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Trade Liberalization and Environmental Interaction in Japan and ASEAN: An Extended Environmental Kuznets Curve with Panel Data

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Cemal Atici

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Abstract

This study examines the trade-environment interaction in the ASEAN region employing extended Environmental Kuznets Curve (EKC) and utilizing panel data. The examination of environmental situation in the region indicates that the region faces some environmental problems such as population growth, increasing industrial activities, and climate change. However, the introduction of new regulations, stricter standards, and promoting renewable energy measures being implemented in the region can help sustainable development. The results indicate that carbon emissions display inverted S shape such that the emission levels per capita decrease with higher GDP in all groups. However, the turning point income levels vary depending on the country group. In general the share of exports to the GDP is main contributor for carbon emission reflecting the negative externality of export based growth. On the other hand, the trade with Japan has no significant impact on the emission levels implying that Japan's import does not stimulate the pollution level in the region. Furthermore, the results demonstrate that the FDI has no deteriorating impact on emission levels. In terms of the agricultural emissions, it is observed that the emission levels confirm the conventional EKC (inverted U shape). In addition, high tariff levels increase the pollution of nitrous oxide meaning that protection leads to higher domestic production and consequently high level of input use that intensifies the pollution. Agricultural subsidies and laxity of regulations also have polluting impacts in the region. The dynamic regression indicates that the pollution of the carbon dioxide and nitrous oxide in previous years will cause pollution in current year because of the cost of eliminating pollution. Given the fact that production requires energy use, the region needs environmentally friendly technologies for energy production. This can be achieved by more research and development expenditures as well as regional collaboration. Since agricultural subsidies and laxity of regulations increase the pollution level in the region, input related subsidies should be reconsidered and agricultural related regulations should be implemented. In this process regional collaboration, technical assistance, and guidance are crucial for the sustainable development of the region.

Introduction

Current path of globalization has raised the trade flow among the countries including the developing ones. However, such an increase can cause environmental problems because of the higher production and trade activities. Trade policies such as tariffs or setting standards on export and import also impact production, consumption, and trade, and consequently change the levels of nitrogen and carbon dioxide emissions. These pollutants lead to the health and environmental problems. Since many developing countries have comparative advantage in pollution intensive goods, production of goods may shift to the developing world as a consequence of trade liberalization. However, as trade liberalization leads to higher income that wealth can raise the environmental awareness as well. Agricultural trade activities impact environmental quality since pollutants caused by trade activities directly affect the natural resources such as land and water. Increasing agricultural trade flow will have various impacts on the environmental quality in ASEAN members and its trade partners. Japan, on the other, is an important trade partner for the ASEAN members (Comtrade, 2010). Although some recent studies (Grossman and Krueger, 1991; Panayotu, 1995; Torras and Boyce, 1998; Anderson, 2001; Cole 2003-2004; Taylor, 2004; Paudel et al. 2005) examined economic growth, trade and environmental interaction, environmental decay caused by agricultural trade flow and globalization which directly impacts natural resources such as water and land, is the area which needs further and detailed examination. The originality of this study stems from its aim to explore the impact of total and agricultural trade flow on environmental decay in Japan and ASEAN countries comparatively. It is expected that the result of this study will contribute designing sustainable environmental trade policies in the region. The main objective of the study is to determine the trade-off between the trade liberalization and environmental pollution in Japan and selected ASEAN countries comparatively. The specific objectives are: to determine the flow of aggregate and agricultural trade related pollutants such as CO_2, nitrogen, and methane pollutants in Japan and ASEAN countries, considering this region's trade flow with Japan, to examine the trade-environment interaction employing an extended Environmental Kuznets curve, to explore the optimum level of trade per capita and income that determines threshold level of environmental pollution and recommend optimal trade policies to improve environmental quality.

1. Review of Literature

Usually, the EKC was estimated to examine and test the income-environmental relationships. Grossman and Krueger's (1991) study of air quality and income interaction was an early example of that kind of studies. Also Shafik and Bandyopadhyay (1992) and Panayotu (1995) further examined environment growth relationships. Many other studies examined the Kuznets curve for different pollutants. For instance, Torras and Boyce (1998), Anderson (2001), Paudel et al. (2005) examined water pollution employing the Kuznets curve. Copeland and Taylor (2004) reviewed the trade and environment interaction and some other studies such as Cole (2003-2004) and Atici (2009) carried out empirical studies on trade related pollution. Recent studies examined the EKC in a panel data context as more data available on the subject.

In terms of panel version of Kuznets curve there have been some studies. Selden and Song (1994) investigate the EKC using a cross-national panel of data on emissions of four important air pollutants: suspended particulate matter, sulfur dioxide, oxides of nitrogen, and carbon monoxide. They find that per capita emissions of all four pollutants exhibit inverted-U relationships with per capita GDP. While this suggests that emissions will decrease in the very long run, their forecast indicates a rapid growth in global emissions over the next several decades. Matyas (1998) tested Kuznets' U-curve hypothesis on two unbalanced panel data sets of 47 and 62 countries, for the period 1970-93, using two-way fixed and random effects models. It is shown that there is no hard empirical evidence to support the usual econometric model formulations and the U-curve hypothesis. List (1999) uses a new panel data set on state-level sulfur dioxide and nitrogen oxide emissions from 1929-1994. The findings suggest that previous studies, which restrict cross-sections to undergo identical experiences over time, may be presenting statistically biased results. Barro (2000) indicates that the EKC hypothesis does not explain the bulk of variations in inequality across countries or over time. Thornton's (2001) study using panel data set of Gini coefficients, income quintiles and real GDP per capita in 96 countries over the postwar period, suggest that the relation between income inequality and development corresponds to an inverted-U, as hypothesized by Kuznets. Perman and Stern (2003) use cointegration analysis to test the EKC hypothesis using a panel dataset of sulfur emissions and GDP data for 74 countries over a span of 31 years. They find that the data is stochastically trending in the time-series dimension. Given this, and interpreting the EKC as a long run equilibrium relationship, support for the hypothesis requires that an appropriate model cointegrates and that sulfur emissions are a concave function of income. Their study suggests that even they find cointegration; many of the relationships for individual countries are not concave. The results show that the EKC does not support the case of sulfur emissions.

Halkos (2003) uses a large database of panel data consisting of 73 OECD and non-OECD countries for the period of 1960-1990 and apply for the first time random coefficients and Arellano-Bond Generalized Method of Moments (A-B GMM) econometric methods. The findings indicate that the EKC hypothesis is not rejected in the case of the A-B GMM. On the other hand there is no support for an EKC in the case of using a random coefficients model. Their turning points range from $2805-$6230 per capita. Romero-Avila (2008) investigates the time series properties of per capita CO_2 emissions and per capita GDP levels for a sample of 86 countries over the period 1960-2000. For that purpose, they employ a panel stationary test which incorporates multiple shifts in level and slope, thereby controlling for cross-sectional dependence through bootstrap methods. Their analysis renders clear evidence that per capita GDP levels are nonstationary for the world as a whole while per capita CO_2 is found to be regime-wise trend stationary. The analysis of country-groups shows that for Africa and Asia, per capita CO_2 is best described as no stationary, while per capita GDP appears stationary around a broken trend. In addition, they find evidence of regime-wise trend stationarity in both variables for the country-groups consisting of America, Europe and Oceania.

Mazzanti's (2008) study provides new empirical evidence on Environmental Kuznets Curves (EKC) for greenhouse gases and other air pollutant emissions in Italy. A panel dataset based on the Italian NAMEA (National Accounts Matrix including Environmental Accounts) for 1990-2001 is analyzed. The highly disaggregated dataset (29 production branches, 12 years and nine air emissions) provides a large heterogeneity and can help to overcome the shortcomings of the usual approach to EKC based on cross-country data. Both value added and capital stocks per employee are used as alternative drivers for analyzing sectoral NAMEA emissions. Trade openness at the same sectoral level is also introduced among the covariates. They find mixed evidence supporting the EKC hypothesis. The analysis of NAMEA-based data shows that some of the pollutants such as two greenhouse gases (CO_2 and CH4) produce inverted U-shaped curves with coherent within-range turning points. Other pollutants (SOX, NOX, PM10) show a monotonic or even N-shaped relationship. Macro sectoral disaggregated analysis highlights that the aggregated outcome should hide some heterogeneity across different groups of production branches (industry, manufacturing, and services). Services tend to present an inverted N-shape in most cases. Manufacturing industry shows a mix of inverted U and N-shapes, depending on the emission considered.

Halkos and Tzeremes (2009) examine the long-run effects of large-scale structural change with and without international capital accumulation, mobility and ownership. They demonstrate the relative merits and limitations of different treatments of international capital accumulation, mobility and ownership. Their findings support the work of Baldwin and others who have demonstrated that ignoring capital accumulation, mobility and ownership underestimates net output and welfare effects of large-scale structural change.

Lee at al. (2009) apply the dynamic panel generalized method of moments technique to reexamine the environmental Kuznets curve (EKC) hypothesis for carbon dioxide emissions and asks two critical questions: "Does the global data set fit the EKC hypothesis ?" and "Do different income levels or regions influence the results of the EKC ?" They find evidence of the EKC hypothesis for CO_2 emissions in a global data set, middle-income, and American and European countries, but not in other income levels and regions. Thus, the hypothesis that one size fits all cannot be supported for the EKC. Managi and Kaneko (2009) analyze how the performance of environmental management has changed over time using province level data for 1992-2003 for China. Mixed results for environmental performance are shown using nonparametric estimation technique. They find that environmental performance index, abatement effort, and increasing returns to pollution abatement play important roles in determining the pollution level over the period of the study. In another related study Lee et al (2010) examines the environmental Kuznets curve (EKC) hypothesis for water pollution by using a recent generalized method of moments dynamic technique, for a sample of 97 countries during the period 1980-2001. The empirical results show evidence of the inverted U-shaped EKC relationships existence in America and Europe, but not in Africa and Asia and Oceania. Thus, the regional difference of EKC for water pollution is supported. Furthermore, the estimated turning points are, approximately, US$13.956 and US$38.221 for America and Europe, respectively.

