

THE NEXUS BETWEEN TRADE OPENNESS AND CO₂ EMISSIONS IN SELECTED BIMP-EAGA COUNTRIES

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ABSTRACT

This study is to examine the relationship between trade openness and CO₂ emission in selected BIMP-EAGA countries for the period 1970-2008 using annual time series data. Augmented Dickey Fuller test, Johansen and Juselius test and Vector Error Correction Model have been employed to conduct the analysis. According to the empirical analysis, the long-run relationship is found between trade openness and environmental quality in Malaysia. The findings also indicate that there is a short-run uni-directional relationship in the Philippines. As a result, to lessen the environmental harm, countries become more open in trade in order to gain better transfer of new clean technology, knowledge and skills to improve their industrialization processes and achieve long-term environmental sustainability.

Keywords: Trade Openness, CO₂ emission, Vector Error Correction Model

1.0 INTRODUCTION

In recent years, concerns over the ever-increasing carbon dioxide (CO₂) emission have been extensively debated worldwide. The anthropogenic pollution, which is directly and indirectly resulted from domestic households to heavily industrialized activities, has been receiving greater attention due to its impacts towards the greenhouse effects and eventually massive global warming. Consequently, the expansion of economic activities has raised the issues predominantly on the relationship between trade and environmental quality. Above all, the stages in producing and transporting of goods and services for export and import are often associated with the detrimental effect of environmental degradation activities across different continents. Due to these injurious activities, the relationship between trade openness and environmental quality has become a debatable topic among researchers and has been highlighted in a number of previous studies (Boulatoff & Jenkins, 2010; Choi et al., 2010; Naranpanawa, 2011). The prospect of greater trade openness in a way could encourage trade activities and hence lead to higher CO₂ emission which is harmful for the environment and society in the long-run.

CO₂ is a colourless, odourless and non-poisonous gas formed by combustion of carbon and in the respiration of living organism and is considered a greenhouse gas (GHG) emissions while emission means the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time (OECD, 2011). According to Pritchett (1996), openness is defined as "simply as an economy's trade intensity". In other word, openness can be defined more accurate as in relation to barriers to international trade imposed by government authorities (Stensnes, 2006). The environmental problems are inevitable as trade openness play a crucial role to accelerate the economic development. Environmental degradation is the price that country has to pay to achieve economic growth. At present, most of the countries have opened their market to achieve specialization and benefit from trade openness. For instance, since China initiated on their open door policy,

the increasingly intensive international trade between the China and the rest of the world has become the main engine of urban growth (Li & Tu, 2011). Li and Tu also stated that the trade liberalization generates both positive economic growth and the agents of environment degradation.

Since early 1990's, several empirical studies have examined the relationship between trade openness and environmental quality in different development stages and the outcome also lead to different results. Since environmental goods and quality are normal goods, this denotes that increase income earning from free trade would increase individual's demand for clean environmental quality (Choi et al., 2010). Based on previous studies, there is positive relationship between trade openness and environmental quality. For instance, increasing in demand of goods could increase the production output and later affect the emission produced (Fotros & Maaboudi, 2010). Trade openness and environmental degradation can be linked in many ways. In a study by Keintz (1971), it is found that the total value of trade is an important determinant for travel demand for instance in tourism sector. This is supported by Webber (2000) and Turner and Witt (2001). In this case, countries tend to liberalize the trade of goods and services sector which includes manufacturing, agriculture and tourism sector which, in turn, lead to the removal or reducing of trade barriers. As a result, although trade openness could lead to greater trade which further lead to economic expansion, the issues pertain to environmental degradation may arise depending on the country's policy efficiency and also the comparative advantage. Therefore, in the "race to the bottom" hypothesis, in dealing with global competitions, downward pressure are placed on countries to lower the environmental standards to gain advantage for trade and Foreign Direct Investment (FDI) which basically happens to developing countries. (Loi, 2010) Despite providing vast economic opportunities by reducing the environmental standards, in the long-run, the developing countries have to suffer the problems of declining environmental quality such as air, water and soil pollution, climate change and deforestation.

