THE IMPACT OF ECONOMIC GROWTH ON THE ENVIRONMENT: EVIDENCE FROM ENVIRONMENTAL KUZNET CURVE ANALYSIS IN 7 ASEAN COUNTRIES

JOURNAL

Made By:
Nuhansyah Arga Pangestu
125020107121015

INTERNATIONAL UNDERGRADUATE PROGRAM IN ECONOMICS

ECONOMICS AND BUSINESS FACULTY
BRAWIJAYA UNIVERSITY
MALANG
2017

The Impact of Economic Growth on the Environment: Evidence from Environmental Kuznet Curve Analysis in 7 ASEAN Countries

Nuhansyah Arga Pangestu
Economics and Business Faculty, Brawijaya University
Email: nuhansyah.ap@gmail.com

Abstract

Environmental degradation is one of the issues resulted from the economic development. ASEAN countries are no exception. As a 'new economic market', economic growth has affected environmental degradation. The basic theory of the relationship between economic growth and environmental degradation was introduced by Grossman and Krueger in 1991 by adapting the Kuznet Curve inequality theory published by Simon Kuznet in 1955. This theory, Environmental Curve Kuznet theory (EKC), posited that there is possibility of economic growth which could pose a positive impact on ecosystem and environmental improvement. This study tries to prove that EKC theory can occur in ASEAN countries. In addition, this study also aims to illustrate the position of turning point of inverted U-curve in ASEAN region and compare the real and estimated value of EKC theory of each country. Several variables used in the study are Gross Domestic Product per capita, added value of industrial sector, and percentage of urban population growth. These variables are used as a reference to prove the influence between economic growth and environmental degradation, as reflected by Carbon Dioxide (CO2) pollution variables. The results of this study shows that all economic variables have a significant impact on CO2 pollution levels. Furthermore, this study proves that there is a turning point where ASEAN countries will enjoy positive results from economic growth on the environment. Nevertheless, not all ASEAN countries are able to pass the point due to the close distance between the real and estimated value of EKC theory that rise annually.

Keywords: environmental economics, Kuznet Kurve, Environmental Kuznet Curve, industrialization, urbanization, panel data regression, fixed effect model

Abstrak

Degradasi lingkungan adalah salah satu isu yang timbul akibat meningkatnya pertumbuhan ekonomi suatu negara. Tidak terkecuali kawasan ASEAN. Sebagai 'pasar ekonomi baru', pertumbuhan ekonomi akan berimbas kepada degradasi lingkungan. Dasar teori hubungan antara pertumbuhan ekonomi dengan degradasi lingkungan diperkenalkan oleh Grossman dan Krueger pada tahun 1991 dengan mengadaptasi teori inekualitas Kurva Kuznet yang dipublikasikan oleh Simon Kuznet pada tahun 1955. Teori yang dinamai teori Kurva Kuznet Lingkungan (EKC), menyebutkan bahwa ada kemungkinan perumbuhan ekonomi mampu berdampak positif pada perbaikan ekosistem dan lingkungan. Studi ini akan membuktikan bahwa teori EKC tersebut dapat terjadi pada negara-negara ASEAN. Selain itu, studi ini juga bertujuan untuk menggambarkan posisi titik balik kurva U terbalik di kawasan ASEAN serta ditambah perbandingan antara nilai riil dan estimasi dari teori EKC pada setiap negara. Beberapa variabel yang digunakan adalah Produk Domestik Bruto per kapita, nilai tambah pada sektor industri, serta presentase pertumbuhan populasi perkotaan. Variable tersebut dijadikan acuan untuk membuktikan adanya pengaruh antara pertumbuhan ekonomi dengan tingkat degradasi lingkungan, yang dalam studi ini direfleksikan dengan variabel polusi Carbon Dioksida (CO2). Hasil dari studi ini menunjukkan bahwa semua variabel ekonomi memiliki dampak signifikan terhadap tingkat polusi CO2. Lebih lanjut, studi ini membuktikan bahwa ada titik balik dimana negara-negara ASEAN akan menikmati hasil positif dari pertumbuhan ekonomi terhadap lingkungan. Walaupun demikian, tidak semua negara ASEAN mampu melewati titik tersebut dikarenakan masih dekatnya jarak antara nilai riil dan estimasi dari teori EKC yang bergerak naik setiap tahunnya.

Kata Kunci: ekonomi llingkungan, Kurva Kuznet, Kurva Kuznet Lingkungan, industrialisasi, urbanisasi, regeresi panel data, model efek tetap

A. INTRODUCTION

Analysis on the relationship between economic growth and the environmental sustainability has become the new scope of research since acknowledge the global trade. Environmental economics research comes from a long-live debate over the environmental consequences of liberalized trade. The debate was originally stood right after the North American Free Trade

Agreement (NAFTA) and the Uruguay Round of GATT negotiations. Previous studies have proven that liberalized trade in one country can affect the condition of the environment and social welfare in the domestic area (Copeland and Taylor, 2004; Grossman and Krueger, 1991). Low human awareness on the development of world economics and decreasing biodiversity can be assumed as the signal of the environment from the safe phase to become critical. Increasing air pollution level and renewable resources of energy are the indicators of environmental degradation.

The existing stock of greenhouse gases is largely the result of past emissions from rich countries (Stern, 2006). The production waste is quite high started from the industrial revolution in Europe until the World War period. However, starting from late 1970s to the millennia, most of the emissions growth is likely to be in developing countries. It is happened because most of them try to take a part in international market. It is also clear that energy sector has the highest percentage of CO2 level. It is not going well with the lack of support on energy efficiency and greener technologies. Sustainability should be solved at the level of preferences or technology, not at the level of optimal prices, therefore focusing on the human-nature-relationship that will materialize the long-term and inherently uncertain future (Costanza et.al, 2015; Baumgärtner and Quaas, 2009).

Focus on the impact of fiscal policy on the environment to interfere the disadvantage of free trade and economic production had been grown by many researchers. However, the main idea of environmental policy was never been realized. The actual point of environmental policy is to maximize the benefit of environmental assets as closer to optimal levels, which lead a country to have social benefits and welfare (Pindyck, 2006). Without a good understanding on the basic theory and only policy-oriented, real value to promote the efficient use of environmental resources cannot make the cooperation between government and private to be allocated efficiently.

In the case of liberalized trade, there is a distinct output over period of time. On the initial period, it may create a setback on environment preservation. When government has controlled the structural change, in case of income and possible pollution haven effects, trade openness exhibits a negative and significant relationship with pollution (Cole, 2004). Meanwhile in the future, it assumed to make a good result to the environmental condition. Theory that correlated with the above assumption was coming from Grossman and Krueger (1991) publication that adapted the Kuznet Curve hypothesis published by Simon Kuznets (1955).

