Faculty of Economics and Business

THE EFFECT OF ECONOMIC GROWTH AND ENERGY CONSUMPTIONS TOWARDS CARBON DIOXIDE EMISSIONS FOR DEVELOPED AND DEVELOPING COUNTRIES IN ASIA

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Statement of Originality

The work described in this Final Year Project, entitled
"**The Effect of Economic Growth and Energy Consumptions towards Carbon Dioxide Emissions for Developed and Developing Countries in ASIA**"
is to the best of the author's knowledge that of the author except
where due reference is made.

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ABSTRACT

THE EFFECT OF ECONOMIC GROWTH AND ENERGY CONSUMPTIONS TOWARDS CARBON DIOXIDE EMISSIONS FOR DEVELOPED AND DEVELOPING COUNTRIES IN ASIA

By

Thanes Raj Padmanathan

The general objective of this paper is to examine the relationships between carbon dioxide emissions, economic growth and energy consumptions for developed (Singapore and Japan) and developing (Indonesia and Thailand) countries in Asia by using times series data for the period 1971-2013 at the annual data. The unit root tests, cointegration test and Vector Error Correction Model test are conducted in this study. This study found that the cointegration relationship exists in Japan, Indonesia and Thailand only. Furthermore, energy consumption is identified to be a significant variable in determining the carbon dioxide emission for Japan, Indonesia and Thailand. Besides, the square of RGDP is included to identify the existence long run relationship in Environmental Kuznets Curve (EKC), which results in an inverted U-curve relationship for Japan and Thailand, whereas Indonesia is a U-curve relationship. Economic growth play an important role in determines causality for Indonesia, Thailand and Singapore. Overall, to reduce carbon dioxide emission and to increases energy efficiency, sustainable conservation policies need to be implemented to abate unnecessary energy wastage thus increases economic growth.

ABSTRAK

KESAN PERTUMBUHAN EKONOMI DAN PENGGUNAAN TENAGA TERHADAP PEMBEBASAN KARBON DIOKSIDA UNTUK NEGARA-NEGARA MAJU DAN MEMBANGUN DI ASIA

Oleh

Thanes Raj Padmanathan

Kajian ini dijalankan untuk menyiasat hubungan antara pembebasan karbon dioksida, pertumbuhan ekonomi dan penggunaan tenaga untuk negara-negera maju (Singapore dan Japan) dan membangun (Indonesia dan Thailand) di ASIA dalam tempoh 1971 hingga 2013. Kaedah yang digunakan adalah ujian kepegunan, ujian kointegrasi dan *Vector Error Correction Model*. Kajian ini mendapati bahawa wujudnya hubungan kointegrasi di negara Jepun, Indonesia dan Thailand sahaja. Tambahan pula, penggunaan tenaga merupakan salah satu pemboleh ubah yang signifikan untuk menentukan pembebasan karbon dioksida bagi negara Jepun, Indonesia dan Thailand. Selain itu, pembolehubah RGDP kuasa dua dimasukkan dalam kajian ini bagi mengenalpasti samaada wujudnya hubungan jangka panjang dalam *Environmental Kuznets Curve (EKC)*. Keputusan mendapati wujudnya hubungan keluk sonsangan-U bagi Jepun dan Thailand, manakala hubungan keluk-U bagi Indonesia. Pertumbuhan ekonomi juga adalah penting untuk menentukan sebab-musabab bagi Indonesia, Thailand dan Singapura dalam hubungan jangka pendek. Secara keseluruhan, untuk mengurangkan pembebasan karbon dioksida dan meningkatkan kecekapan tenaga, dasar pemulihan yang lestari diwujudkan dalam mengurangkan pembaziran tenaga dapat meningkat pertumbuhan ekonomi negara.

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INTRODUCTION

1.0 Introduction

The Intergovernmental Panel on Climate Change (2011) report puts forward the fact that the most important issues or environmental problem in this modern era is global warming. In the last three decades, the increase in greenhouse gases emissions is a major threat of global warming and climate change has been the big deal from developing countries to developed countries for the all societies. Besides, there has been some growing concerned over the method of 'low carbon and green growth (Hwang & Yoo, 2014). The economic growth of the developed countries impels intensive use of energy and other natural resources which will result of emission that could lead to environmental degradation. This issue has been argued by the developing and underdeveloped countries that any restriction on carbon energy would impede economic growth and them also suggested that developed countries should raise funds to mitigate global warming for the developed countries activities (Hwang & Yoo, 2014).

