

CHAPTER 2

Literature Review and Theory

2.1 Theory

The theory concerning this study will be explained in two ways. They are an environmental theory, economic growth theory and econometric theory.

2.1.1 Environmental Theory

The most influential three theories contained in nowadays. These theories are first formally environmental literature in the work of English economists who lived between the late 18th and 20th centuries. These theories are the Malthusian theory, John Stuart Mill's theory and Neoclassical Theory. Each theory has something different to contribute and, together they present a comprehensive scheme for solving environmental problems.

The basic Malthusian theme of increasing resource scarcity was modified to present a modern, neo-Malthusian perspective. Thus, in addition to the traditional population concerns, would calamity could result from environmental degradation which also diminished the natural resource base. Neo-Malthusian concerns were evident in Paul Ehrlich's (1968) best-selling book *The Population Bomb*. The book claimed that there were too many people on the earth, and because of a decrease in the doubling time of population growth, the situation was worsening every day. The environment would deteriorate, as humanity used more fertilisers and pesticides, cleared forests, increased the siltation of streams, encountered the greenhouse effect and engaged in nuclear warfare. The Malthusian theme in the post-Rachel Carson literature was found in the Club of Rome-sponsored study 'The Limits to Growth' (1972). The study used an MIT based computer model which had several scenarios of future world resource stocks and population. Increasing population and industrial production in grim

Malthusian fashion would severely outstrip limit natural resources thus crashing human civilisation. In their attempt to save the human race, the researchers devised and fed to the model other more optimistic alternative future scenarios, but the outcome was always the same. At some point during the 21st century natural resource stocks would drop, followed by a dramatic population decline.

Neoclassical economics had largely discarded Mill's theory of the steady state economy. Mill forecast that an increase in human population and human population wealth could not continue in perpetuity. Mill's had a heart and a mind to make intelligent choices which might involve denial of material needs. Mill assumed that the stationary state would be eventually reached where both population and consumption were being stabilised at the level of the stationary state. In 1973, economist Herman Daly published an article titled "The Steady State Economy" acknowledging John Stuart Mill as his intellectual forerunner. In place of economic growth, Daly like Mill recommended moral growth where anxiety about material trappings was replaced with a concern for some higher and greater good.

Neoclassical economists made some significant contributions to environmental theory during the 1950's. In particular, they had come to recognise the common property nature of much environmental as the cause of many economic externalities. Since the oceans, and the atmosphere belonged to everyone hence to no one they were freely exploitable. The common property then was seen as a type of market failure which could reduce social well-being. Modern neoclassicist has been able to bring practical skills to environmental matters. They have been able to suggest specific methods of analysis to determine the economic importance of environmental damage, to examine the trade-offs required to control losses and also to suggest specific policy instruments for reducing damages. These mainstream economists will continue to provide essential information to elected officials who must draft and vote on environmental legislation.

2.1.2 Economic growth Theory

Economic growth is the increase in the goods and services produced by an economy, typically a nation over an extended period. It is measured as the percentage increase in real gross domestic product (GDP) which is gross domestic product adjusted for inflation. Gross Domestic Product is the market value of all final goods and services

produced in an economy or nation. The three main types of economic growth theories over time have all attempted to answer that question. Economic growth theories are concerned with (1) the factors that determine potential economic growth, (2) the interdependence of the macroeconomic categories that ensure stable economic growth and (3) the manner in which steady growth is achieved that is whether it is achieved automatically or can only be guaranteed through state intervention. The rate of economic growth refers to the geometric annual rate of increase in GDP between the first and the last year over a period. Implicitly, this rate of growth is the trend in the average level of GDP over the period, which implicitly ignores the fluctuations in the GDP around this trend. An increase in economic growth caused by the more efficient use of inputs is referred to as fast growth.

2.1.3 Econometric Model

In this study, the variables GDP, and urban populations are applied as key factors affecting CO₂ emission. We can express the relationship applying the following functional form between CO₂ emission and economic growth (GDP) as follows;

$$CO_2 = f(GDP, URB) \quad (1)$$

CO₂ is Carbon dioxide emission (metric tons per capita), and GDP is GDP per capita (constant LCU), URB is Urban Population (Number of the population). We decompose overall CO₂ emissions in emission based on gas fuel consumption (e.g. natural gas) Liquid fuel consumption (e.g., petroleum) and solid fuel consumption (e. g coal or fuel woods). GDP is per capita income measured in constant LCU. We use the level of utilisation to explain where consumption of different fuel types can take place. For instance, it is more likely that people use more cars or natural gas heaters, in urban settings. To examine the relationship between CO₂ emission and Economic growth by using such as Augmented Dickey Fuller unit root test and, Johansen cointegration test under the Vector Error Correction (VEC) models. By using the first difference transformation to tackle the non-stationary issue the variables can be stationary.