Grossmann and Kruger so-called Environmental Kuznet Curve (EKC) was firstly intended to measure the impact of international trade on industrialization and worsened production waste. Stern (2004) stated that EKC is a hypothesized relationship between various indicators of environmental degradation and income per capita. In the early stages of economic growth degradation and pollution increase, but beyond some level of income per capita, which will vary for different indicators, the trend reverses, so that at high income levels economic growth leads to environmental improvement. This theory holds that large production both on manufacture and agriculture could harm the green area such as forest and river.

On the Environmental Kuznet Curve theory, the tradeoff between environmental quality and economic growth is a massive dilemma. For example, liberalized trade and manufacturing production logically will decrease the natural resource and land space on the first hand. Then in some sort of time, it will turn out to make trader, in this case government and private sector, achieve good momentum to shift toward greener technology.

Inclusion of environment into the economic circular flow model is necessary thus a theory appeared and called as 'Biosphere Circular Flow Model.' This theory is focusing on how the natural take a role as a receptor of various undesirable outputs of the production/consumption processes, i.e. of pollution and wastes (Harris and Codur in Halkos and Paizanos, 2015). The flow model is seemingly related with EKC theory. It is because EKC stands as well on the technological link between a good (consumption) and a bad (pollution). EKC link the consumption of the good which generates pollution and some kind of resources abatement expense in objective to ameliorate its waste (Halkos and Paizanos, 2015). This theory is can be proved by seeing people in high-income countries nowadays have a higher demand for consumption and less demand on polluted area (Andreoni and Levinson, 2001).

EKC theory stated the global trade and income level have an influence the pollution, there is a question, how the real condition on developing and developed nation. Copeland and Taylor (2004) maintained that trade may encourage a relocation of polluting industries from countries

with strict environmental policy to those with less stringent policy. This action whether could increase global pollution (domino effect) or weakened the environmental policy. It is possible because developing countries prefer to loosen their environmental regulations as a step to maintain international competitiveness. This theory is called as pollution have hypothesis, and it can be the reason why research on relationship between economic activity and environmental degradation is necessary.

Cole (2004) stated that pollution haven hypothesis influenced by the stringency of environmental regulations between the developed and developing countries which will cause comparative advantage in pollution intensive production. To remain competitive, these firms relocate to low-income countries (developing countries) whose people are in high demand for jobs and income. The local governments in these countries usually ignore regulation and environmental enforcement to promote investment and pull up economic growth. When it happens with a mechanism, polluter firm can minimize the production costs by polluting with impunity. Stern (2004) argued that structural factors on both the input and output side seems do play a role in modifying the gross scale affect though they are mostly less influential than time-related effects.

From the report of Karki, Mann, and Salehfar (2005), obtained that ASEAN as an international institution, in the last two decades, has raised the concern of sustainable economic and energy development into a realistic way. Understanding of institutional blueprint and the policy budgeting is still far away from satisfactory point.

Table 1: CO2 Emissions from fuel combustion 1990–1998, (in million tons)

Countries	1990	1998	%CO2 increase (1990-1998)
Brunei	3.2	4.9	53
Indonesia	141.5	226.5	60
Malaysia	47.4	92.4	95
Philippines	36.0	62.0	72
Singapore	34.9	43.5	25
Thailand	80.2	148.1	85
Vietnam	18.0	32.9	83
ASEAN	365.1	618.1	69

Source: IEA (2000) in Karki, Mann, and Salehfar (2005).

Based on Table 1, some of ASEAN countries such as Indonesia and Vietnam were becoming a state haven for large-scale industrial enterprises that typically produce a lot of waste and pollution (pollution-intensive industry). It can be seen that all ASEAN countries also has an increase CO2 level from fuel combustion. Even though the global financial crisis happened in late 1990s, it cannot influence people to decrease vehicle use. High level of economic growth may be associated with worsening environmental conditions in less developed or poor countries (Dinda, 2004).

Rapid economic growth in ASEAN countries demands much sector to be improved along. Improvement on these sectors generally will decrease the quality of the environment. According to Copeland and Taylor (2004), insufficiency number of research which measures the relationship between economic growth and its implication to the environment will cause a setback on citizen goodwill on the nature preservation and management. Considering the argument from Grossman and Kruger (1991) and Stern (2004), nowadays, ASEAN countries still trapped on the first stage of EKC. Acknowledgement of the local communities and sub-national units is still minimum and not a good sign of economic cooperation. Dependency of ASEAN countries in using the fossil power plant and manufacturing sector, also lack of innovation and low effort on developing the renewable resource is the main factor why level of carbon dioxide is high in ASEAN countries.

Development of variables and methods of analysis conducted by experts prompted to determine whether the ASEAN countries including the pollution haven country or not. This study will prove whether the economic growth has significant impact on the environment or not based on EKC theory. This study has several objectives, those are: first, to know whether there is an impact of economic growth in ASEAN countries to its domestic pollution level; to analyze how the impact of economic variables to pollution in ASEAN region; to prove that inverted U-shape curve of Environmental Kuznet Curve hypothesis exists in the ASEAN region and acknowledge the

turning point; and to analyze which country that is still trapped by pollution-intensive stage of economic growth.

Section 2 recaps the basic theory and reviewed previous studies on EKC scope. Section 3 describes the data sampling and the analysis method of this study. Section 4 shows the findings and discussion of econometric models due to carbon dioxide emission ASEAN countries. Section 5 is the conclusion and added with several recommendations about future environmental policy.

B. LITERATURE REVIEW

Environmental Economics

Worsening condition of nature in present time is one of the reasons why development on environmental-based economics emerged. Climate change, for example, has profound implications for the environment in which social and economic activity takes place, and can thus have similarly important effects on prosperity and human development (Stern, 2006). It is why he argued that adaptation has the potential to reduce the impact of climate change. Over a decade, climate change is already inevitable, and it will be the same if mitigation strategies only obtain a minor effect to control present level of greenhouse gases.

Munda (1997) mentioned that environmental economics can be considered as a particular specialization of two fundamental questions; the problem of environmental externalities, and the correct management of natural resources (in particular, the optimal intergenerational allocation of non-renewable resources). Still, it is difficult to measure externalities because of the complexity and estimation. Even though, studies have proven that externalities can be determined through the more applicable way, such for environment; it is possible to analyze the environmental condition using the pollution level or government allocation on the environmental sector. Government role on the environmental economics is significant because their job is to put aside profit and focus on people welfare.

