#### *Proposed Hypotheses:*

##### *Carbon Tax and CO<sub>2</sub> Emissions:*

The importance of pricing the emissions cannot be ignored while studying the environmental degradation and climate change. Apart from the above, other empirical findings has also inconclusive results. For example, it is argued that the carbon tax in China using dynamic general equilibrium model to check the impacts on the macro economy and has been found to reduce the CO<sub>2</sub> emissions on the cost of a little damage to GDP, i.e. Only 1.1% loss of GDP could reduce 17.45% of Carbon emissions [37]. It is estimated that there will be a 14% decrease in the GHG emissions if a carbon tax of \$15 per ton is applied [36], while [38] and also argued that a carbon tax has a significant decreasing impact on the GHG emissions in European countries and it could reduce the emissions up to 15 percent. It is stated that the carbon tax can promote the development of alternative fuels as well as energy saving due to more efficient and significant mitigation effects than the energy tax [39].

Conversely, there is literature which state that a carbon tax is a bad idea and it will not decrease CO<sub>2</sub> emissions. It is stated that without international agreement taxes have the advantage to be implemented by individual countries, but, besides addressing the beneficial effects of externalities these environmental taxes have dead-weight losses [40]. It is revealed that these are people not the corporation who will suffer from the regulation of climate change and a hypothetical carbon tax will hit the income group having low income two times more than how strong it will strike the 10% higher income level people [41]. The high carbon tax application may not be appropriate in the short run looking into the situation and main goal of developing countries to achieve economic development, high energy prices may affect the pace of development [42]. On the basis of the above contradictory and inconclusive empirical findings, it is needed to be investigated more. The proposed hypothesis of the study is:

*H1 (a): Carbon tax will decrease the CO<sub>2</sub> emissions in atmosphere.*

*H1 (a): Carbon tax will not decrease the CO<sub>2</sub> emissions in atmosphere.*

##### *Financial Development and CO<sub>2</sub> Emissions:*

It is concluded that a link can be established between environmental degradation and development of the financial sector and a lot of funds can be attracted at lesser costs if the financial sector is affective [43]. The study concluded that financial development can improve environmental quality and also found a feedback hypothesis between CO<sub>2</sub> emissions and financial development using Granger causality [29]. Similarly the study on Malaysia concluded empirically that CO<sub>2</sub> emissions can be reduced by financial developments and CO<sub>2</sub> intensity is increased by the used of energy consumption and economic growth [44].

In contrast, using the quarterly data of Indonesia the study reported a unidirectional causality running from financial development towards CO<sub>2</sub>, i.e. financial development causes the CO<sub>2</sub> emissions. The study also investigated the impact of financial development by applying CO<sub>2</sub> emissions function and concluded that the CO<sub>2</sub> emissions are lowered by development of financial sector by attracting investors towards the eco-friendly technology[45]. The study of [24] documented that a developed financial sector can play a very vital role looking into the carbon trading practices and the emission of harmful environmental gases can be alleviated by using the financial sector as a device for inducement. This contradictory literature calls for further investigation about the relationship between the variables. The proposed hypothesis of the study is:

*H2 (a): The financial development will reduce the concentrations of CO<sub>2</sub> emissions.*

*H2 (b): The financial development will increase the concentrations of CO<sub>2</sub> emissions.*

*R&D Expenditures and CO<sub>2</sub> Emissions:*

It is argued that the stock of knowledge can be created through research centers and public universities by funding them and also by aiding to the private R&D by providing the subsidies and grants, i.e. the climate policy of upstream or technology-push [46] and [47].

Conversely, it is argued that the emissions are not influenced simultaneously by the U.S government spending on energy R&D[48]. The literature is contradictory and need more investigation about the relationship. This study will look into the present R&D expenditure that either they are sufficient to reduce CO<sub>2</sub> emissions by attracting ore new technologies or should the government increase the spending in R&D sector. The proposed hypothesis of the study is:

*H3 (a): The increase in R&D expenditures will decrease the CO<sub>2</sub> emissions.*

*H3 (b): The increase in R&D expenditures will not affect the CO<sub>2</sub> emissions.*

*Scope and Methodology of the Study:*

This research work is related to the global problem of environmental degradation by the emission of CO<sub>2</sub>. The proposed study will try to find out if there is any technique to solve this global problem in Malaysia in terms of reducing the emission level. The data on the variables of the study like CO<sub>2</sub> emissions and financial development (Credit to private sector) will be collected from World Development Indicators (WDI, 2013). The data on R&D (in the model as RDE) expenditures will be collected both from the Bank Negara Malaysia (BNM) annual reports and WDI. For carbon tax the data will be proposed by comparing to the carbon tax of the different alike developing countries, economically and emission wise. The study period of the proposed study will be from 1980-2013 for Malaysia. The proposed methodology of the study will be vector error correction model (VECM) using E-views or STATA. The data will be checked for stationarity and then will be tested for the long-run relationship by Johanson co-integration test. The study will also employ variance decomposition and impulse response function to better analyze the data. The proposed methodology is in line with the past studies conducted for the relationship between CO<sub>2</sub> and its determinants including [49] and [50]. The proposed study suggest the usage of double-log model for empirical results in the light of past studies including [51] for Malaysia, [52] for China and [29] for Portugal.

$$\text{LogCO}_2 = \beta_0 + \beta_1 \log C_{\text{Tax}} + \beta_2 \log \text{FD} + \beta_3 \log \text{RDE} + \beta_4 \log \text{X} + \mu$$

Where **X** represent the group of control variables

*Significance of the Study:*

Together with the empirical and theoretical contradiction about the relationship of variables there are many other reasons why this proposed study is important. Environmental degradation due to the emission of CO<sub>2</sub> in the atmosphere is the most burning issue in the today's global research. Malaysia as a developing country is also facing the problem of increasing CO<sub>2</sub> emission regardless of its efforts to control it by implementing some acts and policy controls. The proposed research is important because it will add some new ideas to the existing knowledge about the topic by incorporating new independent variables which are to the best of my knowledge not used so far in Malaysian context. The proposed research will be helpful for the future researchers as it will give some new suggestions and directions for future research in the same field. The industrialists and policy makers may also be benefited from the proposed study as it may help them deciding the use of resources in production and formulating proper environmental protection and emission pricing policies respectively, by giving them a clear picture of variables causing the environmental pollution. The proposed study may be helpful in giving a new dimension in the CO<sub>2</sub> emission reduction by applying tax on polluters rather than to reduce the economic growth or energy consumption. The proposed study will be beneficial to the society as it will decrease the environmental pollution and the individual may get benefit from the redistribution of the tax revenue collected by the government in the shape of incentives or by reducing the income or payroll taxes.

*Conclusions:*

There has been a large emphasis given on the research related to the CO<sub>2</sub> emissions in the developed economies of the world but still there are some gaps found in case of developing economies as they are in the transition phase so they go for the economic growth commonly irrelevant of the environmental quality. Malaysia is also one of the fast growing economy and is exploiting a great amount of fossil fuels, gas and oil to continue its economic growth with a great pace and most of the industries local and foreign are not doing the sustainable practices and are emitting a large amount of pollutants in the atmosphere and oceans. This proposed study conclude that the government of Malaysia should impose carbon tax on the pollutant emitting industries in order to control this environmental pollution. Moreover, the study suggests that research and development

expenditures should also be given some more percentage in the annual budget. This proposed study argues that financial development should be the calculated one and it should not be on the expense of environmental quality. Inducing the financial sector the government can reduce the emissions of harmful gases and also can do carbon trading effectively.

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