Trade openness is said to improve the environmental quality in the case of developed countries, while damage the environmental quality in developing countries. However, the results are still in a conundrum as trade openness might have positive and negative impact on environment in the short-run or the long-run. The problems between environmental degradation and trade openness in developing countries have motivated this research by focusing on the selected BIMP-EAGA countries in this case Malaysia, Indonesia and the Philippines.

1.1 Malaysia

According to Mohd Wahid and Mohammad Nurul (2009), the trade openness has both positive and negative impact on the environment in Malaysia. Malaysia is one of the countries in Asia that experienced rapid growth in industrialization. This rapid development has produced various environmental problems. Mohd Wahid and Mohammad Nurul stated that rapid growth in foreign investment and trade openness enables Malaysia to be recognized as one of the fastest growing South East Asian countries. However, economic success has led to a rising environmental degradation issues including water pollution, depletion of resources such as forests, wetland and fisheries and damage of flora and fauna. Based on Climate Change Performance Index (CCPI, 2012), Malaysia has ranked number 49th from 58 countries with CCPI scores of 49.2 out of 100. The underlying factors for such meagre scores are due to its rapid industrialization and uninhibited emissions of waste.

Kyoto Protocol was established in Kyoto, Japan in December 1997 to provide mechanism for countries to meet respective emission targets at low economic cost. This mechanism allowed international emission trading where carbon trading could be traded internationally by developed countries based on the "cap and trade system"¹ (Amran et al., 2012). All members of Kyoto Protocol are allowed to trade their carbon credit. In order to protect the environment quality, Malaysia has become the member of Kyoto Protocol since 2002. Malaysia only applied clean development mechanism (CDM). Through this mechanism the Northern country (known as Annex 1 countries) is allowed to finance project in the South (such as the creation of a tree plantation) which aims in mitigating GHG emission in return for credit. This credit included passport to allow additional GHG emission in the Annex 1 country.

1.2 Indonesia

According to Sudo (2012), Indonesia is the largest ASEAN country with over 218 million people. Indonesia is rich in natural resources (fossil fuels, forest and ocean resources). Oil is the primary energy source for electricity sector in Indonesia. Since the decline in oil production, the government tends to change the primary energy source for electricity from oil to domestic coal. As a result of increasing energy demand, the growth in CO₂ emission from energy sector increases by 6.5 percent between 2000 and 2010, greater than the primary energy growth rate of 6 percent per year. Based on Climate Change Performance Index (CCPI, 2012), Indonesia has ranked number 26th from 58 countries with CCPI scores of 57.2 out of 100.

Sudo (2012) elucidated that Indonesia has the second largest forest area in the world and functions as one of the world's main "carbon sinks"². Sudo also stated that Indonesia is facing a serious problem in GHG emission and air pollution that come from deforestation due to wildfire and human activities that produce carbon emission. However, according to Bowitz et al. (1996), for large scale power generation, biomass, solar and nuclear technologies are considered as the possible backstop technologies and further as an insurance in mitigating the GHG emissions in the long-run in Indonesia as the country is rich in these resources.

There are six main sectors contributing to GHG emission such as fuel combustion, fugitive emissions from fuels, agricultural, industrial process, land-use change and forestry and waste (United Nation Framework Convention on Climate Change, 2005). The fuel combustion sector (35 percent) and land-uses change and forestry (33 percent) are main contributors of CO₂ emission in Indonesia. United Nation Framework Convention on Climate Change (2005) also mentions that the CO₂ emission is projected to increase by more than three times in 2025. In order to control the environment quality, Indonesia has introduced some domestic policies to reduce the carbon emission due to climate change in Indonesia. Furthermore, to reduce carbon emission from forestry sector, the government policies such as prevention of forest fires, reforestation of damage forest, development of park and urban

¹ Cap and trade is an environmental policy tool that delivers results with a mandatory cap on emissions while providing sources flexibility in how they comply. Successful cap and trade programs reward innovation, efficiency, and early action and provide strict environmental accountability without inhibiting economic growth. (Environmental Protection Agency, 2013)

² Carbon sinks is the resources or processes that incorporate atmosphere carbon into plant, soil and water. (Ravin and Raine, 2012)

forest, reduction of fuel subsidies, restructuring the fuel price and recovery Methane from landfill is introduced (Sudo, 2012).