A relevant question about sustainability in an open system context is whether trade can substitute for lack or sustainability of environment and nature at the national/regional/local level. Baumgärtner and Quaas (2009) argued that the emerging field of sustainability economics can be defined by four core attributes;

a. subject focus on the relationship between humans and nature,
b. orientation towards the long-term and inherently uncertain future,
c. normative foundation in the idea of justice, between humans of current and future generations as well as between humans and nature,
d. concern for economic efficiency, understood as non-wastefulness, in the allocation of natural goods and services as well as their human-made substitutes and complements.

Sustainability is about long term period and consistency, because many countries are stricken by budgetary problem. Good environmental condition needs sacrifice. In the case of developing countries, they still lack of institutional role and the respect on the environment.

The challenge to ecological economics in the future is to develop models that capture these features well enough to incorporate at least the major risks in economic decisions that increase the level of stress on ecological systems. Based on Halkos and Paizanos (2015), measurement on environmental pollution in growth models during recent decades has increased the urgency of environmental problems, both in national and global levels, provoked a growing body of research that incorporate environmental pollution factors in growth models and explicitly explores the relationships between economic growth, capital accumulation and environmental degradation.

Adaptation and evaluation on the present time is an essential policy response, therefore international community must find ways of supporting adaptation, especially in the most vulnerable countries (Stern, 2006). Such considerations suggest that the best and perhaps the only strategy for achieving ecological sustainability involves differentiating between developed nations in North and developing nations in South (Ekins, 1993). The problem to closing the gap between them is transferring the technologies between different economic and cultural should is uncertain in the future.

Issues on Environmental Economics

Economists believe that high institutional cost and low people participation is becoming the thick wall to endure the sustainable policy. Based on Dinda (2004), expensive cost on managing and recomposing the environmental policy can halt the prospect of long term preservation, thus make much of the countries only focusing on short term agenda. In this case, it is imaginable that maturity of the government is key determinants of the future path of environmental policy. People influence is also the strongest link to measure how far the relationship between income and environment condition actually happen.

Better grade of public good, in some point mentioned domestic air and water quality, can only provided by state because their citizens have a limitation to advance the technology privately (Dinda, 2004). Impact of the policy is mainly depending on geological value of the local area, in other mean, each region has its own identical effect based on the preferences and/or concession of both government and the citizen. In overall, the major determinant of environmental policy is the socio-political regime of a particular country.

From Pindyck (2006), there are three main problems that commonly discussed in the scope of environmental economics;

a. First, both the calculation of cost-benefit analysis on this study is never determined, thus researcher cannot map out the best policy could be taken by,
b. Second, financing the cost on environmental policy is nearly-impossible to do,
c. Third, uncertainty of the discount rates to measure present value is a big problem.

Ekins (1993) stated that environmental issues would not be resolved theoretically, but is essentially using an empirical question. But there is no reason for the lack of a priori theoretical agreement on this point to impede practical implementation of a policy which all sides agree to be desirable on both ecological and economic grounds; namely, the internalization of environmental externalities and/or their reduction through the determined introduction of technologies to reduce environmental impacts.

Economic Activity and Environment Relationship

It has to be noted that to put a precise monetary value to an environmental externality implies the solution of very important problems, e.g., uncertainty connected to the environmental impact, correct time horizon and correct discount rate. In Grossman and Krueger (1991), they distinguish three kinds of mechanisms to relate trade and foreign investment policy with the fluctuations of pollution level and sustainability of environmental resources;

- First, there is a scale effect, capturing the simple intuition espoused by the environmental advocates. That is, if trade and investment liberalization causes an expansion of economic activity, and if the nature of that activity remains unchanged, then the total amount of pollution generated must increase.
- Second, there is a composition effect that results from any change in trade policy. When trade is liberalized, countries specialize to a greater extent in the sectors in which they enjoy competitive advantage.
- Finally, there is a technique effect that is output need not be produced by exactly the same methods subsequent to a liberalization of trade and foreign investment as it has been prior to the change in regime.

Costanza et.al (2015) argued that human cannot deceive the ongoing problem even though human can solve economic problems in the past. Most current economic policies are largely based on the underlying assumption of continuing and unlimited material economic growth. The level of economic development might also affect the magnitude of the relationship between fiscal spending and environmental degradation (Halkos and Paizanos, 2015). Nevertheless, all but one of the studies that examine the direct effect of government expenditure on environmental quality, report a unified estimate based on a world sample of countries.

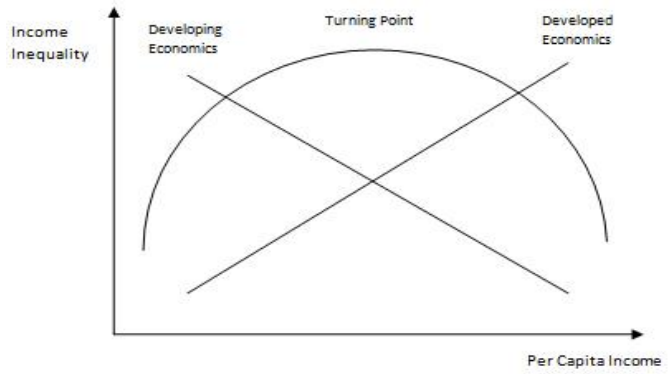
Kuznet Curve

Kuznet (1955) hypothesized an inverted-U shape relationship between an indicator of income inequality and the level of economic growth, which later on known as Kuznet Curve. His research mainly talked about the character and cause of long-term changes in the personal distribution of

income. Later on, Kuznet (1955) put the income distribution of the total population viewed as combination of income distribution of rural and urban population. The structure reveals that;

a. Average per capita income of rural population is usually lower than the urban,
b. Inequality in percentage share within the distribution for rural population is somewhat narrower than in that for the urban population –even when based on annual income; and this difference would probably be wider for distributions by secular income levels.

Figure 2: Kuznet Curve Hypothesis



Source: Alstine and Neumayer (2010).

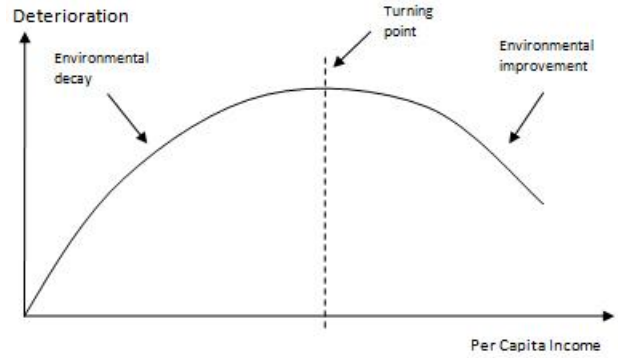
Figure 2 explain the stage of Kuznet Curve and form the initial value to the future value. This theory is improving the way of linking per capita income to the income inequality. It is plausible to assume that in earlier periods of industrialization, even when the non-agricultural population was still relatively small in the total; its income distribution was more unequal than that of the agricultural population. The major offset to the widening of income inequality associated with the shift from agriculture and the countryside to industry and the city must have been a rise in the income share of the lower groups within the nonagricultural sector of the population.