2.1.3.1 ADF test

Named for American statisticians David Dickey and Wayne Fuller developed the test in 1979. Using the Dickey-Fuller test is to determine whether a unit root. This feature showed that the issues causes in statistical inference and is present in an autoregressive model. The formula was appropriated for trending time series like asset prices. It is the simplest approach to test for a unit root, but most economic and financial times series have a more complicated and dynamic structure than can be captured by a simple autoregressive model, which is where the augmented Dickey-Fuller test comes into play. The Augmented Dickey-Fuller statistics used in the ADF test is a negative number, and the more negative it is, the stronger the rejection of the hypothesis that there is a unit root. Of course, this is only at some level of confidence. In this study, we employ the Augmented Dickey-Fuller (ADF).

The ADF test requires the equations as follows;

$$\Delta X_t = \beta_0 + \beta t + \theta X_{t-1} + \sum_{i=1}^m U_t \Delta X_{t-i} + \epsilon_t \quad (2)$$

Where Δ is the difference operator, x is the series being tested, m is the number of lagged differences and ϵ is the error term. The null hypothesis is unit root, and the alternative hypothesis is level stationary. If the coefficient of the lag $X_{t-1}(\theta)$ is significantly different from zero, the null hypothesis is rejected.

2.1.3.2 Johansen cointegration test

The cointegration test is used to check the presence of a long-run relationship among the selected economic and financial variables. Gonzalo and Granger (1995) point out that the evidence of cointegration among national stock-market indices implies equilibrium constraints, which prohibit the cointegrated stock-market indices from diverging too much in the long run. This is because the indices share common stochastic trends or the same driving forces over the period. The absence of cointegration indicates that within the stock market there is no long-run relationship. Many prior studies show that an extensive sample period is necessary to discover a co-integration connection in the long run. In maximum likelihood, two nested models may also be compared, but the comparison involves different statistics. One major test is the likelihood ratio test (LRT). Here, we have two models, term the “full” model and the “reduced” model. To meet the requirement of nested models, all of the parameters in the reduced model must

be contained in the general model. The parameters of the full model that are not estimated in the reduced model are called “fixed” parameters and are usually set to a value of 0. Let $L(x)_f$ and $L(x)_r$ denote the log likelihoods of, respectively, the full and the reduced models. Let p_f and p_r denote, respectively, the number of parameters in the full and reduced models. The likelihood ratio test is

$$LRT = 2(L(x)_f - L(x)_r) \quad (3)$$

The two statistics are the Akaike information criterion usually abbreviated as AIC (Akaike, 1974) and Schwarz’s criterion (Schwarz, 1978). For a model with p parameters and a data set with N total observations, their respective formulas are

$$AIC = -2 \ln(L(x)) + 2p \quad (4)$$

$$SC = -2 \ln(L(x)) + \ln(N) \quad (5)$$

Note that the equations differ only in the weight assigned to the number of parameters for the LR χ^2 . When a series of models are fitted to data, the one with the lowest AIC or lowest SC is preferred.

2.1.3.3. VECM model

The vector error correction model is designed to estimate the dynamic adjustments of the first difference of variables. VECM can be only if the variables used in the system are found to be cointegrated. A simple VEC term can be expressed as

$$\Delta y_t = \beta_0 + \beta_1 \Delta y_{t-1} + \dots + \beta_n \Delta y_{t-n} + \gamma_1 \Delta x_{t-1} + \dots + \gamma_n \Delta x_{t-n} - \lambda_y (y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + V_t^y \quad (6)$$

$$\Delta x_t = \beta_0 + \beta_1 \Delta y_{t-1} + \dots + \beta_n \Delta y_{t-n} + \gamma_1 \Delta x_{t-1} + \dots + \gamma_n \Delta x_{t-n} - \lambda_x (y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + V_t^x \quad (7)$$

2.1.3.4 Impulse response function

The basic tool used in this study is a simple one, widely employed in other fields.