1.3 Philippines

In the Philippines, the industrial production is a major sector that leads to environmental degradation such as water pollution and air pollution. The food industries and other agricultural based industries such as processing of coconut, sugar cane, rice cone, pineapple and beverages are the major source of water pollution. The other sources of water pollution are pulp mills, chemical plants, pharmaceuticals, metal finishing and textile manufacturing. The cement industry, oil refiners and chemical plants are the major source of air pollution in the Philippines. The government introduces a policy to prevent this environment problem that arises from trade activities to be detrimental in the future. Peralta (2008) mentioned that the Philippines has a high susceptibility to present and future risks relating with climate change. The three factors are the location and geography; economic dependence on climate-sensitive agriculture and fisheries, agro-industry, and tourism; developing country status and deteriorating poverty issues. Furthermore, lack in factors of productions such as land, labour and capital could further lead to problems in mitigating the climate change in this sense.

This paper is organized as follows: the next section reviews previous literatures concerning CO₂ emission and trade openness; the third section describes the data and methodology; the fourth section presents the empirical results for this research and finally the fifth section presents some concluding remarks.

2.0 LITERATURE REVIEW

The literature shows the linkage between the trade openness and environmental quality in other countries. There are a number of studies which analyze on the determinants of the relationship between trade liberalization, income or economic growth and environmental quality using a variety of methods and models. Some of the studies use Environment Kuznets Curve (EKC) to analyze the unique relationship between trade liberalization and environment quality. The study conducted by Atici (2011) examines the trade liberalization and environmental interaction in Japan and ASEAN using extended Environmental Kuznets Curve (EKC) with panel data from 1960-2006. Atici (2011) found that the carbon emission have inverted S-shape with trade liberalization when EKC is examined. It is indicated that the level of per capita carbon emission will decrease when the level of GDP increase. However, this condition depends on the country group. In developing countries, the carbon emission still increases in the future since they continue to produce and export more industrial output in the future. Islam et al. (2011) investigate the relationship between international trade and carbon emission in Bangladesh from 1976-2008. They found that strong positive relationship exists between international trade and carbon emission from gas fuels in Bangladesh. For the most part, carbon emission from gas fuel comes from various manufacturing sector that involve with international trade. Manufacturing sector and government sector must reinvestigate their environmental policy to lessen the carbon emission problem to exacerbate in future. Boulatoff and Jenkins (2010) have investigated the long-term nexus between openness, income and environmental quality using times series data from 1980 to 2008 in 21 countries (including G7, BRIC and middle and low income) and found the evidence of long term relationship between income, trade and carbon emission from oil pollutant. They further explain that it might be more appropriate to look at specific sources of emission when attempting to evaluate the existence of the

EKC. In the case of CO₂ emission, the oil source has series of connection with income and trade.

Loi (2012) noted economies which are more open to trade and foreign direct investment would increase more pollution levels in developing countries. Loi (2012) said there is positive trade coefficient between level of openness and CO₂ emission. The poor countries tend to pollute more than rich countries due to increase trade liberalization which would make CO₂ increase more. Trade openness does not tend to improve environment due to efficiency use of resources and the increasing competitiveness. Loi (2012) suggests the developed countries to assist developing countries to lower their pollution through making sound environmental policy, to assist techniques and finances in environment friendly method of production. Choi et al. (2010) found that China and Korea have a positive long-run relationship between CO₂ emission and GDP. Despite indicating a negative relationship between CO₂ emission and openness in Korea, there is no short-run significant relationship for China. In the case of Japan, the GDP is not the only way to enhance the standard of environment therefore not indicating any significant long-run relationship among the variables. However, freer trade has led Korean economic to sky-rocket thus elevating their standard of living which encourages their citizen to choose more environmental friendly way of living. Nonetheless in the case of China, the unique politic and economic condition explains the CO₂-GDP nexus.