According to United Nations Framework Convention on Climate Change (UNFCCC), the definition of carbon dioxide (CO_2) is a colourless, odourless and non-poisonous gas formed by combustion of carbon and the respiratory gases of living organisms and is considered as greenhouse gases. While the emissions mean the release of greenhouse gases or their precursors into the atmosphere over a specified area at a period of time. Carbon Dioxide emissions have grown dramatically in the past century because of human activities, mainly by the use of

fossil fuels as well as changes in land, such as the burning of coal, oil and gas increased along with growing industrialization and transport. Emissions rose particularly quickly after the Second World War. Around 1900 emissions of carbon dioxide were about 10,000 kilotons a year. They peaked at just over 90,000 kilotons a year in the early 1970s (UNFCCC, n.d.). Carbon dioxide (CO_2) is regarded to be the main source of greenhouse effect and has captured great attention in recent years and has directly linked with economic growth and developments.

CO_2 emission is one of the many environmental indicators used in past research. Over the years, the level of CO_2 emission in the atmosphere has substantially increased and quickly became a main contributing reason to the global warming phenomena. This issue is partly related to post-Kyoto negotiations over the climate change in the countries so, it is important to relate with the relationship between the CO_2 emission, economic growth and energy consumption (Hwang & Yoo, 2012). However, these past studies have commonly produced mixed results such as their findings vary depending on the country, the period and the method of the study. Through this study, it was found that most of the past researches done were on developed countries or better known as Organization for Economic Co-operation and Development (OECD hereafter) (de Bruyn et al., 1998; Grossman & Krueger, 1995; Ang, 2007), while very minimal attention has been paid to the Asian countries. This research is on developing and developed countries in Asian related with the Kyoto Protocol and Environmental Kuznets Curves.

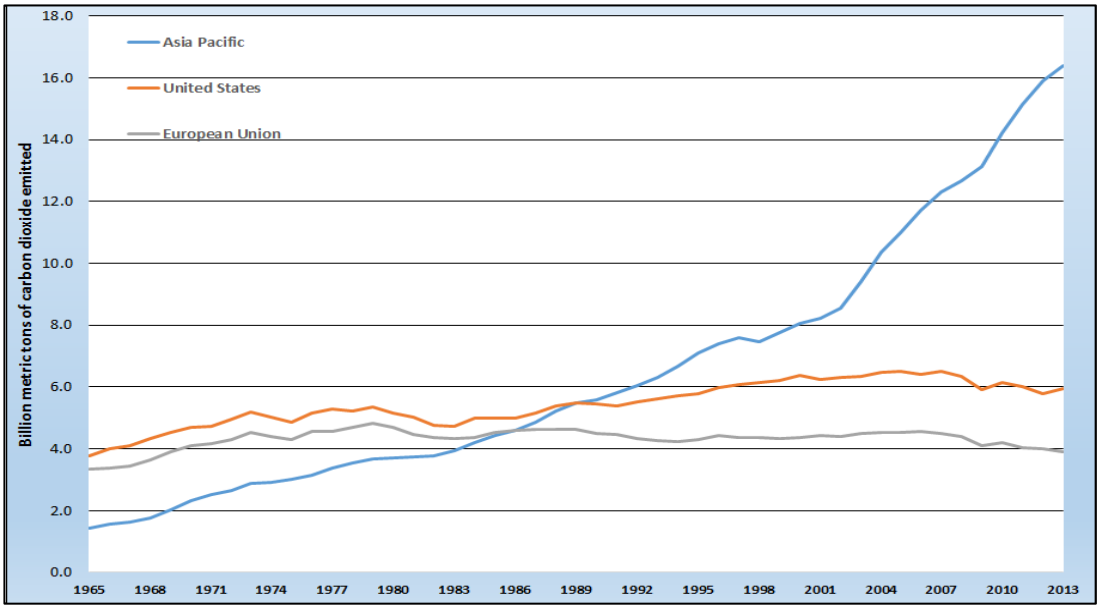
Before going further into this study, there is the need to understand the fundamental understanding about trend for the macroeconomic indicators such as energy

consumption, gross domestic product and carbon emissions for the selective countries which are Indonesia, Thailand, Singapore and Japan for the Asian case study as the developing and developed countries respectively.