In terms of trade and environment there have been some studies. Muradian and Martinez (2001) argue that neither environmental economics nor ecological economics take into account the structural conditions determining the international trade system. Based on some new empirical evidence on material flows, they stress the notion of environmental cost-shifting. Cole (2003) assesses the strength of the Environmental Kuznets Curve (EKC) which posits an inverted-U relationship between per capital income and pollution. Specifically, answers are sought to the following related questions: (1) How robust is the EKC relationship? (2) To what extent can the EKC relationship be explained by changing trade patterns as opposed to growth-induced pollution abatement? The results indicate that the inverted-U relationship between per capita income and emissions is reasonably robust and little evidence is found to suggest that trade patterns are a significant determinant of the inverted-U shape. Dinda (2004) reviews some theoretical developments and empirical studies dealing with EKC phenomenon. Evidence of the existence of the EKC has been questioned from several points, and only some air quality indicators, especially local pollutants, show the evidence of an EKC. Dobson and Rablogan (2009) test the Kuznets hypothesis in the context of trade liberalization using data for Latin America. The evidence is consistent with the Kuznets hypothesis. The curvilinear relationship between openness and inequality suggests that Latin American countries should continue with trade liberalization measures but also introduce redistribution policies to ease the adverse consequences of liberalization. Atici (2009) examines the impact of various factors such as gross domestic product per capita, energy use per capita, and trade openness on carbon dioxide emission per capita in the Central and Eastern European Countries. The extended Environmental Kuznets Curve (EKC) was employed utilizing the available panel data from 1980 to 2002 for Bulgaria, Hungary, Romania, and Turkey. The results confirm the existence of an EKC for the region such that CO_2 emission per capita decreases over time as the per capita GDP increases. Energy use per capita is a significant factor that causes pollution in the region indicating that the region produces environmentally unclean energy. The trade openness variable implies that globalization did not facilitate the emission level in the region. The results imply that the region needs environmentally cleaner technologies in energy production to achieve sustainable development.

In terms of Japan and ASEAN region there have been some panel studies as well. For instance Coondoo and Dinda (2002) examine a study of income-CO_2 emission causality based on a Granger causality test to cross-country panel data on per capita income and the corresponding per capita CO_2 emission data. Their results indicate three different types of causality relationship holding for different country groups. For the developed country groups of North America and Western Europe the causality is found to run from emission to income. For the country groups of Central and South America, Oceania and Japan causality from income to emission is obtained. In terms of the country groups of Asia and Africa the causality is found to be bi-directional. The regression equations estimated as part of the Granger causality test further suggest that for the country groups of North America and Western Europe the growth rate of emission has become stationary around a zero mean, and a shock in the growth rate of emission tends to generate a corresponding shock in the growth rate of income. In contrast, for the country groups of Central and South America, Oceania and Japan a shock in the income growth rate is likely to result in a corresponding shock in the growth rate of emission. Tamazian (2009) using standard reduced-form modeling approach and controlling for country-specific unobserved heterogeneity, investigate the linkage between not only economic development and environmental quality but also the financial development. Panel data over period 1992-2004 is used. They find that both economic and financial developments are determinants of the environmental quality in BRIC economies. Their results show that higher degree of economic and financial development decreases the environmental degradation. The financial liberalization and openness are essential factors for the CO_2 reduction. The adoption of policies directed to financial openness and liberalization to attract higher levels of R&D-related foreign direct investment might reduce the environmental degradation in countries under consideration. In addition, the robustness check trough the inclusion of US and Japan does not alter main findings.

Although there is a large body of literature on emission level and income relationship, the examination at sectoral and regional level is needed. Specifically, pollutants caused by increasing total and agricultural trade flow needs to be evaluated in an extended view. This study therefore aims to explore that relationship employing an extended EKC utilizing panel data for Japan and selected ASEAN countries. By carrying out that research we can obtain some results related to the trade and environment interaction such as the impact of income, trade openness, and environmental standards on the level of environmental pollutants. Then, it is possible to calculate threshold level of income and trade activity that impacts the level of pollutants. The finding of this study is expected to help designing sustainable policies in the region.

2. Overview of the ASEAN

2.1. History

The main rationale behind the emergence of economic regionalism in the region can be explained by the deepening of regional economic interdependence in East Asia. The intraregional trade as a share of East Asia's total trade has risen from 35 % in 1980 to 55 % in 2004 and it is higher than North American Free Trade Area (46 %) (Kawai, 2006). The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967 in Bangkok, Thailand, with the signing of the ASEAN Declaration by the founding members, namely Indonesia, Malaysia, Philippines, Singapore and Thailand. Brunei Darussalam joined on 8 January 1984, Vietnam on 28 July 1995, Lao PDR and Myanmar on 23 July 1997, and Cambodia on 30 April 1999. Thus number of members has reached to ten. According to the ASEAN Declaration the aims and purposes of ASEAN is to accelerate the economic growth, social progress and cultural development in the region, promote regional peace and stability through abiding respect for justice and law in the relationship among countries of the region and adherence to the principles of the United Nations Charter, the expansion of their trade, including the study of the problems of international commodity trade, the improvement of their transportation and communications facilities and the raising of the living standards of their peoples (ASEAN Secretariat, 2010).

The brief development of ASEAN can be stated as follows. In 1992, the Common Effective Preferential Tariff (CEPT) scheme was signed as a schedule for phasing tariffs and as a goal to increase the region's competitive advantage. This law would act as the framework for the ASEAN Free Trade Area (AFTA). At the 9th ASEAN Summit in 2003, the ASEAN leaders decided to form an ASEAN Community. At the 12th ASEAN Summit in January 2007, the leaders affirmed their strong commitment to accelerate the establishment of an ASEAN Community by 2015 and signed the Cebu Declaration on the Acceleration of the Establishment of an ASEAN Community by 2015. The ASEAN Community is comprised of three pillars. These are: the ASEAN Political-Security Community, ASEAN Economic Community (AEC) and ASEAN Socio-Cultural Community. These pillars and the initiatives such as the Initiative for ASEAN Integration Strategic Framework and Work Plan Phase II (2009-2015) constitute the roadmap for ASEAN Community. The ASEAN Vision 2020, adopted by the ASEAN leaders on the 30th Anniversary of ASEAN, declared their vision to be outward looking, living in peace, stability and prosperity, partnership and development of the region. (ASEAN Secretariat, 2010). The ASEAN Charter entered into force on 15 December 2008. Through this charter, ASEAN will operate under a new legal framework and establish a number of new institutions to improve its community building process. On February 27, 2009 a Free Trade

Agreement with the ASEAN regional bloc of 10 countries and New Zealand and Australia was signed.

There are some crucial policies that will significantly contribute to the establishment of AEC (Soesastro, 2008); developing AEC scorecards based on solid analysis of key obstacles to integration to enable policy makers to design appropriate measures, streamlining rules of origin in the region, and reexamining the ASEAN investment area initiative by improving business environment, regulations, tax regimes, competition policy and corporate and labor laws.

2.2. Main Economic Indicators

The main economic indicators of Japan and ASEAN members can be presented as in Table 1. As can be seen the highest population growth rate belongs to Singapore (3.1) followed by the Laos (2.8) while Japan has a minus growth rate. Japan ranks first in terms of GDP (almost five trillion dollars) followed by Indonesia and Thailand. Laos, Cambodia and Brunei have the lowest GDP values between 5-10 billion dollars. Singapore has the highest GDP per capita (51.000 $) followed by Brunei (45816 $) and Japan (38455$). The inflation rate is highest in Myanmar (26.8 %) while generally low in other countries. The unemployment rate is highest in Indonesia (8.4 %) followed by Philippines (7.4 %) and other countries have similar low rates. Japan receives highest FDI with almost 25 billion dollars and closely followed by Singapore.

The total and agricultural trade flows of Japan and ASEAN is presented in Table 2. Japan has the highest export value (714 billion dollars) followed by Singapore, Malaysia, Thailand and Indonesia. Japan, Singapore, Indonesia, Malaysia, and Thailand have trade surplus. In terms of agricultural trade, Thailand, Malaysia and Indonesia have similar (about 17 billion dollars) export earnings. Japan’s agricultural imports amount to 46 billion dollars. The share of agricultural export compared to total export is highest in Indonesia (almost 15 %) followed by Vietnam, Thailand, and Malaysia in similar levels (10-11.77 %).

Table 1: Main Economic Indicators of Japan and ASEAN, 2008

Countries	Area, sq. km.	Population	Population Growth Rate	GDP, current US$, mil.	GDPC, Current US$, PPP	Inflation	Unemployment Rate	FDI, US $ mil.
Japan	364.500	127.704.000	-0.1	4.914.840	38.455	1.4	4.0	24.551
Brunei	5.765	406.000	2.1	14.146	45.816	1.9	3.7	239
Cambodia	181.035	14.957.800	2.1	10.368	1.789	5.3	0.8	815
Indonesia	1.860.360	231.369.500	1.2	546.527	4.365	2.8	8.4	7.918
Lao PDR	236.800	5.922.100	2.8	5.742	2.396	8.5	1.3	227
Malaysia	330.252	28.306.000	2.1	191.618	12.258	1.1	3.6	7.318
Myanmar	676.577	59.534.300	1.8	24.023	1.094	26.8	4.0	975
Philippines	300.000	92.226.600	2.0	161.148	3.587	4.4	7.4	1.520
Singapore	710	4.987.600	3.1	177.568	51.392	-0.6	2.2	22.801
Thailand	513.120	66.903.000	0.6	264.230	7.940	3.5	3.2	9.834
Vietnam	331.212	87.228.400	1.2	96.317	3.080	6.9	1.3	8.050

Source: ASEAN Secretariat, 2010; World Bank, 2010.

Table 2: Total and Agricultural Trade Values of Japan and ASEAN Members, 2007, 1000 $

	Total Trade		Agricultural Trade		
Countries	**Export**	**Import**	**Agricultural Export**	**Agricultural Import**	**Share of Agricultural Export to Total Export**
Japan	714.327.036	622.243.336	2.273.442	46.042.272	0.32
Brunei	7.667.929	2.100.723	2.963	272.029	0.03
Cambodia	4.089.000	5.423.600	68.395	565.352	1.67
Indonesia	118.014.000	92.778.437	17.678.771	8.632.963	14.98
Laos	922.690	1.066.850	39.137	201.447	4.24
Malaysia	176.211.267	146.982.262	17.672.650	8.932.272	10.02
Myanmar	6.337.870	3.311.570	470.796	686.213	7.42
Philippines	50.466.000	57.995.661	3.079.913	5.620.714	6.10
Singapore	299.298.200	263.155.000	4.944.655	6.889.368	1.65
Thailand	152.097.740	139.965.680	17.903.937	5.164.643	11.77
Vietnam	48.576.000	62.678.000	5.636.997	4.553.644	11.60

Source: FAO, 2010.

Table 3: Share of Export to GDP in Japan and ASEAN Members, 1000$, 2008

Countries	Export	GDP	Share of Export to GDP, %
Japan	776.205.583	4.910.840.000	15.80
Brunei	7.667.929	11.470.702	66.84
Cambodia	4.089.000	10.354.122	39.49
Indonesia	136.181.163	510.730.000	26.66
Laos	922.690	5.543.146	16.64
Malaysia	198.123.100	221.773.000	89.33
Myanmar	6.337.870	14.936.419	42.43
Philippines	48.669.501	166.909.000	29.15
Singapore	336.633.273	181.948.000	185.01
Thailand	172.477.564	272.429.000	63.31
Vietnam	62.324.209	90.644.972	68.75

Source: World Bank, 2010; Comtrade, 2010.

The share of exports to current GDP is presented in Table 3. As can be seen Singapore and Malaysia have highest shares and other developing members' share vary between 25 and 73 %. Compared to other nations, the region has high level of export share in GDP (World Bank, 2010) indicating that the ASEAN members' economy is export driven.