3.0 RESEARCH METHODOLOGY

3.1 Data

This study uses annual time series data from 1970 to 2008 from World Bank Indicator 2012 in which the CO₂ emissions is acquired from Carbon Dioxide Information Analysis Center (CDIAC). In order to investigate the relationship between trade openness and environmental quality, the index trade openness (TO) have been obtained through calculations. The trade openness (TO) variable as a percentage of gross domestic product (GDP) is measured as a share of the sum of exports (X) and imports (M) of goods and services in GDP $((X+M)/GDP)$. The CO₂ emission derived by total CO₂ in kg per 2000 US\$ of GDP. The CO₂ emissions are those stemming from the burning of fossil fuels and the manufacture of cement.

3.2 Methodology

3.2.1 Augmented Dickey-Fuller (1979) Unit Root Test

The Augmented Dickey-Fuller (1979) is a test for a unit root in a time series sample that is applied to identify whether the variable is stationary or non-stationary. A stationary series is defined as a series that tend to return to its mean value and fluctuate around it within a more or less constant range. However, non-stationary is defined as a series that has different mean at the different points in time and its variance increases with the sample size (Harries & Sollis, 2003).

3.2.2 Johansen and Juselius Cointegration Test

According to Dritsakis (2004), if the time series variables are non-stationary in level that means they are integrated (of order one) and their first differences are stationary. If there exist one or more linear combinations among them and stationary, these variable also might be cointegrated. If these variables are cointegrated, then there is stable long-run or

equilibrium linear relationship among them. Cointegration test is performed when the hypothesis of a unit root is not rejected. The hypothesis test for cointegration is null hypothesis for non-cointegration exists against the alternative hypothesis of cointegration, using Johansen's maximum likelihood method. To model each variable (which is assumed to be jointly endogenous) the vector autoregression approach is used as a function of all the lagged endogenous variables in the system. Johansen (1988) has pointed out the simple case where X_t is integrated of order one, such the first difference of X_t is stationary.

3.2.3 Vector Error Correction Model

Granger causality is applied to examine the causality pattern between the trade openness and CO₂ emission. This Granger causality test is derived on VEC Granger Causality/Block Exogeneity Wald Tests. In VECM model The F-test or Wald χ^2 of the explanatory variables (in first differences) indicates the short-run causal effects while the long-run causal relationship is implied through the significance of the lagged error correction term (ECTs) which contains the long-run information. According to Granger (1988), if cointegration is detected then the Granger causality test must be conducted in vector error correction model (VECM) to avoid problem of misspecification in the result. Otherwise, if there is no cointegration is detected the Granger causality may be conducted as a short-run causality test.

4.0 EMPIRICAL RESULTS AND DISCUSSION

The following tables show the empirical results for the long-run and short-run relationship between trade openness and environmental quality in selected BIMP-EAGA countries specifically in Malaysia, Indonesia and Philippines.

4.1. Augmented Dickey-Fuller (1979) Unit Root Test Result

Table 4.1 shows the ADF Unit Root test results in level and first difference for the three selected ASEAN countries which are Indonesia, Malaysia and Philippines. The result in level and first difference are selected based on intercept with trend.

Table 4.1: Unit Root Test Results for Augmented Dickey-Fuller Series in Level and First Difference

Series	ADF	
	Level with trend	First Difference with trend
Indonesia		
LCO ₂	-2.8103 (0)	-5.7712 (0) **
LTO	-2.3873 (0)	-8.0109 (0) **
Malaysia		
LCO ₂	-2.7928 (1)	-11.8256 (0) **
LTO	-1.0824 (1)	-5.3696 (0) **
Philippines		
LCO ₂	-1.3242 (1)	-5.1049 (0) **
LTO	-0.5591 (0)	-4.7247 (0) **

Notes: Asterisks (*), (**) and (***) indicate significant at the 10%, 5% and 1% levels, respectively. LCO₂= natural log of CO₂ and LTO = natural log of trade openness. The critical values of ADF test can be founded in the Mackinnon (1991). Optimum the lag length in the ADF test was chosen based on Schwarz Info Criterion. Lag selection figures are shown in ().