1.1 Background of the Study

Asia is the largest continent in the world especially in area and population. Asia creates nearly one third of the landmass, lying entirely north of the equator except for some Southeast Asian islands. It is connected to Africa by the Isthmus of Suez and borders Europe along the Ural Mountains and across the Caspian Sea. It is consisting of 49 countries where two countries which are Russia and Turkey have part of the land in Europe. Indonesia, Thailand and Singapore are Southeast Asia countries while Japan is East Asia country where they are in Asia continents.

Figure 1.1: Global Carbon Dioxide Emissions According to Region, Year 1965 to 2013



(Sources: Adapted from BP Statistical Review of World Energy, 2013)

According to the statistics released by United Nations Environment Programme, Asia Pacific (76%) region has more annual carbon dioxide emissions than the United States and Europe Union combined from year 2013. Japan (55 billion metric tons) is the second highest in CO2 emission leaving behind China in Asia. Indonesia is one of the country in Southeast Asia countries has the highest among of carbon dioxide emission produced other than Thailand and Vietnam. But Singapore has very high energy consumption than other country in Southeast Asia region by its size area. The world's primary energy demands are the energy from the fossil fuel with 80% of the total consumption of energy. The use of fossil fuels energy contributes to the releases of the carbon dioxide through several joint products. Once its release into the atmosphere, carbon dioxide (CO_2) contributes to the climate changes and gives impacts to the world economy.

For global CO_2 emissions, 2012 was a remarkable year in which emissions increased by only 1.1% less than half of the average annual increase of 2.9% seen over the last decade, reaching 34.5 billion tonnes. The CO_2 had 1% decline in year 2009, then rise 4.5% in 2010, and a 3% increase in 2011 to the 1.1 % global increase emissions in 2012 (IMF, 2013). Rapid economic development is linked with environmental problems, which is the critical issue faced by the business world today of the awareness limits on carbon dioxide (CO_2). On the other hand, Indonesia, Thailand, Singapore and Japan are includes in Kyoto Protocol. The Kyoto Protocol is an international agreement which its members must commits itself in the effort to reduce and achieved the binding emission reduction targets. Kyoto Protocol is linked to the United Nations Framework on Climate Change. Under this program, each country's actual carbon emissions are required to be monitored and recorded for each

activities carried out. Kyoto Protocol demands the reduction of greenhouse gases emission to 5.2% from year 2008 to 2012 which is lower than year 1990 for the developed countries.