$$YY_{tt} = AA_0 + AA_1 YY_{tt-1} + \varepsilon \varepsilon_{tt} \quad (8)$$

Where $YY_{tt} = [yy_{1tt} \dots yy_{nnt}]; \varepsilon\varepsilon_{tt} = [\varepsilon\varepsilon_{1tt} \dots \varepsilon\varepsilon_{nnt}]$ is a vector. Consider the one step ahead forecasts of $yy_1 \dots yy_n$ formed in period t

$$YY_{tt+1} = AA_0 + AA_1 YY_{tt} + \varepsilon\varepsilon_{tt+1} \quad (9)$$

Similarly,

$$YY_{tt+2} = AA_0 + AA_1 YY_{tt+1} + \varepsilon\varepsilon_{tt+2} \quad (10)$$

The impulse response functions for the unconstrained or reduced form VAR are not very interesting, but it is still of some interest for future reference to consider how to calculate these functions.

$$1 = YY_{tt} = AA_0 + AA_1 YY_{tt-1} + \varepsilon\varepsilon_{tt} \quad (11)$$

$$2 = YY_{tt+1} = AA_0 + AA_1 YY_{tt} + \varepsilon\varepsilon_{tt+1} \quad (12)$$

These impulse response functions are not very interesting because the $\varepsilon\varepsilon$'s are reduced form shocks which do not have clear economic content and because they can be contemporaneously correlated with one another so that the simulation experiments do not make much sense. Structural VAR propose ways to restrict VAR so that these kinds of exercises are meaningful.

2.2 Literature Review

Numerous studies have examined the relation among CO₂ emission energy consumption and economic growth. **SeetanahBoopen and SannasseeVinesh (2008)** studied “On the relationship between CO₂ emission and economic growth” during 1975 to 2009. The variables are investment ratio, GDP, Education level, population level. The VAR model is used in this paper. The finding of result showed that the economic and human activities are having increasingly negative environmental impacts on the country relative to their economic prosperity. **Shehryar Rashid (2009)** studied ‘The environmental Kuznets curve case for the USA and the BRIC countries’ during 1981-2006. Using variable is CO₂, GDP per capita. The parametric model is used. The result showed that the standard for environmental improvement is lower for BRIC countries than the USA. **AviralKumarTiwari (2011)** studied “Energy consumption, CO₂ emissions and economic growth in India” over during 1971-2007. The variables are CO₂, GDP, and Energy use. The VECM model is used. The finding of this research showed that Energy Consumption on CO₂ emission and GDP per capita have a positive impact

but its impact is negative on capital and population. **Vardakas Evangelia (2012)** investigate that “The relationship between CO₂ emissions and economic growth in U.S over the period 1960 to 2008”. The variables are CO₂ and GDP per capita. In this research, ADF, PPP Test, VAR and VEC model are used. The finding of result showed that CO₂ emissions do not affect GDP per capita either a long run or short term. **Mustafa Saatci and Yasemin Dumrul (2013)** studied the “Relationship between Energy consumption and Economic growth in Turkey”. They investigated energy use, economic growth by using cointegration test with structural breaks Turkey during 1960 to 2008. Using variables are CO₂, GDP per capita, and Energy use. The finding of this research was that Turkey’s energy consumption and economic growth has a positive relationship varying quantity with structural breaks. **Jo-Hui Chen and Yu-Fang Huang (2013)** studied the “Relationship between Carbon Dioxide (CO₂) Emissions and Economic growth” over the period 1981-2009. The empirical analysis is based on panel unit roots co integration in the heterogeneous panel and panel causality tests. The result showed that there is a positive relationship among CO₂, Energy use, Electric power, and GDP per capita. **Faridul Islam, Muhammad Shahbaz (2013)** studies “Is there an Environmental Kuznets Curve for Bangladesh during 1971-2010”. CO₂, EC, GDP per capita are used as variables in this research. The result shows that energy consumption is a major contributor to CO₂ emissions trade openness lower CO₂ emissions but urbanisation worsens it.

Sahbi Farhani, Sana Mrizak, Anissa Chaibi (2013) studies on “The environmental Kuznets curve and sustainability in MENA countries” during 1990-2010. These variables are CO₂, EC, GDP per capita, TOT. The studies of result showed that there is inverted U shape relationship between sustainability and human development. **Jo-Hui Chen and Yu Fang Huang (2014)** studied on “Nonlinear environment and economic growth nexus” during 1985-2012. Using variables is CO₂, GDP per capita in this research. The result showed that the CO₂ emissions, Oil consumption, gas consumption and coal consumption are a positive relationship.