When a nation forced to increase the scale of production in to achieve economic growth, government was sacrificing the revenue derived from the traditional sectors such as agriculture and plantations. Thus it will make inequality income distribution between urban and rural area domestically.

Environmental Kuznet Curve

Introduction of Environmental Kuznet Curve theory firstly arrived in 1991, by Grossman and Krueger. Creation of the EKC hypothesis is the adaptation and reformation of inverted-U-shaped Kuznet curve. EKC empirical evidence relies on reduced-form regressions of environmental quality on income and other covariates (Andreoni and Levinson, 2001). EKC describe the relationship between measured levels of environmental quality change as the fortunes of a country change on per capita income, across time (Yandle et.al, 2002; Dinda, 2004).

Figure 3: Environmental Kuznet Curve Hypothesis



Source: Yandle et.al (2002)

Environmental Kuznet Curve hypothesis is intended to represent a long term relationship between environmental impact and economic growth (Dinda, 2004). He stated that developed

countries are often pictured with a good emission abatement and better environmental policy performance rather than in developing countries, which environmental degradation still advance increases over time. In the other hand, developing countries' income levels is not quite high to be able to reach turning points. It also accepted by Yandle et.al (2002), that consider the transition from lower to higher levels of per capita income involve a long period of time. Stagnancy and recession in the transition process cause a setback in environmental progress and took much time period.

EKC stages are heterogenic or differ across countries, likewise distortion and/or unobserved effect will happen across time period. It is the reason that link between EKC and policy implementation is frail. For example, clustering waste management and reforestation probably has little impact toward pollution alleviation because it cannot overcome the number of assembly plant on the entire country. Previous studies assume that each country should follow EKC with same shape but level of the curve may vary across countries as per their economic position.

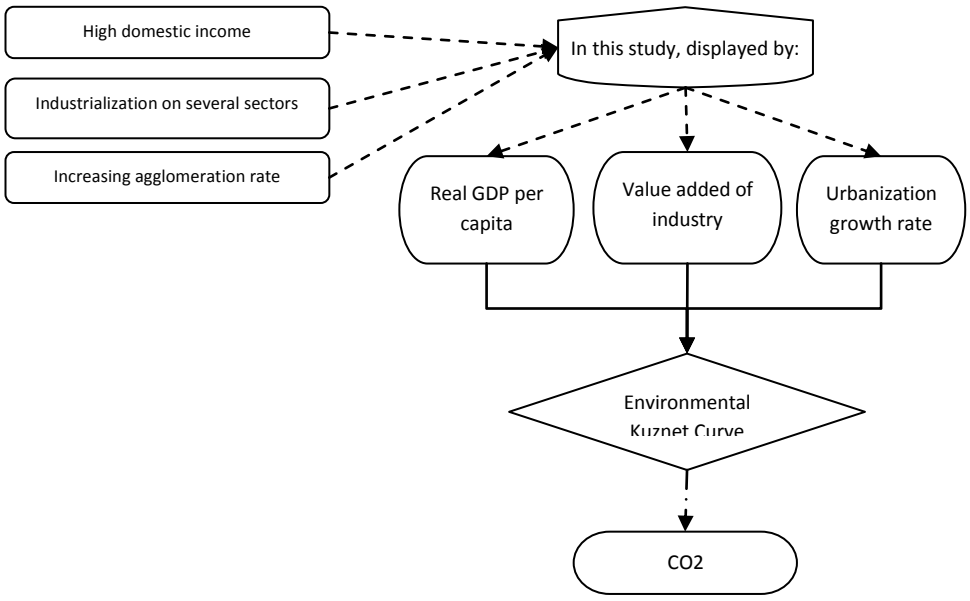
EKC Calculation

EKC calculation could involved many aspect and variables. Both economic variable and environment variable are necessary to include in the estimation. It is clear that the EKC-type relations exist for some environmental pressure factors and a transition is expected at a crucial point, i.e., turning point. Dinda (2004) argued that turning points of these inverted-U-shaped relationships vary for different pollutants or environmental indicators. Demographical and sociological variable are considered necessary to use because EKC curve may vary across countries as initial their economic position. According to Alstine and Neumayer (2010), majority of studies on EKC assumed that equation is estimated on the following form;

$$E_{it} = (\alpha + \beta_i Fi) + \beta_2 Y_{it} + \beta_3 (Y_{it})^2 + k_t + \varepsilon_{it} \quad (1)$$

where E reflect the environmental indicator, either in per capita form or in the form of concentrations, Y denotes per capita income, F denotes country-specific effects, k refers to year specific dummies or a linear time trend and i and t refer to country and year, respectively.

Theoretical Framework



C. DATA AND METHODOLOGY

Research Type

The scope of this study is about the impact of economic activity (GDP per capita), value added of industry, and urbanization growth rate to the domestic pollution level in 7 ASEAN countries on the period 1990-2013. This study is using quantitative data approach which consist

more than 100 data cell. Several ASEAN countries have been selected as the object of this study based on the level of economic developments and the availability of data. Selected ASEAN countries are; Brunei Darussalam, Indonesia, Malaysia, Philippines, Thailand, and Vietnam.

Data Collection and Sampling

Data in this study is structured as panel data. All of mentioned variables are collected from World Bank Development Indicators (WDI) Database which published through World Bank website at http://databank.worldbank.org/data/

Panel data comprehends both cross-section and time-series data. The use of models of panel data is used with the aim to obtain a better estimation results (efficient) by increasing the number of observations which have implications for the increasing degree of freedom (degree of freedom). Data collected in this study consist of 7 ASEAN countries (i = 7) started from year 1990 to 2013 (t = 24). Those variables consist of;

- CO2 emission,
- Real GDP per capita,
- Quadratic transformation of GDP per capita,
- Value added of industry
- Urban growth rate

For the analysis tools, this study is using *Eviews9.0* for the Breusch-Pagan LM test and *Eviews7.0* for the rest of statistical analysis.