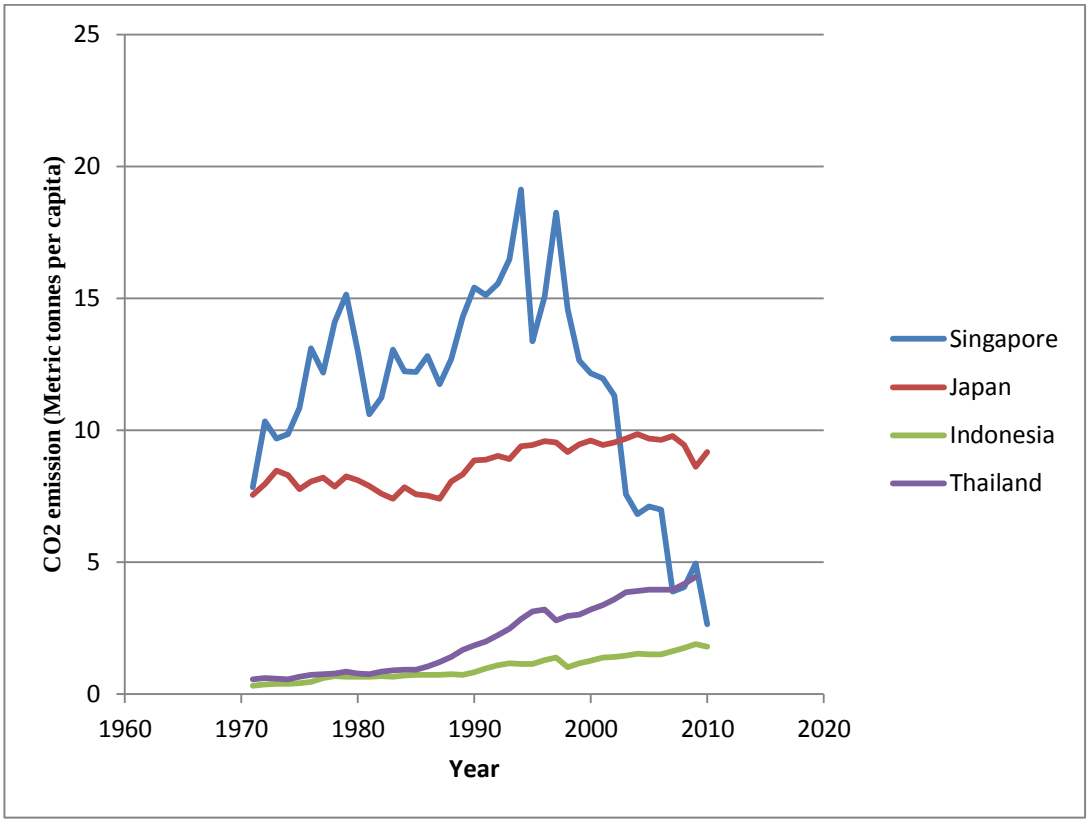
There are some reasons to study four Asian countries which are Indonesia and Thailand as developing countries, while Singapore and Japan as developed countries. Firstly, the four Asian countries are includes in the Kyoto Protocol in Annex I Party according to the United Nations Framework Convention on Climate Change. Second is the characteristic of the country itself. Indonesia is the largest archipelagic state in the world with very high rate of urbanization which ranked fourth in the world as most populated country. The determinants of CO_2 emission, economic growth, and energy consumption in Indonesia will be urbanization and industrialization. Besides, Thailand had some political change offences and has high CO_2 emission among Southeast Asia countries which will be help for this study to find the relationship.

Meanwhile, Singapore has the highest income level among all ASEAN countries. Economic growth is the one variables used in this study paper to determine CO_2 emission thus it is crucial to examine whether high income level will exhibit high CO_2 emission. Last but not least is the Japan. Japanese government announced in 2002 that they will relied heavily on the usage of nuclear energy to reduce the greenhouse gas emissions which is in line with the implementation of Kyoto Protocol. But this changed after Japan involved with the earthquake, Japan fossil fuel energy consumptions has increased by 30% due to the shutdown of nuclear power plants.

In the subsequent section, CO_2 emission, RGDP, and energy consumption in each of the chosen country will be explained in details.

1.1.1 Trend of Carbon Dioxide Emissions

Figure 1.2: CO_2 Emission for Developed and Developing Countries in Asia, Year 1971-2010



(Sources: World Development Indicator, World Bank, 2013)

The figure shows that the CO_2 emission per capita for the developing and developed countries in Asia from year 1971 to 2010. It shows that the developing countries which are including Indonesia and Thailand have an increasing trend from year 1971 to 2010. However, for the developed countries including Singapore and Japan, it shows that an inconsistent trend where there is a lot of up and down from year 1971 to 2010. According to Jafari, Othman and Nor (2012), Indonesia is one of the world second largest tropical forest which has the fastest deforestation rate in the world and

ranked third in greenhouse gases emission after United States and China. According to Energy Information Administration (2011), CO_2 emission for Indonesia grew the fastest among all ASEAN countries due to the development of energy intensive industries in the country from year 1980 to 2001. Indonesia has increased the CO_2 emission from 0.33 metric tonnes per capita in year 1971 to 1.803 metric tonnes per capita in year 2010 with the increases of its population.

The second developing country is Thailand, whereby the CO_2 emissions are increasing due to rapid growth in the industrial sector in Thailand. Thailand's CO_2 emissions were increasing from 0.559 metric tonnes per capita to 4.447 metric tonnes per capita in year 2009. Its shows that the rapid industrialization in Thailand may lead to the environmental pollution such as solid and hazardous waste that produced from the residents. It has boomed in year 1986 which is 1.055 metric tonnes per capita from 0.938 metric tonnes per capita which is increasing 12.47%. Both developing countries has suffered the 1997 and 1998 financial crisis where is shows the trend is decreasing in the respectively year.