Trade relationship between Japan and ASEAN is quite strong. Total trade between ASEAN and Japan expanded by 22.1% from US$ 173.1 billion in 2007 to US$ 211.4 billion in 2008. ASEAN exports to Japan increased by 22.8% from US$ 85.1 billion in 2007 to US$ 104.5 billion in 2008. ASEAN imports from Japan for the same period also grew from US$ 87.9 billion to US$ 106.8 billion or by 21.5%. Japan is the largest trading partner of ASEAN with a share of 12.4% of ASEAN's total trade (ASEAN Secretariat, 2010). The Japan and ASEAN bilateral trade flow is presented in Table 4. Among the members, Indonesia exports the highest level of goods to Japan with almost 28 billion dollars, followed by Malaysia, Singapore and Thailand (16.6-21.5 billion dollars). Thailand is the highest importer from Japan (33 billion dollars). Singapore, Indonesia, Vietnam and Philippines are important trading partner with Japan in terms of Japan's share in their total exports. Thailand ranks first with almost 3 billion dollars worth of agricultural exports to Japan while Thailand is also an important export destination for Japanese agricultural commodities. Japan is a significant agricultural export market for Myanmar, Philippines, Singapore, Thailand, and Vietnam in terms of share of agricultural commodities exported to Japan compared to total agricultural exports. The main items imported to Japan from the ASEAN members can be seen in Table 5. As can be seen main items imported are, crude materials, mineral fuels, food, and manufactured products. The main agricultural exports of related countries are presented in Table 6. As can be observed, palm oil, rice, rubber, nuts, coffee, and vegetables are main trade items.

Table 4: Japan-ASEAN Trade Flow, 2008 US$

	Total Trade with Japan			Agricultural Trade with Japan		
Countries	**Export**	**Import**	**Share of Japan in Total Exp**	**Agricultural Export**	**Agricultural Import**	**Share of Japan in Agr Exp**
Brunei	2.337.531.112	214.648.217	30.48	3.210	311.685	0.10
Cambodia	32.138.155	114.122.692	0.78	637.946	77.660	0.93
Indonesia	27.743.856.152	15.129.172.530	23.50	818.126.964	44.301.233	4.62
Laos	18.070.551	62.500.526	1.95	1.559.016	9.341	3.98
Malaysia	21.519.815.578	19.528.220.281	12.21	899.764.121	55.523.613	5.09
Myanmar	315.451.359	188.058.355	4.97	91.036.525	28.669	19.33
Philippines	7.707.063.297	7.121.851.232	15.27	507.861.767	34.712.389	16.39
Singapore	16.659.803.006	25.942.796.045	5.56	659.269.078	111.736.089	13.33
Thailand	19.878.818.275	33.420.401.498	13.07	2.969.812.496	282.407.532	16.58
Vietnam	8.467.749.670	8.240.307.447	17.43	1.058.799.950	80.770.171	18.78

Source:Comtrade, 2010; Trade Statistics of Japan, 2010.

Table 5: Japan's Main Import Items from ASEAN, US$, 2008

Countries	Item	Value
Brunei	Mineral Fuels (natural gas, petroleum products)	2.335.511.520
Cambodia	Miscellaneous Manufactured Articles (clothing, furniture etc)	118.566.882
Indonesia	Food	992.553.628
	Crude Materials (wood, lumber, metals)	4.914.852.301
	Mineral Fuels	19.471.033.571
	Manufactured Goods	2.875.808.398
Laos	Miscellaneous Manufactured Articles (clothing, furniture etc)	7.613.687
Malaysia	Food (Fish, cereals, Coffee Tea, Cacao)	270.313.631
	Crude Materials (wood, lumber, metals)	614.975.999
	Mineral Fuels (natural gas, petroleum products)	10.578.702.695
	Miscellaneous Manufactured Articles	1.479.973.161
Myanmar	Food (Fish and prep)	80.416.780
	Miscellaneous Manufactured Articles	189.865.695
Philippines	Food (Fruits and vegetables)	1.157.454.895
	Crude Materials	815.769.118
	Manufactured Goods	851.823.754
	Machinery and Transport equipment	4.210.553.169
Singapore	Machinery and Transport equipment	3.104.046.499
Thailand	Food (fruits and vegetables, rice)	3.232.360.538
	Crude Materials	1.540.463.554
	Chemicals	1.655.196.140
	Manufactured Goods	2.261.759.747
	Machinery and Transport Equipment	7.264.664.244
Vietnam	Food (Fish and Prep)	965.536.228
	Mineral Fuels	2.773.016.887
	Manufactured Goods	742.970.710

Source: Comtrade, 2010.

Table 6: Main Agricultural Items Exported and Imported in Japan and ASEAN, 2007

Country	Main Items Exported	Main Items Imported
Japan	Food Prep., Cigarettes, Pastry	Maize, Pork, Cigarettes
Brunei	Rubber, Meat, Sugar	Cigarettes, Rice, Beverage
Cambodia	Rubber, Cigarettes, Maize	Cigarettes, Sugar, Beer
Indonesia	Palm Oil, Rubber, Coffee	Wheat, Cotton, Sugar
Laos	Coffee, Maize, Sesame Seed	Beverages, Alc., Beverages, Food Prep.
Malaysia	Palm Oil, Rubber, Fatty Acids	Cocoa Beans, Maize, Sugar
Myanmar	Rice, Vegetables, Sesame Seed	Palm Oil, Food Prep, Beverage
Philippines	Rice, Coconuts, Bananas	Rice Milled, Wheat, Soybeans
Singapore	Eggs, Vegetables, Coconuts	Beverages Alc., Wine, Food Prep.
Thailand	Rice, Cassava, Rubber	Soybeans, Cotton, Food Prep.
Vietnam	Rice, Vegetables, Cashew Nuts	Soybeans, Palm oil, Wheat

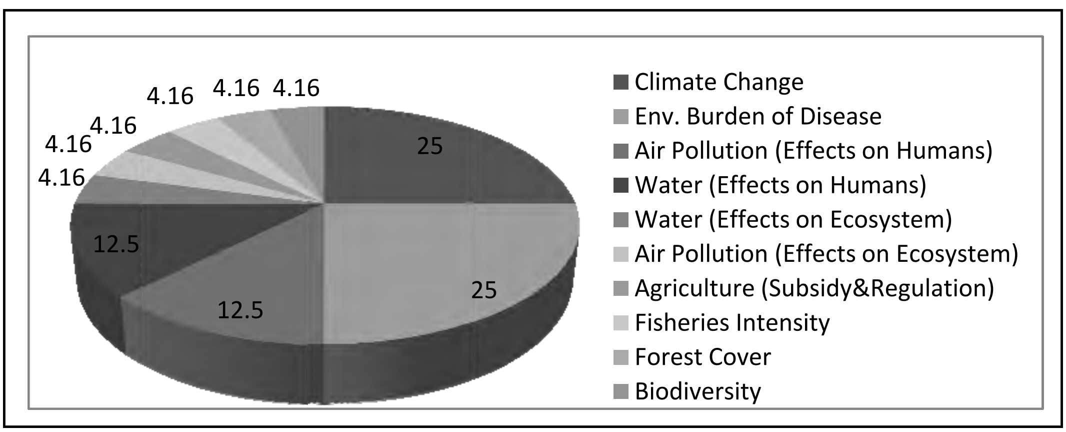
Source: FAO, 2010.

2.3. Environment

2.3.1. The Environmental Performances

The Environmental Performance Index (EPI) constructed by the Yale University (2010) ranks the countries according to their environmental performances. The rank is between 0-100 with 100 is higher performance. The composition of the EPI is presented in Figure 1. As can be seen, climate change, environmental burden of disease, air pollution on humans and ecosystem, water quality, agricultural subsidies, fisheries intensity, forest cover, biodiversity, and water access are main ingredients.

Figure 1: The EPI Indicators, %



Source: EPI, 2010.

Table 7: Environmental Performance Indices of Japan and ASEAN Members, 2010

Countries	EPI Score
Japan	72.5
Brunei	60.8
Cambodia	41.7
Indonesia	44.6
Laos	59.6
Malaysia	65.0
Myanmar	51.3
Philippines	65.7
Singapore	69.6
Thailand	62.2
Vietnam	59.0

Source: EPI, 2010.

Table 7 presents the EPI scores for the region. Japan ranks first with the score of 72.5 followed by Singapore (69.6). Cambodia ranks last with the score of 41.7 followed by Indonesia (44.6). Other countries have similar scores ranging between 51.3 and 65.7.

2.3.2. Environmental Situation in the Region

The ASEAN environmental report (2009) classifies the environmental situation in terms of fresh water and marine ecosystems, terrestrial ecosystems, atmosphere and sustainable production and consumption.

2.3.2.1. Fresh Water and Marine Ecosystems

ASEAN region is rich in freshwater resources. According to the ASEAN report (2009), Brunei Darussalam, Laos, and Malaysia have the highest per capita water resource availability. With increasing population and economic activities, the rate of water use has increased across the region with the agricultural sector consuming almost 75 %. On the other hand, water consumption in ASEAN is expected to double during the latter half of the 21st century. The ASEAN member states (AMS) have taken actions to optimize water use such as reforming water tariffs, improving efficiency of water utilities and introducing new regulations. Among measures that AMS have put in place to protect water quality includes the construction of sewerage facilities, establishing regulations and imposing effluent taxes. There are more 1.764 water quality monitoring stations throughout ASEAN. In 2006, 86 % of the ASEAN population had access to improved drinking water sources and 74 % used improved sanitation facilities.

There are significant ecosystems in the region such as mangrove and peatland. The region has over 52.000 square kilometers of mangrove, more than half of which are in Indonesia. The region has more than 25 million hectares of peatland, representing 60 % global tropical peatland. Many of the wetland areas have been designated as Ramsar (The Convention on Wetlands of International Importance signed in Ramsar**,** 1971**)** sites. There are 29 Ramsar sites in the region as of 2008 covering 1.320.391 hectares. The region also has a coastline of 173.000 kilometers that harbors tropical marine diversity. Coral reefs in the region account for 34 % of world's total reefs, with the highest are being in Indonesia, Malaysia and the Philippines. At both national and regional levels, various initiatives have been taken by AMS to promote sustainable management of these resources. The marine protected areas in ASEAN as of 2007 covered 87.778 square kilometers.