In summary, at first difference, the LCO₂ and LTO in Indonesia, Malaysia and Philippines are stationary as we can reject the null hypothesis of a unit root existence at 5% level of significant. All variable are said to be integrating at order one after taking the first difference. Later, we continue with cointegration test to determine whether the pair of variable (LCO₂ and LTO) is cointegrated for Indonesia, Malaysia and Philippines.

4.2 Johansen and Juselius Cointegration Test Result

According to the Johansen and Juselius test, there appear to exist only one cointegrating relationship between variables. Table 4.2 shows that Malaysia has one cointegrating vector exist and that indicates that there is significant long-run cointegrating vector between trade openness and CO₂ emission for Malaysia. On the other hand, Table 4.3 and Table 4.4 indicates that Indonesia and Philippines does not show a long-run relationship between variables as there is no cointegration vector exist in the series. As a result, in the case of Malaysia, VECM model would be applied to analyze the variables. On the contrary, a short-run causality tests would be used to examine the causality pattern in Indonesia and Philippines. Therefore, we can conclude that only Malaysia show a series of cointegration between trade openness and CO₂ emission.

Table 4.2: Johansen and Juselius Cointegration Test Result for Malaysia

Null	Alternative	k= 2 r= 1			
		Maximum Eigenvalue		Trace	
		Unadjusted	95percent C.V.	Unadjusted	95percent C.V.
r = 0	r = 1	14.8143**	14.2646	16.2416**	15.4947
r ≤ 1	r = 2	1.4273	3.8415	1.4273	3.8415

Notes: Asterisks (**) denote statistically significant at 5 percent level. The *k* is the lag length and *r* is the cointegrating vector(s). Chosen r: number of cointegrating vectors that are significant under both tests.

Table 4.3: Johansen and Juselius Cointegration Test Result for Indonesia

Null	Alternative	k= 3 r= 0			
		Maximum Eigenvalue		Trace	
		Unadjusted	95percent C.V.	Unadjusted	95percent C.V.
r = 0	r = 1	9.4935	14.2646	12.7468	15.4947
r ≤ 1	r = 2	3.2533	3.8415	3.2533	3.8415

Notes: Asterisks (**) denote statistically significant at 5 percent level. The *k* is the lag length and *r* is the cointegrating vector(s). Chosen r: number of cointegrating vectors that are significant under both tests.

Table 4.4: Johansen and Juselius Cointegration Test Result for Philippines

Null	Alternative	k= 3 r= 0			
		Maximum Eigenvalue		Trace	
		Unadjusted	95percent C.V.	Unadjusted	95percent C.V.
r = 0	r = 1	8.155	14.2646	10.315	15.4947
r ≤ 1	r = 2	2.159	3.8415	2.159	3.8415

Notes: Asterisks (**) denote statistically significant at 5 percent level. The *k* is the lag length and *r* is the cointegrating vector(s). Chosen r: number of cointegrating vectors that are significant under both tests.

4.3 Vector Error Correction and Granger Causality Test Result

4.3.1 Vector Error Correction Model (VECM)

Table 4.5: VECM Results for Malaysia

Dependent Variable	ΔCO_2	ΔTO	ECT	
	χ^2 -statistics		Coefficient	t-ratio
ΔCO_2		2.091 (0.351)	12.3723	2.9263
ΔTO	1.076 (0.584)		-0.0596	-2.1291**

Notes: The χ^2 -statistic tests the joint significance of the lagged values of the independent variables, and the significance of the error correction term(s). Δ is the first different operator. Asterisks (**) indicate statistically significant at 5 percent level. () indicated p-value.