For the developed countries, Singapore's CO_2 emission fluctuates over the years and there is no obvious increasing or decreasing trend. This is observed as precautions and actions were taken by the Singapore government in promoting environmental awareness among business, consumers and the community (Birchall, Stiles & Robinson, 1993). Nonetheless, Singapore was also affected by the 1997 Asian financial crisis. Singapore's CO_2 emission has been decreased to 2.163 metric tonnes per capita in year 2010 and the highest emission was is year 1994 which is at 19.119 metric tonnes per capita. Singapore's CO_2 emission shows a declining trend after reaching

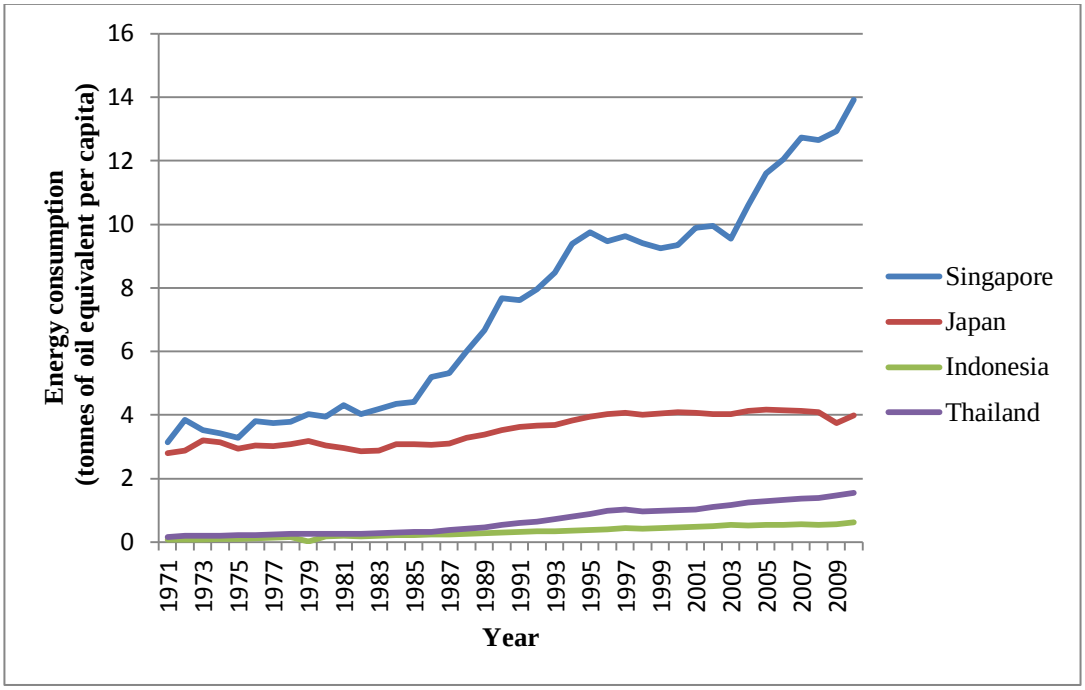
its peak at 1994. This was due to a switch to the usage of cleaner natural gas for power generation and other government energy efficiency measures.

For the second developed countries, Japan also there is not at increasing or decreasing trend obviously shown. However, the CO_2 emission in year 1987 which has 7.418 metric tonnes per capita is increased to 9.186 metric tonnes per capita in year 2010. This shows some increasing trend for that period of 1987 to 2010. This shows the responsibility of government to control over the CO_2 emissions.

As a conclusion for the CO2 emissions, the figure clearly shows that the CO_2 emissions for the developing countries overall have low CO_2 emission but has increasing trend than developed countries which has high CO_2 emission and inconsistent trend.

1.1.2 Trend of Energy Consumptions

Figure 1.3: Energy Consumptions for Developed and Developing Countries in Asia, Year 1971-2010



(Sources: World Development Indicator, World Bank, 2013)

The figure shows that the energy consumption of primary resource for the developing and developed countries in Asia from year 1971 to 2010. Overall, the energy consumptions in Indonesia and Thailand which is developing countries and Singapore as developed country has increasing trend. For the Japan as one of the developed countries in this study, firstly it shows decreasing trend from year 1972 to 1983 and increasing trend from year 1984 to 2010. The financial crisis is mainly effected the energy consumption in Singapore in year 1997 and 2005, which it indicate a shock in the trend.