2.3.2.2. Terrestrial Ecosystems

The ASEAN region is one of the most densely forested areas in the world covering 43 % of the total land compared to the world average of 30 % (ASEAN, 2009). Brunei Darussalam, Cambodia and Malaysia have more than half their land area covered by forests. Due to the expansion of agriculture and human settlements to provide for the growing population, the region's total forest cover declined at about 1.3 percent per year from 2000-2005. However, the deforestation slowed significantly between 2006 and 2007 as indicated by the deforestation rate of 1.1 percent between 2000 and 2007. Vietnam has increased its forest cover by about 17.000 square kilometers since 2000. New protected areas have been established in Lao PDR, Malaysia, Myanmar Philippines, Thailand and Vietnam. On the other hand, the AMS contain over 20 % of all known plant, animal and marine species in the world. The region is home to three mega-diverse countries (Indonesia, Malaysia and the Philippines); some bio-geographical units (Malesia, Wallacea, Sundaland, Indo-Burma and the Central Indo-Pacific); and many centers of concentration of restricted-range bird, plant and insect species. AMS with high number of recorded species include Malaysia (21.914), Philippines (18.535), Indonesia (17.157) and Vietnam (16.740). In addition, species endemism in the ASEAN region is quite high. As of 2008, there were a total of 26.268 endemic species recorded in Southeast Asia. Indonesia, the Philippines and Malaysia have recorded over 7.000 endemic species each (ASEAN, 2009). However, the region's rich biodiversity is at risk with hundreds of species in AMS being categorized as threatened. The threats include climate change, habitat loss, and illegal wildlife trade. Climate change is predicted to become the dominant driver of biodiversity loss by the end of the century. While the illegal wildlife trade affects all AMS, biodiversity-rich Indonesia, Malaysia and Myanmar are particularly at risk. ASEAN has initiated and implemented various programs to protect its terrestrial ecosystems and biodiversity. The ASEAN Heritage Parks Program, ASEAN-Wildlife Enforcement Network and the tri-country Heart of Borneo Initiative are some of the collaborative efforts undertaken by AMS.

2.3.2.3. Atmosphere

The quality of atmosphere in the region is threatened by some factors such as the rapid rise in population. The ASEAN Environmental Report (2009) projected that the population will increase from 580 million in 2008 to 650 million in 2020, increasing urbanization, and industrial activities. The transportation and the industrial sectors are the two major contributors to air pollution in region. Although Singapore and Brunei Darussalam reportedly have better air quality, over 95 percent of days in 2008, Indonesia, Malaysia and Thailand had more variable air quality. On the other hand, main air pollutants have also been reported to be declining. For instance SO2 in Malaysia and PM10 in Bangkok, Thailand and in Manila, the Philippines are declining due to air pollution control measures undertaken. AMS are putting in new policies and programs in place to improve air quality. The introduction of new regulations and stricter standards, cleaner fuels, green vehicles, improving public transportation, and promoting renewable energy are amongst measures being implemented in the region. AMS have also strengthened their air quality monitoring networks – there are now 177 air quality monitoring stations throughout ASEAN. Transboundary smoke haze is a main problem for ASEAN members especially during the dry El Nino periods. Climate change is affecting the region through more intense and frequent heat waves, droughts, floods, and tropical cyclones. It is expected to become even severe as a large proportion of the population and economic activity is concentrated along coastlines; the region is heavily reliant on agriculture for livelihoods; there is a high dependence on natural resources and forestry; and the level of poverty remains high making the people more vulnerable to these hazards. The mean temperature in the region increased by 0.1 to 0.3 degree Celsius per decade between 1951 and 2000; rainfall trended downward during 1960 to 2000; and sea levels have risen 1 to 3 millimeters per year (ASEAN, 2009).

2.3.2.4. Sustainable Production and Consumption

Sustainable production and consumption is one of the areas that the region faces some managerial difficulties because of the increasing population and urbanization. Currently, most AMS dispose their municipal solid wastes at sanitary landfills or open dumps. The reduction, reuse and recycling (3R) of waste is also becoming increasingly common in the region. Most AMS have initiated various programs to encourage 3R including awareness campaigns and engaging local communities in waste management. Some AMS have formulated new and specific legislations to govern the management of municipal solid waste and industrial waste, apart from their existing environmental regulations. The AMS have embraced the concept of sustainable consumption and production so that wastes are regarded as resources and managed throughout the life-cycle of a product or process. Sustainable production promotes minimal use of resource and energy in the production of goods and services while ensuring that its impacts on the environment are minimized. In line with this concept, AMS are promoting sustainable agriculture, cleaner production, eco-labeling and sustainable forestry practices. Indonesia Singapore, Thailand and Vietnam have also established their national eco-labeling schemes. As export-oriented nations, these initiatives, particularly the product certification programs, are important tools to enhance business competitiveness. The internationally-recognized certification, products from AMS can penetrate various markets (ASEAN, 2009).

ASEAN has been relatively active compared to other nations in the region with regard to environmental policies. The ASEAN has elaborated the environmental programs with the guidance of UNEP. These programs aimed nature conservation, industry and environment, marine environment, training and education in the region (Shiroyama, 2007). In addition, there has been a growing amount of bilateral and regional technological cooperation in the region and institutions such as 10+3 (ASEAN, China, Japan, Korea) and Asia-Pacific Partnership on Clean Development and Climate (APP) can serve as good platform to improve cooperation in the region (Kameyama et al., 2008). The overview of some selected parameters of environmental situation in Japan and AMS can be presented in Table 8.

Table 8: The Overview of Selected Environmental Indicators in Japan and ASEAN, 2008

Countries	Total Internal Renewable Freshwater Resources (billion m^3)	Fresh Water Per Caita, m^3	Forest to Land Ratio, %	Carbon Emissions, kt (1000 Ton), 2006	Carbon Emissions per Capita, ton
Japan	430.0	3367.16	68.2	1.292.469	10.12
Brunei	8.5	20935.96	76.0	5906	14.54
Cambodia	120.6	8062.68	55.3	4071	0.27
Indonesia	2838.0	12266.09	44.8	333.241	1.44
Laos	190.4	32150.75	40.7	1425	0.24
Malaysia	580.0	20490.35	62.4	187.729	6.63
Myanmar	880.6	14791.47	46.3	10.017	0.16
Philippines	479.0	5193.72	22.8	68.279	0.74
Singapore	0.9	180.44	4.3	56.176	11.26
Thailand	210.0	3138.87	28.1	272.323	4.07
Vietnam	366.5	4201.61	38.5	106.054	1.21

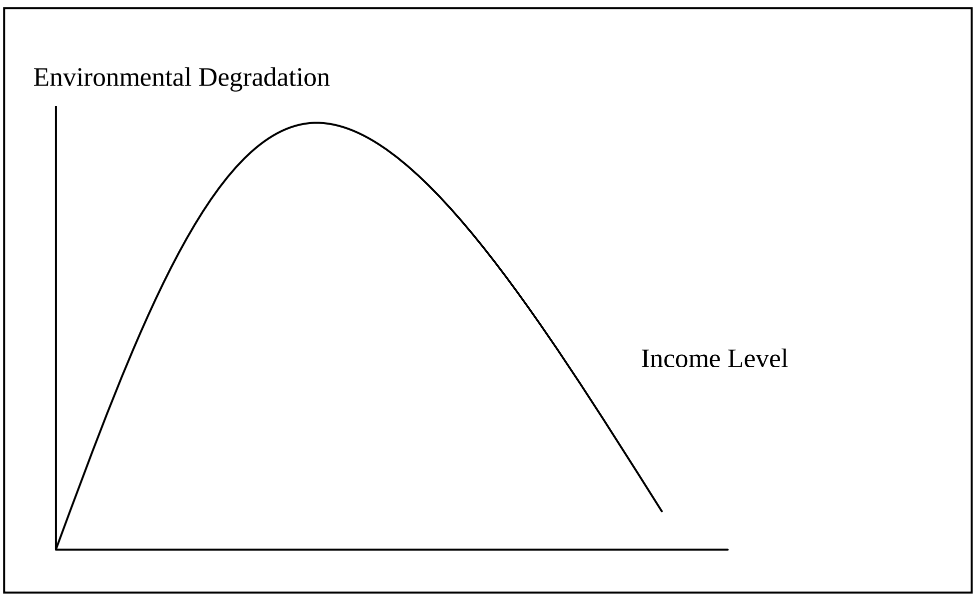
Source: Compiled from ASEAN, 2009; FAO, 2010; World Bank, 2010.

3. Method

In this study, the interaction between income, trade and environment is modeled utilizing the environmental Kuznets curve combined with some additional qualitative indicators. EKC (Figure 2) suggest that as development progress, environmental damage increases due to greater use of natural resources and high level of emissions, but as economic growth continues cleaner habitat becomes more valuable and willingness to live in a better environment becomes a priority (Munasinghe, 1999). Therefore in the early stages of economic growth the environmental degradation increases but after a certain level of income is attained, the degradation decreases and improvement starts (Markandya et al., 2002).

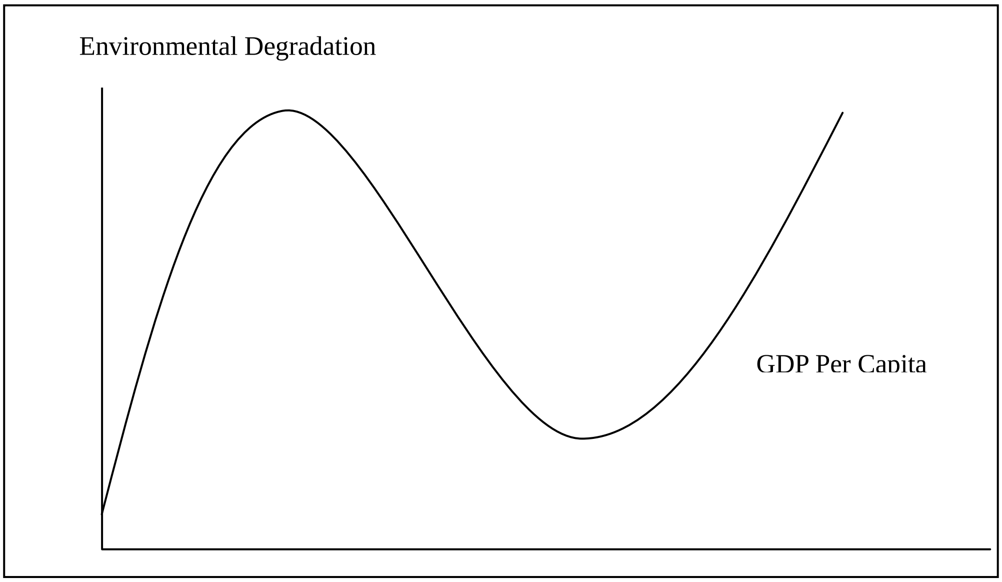
Some studies (Suri and Chapman, 1998) includes the cubic term to see whether a N shaped curve (Figure 3) is observed after income level increases a lot but environmental degradation starts again because of some luxury spending (See Dinda, 2004 for review other related literature).

Figure 2: Environmental Kuznets Curve



Source: Markandya et al., 2002.

Figure 3: The EKC with N Shape



Source: Suri and Chapman (1998).