Raft Kasperowicz (2015) studied the “Economic growth and CO₂ emissions” during 1995-2012). Using the variables GDP per capita, and CO₂ emissions, the VECM model, is used. The empirical result showed that the long run relationships between GDP

per capita and CO₂ emissions are negative. **Mesut Bahbey (2015)** studied the “Relationship among CO₂ emissions, Economic growth and Foreign Direct Investment and the environmental Kuznets curve hypothesis in Turkey over 1974 to 2011”. The variables are GDP, FDI, CO₂. The findings of result indicated that in the long run foreign direct investment affects CO₂ emissions. **Dinh Hong Linh and Shih Molio (2015)** studied “CO₂ emissions Energy Consumption, Economic Growth, FDI in Vietnam during 1980 to 2010”. In this research, the variables are CO₂, economic growth, Energy consumption, FDI used. The finding of result indicated that the four bi-directional causality relationship in the long run between CO₂ and income, energy utilisation and revenue, power consumption and FDI, and revenue and FDI. **Rossazana Ab Rahim and Teoh Xin-Di (2015)** studied “The determinants of CO₂ emissions in ASEAN+3 countries.” during the period of 1991 to 2012. Using variables are CO₂, ENE, GDP per capita, and Urbanization. This result of paper indicated that there is a long run relationship between CO₂ emission, Energy, and economic growth.

Ojewumi, Johnson, Sunday (2015) studied “Environmental Kuznets curve hypothesis in Sub-Saharan African countries during 1980-2012.” These variables are CO₂, GDP per capita. The result indicated that EKC is invalid for the selected countries of SSA some pollutant but valid for other. **Goh Han Hwa, You Huili, Tansu Hong (2016)** studied “A panel study of the EKC for Carbon Emissions in ASEAN 5 countries during 1981-2010”. GDP per capita, CO₂, Trade openness, and FDI are used in this research. The result indicated that the relationship between economic growth and CO₂ emissions exists in inverted S shape both short and long run for ASEAN countries.

Vijayalaxmi D Khed (2015) studied the “Nexus of economic growth and environmental degradation in India EKC approach” during the period of 1991-2014. In this research, CO₂, GDP per capita, FDI, Population density are used. The EKC hypothesis has failed to explain the inverted relationship between per capita CO₂ emissions and per capita GDP in India.

Manuel Arianna, Zambarano Troccolo, Monserrate Quiroz (2016) studied “Testing the EKC hypothesis in Iceland during 1960-2010”. Using variables are CO₂,

GDP per capita, and Trade oppresses. The result indicated that there is a significant direct relationship between consumption energy and CO₂ emission in both short and long run.

Table 2.1: Summary of Literature Review

Author	Title	Variables	Sources of data	Methodology	Results
Seetnah Boopen and Sannasee Vinesh (2008)	On the relationship between CO ₂ Emissions and economic Growth. (1975-2008)	CO ₂ , GDP, EMP, SER	World bank database	VAR model	The result showed that economic and human activities are increasing negative.
Shehrya Rashid (2009)	The EKC case for USA and BRIC countries . (1981-2006)	CO ₂ , GDP per capita	World bank database	Parametric model	The result indicated that the standard of BRIC countries for environmental improvement is lower than US.
Aviral Kumar Tiwari (2011)	Energy Consumption CO ₂ emission and Economic Growth in India .(1971-2007)	CO ₂ , Energy use, GDP	World bank database	VAR model	The empirical result described that energy consumption has positive impact.

Table 2.1: Summary of Literature Review (Continued)

Author	Title	Variables	Sources of data	Methodology	Results
Varakaglia (2012)	The relationship between CO ₂ emissions and economic growth in U.S. (1960-2008)	CO ₂ ,GDP	World bank Data base	VAR and VECM model, ADF,KPSS PP Perron test	The result indicates that the relationship between CO ₂ emission and economic growth.
Mustafa SAATCI, Yasemin DUMUL (2012)	The relationship between energy consumption and economic growth in Turkey. (1960-2008)	GDP,ENE OIL COAL, ELE, RENEW	World bank Data base	Unit root test ,Co integration test VECM model	The empirical result indicated that the energy Consumption and economic growth has a positive relationship.
Jo-Hui Chen and Yu-Fan Huang (2013)	The study of the relationship between CO ₂ emission and Economic growth. (1972-2014)	CO ₂ , GDP, EU,FDI, URB	World bank Data base	Panel unit root test, and Granger causality test VEC model	This study verifies that there are positive long run relationship among CO ₂ and economic growth.