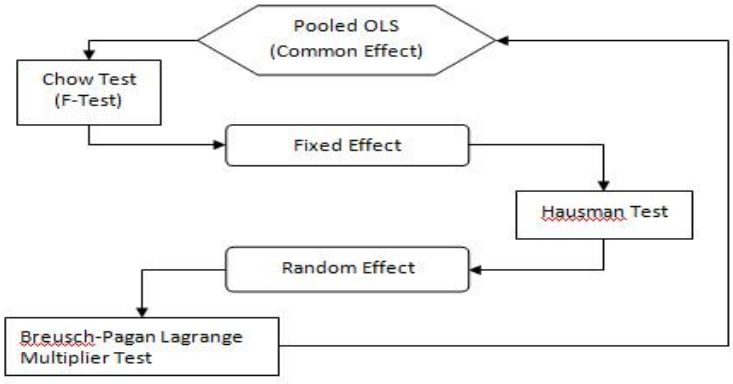
Data Analysis Method

EKC studies need quadratic transformation and/or cubic transformation as the representation of inverted U-shape. Measuring the turning point is one of challenges on EKC model analysis, although the turning point is not convincing and linear with the field. Thus, data equation in this study is;

$$CO2_{it} = \beta_0 + \beta 1\ GDPPC_{it} + \beta 2\ GDPPC^2_{it} + \beta 3\ INDVA_{it} + \beta 4\ URB_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

where, I is 1,…N, countries or cities; t is 1,…T, years, or time intervals; $CO2_{it}$ is the environmental stress variable (in this case CO2); a_i is the country or site specific effect; GDPPC is the real GDP per capita; $GDPPC^2$ is the estimated quadratic value of GDP per capita; $INDVA_{it}$ is the value added of industry variable; URB_{it} is the urbanization growth rate variable; and ε_{it} is an error term. When *t* represents different time periods for the same individual, the unobserved effect is often interpreted as capturing features of an individual, such as cognitive ability, motivation, or early family upbringing, that are given and constant over time *t* (Wooldridge, 2002).

Figure 4: Estimation Process of Models in Panel Data Regression



Source: Data processed, 2017

EKC Turning Point

Stern (2004) stated that the existence of turning point as the indicator of the initial condition of environmental restoration is important in EKC analysis. Turning point can be gained by transform the equation into the zero-sum first difference. The initial quadratic equation is stated in Equation 2, thus, the first difference transformation of Equation 2 is;

$$\Delta CO2/_{\Delta GDPPC} = \beta_1 + 2\beta_2 GDPPC \quad (3)$$

With a zero-sum, it is possible to transform the equation into;

$$GDPPC = \frac{-\beta_1}{2\beta_2} \quad (4)$$

D. RESULT AND DISCUSSION

Panel data regression analysis in this study is based on Wooldridge (2002). There are several steps that should be taken to the selection of the model. The first stage is to do the Chow test, which willing to choose the best model between common effect and fixed effect model. After that, the next step is the Hausman test, which necessary to choose either fixed effect model or random effect model is the best model to analyze.

Chow Test

Table 2: Chow test estimation output

Redundant Fixed Effects Tests			
Equation: EKC			
Test cross-section fixed effects			
Effects Test	Statistic	d.f.	Prob.
Cross-section F	64.695539	(6,157)	0.0000
Cross-section Chi-square	209.136111	6	0.0000

Source: Data processed, 2017

Table 2 has show the Chow test output that choose the best way to estimate the equation is fixed effect model because the probability value is below the alpha (0.0000 < 0.05), or the other word, H0 is denied.

Hausman Test

Table 3: Hausman Test Estimation Output

Correlated Random Effects - Hausman Test			
Equation: EKC			
Test cross-section random effects			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	10.528316	4	0.0324

Source: Data processed, 2017

Table 3 show the output of Hausman test that has proven the best way to estimate the equation on this study is fixed effect model because the prob. value is below the alpha (0.0324 < 0.05). This output is consistent with the output of Chow test, which lead to the use of fixed effect in this study.

Breusch-Pagan Lagrange Multiplier Test

Table 4 showed that the Breusch-Pagan p-value is 0.0000 or the H0 is rejected. Even though this test is optional, it helps to determine the suitable estimation, which for this model is fixed effect model.

Table 4: Breusch-Pagan LM test Estimation Output

Lagrange Multiplier Tests for Random Effects
Null hypotheses: No effects
Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	402.5897	4.912358	407.5021
	(0.0000)	(0.0267)	(0.0000)

Source: Data processed, 2017

Significance Test and Final Result

Therefore, in the case of fixed effect model, Wooldridge (2002) explained that if the time-series data (T) is much larger than cross-sectional data (N), the cross-sectional data can be held fixed while the time period can be growing annually. Below is the cross-sectional fixed effect in ASEAN countries;

Table 6: Cross-sectional Fixed Effect

BRN	-71504.34	SGP	-64077.96
IDN	-64931.59	THA	67595.78
MYS	7121.060	VNM	87125.52
PHL	38671.54		

Source: Data Processed, 2017

From Table 6, the individual effect of ASEAN countries are varying. Most countries have a positive effect to the pollution level. In the case of high-income countries such as Brunei and Singapore, they have a negative effect on pollution level. The interesting result is Indonesia has a negative effect to the pollution level.

Table 9: Significance test (F-test) output

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-77834.67	19132.14	-4.068267	0.0001
GDP	10.05696	2.704641	3.718407	0.0003
GDPSQ	-0.000187	3.66E-05	-5.100344	0.0000
INDVA	1.74E-06	6.48E-08	26.90030	0.0000
URB	4408.541	1726.097	2.554051	0.0116

Source: Data processed, 2017

The final estimation output using fixed effect model is;

$$CO2 = -77834.67 + 10.05696*GDP - 0.000187*GDPSQ + 1.74E\text{-}06*INDVA + 4408.541*URB + \alpha_i + \varepsilon_{it}$$

Based on Table 9, using the degree of freedom 5% (0.05), it has drawn that all of independent variables has a significant relationship to dependent variable. This output accepts the all of hypothesis stated in this study that GDP per capita and its quadratic transformation, value added of industry, and urbanization growth rate has a significant impact on domestic pollution level.

GDP per capita – CO2 Relationship in ASEAN Region

Gross Domestic Product per capita relationship to the pollution level is 10.05696. Viewed from the EKC theory, it is agreed hypothesis that equality of economic growth can trigger the increase of CO2 level. On the quadratic transformation perspective, there is a positive impact to the decrease of CO2 level. It is revealed on the coefficient value of GDPSQ that is accounted at 0.000187 point, which means if a country maintains the GDP per capita growth through years, in the future it will decrease about 187 tonne of CO2 per year.