Trade and environmental degradation is also closely related such that with the process of globalization, differences in environmental regulations may provide a comparative advantage in pollution intensive production among countries and is called Pollution Haven Hypothesis (Cole, 2004). Trade liberalization also provides the resources more efficiently and minimizes the quantity of input needed for per unit of output reducing the waste (Cole, 2000). Therefore, this study aims to apply this hypothesis to the ASEAN countries to determine whether the members of this bloc response to economic growth and increasing trade flow due to the globalization and trade liberalization in a similar manner. The model will be estimated utilizing the panel data related to the environmental pollutants originating from agricultural trade activities. In the study, GDP per capita, trade openness indicators (TI), environmental regulations, and environmental performance indicators (EPI) will be utilized. Therefore, the general form of the model used in this study can be represented as

$$lned_{it} = \beta_0 + \mu_{it} + \lambda_{it} + \beta_1 lngdpc_{it} + \beta_2 (lngdpc_{it})^2 + \beta_3 (lngdpc_{it})^3 + \beta_4 lnr\_e/gdp_{it} + \beta_5 lnr\_pe/te_{it} + \beta_6 lnr\_expJ/te + \beta_7 lnr\_peJ/eJ_{it} + \beta_8 lnr\_fdi/gdp_{it} + \beta_9 rq_{it} + \varepsilon_{it} \quad (1)$$

where;

ed: Environmental degradation (CO_2 per capita, kg.), *gdpc*:Gross domestic per capita, PPP, in real terms,

r_e/gdp: Ratio of current export to current gross domestic product in reporting countries,

r_pe/te: Ratio of polluting export (iron&steel, chemicals, lime&cement) to the total export, in reporting countries,

r_eJ/te: Ratio of export to Japan to the total export, in reporting countries,

r_peJ/te: Ratio of polluting exports to Japan to the total export to Japan, in reporting countries,

r_fdi/gdp: Ratio of the net foreign direct investment inflow to the current gdps, in reporting countries, US$,

rq: Requlation quality which takes the value 1 for counties having positive value and 0 otherwise.

μ:Individual effects,

λ:Time effect.

For the agricultural sector, I have specified the model as follows

$$lned_{it} = ln\beta_0 + \mu_{it} + \beta_1 lngdpc_{it} + \beta_2 (lngdpc_{it})^2 + \beta_3 lnr\_agreJ/te_{it} + \beta_4 lnagrtar_{it} + \beta_5 lnagrsubs_{it} + \beta_6 lnagrpestreg_{it} + \varepsilon_{it} \quad (2)$$

where;

ed: Environmental emissions caused by agricultural activities (Nitrous oxide, Methane),

gdpc: Gross domestic product per capita, PPP, in real terms,

r_agreJ/te: Ratio of the agricultural exports to Japan to the total agricultural exports in reporting countries,

agrtar: Reporting countries' average agricultural tariff levels

agrsubs: Reporting countries' agricultural subsidy scores *agrpestreg*: Reporting countries pesticide regulation scores

Since GDP per capita reflects a country's income and level of development, we can expect that initial levels of income induces pollution however, as income rises further environmental degradation decreases because of the environmental consciousness and level of technology that utilities cleaner energy. The region consists of mainly export oriented countries. Thus, as the ratio of current exports to current GDP increases, it is expected that emission levels increase as well. Japan has a strong trade ties with some of the members in the region. Thus trade with Japan may induce higher emissions levels. However, since Japan has higher regulations both in industrial products and agricultural ones, these regulations may have catalyst effect such that higher regulations may stimulate use of cleaner technologies in the region. Foreign direct investment may also have dubious effect. If FDI inflow brings cleaner technologies we can expect a negative sign for this variable, but if FDI inflow increases pollution it may have pollution haven effect. Tariff variable is used as a proxy for overall external protection and openness in addition to the export openness. It is expected that countries with high level of protection have higher emissions due to the inefficient use of resources. Since regulation quality reflects a county's commitment to reduce environmental externalities, we can expect that countries with better regulation will have less environmental degradations. Subsidies encourage use of polluting inputs in agriculture. Thus countries with high level of subsidies are expected to have higher emission levels.

This study utilizes the panel data over the period of 1970-2006 for carbon emissions and agricultural related emissions over the period of 1990-2-2005. Since the data for agricultural emissions are limited reported by five year interval yearly basis (World Bank, 2010) the agricultural emissions are estimated by panel data utilizing five year interval data. The data used for this study comes from various international sources. The pollutant data (CO_2, nitrous oxide, methane) current GDPs, FDI, population, regulatory quality are from World Bank (2010), real GDPs are from UN (2010), GDPs based on PPP are from Penn World Table (2010). The export and import values are from UN Comtrade (2010) based on four digits SITC Rev 1 classification. Tariff rates are from WTO (2006). Agricultural export and import values, production are from FAO (2010). EPI indicators are from EPI (2010).

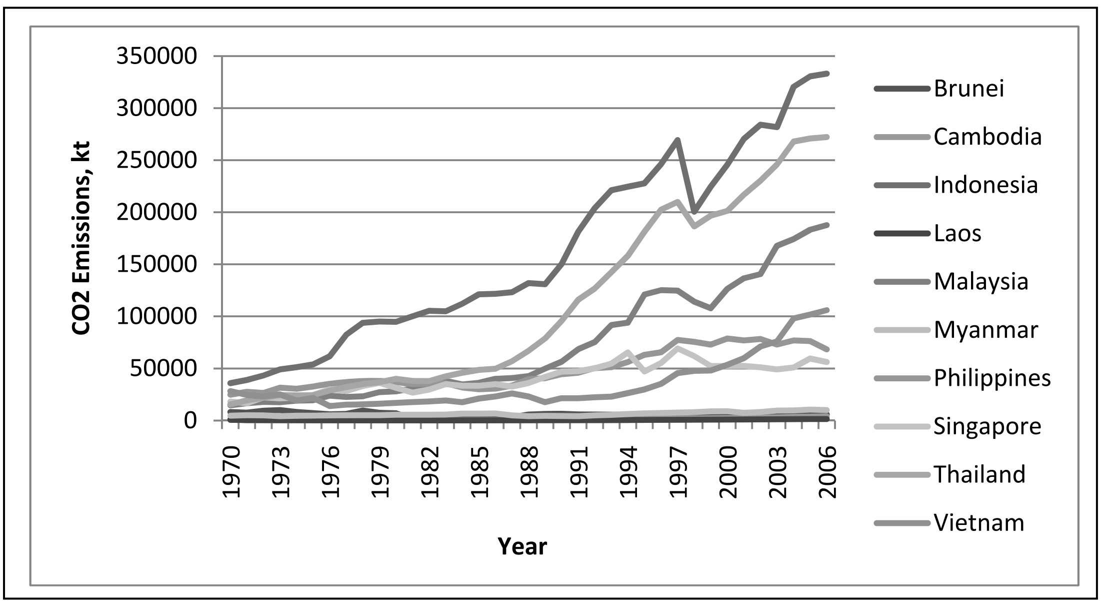
4. RESULTS

4.1. Carbon Emissions

The overview of CO_2 emissions can be seen in Figure 4. As can be seen from the graphs, the CO_2 emissions have an increasing trend in all members except Brunei, and the emissions have an increasing trend in Indonesia, Malaysia, Thailand, Vietnam, and Singapore. In terms of the per capita emissions (Figure 5), the emission levels are decreasing in Brunei, while have a higher increasing trend in, Malaysia, Thailand, Indonesia, and Vietnam. On the other hand, Japan's total and per capita emissions are increasing over the years.

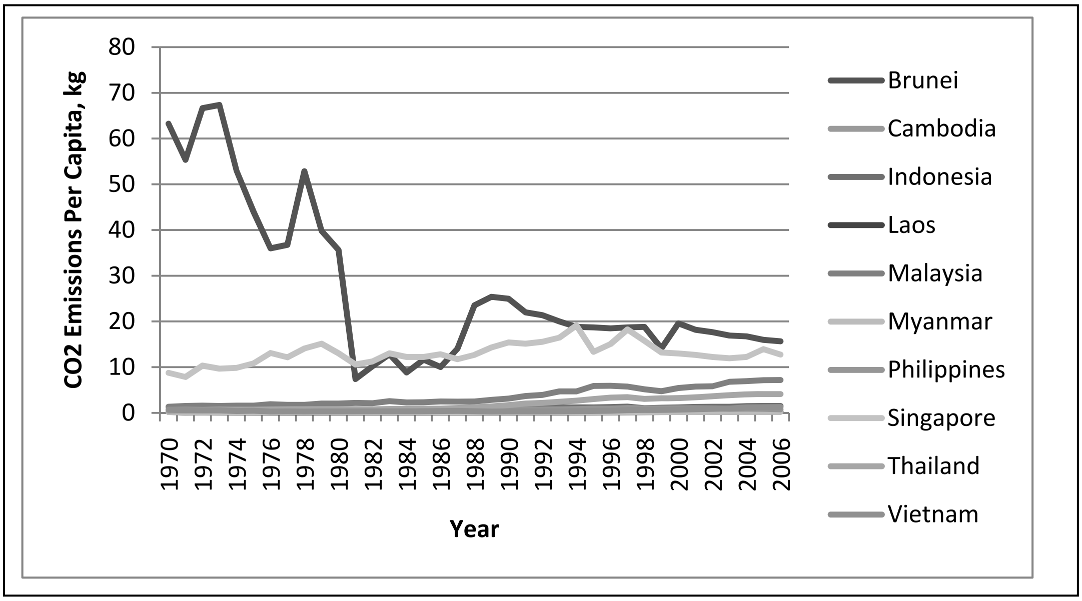
Japan's both total and per capita emissions display similar patter such that the emission levels are increasing over the years (Figure 6 and Figure 7).

Figure 4: CO_2 Emissions in ASEAN, 1970-2006, kt.



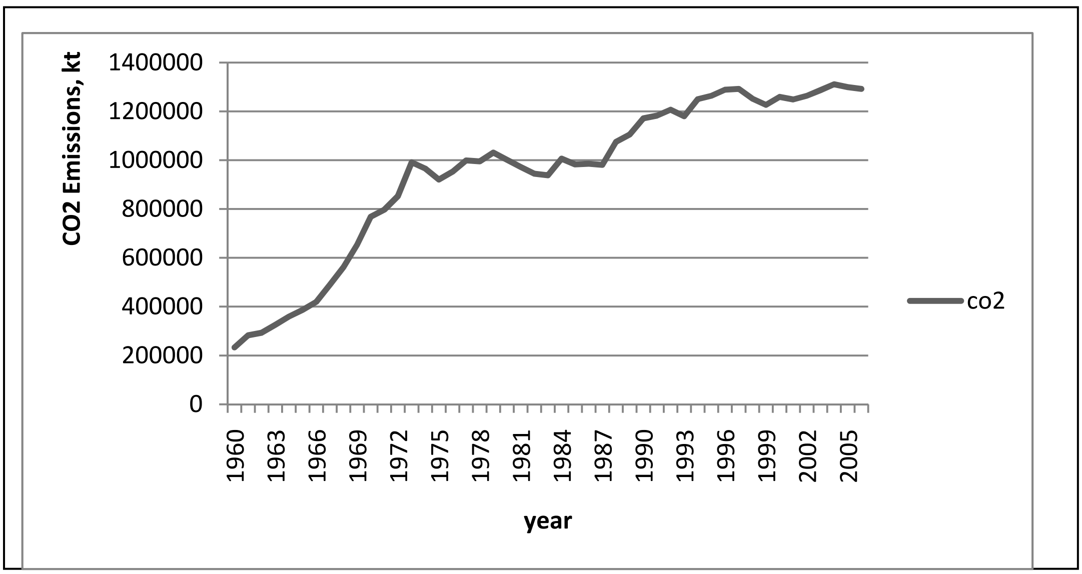
Source: World Bank, 2010.