According to the results based on Table 4.5, in the short run, TO and CO₂ emission is found to be not statistically significant at 5% level and that implies that TO does not cause CO₂ emission in the short-run and vice versa in Malaysia. Therefore, as a conclusion, trade openness and CO₂ emission does not affect each other since it is insignificant in a short-run perspective. CO₂ emission is also found to have positive long-run relationship for the case of Malaysia. The size of coefficient on the ECT is -0.0596 which shows that the speed of adjustment is about 5.96 percent and it requires 16.78 years for the model or system to restore back to equilibrium in long-run.

4.3.2 Causality Test

Table 4.6 tabulated the results of Granger causality test based on χ^2 -statistic for Indonesia and Philippines. Based on result in Table 4.6, in Indonesia, the trade openness and CO₂ does not cause each other in short-run. In the case of Philippines, the study found short-run causality running from CO₂ to trade openness. As a conclusion, there is uni-directional causality existing in Philippines and no causality exists in the Indonesia in the short-run.

Table 4.6: Granger Causality Results for Indonesia and the Philippines

Dependent Variable	ΔCO_2	ΔTO
	χ^2 -statistics	
Indonesia		
ΔCO_2	-	3.6541 (0.301)
ΔTO	1.176 (0.759)	-
Philippines		
ΔCO_2	-	0.386 (0.943)
ΔTO	12.901 (0.004)**	-

Notes: The χ^2 -statistic tests the joint significance of the lagged values of the independent variables, and the significance of the error correction term(s). Δ is the first different operator. Asterisks (**) indicate statistically significant at 5 percent level. () indicated p-value.

Researchers found that the trade openness has an important role in causing CO₂ emission (Choi, Cho and Heshmati, 2010). This suggests that in order to reduce pollution, the countries attempt to open their trade to improve their environmental quality. The situation happens mostly in developing countries that aim to become high income countries. In order to become newly industrialized countries, they produced more goods and services to increase their gross domestic product (GDP). At the same time, the pollution level has been increased because the environmental quality is regarded as luxury goods and not normal goods (Choi et al., 2010). However, after achieving a certain level of GDP, the countries tend to import green technologies to lower the pollution. This is because increase

income from free trade can encourage the consumers to obtain a clean environment (Galeotti & Lanza, 1999).

5.0 CONCLUSION

Based on results, all of the variables for Malaysia, Indonesia and the Philippines are said to be integrated at order one. The cointegration result indicated that the TO and CO₂ are cointegrated in the case of Malaysia. On the contrary, in the case of Indonesia and Philippines, the TO and CO₂ are not cointegrated. Thus, the result implies that the long-run relationships between TO and CO₂ only exists in Malaysia. On the other hands, in Indonesia and Philippines TO does not cause CO₂ in the short-run, but CO₂ has ability to influence TO of Philippines in the short-run. As many previous researchers studied on the relationship between economic growth-CO₂ emission or trade openness-economic growth, this study fill in the gaps of the literature by analyzing the trade openness-CO₂ nexus in the context of selected BIMP-EAGA countries. The policy implication drawn from this study indicates that CO₂ emission plays a prominent role in trade openness. This result is mostly different from the previous studies as it is found that trade openness cause environmental degradation in the long-run and short-run. This indicates the importance of re-evaluating the current status of trade openness in Malaysia and the role of laws regarding environmental protection and sustainability.

The evidence suggests that the demand for less polluted environment influence countries to start using clean technologies and increasing the clean production with less energy consumption that contributed more pollution. Thus, pertaining to reduce the environmental damage, the countries become more open in trade to gain better transfer of new clean technology, knowledge and skills to improve their industrialization processes and achieve long term environmental sustainability. Furthermore, policymakers should initiate the effort to embed the environmental-friendly elements in any trade-based relationship or any sectors that are related to trade directly or indirectly. The limitation of this study is the ability to incorporate other types of environmental indicators and also other variables that could contribute to the trade openness. Thus, for future studies, it is suggested to integrate more variables in longer time period as well as to focus on the trade-environment nexus in larger scale such as in ASEAN or in Asia.

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