This study has an output similar with the positive-negative coefficient pattern found by Onafowora and Owoye (2014), Abdouli and Hammami (2016), and Wang et.al (2015) who found the relationship between GDP and CO2 is inverted-U shape. However, it is rather different with Kahuthu (2009), which happened on the logarithmic form, not in the level form. This finding also concurs to EKC theory that the economic growth will decrease the pollution level if ASEAN counties can maintain their GDP per capita in the future years. About 187 tonne will decrease for every percent of economic growth in the future (while others independent variable remains catteries paribus), which this can be a good output. However, there is the doubt if those countries will focus to the greener economic activity. GDP per capita is the function of several variables in it, such as consumption expenditure, foreign investment, and the net trade. Thus makes explanation about GDP-pollution relationship is rather difficult and comprehensive.

Industrialization – CO2 Relationship in ASEAN Region

For the impact of industrial activity, a positive coefficient of the value added of industry scored at 1.74E-06 is obtained. It means that industrialization in ASEAN region will impact an increase of CO2 level on 1.74 centitonne. It is proved that selected ASEAN countries worsen the pollution level through high operation of industrial sector, although the amount is far from the expectation.

In the case of industrial activity, there is an example of Vietnam which has a high dependency on the industrial sector. Along with the increasing industrial output, Vietnam makes the domestic pollution level to worsen every year. Started from 1994, CO2 level in Vietnam is increasing toward depraved level. Until 2011, Vietnam industrial sector declined that made its pollution level decreased along.

Urbanization – CO2 Relationship in ASEAN Region

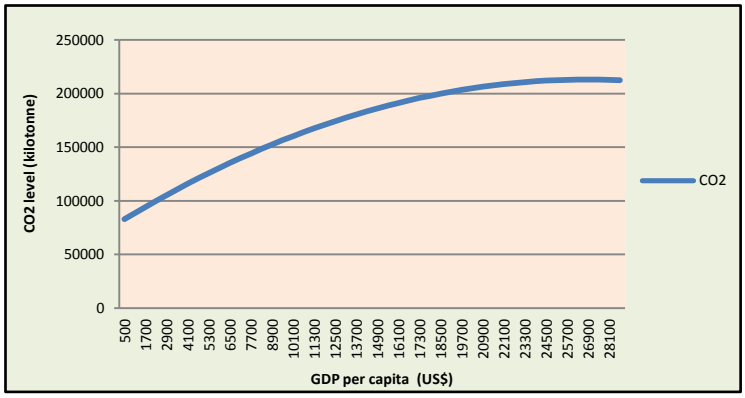
According to the estimation output, annual increase of urbanization growth will increase the CO2 level about 4408.541 point, which means that every percent of people in ASEAN countries who are moving to the city area, they will produce additional pollution around 4408.541 kilotonne. In this study, it is approved that urbanization variable does have a significant effect, yet it is close to the significance level. This output is consistent with Azam and Khan (2016) who found that urbanization is only significant for developed country, while the developing country have not significant relation. The same output also happens in Wang et.al (2015) who mentioned that urbanization-pollution relationship is not significant in China. If reviewing to the EKC theory, the spread of the population will create an impact if those people are consumptive and/or wok on the industrial sector.

As an example to prove the relationship, the urbanization growth in Thailand can increase the CO2 level in the late year, although in the later years, it seems not significant. This output thus accepting the result of significance test that depicts rather unconvincing impact of urbanization growth rate to the CO2 level. In Hettige et.al (2000), it stated similar argument that mentioned labor in developing countries generate not only pollution per unit, but also produce more per unit output in the same proportion. After all, there is possibility that different output can be gained between developing and developed countries.

Turning Point of EKC in ASEAN Region

Below is the depiction of hypothetical curve of EKC turning point in ASEAN region.

Figure 7: Hypothetical Environmental Kuznet Curve in ASEAN Region



Source: Data processed, 2017

In this study, the estimated turning point for all ASEAN countries is when GDP per capita achieved $26,890.27. In figure 4.4 above, the hypothetical curve of EKC is shown the estimated turning point. This point is already achieved by Brunei and Singapore. It is showed that they started to focus the economic development on the green tourism and green technology. For example, Singapore has many landmarks that intended not only to attract people, but also accommodating its narrow green area. Meanwhile for Brunei, they has focused on different economic sector rather than only focusing on petroleum manufacture, where they also maintaining the population thus make per capita income is scaling in the stabile level.

In this study, the use of GDP per capita will cause a disadvantage along with it, for example, significant differences is that the total population of each ASEAN countries. A country that has vast land area such Indonesia and Philippines is also having large population, which will decrease the level of GDP per capita.

There is a huge gap between populations of Indonesia with the other countries. Moreover, the total population of Indonesia was growing about 4,000,000 annually. Countries of Indonesia and Philippines will never reach the turning point if they cannot put more effort to control the birth rate and more flexible on the migration policy. Therefore, because of the high population, Indonesia also is the leading consumer of liquid fuel. Many people domestically have bought private vehicle and do not use the public transportation. This may cause a risk on the national oil reserve because it will deplete faster than before. This is the same condition with Thailand where many people use private vehicle. This condition is worsening when look into the low quality of public transportation on Thailand. Thus, policies such as birth rate limitation and/or fuel price reform along with tax abatement on vehicle transaction have a ability to control the increasing level of CO2 emission.

Environmental Kuznet Curve Analysis in Selected ASEAN Countries

Data panel analysis, especially fixed effect model, has included the individual heterogeneity to the equation. Wooldridge (2002) explained that individual effect can explain the proxy or the unobserved variable of panel data regression. Moreover, based on the topic of fixed effect model in Wooldridge's book, it can increase the robustness of the model because it is obligatory related to each explanatory variable.