Figure 5: CO_2 Emissions Per Capita in ASEAN, 1970-2006, kg.



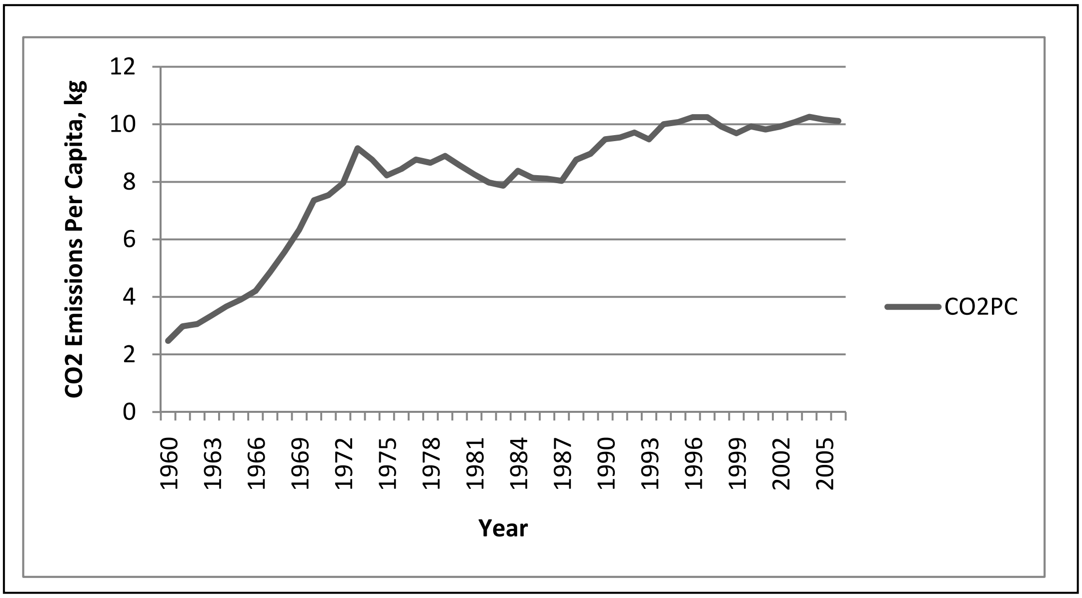
Source: World Bank, 2010.

Figure 6: Japan's CO_2 Emissions, kt, 1960-2006



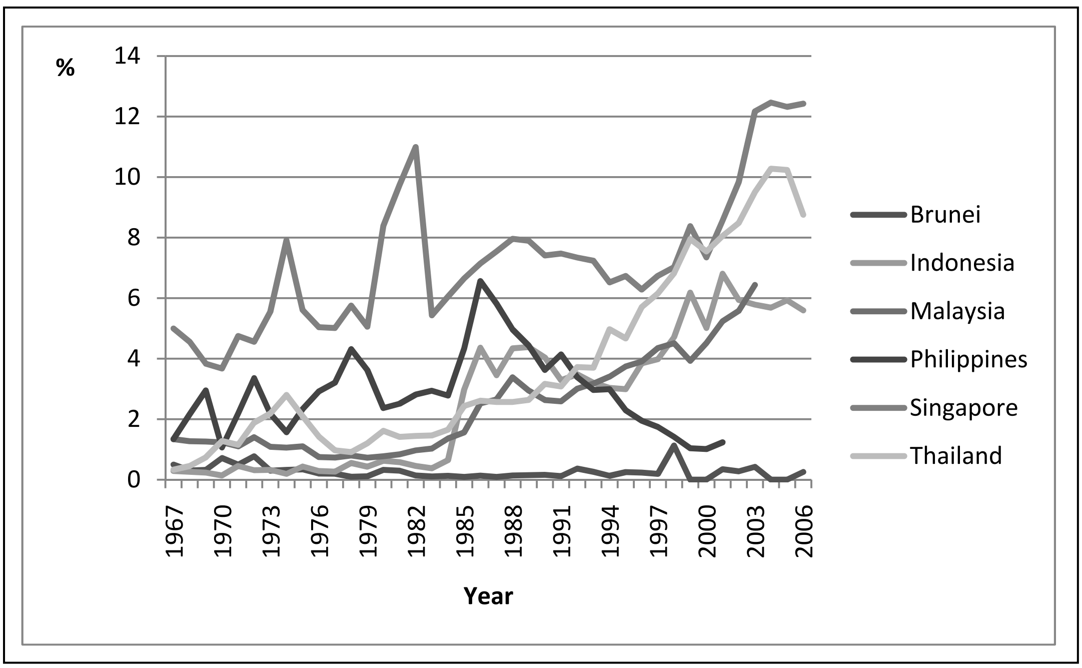
Source: World Bank, 2006.

Figure 7: Japan's CO_2 Emissions Per Capita, 1960-2006



Source: World Bank, 2006.

Figure 8: The Export Share of Polluting Industries in Total Exports in ASEAN, 1967-2006



Source: Comtrade, 2010.

Table 9: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
co_2pc	370	4.78	9.87	.004	67.36
gdpc	370	6311.60	9761.44	122.85	56574.02
r_e/gdp	311	47.79	40.83	1.54	194.09
r_pe/te	296	.025	.028	0	12.46
r_eJ/te	365	19.86	17.13	0.015	79.31
r_peJ/te	322	0.30	0.50	0	4.57
r_fdi/gdp	311	2.95	3.76	-2.75	20.06
tariff	370	27.44	20.37	9.70	83
rq	370	.50	.50	0	1

Table 10: Correlation Matrix of ASEAN CO_2 Emission (n=370)

	$lnco_2pc$	*lngdpc*	*lnr _e/gdp*	*lnr _pe/te*	*lnr _eJ/te*	*lnr _peJ/te*	*lnr _fdi/gdp*	*lntariff*	*rq*
$lnco_2pc$	1.00								
lngdpc	0.85	1.00							
lnr_e/gdp	0.90	0.82	1.00						
lnr_pe/te	0.55	0.49	0.40	1.00					
lnr_eJ/te	-0.48	-0.49	-0.66	-0.23	1.00				
lnr_peJ/te	0.15	0.10	0.08	0.78	-0.08	1.00			
lnr_fdi/gdp	0.68	0.58	0.78	0.27	-0.67	0.01	1.00		
lntariff	-0.75	-0.59	-0.77	-0.41	0.68	-0.18	-0.59	1.00	
rq	0.44	0.34	0.33	0.32	-0.35	0.17	0.25	-0.46	1.00

The Figure 8 above presents the export share of polluting industries (iron&steel, chemicals, lime and cement in SITC Rev1) to total exports over the years. As can be seen only the Philippines' export share decreased over time while other countries displayed increasing trend indicating that the region may become pollution haven for polluting sectors.

The summary statistics and correlation matrix based on the variables selected is presented in Tables 9 and 10. As can be seen there are no perfect correlations, but the GDP per capitas and the export-GDP ratio are closely correlated.

4.1.1. Japan's CO_2 Emissions

The extended EKC result for Japan is presented in Table 11. This estimation utilizes the time series data over the period of 1962-2006. As can be seen Japan's share of exports to its GDP *(e/gdp)* has an alleviating impact on per capita emissions while import share *(i/gdp)* has a deteriorating impact meaning that Japan's import based production leads high pollution. In other words increasing exports do not yield higher per capita pollution level. This can be explained by consumption of polluting industries in domestic market. The

Table 11: Japan's Carbon Emission Per Capita Regression Results (Dependent variable ln-CO_2 per capita)

Variables	Parameter Estimation
c	-76.45***
	(-4.50)
lngdpc	22.46***
	(3.79)
$lngdpc^2$	-2.38***
	(-3.49)
$lngdpc^3$	0.08***
	(3.25)
lnr_e/gdp	-0.08
	(-1.09)
lnr_i/gdp	0.13**
	(2.41)
R^2	0.98
dw	1.72
N	45
T.P	*5602(1977); 33158 (2006)*

Note: t values are in parenthesis. *, **, *** denotes 10, 5, 1 percent significance respectively.

turning point incomes indicate that Japan has reached second turning point ($33158) in 2006.

4.1.2. ASEAN CO_2 Emissions

The CO2 emissions panel regression is reported below. The tables present the Random Effects (REM) and Fixed Effects (FEM) estimations. The t values reflect the heteroscedasticity consistent (robust) standard errors. The autocorrelation is corrected using AR1 estimation for both REM and FEM if it is observed. In estimating panel data models, FEM or REM can be chosen. In the FEM, unobservable individual effects are assumed to be fixed parameters to be estimated. The REM assumes that individual effects can be included as a part of the error term, which assumes that there is no correlation between the error term and other regressors. If the number of individual units is large, FEM would lead to loss of a degree of freedom because of the use of additional dummy variables. Also, FEM cannot estimate time invariant variables. The Hausman specification test (HS) can be used to determine which model to choose (Baltagi, 2008; Wooldridge, 2002). More specifically, in a panel regression form

$$y_{it} = \alpha + X'_{it}\beta + u_{it} \qquad (3)$$

where *(i)* denotes countries and *(t)* denotes time, the disturbances can be represented as

$$u_{it} = \mu_i + v_{it} \quad (4)$$

where μ represents the unobservable individual effects and v represents the remaining disturbance. In the FEM, the μ_i is assumed to be fixed parameters to be estimated and X_{it} is assumed to be independent of the v_{it}. Therefore the regression becomes

$$y_{it} = \alpha + \delta\mu_i + \beta x_{it} + v_{it} \quad (5)$$

If the μ_i is assumed random and independent of v_{it}, the REM can be used, such that

$$y_{it} = \alpha + \beta x_{it} + \mu_i + v_{it} \quad (6)$$

The result of overall ASEAN carbon emission panel regression can be seen in Table 12. The HS test favors FEM but both estimations have similar results. According to the findings, the carbon emissions display inverted S shape with income over the years. In the beginning income level leads to decrease in per capita emissions, after certain level of income ($148), the emission levels start to increase. This can be attributed to the high growth rate of population accompanied by the lower industrial output that induces pollution in early 1970s. However, further increase in income ($10872) leads to decrease in emission levels again. Given the fact that the region has per capita income of $15652 on average (World Bank, 2010), it can be said that the region has reached its turning point in which the further increments ion income leads to decrease in per capita emissions. However, it should be noted that this is an average turning point based on the ten members' income level. Since the income disparities are quite large in the region, group specific results are needed. The ratio of exports to GDP has a deteriorating effect in the region. Since the region consists of export led members, it can be expected that increasing export flow will certainly lead to environmental degradation. The ratio of FDI to GDP is small but significant implying that the FDI has no deteriorating effect on emission level in general. In terms of the region's trade with Japan, there is no evidence that the pollution exports to Japan increases emission levels in the region. In addition it seems the tariff levels have deteriorating impact on emission levels as expected. However, the differences in regulation quality have unexpectedly positive sign on the emission levels. This finding can be attributed to the fact that environmental regulations are largely ineffective in terms of implementation in the region.