The developed country Singapore has increasing trend overall from year 1971 to 2010, which has increased from 3.136 tonnes of oil equivalent per capita to 13.91 tonnes of oil equivalent per capita with the increasing 343.56%. The trend staring to boom in year 1986 for primary resource, 5.185 tonnes of oil equivalent per capita from 4.401 tonnes of oil equivalent per capita in year 1985. This shows that, the energy consumptions in the country are very high because it is a high industrialization country. Besides, Japan has an inconsistent trend which is decreasing trend from year 1972 (2.885 tonnes of oil equivalent per capita) to year 1983 (2.875 tonnes of oil equivalent per capita) and increasing trend from year 1984 (3.073 tonnes of oil equivalent per capita) to year 2010 (3.976 tonnes of oil equivalent per capita). Japan country has low energy consumptions per capita than Singapore as the developed country and this is maybe due to the population of each country who different quantity of primary energy.

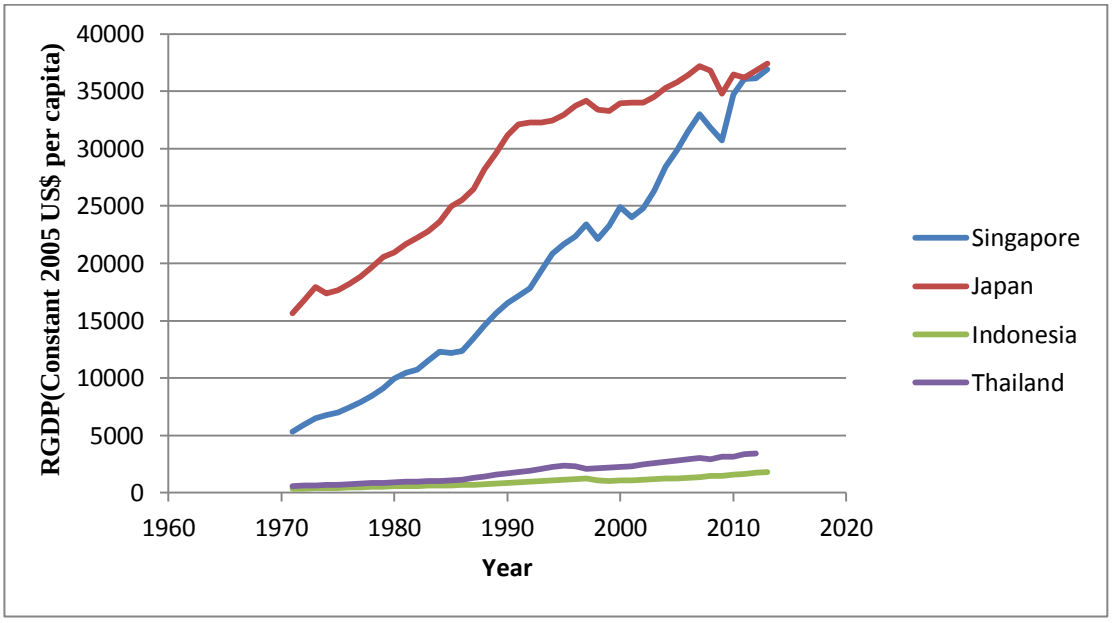
Other than that, for the developing countries, Indonesia's energy consumption for primary resource in year 1971 is 0.073 tonnes of oil equivalent per capita has increased to 0.623 tonnes of oil equivalent per capita in year 2010, which increased

by 750.9%. High level of urbanization and industrialization in the country is the primary cause of the increasing energy consumption (Karki et al., 2005). Furthermore, Thailand almost has similarity of energy consumption trend as Indonesia, which both consider as developing countries in this study. In year 1971, the energy consumptions in Thailand is 0.166 tonnes of oil equivalent per capita has increased to 1.547 tonnes of oil equivalent per capita in year 2010, which increased by 831.93%. The global financial crisis in the middle of year 2007 and year 2008 do not affect much to Indonesia and Thailand, because of the energy consumptions still increases in year 2009.

As conclusion for energy consumptions, it shows that primary energy consumptions in developed countries (Singapore and Japan) are higher than developing countries that are Indonesia and Thailand.