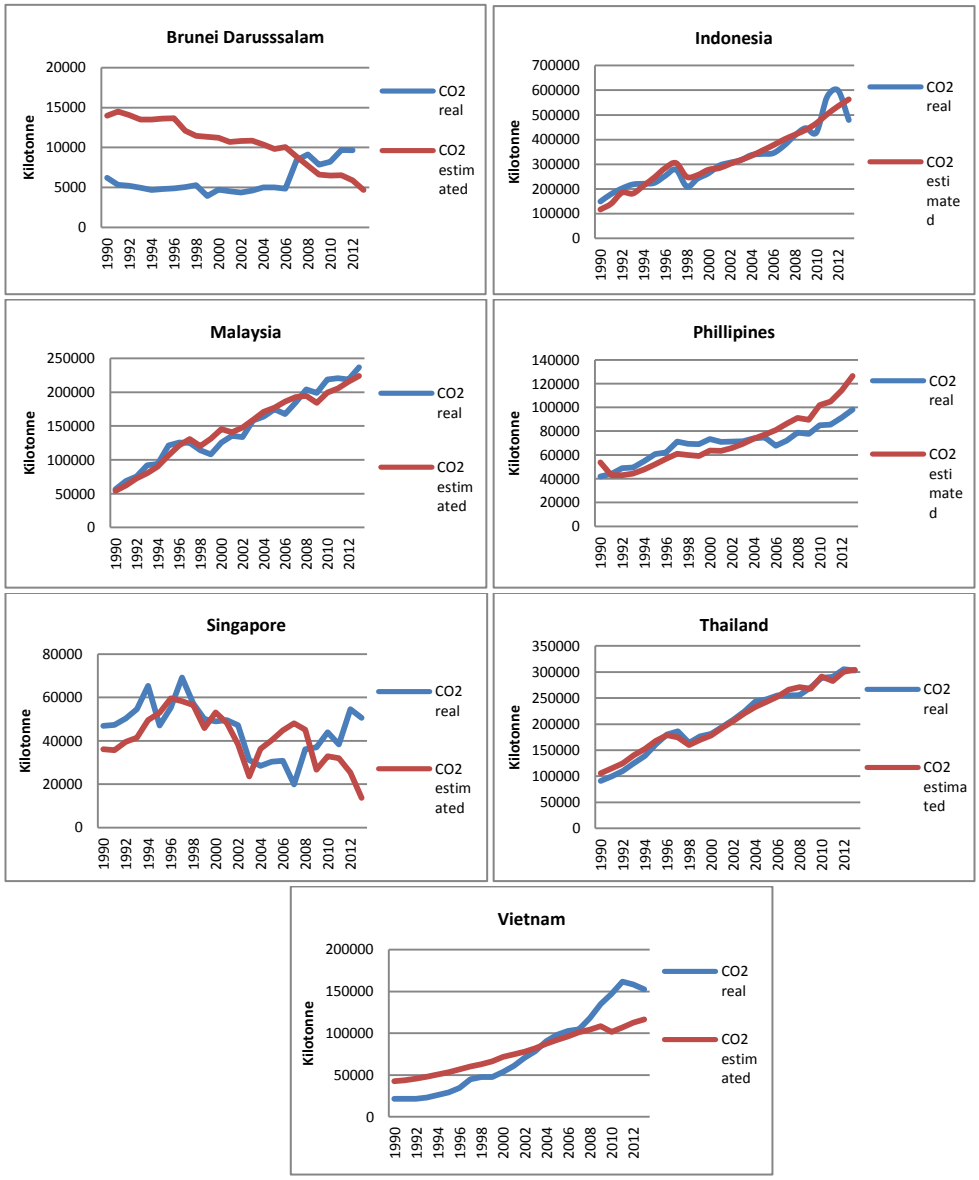
Based on Figure 8, it is clear that there is a gap between real value that comes from the World Bank's World Development Indicator and the predicted value using constant value of annual economic growth. This output is accepting Abou-Ali and Abdelfattah (2015) which they argue usage of dummy variable or individual effect will give a better picture concerning the performance of each individual. Additionally, reviewed from Markandya et.al (2006), they also use inter-country heterogeneity on individual country estimation.

Overall, it depicts that developing countries in ASEAN are still trapped in the first stage and the developed nations are moving toward the late stage, is in line with EKC theory. For the developed nations such as Brunei Darussalam and Singapore, are predicted to have a declining level of CO2. However, the real value of CO2 in both countries is progressing in late years. It is interesting because both governments in the two nations cannot maintain the trend happened in the early years.

For the developing countries, Indonesia and Thailand has a rather similar CO2 level as predicted. In case of Thailand, they almost reach the turning point because it depicted their late years. Meanwhile for Philippines, their CO2 level is below the predicted level start from year 2006. It is a good signal that the government starts to react to decreasing the impact of global pollution. Therefore, all developing nations in ASEAN are still trapped by the pollution intensive economy. This output is in line with the Environmental Kuznet Curve theory which stated that if a nation cannot distribute the economy equally on broad sector, government will only focus on the pollution intensive sector which will improve the economic output but increase the pollution level along with it.

Most of developing countries in ASEAN have done trade and investment liberalization to expand its economic activity which make total amount of pollution increase along with it. Furthermore, they mostly depend on the fossil energy, which then generate harmful pollutants to increase economic output. The economic growth trap maybe caused by the exception of integrated market policy in ASEAN which enacted from year 2016. The ASEAN Economic Society has an objective to increase the opportunity for all participated countries to develop their economic sector through international trade and international job availability.

Figure 8: Environmental Kuznet Curve in selected ASEAN Countries



Source: Data processed, 2017

E. CONCLUSION AND POLICY RECOMMENDATION

Conclusion

The conclusion of this study are:

1. All dependent variables are significant to determine the pollution level. It means that the hypothesis of the study is accepted and indicates that EKC theory exists in 7 ASEAN countries.
2. The amounts of CO2 caused by the increasing level of independent variables are varying.
   i. For the GDP per capita variable, there is a different between the real value and estimated quadratic value. On its original value, pollution level in ASEAN is worsening annually according to the increase of GDP per capita. Meanwhile, positive value is gained by the estimated quadratic value of GDP per capita.
   ii. In the case of industrialization, the growth in the industrial sector will lead to worse pollution level. However, the amount of CO2 produced from the industrial growth is rather not significant.

iii. Urbanization growth has a significant and rather major impact on the pollution level. Moreover, it produce bigger amount of CO2 pollution level than the industrialization factor. Thus, control on the population may lead to the better result rather than focus on industrial policy.

3. This study also found that the turning point on ASEAN countries happen when the annual GDP per capita is $26,890.27. However, not all of the countries can reach this level immediately because it needs constant annual economic growth and better institutional policy.
4. Brunei Darussalam and Singapore are having a positive goodwill on repair and reserve the environment. Their income level surpassed the turning point level. However, different condition happen in much of developing countries in ASEAN region, where countries like Malaysia, Indonesia, and Vietnam still trapped in environmental decay phase because their pollution level is increasing annually. One case, trend in Thailand is slightly different where in the late years they manage to flatten the CO2 increase level.