Table 12: ASEAN CO_2 Emissions Panel Regression Results
(Dependent variable ln- CO_2 per capita)

	ASEAN-ALL	
Variables	REM	FEM
c	5.59* (1.86)	-
lngdpc	-6.46*** (-6.00)	-6.49*** (-5.95)
lngdpc²	1.05*** (7.60)	1.06*** (7.60)
lngdpc³	-0.04*** (-8.19)	-0.04*** (-8.26)
lnr_exp/gdp	0.33*** (5.73)	0.30*** (5.14)
lnr_reJ/te	-0.27*** (-5.49)	-0.29*** (-5.76)
lnr_fdi/gdp	-0.03* (-1.84)	-0.03* (-1.89)
lntariff	0.76*** (3.69)	-
regulation-q	0.52* (1.79)	-
R^2	0.84	0.98
LM (BP)	2603***	
HS	33.05***	
N	264	264
TP		*148 (1983); 10782(1973) 2009:15652*

In order to understand the behavior of the related variables on the emission level, group specific effects are also analyzed. Since there are quite large disparities among the members in terms of income levels, the region is divided into three separate groups: namely high income developed group consisting of Brunei and Singapore (D2), developing group consisting of Indonesia, Malaysia, Philippines, and Thailand (D4), and late developing group consisting of Cambodia, Laos, Myanmar, and Vietnam (LD4). Since the groups have a similar tariff rates and regulation qualities, these two variables were excluded from the specific regressions. The results for specific groups are presented below.

Considering the a priori information on these types of models and based on certain model selection criteria, such as Ramsey's regression specification error test (Reset) the double log model is specified. The variable choice is based on either Schwarz Bayesian Information Criteria (SBIC) that has the lowest value or highest adjusted R^2. The results are reported in Tables 13, 14, and 15.

According to the results of group wise estimation, in group D2, the emission levels exhibit an inverted S shape curve. It means that the emission levels first decrease, then increase at high level of incomes but decrease again at higher level of incomes. The turning point incomes are found to be \$2799 and \$34834. The share of exports in GDP has polluting effect confirming the export based pollution. However, the share of polluting exports to total exports does not have such an impact. It means that this group exports mainly consists of products that are not included in polluting export segment. FDI and export to Japan on the other hand, has an alleviating impact on pollution levels.

The group D4 also exhibits inverted S shaped curve meaning that the emission levels will start to decrease at higher income levels (after $26808). The turning point incomes are found as $152 and $26808. Given the fact that current average income is $7037 per capita in the region of D4, it is clear that the emission levels will continue to rise at least in the medium run. Both the ratio of exports to GDP and ratio of polluting exports to the total exports have polluting impact in the region implying that the region's export contributes to the emission levels and highlights the pollution haven feature. Export to Japan on the other hand has not deteriorating impact on pollution levels implying that Japanese imports do not contribute to the carbon emissions in the region. FDI has a small and insignificant significant impact as well meaning that FDI mostly invests in non polluting sectors.

Table 13: ASEAN-D2 CO_2 Emissions Panel Regression Results
(Dependent variable ln-CO_2 per capita)

	ASEAN-D2	
Variables	REM	FEM
c	123.38** (2.13)	-
lngdpc	-28.97** (-2.13)	-27.07*** (-4.33)
lngdpc²	3.21** (2.21)	2.98*** (4.38)
lngdpc³	-0.11** (-2.27)	-0.10*** (-4.34)
lnr_e/gdp	0.62** (2.36)	0.63*** (8.23)
lnr_pe/te	-0.32*** (-2.68)	-0.36*** (-24.6)
lnr_ej/te	-0.25** (-2.05)	-0.10* (-2.03)
lnr_pej/ej	-0.02 (-0.10)	-0.01** (-2.11)
lnr_fdi/gdp	-0.08 (-1.58)	-0.08*** (-30.21)
R^2	0.73	0.74
LM (BP)	23.33***	
HS	1.13	
T.P	*2799 (1974);34834 (2002)* *2009:48854*	
N	52	52

The group LD4 exhibits similar inverted S shaped curve. The turning point income that pollution starts to increase is found as $154 and decrease as $4268. Given the fact that current income is $2089 in LD4, it is expected that the emissions will increase in the near future. However, the turning point income that emissions start to decrease is lower than that of other members implying that climate change and environmental concerns lead to early turning points. These results are consistent with some of the studies that examine developing country performances (Atici, 2009). The share of exports to GDP has a significant polluting impact in the region while FDI and trade with Japan have alleviating impact.

Table 14: ASEAN-D4 CO_2 Emissions Panel Regression Results
(Dependent variable ln- CO_2 per capita)

	ASEAN-D4	
Variables	REM	FEM (AR1)
c	8.01 (0.99)	-
lngdpc	-4.70 (-0.57)	-2.32*** (-5.11)
$lngdpc^2$	0.72* (1.89)	0.43*** (6.35)
$lngdpc^3$	-0.03* (-1.94)	-0.01*** (-5.77)
lnr_e/gdp	0.63*** (11.05)	0.52*** (275.78)
lnr_pe/te	0.21*** (6.13)	0.15*** (5.45)
lnr_ej/te	-0.02 (-0.39)	-0.03 (-0.70)
lnr_pej/ej	-0.04* (-1.95)	-0.03* (-1.77)
lnr_fdi/gdp	0.01 (0.06)	0.01 (1.04)
R^2	0.84	0.95
HS	8.02	
LM (BP)	1460***	
T.P		*152(1970); 26808(-)* *2009:7037*
N	137	137

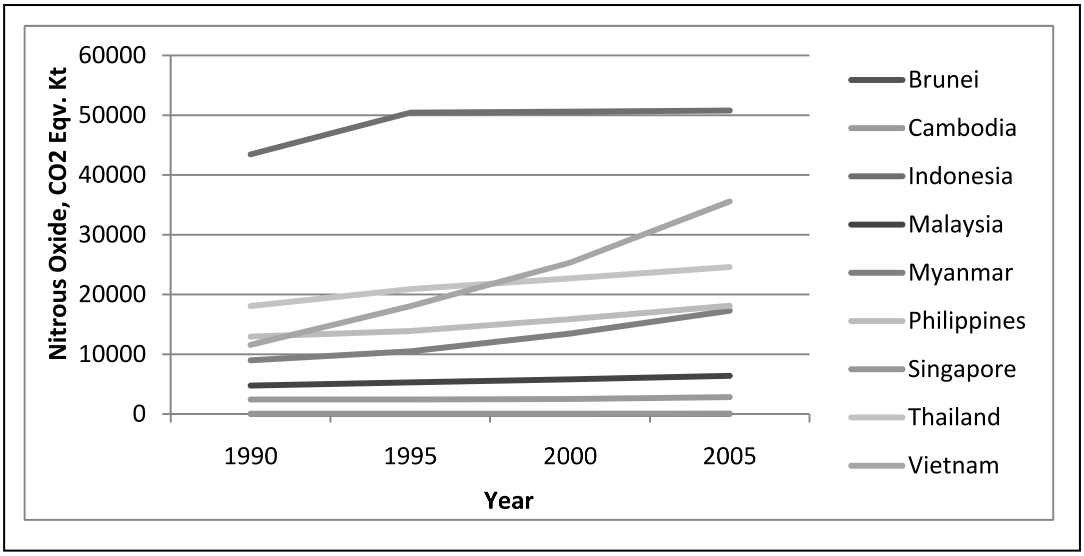
Table 15: ASEAN-LD4 CO_2 Emissions Panel Regression Results (Dependent variable ln- CO_2 per capita)

	ASEAN-LD4	
Variables	REM (AR1)	FEM (AR1)
c	303.47*** (3.29)	-
lngdpc	-46.98*** (-2.69)	-22.68*** (-4.38)
$lngdpc^2$	7.47*** (2.78)	3.61*** (4.45)
$lngdpc^3$	-0.37*** (-2.74)	-0.17*** (-4.25)
lnr_e/gdp	0.05 (0.49)	0.20** (2.34)
lnr_ej/te	-0.01 (-0.014)	-0.18** (-2.20)
lnr_fdi/gdp	-0.03 (-1.04)	-0.09*** (-3.23)
R^2	0.41	0.88
LM (BP)	5897***	
HS	13.09***	
T.P.		*154(1985);4268(-)* *2009:2089*
N	80	80

4.2. Agricultural Emissions

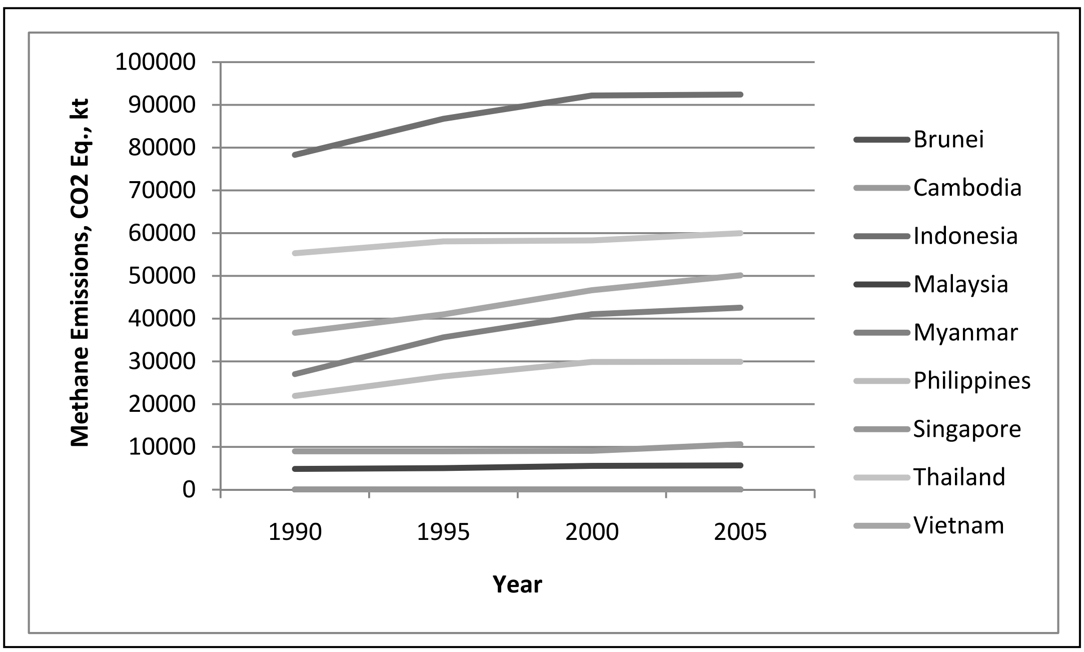
The agricultural nitrate emissions are presented in Figure 9. As can be seen although Indonesia have an high level of nitrate emissions, over the years Vietnam and Thailand emissions have an rising trend. On the other hand, in terms of agricultural methane emissions (Figure 10), Indonesia, Thailand, Vietnam, and Myanmar have higher emission levels. The agricultural emissions are not reported for Laos by the World Bank (2010), therefore the results indicate the all ASEAN members excluding Laos.