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Table 2.1: Summary of Literature Review (Continued)

Author	Title	Variables	Sources of data	Methodology	Results
Faridul Islam Muhammad Shahbaz (2013)	Is there an environmental Kuznets curve for Bangladesh. (1971-2010)	CO ₂ , EC, TOT, POL, GDP per capita	World bank database	ARDL model	The result showed that Energy consumption is major contribution to CO ₂ emissions.
Sahbi Farhani, Sana Mrizak (2013)	The environmental Kuznets curve and Sustainability in MENA countries. (1990-2010)	CO ₂ , GDP per capita, EC, Trade	World bank development indicator	FMOLS, DOLS test	The result indicate that the EKC is U shape between sustainability and human activities.
Janifar Alam (2014)	The relationship between economic growth and CO ₂ emissions in Bangladesh. (1972-2014)	CO ₂ , GDP per capita	World bank development indicator	ADF test VAR model	The study of result showed that relationship between economic growth and CO ₂ emission are positive.

Table 2.1: Summary of Literature Review (Continued)

Author	Title	Variables	Sources of data	Methodology	Results
JoHui Chen YuFang Huang (2014)	Nonlinear environment and economic growth nexus (1985-2012)	CO ₂ , GDP per capita	World development indicator	RSTR model	The result indicate that the significant positive correlation exist CO ₂ emissions.
Rafael Kaspero wiz (2015)	Economic growth and CO ₂ emissions. (1995-2012)	Energy consumption on economic growth and CO ₂	Eurostat data base	Panel analysis and ECM analysis	The empirical result that long run relationship between GDP and CO ₂ emissions is negative.
Mesult bahbey (2015)	Relationship among CO ₂ , Economic Growth and foreign direct investment and environmental Kuznets curve in Turkey. (1974-2011)	GDP, CO ₂ , FDI	World bank Database	Panel unit root test Panel co integration test, Granger causality test	This study showed that the long relationship between GDP and CO ₂ emission and foreign investment.

Table 2.1: Summary of Literature Review (Continued)

Author	Title	Variables	Sources of data	Methodology	Results
DinhHongLinh and Shi Molin (2015)	CO ₂ emission Energy Consumption Economic growth and FDI in Vietnam. (1980-2010)	CO ₂ , GDP FDI, ENE	World bank Database	Panel unit root test Panel cointegration test, Granger causality test	The result showed that long-run relationship between CO ₂ and economic are negative.
RossazanaAb-Rahim Teoh Xin-Di (2015)	The determinants of CO ₂ Emissions in ASEAN+3 Countries. (1991-2012)	CO ₂ , GDP, ENE, URB, Trade,	World bank Database	Panel unit root test and cointegration test	The result indicate that the long run relationship between CO ₂ , GDP and energy.
Ojewumi, Johnson Sunday (2015)	Environmental Kuznets curve hypothesis in SSA countries. (1980-2012)	CO ₂ , GDP per capita	World bank Database	Panel unit root and cointegration test	The result shows that the EKC is invalid for pollutant.

Table 2.1: Summary of Literature Review (Continued)

Author	Title	Variables	Sources of data	Methodology	Results
DinhHongLinh and Shi Molin (2015)	CO ₂ emission Energy Consumption Economic growth and FDI in Vietnam. (1980-2010)	CO ₂ , GDP FDI, ENE	World bank Database	Panel unit root test Panel cointegration test, Granger causality test	The result showed that long-run relationship between CO ₂ and economic are negative.
RossazanaAb-Rahim Teoh Xin-Di (2015)	The determinants of CO ₂ Emissions in ASEAN+3 Countries. (1991-2012)	CO ₂ . GDP, ENE, URB, Trade,	World bank Database	Panel unit root test and cointegration test	The result indicate that the long run relationship between CO ₂ ,GDP and energy.
Ojewumi , Johnson Sunday (2015)	Environmental Kuznets curve hypothesis in SSA countries. (1980-2012)	CO ₂ , GDP per capita	World bank Database	Panel unit root and cointegration test	The result shows that the EKC is invalid for pollutant.

Table 2.1 :Summary of Literature Review (Continued)

Author	Title	Variables	Sources of data	Methodology	Results
Vijayala xmi D Khend (2015)	Nexus of economic growth and environmental degradation in India EKC approach . (1991-2014)	CO ₂ , GDP per capita, FDI, POL	World bank Database	Non Linear Model	The finding show that the EKC is U shaped between CO ₂ and GDP per capita.
Manuel AriannaZ ambaran a , Monserrata (2016)	Testing the EKC hypothesis in Iceland . (1960-2010)	CO ₂ ,EC, GDP per capita, Trade openness	World bank Database	ARDL model	The result showed that Energy consumption and CO ₂ emission are both short and long run relationship.
Goh HanHwa, YouHui Li (2016)	A panel study of the EKC for carbon emission in ASEAN 5 countries .(1981-2010)	GDP per capita, CO ₂ , FDI,TOT	World bank Database	PVECM model	The result showed that the EKC is S shape between CO ₂ and economic growth.



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