Recommendation

Government must increase annual growth of Gross Domestic Product per capita because when the increase value will indicate better income equality. Several fiscal and monetary policies can also be taken by the government to accommodate environmental aspect;

a. Transfer of knowledge on the basic sector such agriculture and forestry will help much of the production time. This transfer can decrease the time of reforestation of the endangered forest area and also the cost of endangered animal conservation.
b. Improving the output of new sector such as creative economy sector can also be internalized as it will develop the variation of production, cut the promotion budget, and increase the income level of through rapid productivity and uniqueness.
c. Tax abatement is also possible to be enacted by the government. In this case, ASEAN government can adapt the environmental tax to be put into the environmental strategy because it is more efficient rather than to do limitation and other budgetary policy. In the case of industrializattion, both upstream and downstream industries also needs to abate tax to increase government reserve.
d. Another policy is to arrange the rule of Corporate Social Responsibility (CSR). Mutual agreement should be more preferring to the environment sustainability and benefiting government actions.
e. Additionally, green development on the industry sector can be done if the government more oriented to the renewable resource power plant. If ASEAN can take this advantage with building renewable power plant, they will lose some environmental tradeoff from the economic activity. It is obvious that industrial sector improvement be gained through the agreement and joint cooperation with developed countries, as United State of America or Germany.
f. Transmigration or birth control is one of the examples. In this case, countries that have vast land area such as Indonesia will gain advantage because the population is indirectly increase the income when new economic zone has been built.

Finally, this study acknowledges many weaknesses in data analysis method such as inefficient statistical analysis, and the existence of data disturbance. Various statistical analysis of this topic is also wide open. Hopefully, there are further researches on sustainable policy in ASEAN countries which can lead to a better social and economic standard.

BIBLIOGRAPHY

Abdouli, M., & Hammami, S. (2016). Economic growth , FDI inflows and their impact on the environment : an empirical study for the MENA countries. *Quality & Quantity*. http://doi.org/10.1007/s11135-015-0298-6

Abou-ali, H., & Abdelfattah, Y. M. (2013). Integrated paradigm for sustainable development : A panel data study ☆. *Economic Modelling*, *30*, 334–342. http://doi.org/10.1016/j.econmod.2012.09.016

Alstine, J. Van, & Neumayer, E. (2010). The environmental Kuznets curve. In E. Elgar (Ed.), *Handbook on trade and the environment* (pp. 49–59). Cheltenham, UK: LSE Research Online. Retrieved from http://eprints.lse.ac.uk/30809/

Andreoni, J., & Levinson, A. (2001). The simple analytics of the environmental Kuznets curve. *Journal of Public Economics*, *80*(2), 269–286. http://doi.org/10.1016/S0047-2727(00)00110-9

Azam, M., & Khan, A. Q. (2016). Testing the Environmental Kuznets Curve hypothesis: A comparative empirical study for low, lower middle, upper middle and high income countries. *Renewable and Sustainable Energy Reviews*, *63*, 556–567. http://doi.org/10.1016/j.rser.2016.05.052

Baumgärtner, S., & Quaas, M. (2009). *What is sustainability economics?* (Working Paper Series in Economics No. 138). *American Literary History*. Retrieved from http://hdl.handle.net/10419/30222

Cole, M. A. (2004). Trade, the pollution haven hypothesis and the environmental Kuznets curve : examining the linkages, *48*, 71–81. http://doi.org/10.1016/j.ecolecon.2003.09.007

Copeland, B. R., & Taylor, M. S. (2004). Trade, Growth and the Environment. *Journal of Economic Literature*, *42*(1), 7–71. http://doi.org/10.1257/002205104773558047

Costanza, R., Cleveland, C., & Perrings, C. (1999). The Development of an Ecological Economics. *Journal of Business Administration and Policy Analysis*, (February), +87.

Dinda, S. (2004). Environmental Kuznets Curve Hypothesis: A Survey. *Ecological Economics*, *49*(4), 431–455. http://doi.org/10.1016/j.ecolecon.2004.02.011

Esty, D. C. (2001). Bridging the Trade-Environment Divide. *Journal of Economic Perspectives*, *15*(3), 113–130. http://doi.org/10.1257/jep.15.3.113

Fullerton, D., Leicester, A., & Smith, S. (2008). *Environmental taxes* (No. 14197). *NBER WORKING PAPER SERIES* (Vol. 13). Cambridge, MA 02138. Retrieved from http://www.nber.org/papers/w14197

Grossman, G. M., & Krueger, A. B. (1991). Environmental Impacts of a North American Free Trade Agreement (No. 3914). *National Bureau of Economic Research Working Paper Series*. Cambridge, Massachusets: National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w3914

Halkos, G., & Paizanos, E. (2015). Environmental Macroeconomics: A critical literature review and future empirical research directions George. *Business*, (67432). Retrieved from https://mpra.ub.uni-muenchen.de/67432/

Hettige, H., Mani, M., & Wheeler, D. (2000). Industrial pollution in economic development : the environmental Kuznets curve revisited, *62*.

Kahuthu, A. (2006). Economic growth and environmental degradation in a global context. *Environment, Development and Sustainability*, *8*(1), 55–68. http://doi.org/10.1007/s10668-005-0785-3

Karki, S. K., Mann, M. D., & Salehfar, H. (2005). Energy and environment in the ASEAN: Challenges and opportunities. *Energy Policy*, *33*(4), 499–509. http://doi.org/10.1016/j.enpol.2003.08.014

Markandya, A., Golub, A., & Pedroso-Galinato, S. (2006). Empirical Analysis of National Income and SO 2 Emissions in Selected European Countries, 221–257. http://doi.org/10.1007/s10640-006-9014-2

Munda, G. (1997). Environmental economics, ecological economics, and the concept of sustainable development. *Environmental Values*, *6*(2), 213–233. http://doi.org/10.3197/096327197776679158

Onafowora, O. A., & Owoye, O. (2014). Bounds testing approach to analysis of the environment Kuznets curve hypothesis. *Energy Economics*, *44*, 47–62. http://doi.org/10.1016/j.eneco.2014.03.025

Pindyck, R. (2006). Uncertainty in Environmental Economics. *Review of Environmental Economics and Policy*, *6*(17), 45–65. http://doi.org/10.1007/s13398-014-0173-7.2

Stern, D. I. (2004). The Rise and Fall of the Environmental Kuznets Curve. *World Development*, *32*(8), 1419–1439. http://doi.org/10.1016/j.worlddev.2004.03.004

Stern, N. (2006). What is the economics of climate change? *World Economics*, *7*(2), 1–10. http://doi.org/10.1257/aer.98.2.1

Wang, Y., Han, R., & Kubota, J. (2016). Is there an Environmental Kuznets Curve for SO2 emissions? A semi-parametric panel data analysis for China. *Renewable and Sustainable Energy Reviews*, *54*, 1182–1188. http://doi.org/10.1016/j.rser.2015.10.143

Wooldridge, J. M. (2002). Econometric Analysis of Cross Section and Panel Data. *Booksgooglecom*, *58*(2), 752. http://doi.org/10.1515/humr.2003.021

Yandle, B., Vijayaraghavan, M., & Bhattari, M. (2002). The Environmental Kuznets Curve, A Primer. *PERC Research Study*, *2*(1), 1–24. http://doi.org/10.1016/j.econlet.2005.03.00