Figure 9: Agricultural Nitrous Oxide Emissions, CO_2 Equivalent, kt.



Source: World Bank, 2010.

Figure 10: Agricultural Methane Emissions, CO_2 Equivalent, kt



Source: World Bank, 2010.

The panel regression results for the agricultural emissions are reported in Tables 16, 17, 18, and 19. As mentioned before because of the limitations on agricultural emission data, panel regression is carried out using five year interval data and for the whole region. Then for robustness check Singapore is excluded and new model is estimated. The choices of control variables are made based on collineraity tests and variable selection criteria (schwarz information criteria, etc.). The nitrous oxide emissions display EKC and the turning point income is found as $5492. The agricultural exports to Japan do not stimulate agricultural exports on the contrary have an alleviating impact on exports. The strict food import regulations may have a role in such interaction. In addition Japan mostly import food products from OECD members. Countries with high agricultural tariffs have higher emission levels implying that protection leads to over production and higher use of polluting inputs. Countries with high agricultural scores in EPI (low subsidy and strict pesticide regulations) have lower emission levels. When Singapore a high re-export country is excluded from the regression the shape of EKC did not change but the turning point income has decreased to $3935 as expected. The methane emissions also display similar results with turning point income of $19438 and $3201 with robust check.

Table 16: ASEAN Agricultural Nitrate Emissions Panel Regression Results (Dependent variable ln-nitrous-oxide per capita)

Variables	REM[AR1]	FEM[AR1]
c	-3.05 (-0.39)	15.08*** (-4.43)
lngdpc	1.54** (2.33)	1.55*** (3.11)
$lngdpc^2$	-0.09** (-2.33)	-0.09*** (-3.15)
lnr_agrexpJ/agrexp	-0.05 (-1.07)	-0.17*** (-3.32)
lnagr_tariff	1.60*** (2.85)	-
lnagrsubsidy	-3.55*** (-2.22)	
lnpestregulation	-0.67* (-1.89)	-
R^2	0.62	0.97
N	36	36
HS	13.49***	
T.P	*5195*	*5492*

Table 17: ASEAN Agricultural Nitrate Emissions Panel Regression Results, Excluding Singapore (Dependent variable ln-nitrous-oxide per capita)

Variables	FEM
lngdpc	1.49***
	(3.04)
lngdpc²	-0.09***
	(-3.03)
lnr_agrexpJ/agrexp	-0.18***
	(-3.82)
R^2	0.92
N	32
T.P	*3935*

Table 18: ASEAN Agricultural Methane Emissions Panel Regression Results (Dependent variable ln-methane per capita)

Variables	REM[AR1]	FEM[AR1]
c	10.90	-
	(1.11)	
lngdpc	0.74**	0.79**
	(1.93)	(2.12)
lngdpc²	-0.04**	-0.05**
	(-1.89)	(-2.34)
lnr_agrexpJ/agrexp	0.074	0.011
	(0.30)	(0.05)
lnagr_tariff	1.97***	-
	(2.70)	
lnagrsubsidy	-5.46**	-
	(-2.54)	
lnpestregulation	-1.15**	-
	(-2.35)	
R^2	0.53	0.99
N	36	36
HS	16.01***	
T.P	*10405*	*19438*

Table 19: ASEAN Agricultural Methane Emissions Panel Regression Results, Excluding Singapore (Dependent variable ln-methane per capita)

Variables	FEM [AR1]
lngdpc	1.13***
	(7.77)
$lngdpc^2$	-0.07***
	(-7.71)
lnr_agrexpJ/agrexp	-0.022
	(-0.30)
R^2	0.99
N	32
HS	26.79***
T.P	*3201*

4.3. Dynamic Estimation

In order to measure the impact of previous period's emission level on current level a dynamic model is specified and estimated. The dynamic model is specified as

$$lned_{it} = \beta_0 + \beta_1 lned_{t-1} + \beta_2 lngdpc_{it} + \beta_3 (lngdpc_{it})^2 + \beta_4 (lngdpc_{it})^3 + \varepsilon_{it} \qquad (7)$$

where
ed=environmental degradation (CO_2, nitrous oxide, methane emissions per capita),
ed_{t-1}: environmental degradation in previous period,
gdpc: gross domestic product per capita.
i=1…10, t=1970-2006 for CO_2, and 1990-2005 for nitrous oxide and methane.

Many economic relationships are dynamic in nature and they allow the researcher to understand better the process of adjustment (Baltagi, 2008). The estimation procedure has evolved over the years. The latest estimation method is called Arellano and Bond Generalized Method of Moments (A-B GMM) estimator. Arellano and Bond (1991) state that the orthagonality condition can be utilized in the panel data setting. Starting from the general description of dynamic panel regression,

$$y_{it} = \delta_{yi,t-1} + u_{it} \qquad (8)$$

where i=1,…N t=1,….T and $u_{it} = \mu_i + \nu_{it}$, $\mu_i \sim IID(0, \sigma_\mu^2)$, $\nu_{it} \sim IID(0, \sigma_\nu^2)$

After the first differencing of equation (1) to eliminate the individual effects,

$$y_{it} - y_{it-1} = \delta(y_{i,t-1} - y_{it-2}) + (v_{it-} v_{i,t-1}) \qquad (9)$$

In this case the variables in first parenthesis are valid instruments since they are not correlated with the terms in second parenthesis. Thus Defining the matrix of instruments W such that

$W = [W_1^{'},...,W_N^{'}]$ and moment equations by $E(W_i^{'}\Delta v_i) = 0$. Multiplying the differenced equation (9) by W`,

$$W'\Delta y = W'(\Delta y_{-1})\delta + W'\Delta v \qquad (10)$$

is obtained. Performing the GLS on (9), the Arellano-Bond (1991) one step consistent estimator is obtained such that

$$\hat{\delta}_1 = [(\Delta y_{-1})'W(W'(I_n \otimes G)W)^{-1}W'(\Delta y_{-1})]^{-1} x[(\Delta y_{-1})'W(W'(I_N \otimes G)W)^{-1}W'(\Delta y)] \qquad (11)$$

The optimal generalized method of moments (GMM) estimator replaces the *Δv* by differenced residuals obtained from the preliminary consistent estimator $\hat{\delta}_1$.

The results are presented in Table 20. As can be seen both CO2 and nitrous oxide emissions have a positive sign, meaning that their polluting effects on current emissions while methane emissions in previous period has a negative sign meaning that it has a alleviating effect on current emissions. The Sargan test for over identification does not reject the null hypothesis that the error term is uncorrelated with the instruments. The results imply that the pollution of the carbon and nitrous oxide in previous years will cause pollution in current year because of the cost of eliminating pollution. It also shows that the dependency of economy to the polluting activities of the related pollutants. For the case of methane, it can be said that the dependency is lower compared to other pollutants and the methane pollution is more manageable.

Table 20: A-B GMM Dynamic Panel Estimation of Emissions for ASEAN

Variables	CO_2	Nitrous Oxide	Methane
c	0.15	-8.32***	-30.37**
	(0.21)	(-6.84)	(-2.21)
lnemission $_{t-1}$	0.83***	0.58*	-1.11**
	(0.027)	(1.88)	(-2.28)
lngdpc	-0.54***	2.33**	11.07*
	(0.l3)	(2.45)	(2.01)
lngdpc^2	0.11***	-0.25	-1.47*
	(0.02)	(-1.50)	(-1.96)
lngdpc^3	-0.006***	0.009	0.06*
	(0.001)	(1.13)	(1.93)
Sargan Test	321.62	1.00	1.83
(overidentification)	p(0.23)	p(0.60)	p(0.40)
N	350	36	36

Conclusions

This study examined the interaction between trade liberalization and environment in Japan and ASEAN countries respectively employing the EKC and utilizing the panel data. The results indicate that the region faces some environmental problems such as population growth, increasing industrial activities, and climate change. However, the introduction of new regulations and stricter standards, cleaner fuels, green vehicles, improving public transportation, and promoting renewable energy are amongst measures being implemented in the region (ASEAN, 2009). The results indicate that in carbon emissions display similar inverted S shape when EKC is examined, such that the emission levels per capita decrease with higher GDP in all groups. However, the turning point income levels vary depending on the country group. Given the fact that developing countries in the region will continue to produce and export industrial outputs, it can be expected that emission levels will still continue in the near future. On the other hand agricultural emissions display conventional EKC. In general the share of exports to the GDP is main contributors for carbon emission reflecting the negative externality of export based growth. Furthermore, the trade with Japan does not contribute to the emission levels in the region indicating that Japan does not stimulate the pollution level in the region. FDI has a small but significant improving effect on all groups except insignificant effect in D4. This finding demonstrates that the FDI mostly invest in non polluting sectors in the region. However given the panel structure of the study, country specific effects needs to be examined in the future studies. In terms of the agricultural emissions, it can be stated that the emission levels confirm the conventional EKC. In addition, high tariff levels increase the emission of nitrous oxide meaning that protection leads to higher domestic production and high level of input use leading to the pollution. On the other hand, countries with high scores in agriculture (EPI, 2009), i.e. less subsidy and better environmental regulations, have better environmental quality in the region. The dynamic regression indicates that the pollution of the carbon and nitrous oxide in previous years will cause pollution in current year because of the cost of eliminating pollution. It also shows that the dependency of economy to the polluting activities of the related pollutants. For the case of methane, it can be said that the dependency is lower compared to other pollutants and the methane pollution is more manageable.

The results imply that the export oriented growth in the region stimulate the pollution, however export to Japan does not. In order to prevent the region to become pollution havens, more strict regulations should be implemented. Given the fact that production requires energy use and energy use per capita is an important factor in pollution (World Bank, 2010) the region needs environmentally friendly technologies for energy production. This can be achieved by more research and development expenditures as well as regional collaboration. Agricultural subsidies and laxity of regulations increase the pollution level in the region. Therefore, input related subsidies should be reconsidered and agricultural related regulations should be implemented. In this process regional collaboration and technical assistance and guidance are crucial for the sustainable development of the region.

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