1.1.3 Trend of Gross Domestic Product

Figure 1.4: Economic Growth for Developed and Developing Countries in Asia, Year 1971-2012



(Sources: World Development Indicator, World Bank, 2013)

The figure shows that economic growth in term of gross domestic product (RGDP) for developing and developed countries in Asia from year 1971 to 2010. Overall, the economic for developed countries which including Singapore and Japan has very high RGDP than developing countries like Indonesia and Thailand. Its shows an increasing trend for both developing and developed countries but the developing countries is more consistent than developed countries with boomed trend.

From the figure, Indonesia's RGDP is increased from 346.86 constant 2005 US$ per capita in year 1971 to 399.39% in year 2012 which is 1732.181 constant 2005 US$ per capita. Indonesia also has affected financial crisis in year 1998 with the RGDP is 1057.089 constant 2005 US$ per capita. High level of urbanization and industrialization in the country is the primary cause of the increasing RGDP. However, for Thailand, the trend is similar with the Indonesia which has a slow increasing trend but is higher than Indonesia RGDP. Thailand RGDP is 3437.841 constant 2005 US$ per capita in year 2012 which is increases 470.45% from the year 1971. After the financial crisis, the RGDP increased steadily which brings the rapid performance and sustainable growth like occurs in the developing countries.

Furthermore, Singapore and Japan has very high economic growth than those developing countries (Indonesia and Thailand) in this study. Singapore is one of the countries that reach the status of "developed" among ASEAN countries. It is ranked as one of the most population cities in the world (Tan, 2006). This can be proven by the figure whereby from year 1971 the RGDP is 5344.387 constant 2005 US$ per capita which increases to 36110.129 constant 2005 US$ per capita that is about increasing 575.66%. Singapore has suffered financial crisis in year 2009 where the RGDP is 30700.471 constant 2005 US$ per capita.

Besides, for Japan as the role model for South East Asia (SEA) countries like Malaysia has very high economic growth. The RGDP of Japan in year 1971 is 15671.199 constant 2005 US$ per capita increases to 36800.99 constant 2005 US$ per capita**.**

As conclusion, the developed countries generally has dominates the economic growth than developing countries because of their high RGDP. The RGDP may be influencing the energy consumptions and CO_2 emission of each country respectively. The economic growth play important role for determine the CO_2 emission.

1.2 Problem Statement

The relationship between environmental quality and economic growth has always been an area of interest among researchers. Several studies have been carried out to examine the relationship between environmental quality and economic growth by adding various variables that is significant in affecting the relationship between environmental quality and economic growth, like energy consumption (Acaravci & Ozturk, 2010; Ang, 2007, 2008; Apergis & Payne, 2009; Bowden & Payne, 2009). However, there are less research carry out for long-run relationship between CO_2 emission, RGDP, and energy consumptions on ASEAN countries.

The main issues that discussed in this study are the main concerns that on-going issues in this selected countries. First strand focuses on carbon dioxide emission and economic growths, which are closely related to testing out the validity so called Environmental Kuznets Curve. Where the previous study examined that developing country has negative relationship, while developed country have positive relationship

with the EKC hypothesis. But the situations are now changing whereby developing countries can become positive relationship (Tietenberg & Lewis, 2009).

Most researches on the EKC hypothesis are carried out using panel data for a group of developing countries and developed countries (Apergis & Payne, 2009; Lee & Lee, 2009). However, a panel data is not able to reflect the single relationship of EKC for each country (Egli, 2004). Saboori et al. (2012b) suggested that study on individual countries is necessary to carry out in order to come out with policies that are effective and sustainable. Moreover, Egli (2004) argued the importance of the different between short-run and long-run effects on environmental quality and economic growth thus equations with explicit short term and long term dynamics are deemed to be more appropriate.

The second strand of the research is related to energy consumption and economic growth. The developed country has more energy consumptions then developing country when the economic growth is increase, which does not prove in the previous studies. This highlights the importance of the link between energy consumption an economic growth (Saboori et. al., 2012a). The third strand is a combination between carbon dioxide emission, energy consumption and economic growth altogether to test the effect with the developed and developing country. According to Yoo (2006), energy consumption in ASEAN is expected to increase from 200 million tons of oil equivalent (Mtoe) in 2000 to 580 Mtoe in 2020. This stimulates the economic growth through encourage foreign direct investment (FDI), employment opportunities in the country and others.

There is still an argument on whether those economic indicators are related to each other or not. So, this study will try to discover more on the relationship either