



Faculty of Economics and Business

DETERMINANTS OF CARBON DIOXIDE EMISSIONS IN ASEAN+3

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**DETERMINANTS OF CARBON DIOXIDE EMISSIONS IN
ASEAN+3**

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the requirements for the degree of Bachelor of Economics with Honours
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Statement of Originality

The work described in this Final Year Project, entitled
“Determinants of Carbon Dioxide Emissions in ASEAN+3”
is to the best of the author’s knowledge that of the author except
where due reference is made.

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ABSTRACT

DETERMINANTS OF CARBON DIOXIDE EMISSIONS IN ASEAN+3

By

Teoh Xin Di

This study is carried out to investigate the determinants of carbon dioxide emissions in ASEAN+3 (Brunei, Cambodia, China, Indonesia, Japan, South Korea, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam) during the period 1991 to 2010. The methodologies that been employed in this study include Im, Pesaran and Shin Panel Unit Root Test, Pedroni (Engle-Granger based) Cointegration Test and Granger-Causality based on Vector Error Correction Model (VECM). Result from panel unit root test shows that all the variables are integrated of order one, $I(1)$. For the cointegration test, the results indicate that a long relationship is exist between carbon dioxide emissions, energy consumption, economic growth, urbanization, trade openness and transportation. The empirical results show that economic growth is directly caused by carbon dioxide emissions, energy consumption, urbanization, trade openness and transportation in ASEAN+3. In short, economic growth, energy consumption and trade openness are the determinants of CO₂ emissions in ASEAN+3.

ABSTRAK

PENENTU PENGELUARAN KARBON DIOKSIDA DI ASEAN+3

Oleh

Teoh Xin Di

Kajian ini bertujuan untuk mengkaji penentu pengeluaran karbon dioksida dalam tempoh 1991 hingga 2010 di ASEAN+3 (Brunei, China, Filipina, Indonesia, Jepun, Laos, Kemboja, Korea Selatan, Malaysia, Myanmar, Singapura, Thailand dan Vietnam). Metodologi yang digunakan dalam kajian ini ialah Ujian Kepegunan Panel Im, Pesaran dan Shin, Ujian Kopengamiran Pedroni (Engle-Granger based) dan Ujian Penyebab Granger dalam Ujian Pembetulan Ralat Vektor (VECM). Keputusan daripada ujian kepegunan panel menunjukkan bahawa semua pembolehubah adalah pegun dalam perbezaan pertama. Dalam ujian kopengamiran, keputusan menunjukkan bahawa terdapat satu hubungan jangka panjang antara pengeluaran karbon dioksida, penggunaan tenaga, keluaran dalam negara kasar, pembandaran, keterbukaan perdagangan dan pengangkutan. Hasil kajian menunjukkan bahawa keluaran dalam negara kasar disebabkan secara langsung oleh pengeluaran karbon dioksida, penggunaan tenaga, pembandaran, keterbukaan perdagangan dan pengangkutan di ASEAN+3. Ringkasnya, keluaran dalam negara kasar, penggunaan tenaga dan keterbukaan perdagangan adalah penentu karbon dioksida di ASEAN+3.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

In the last decades, climate change has been the major concern of developing countries and developed countries. The effects related to climate change are the long-term rise of sea level, higher frequency of tropical storms and alarming rate of cardiovascular and respiratory disease (Stocker et al., 2009). Moreover, global climate change is also expected to increase the vector-borne diseases incidence, especially malaria and dengue. Centers for Disease Control and Prevention (2014) stated that dengue is the world's fastest growing vector-borne disease, especially in Southeast Asia and Latin America. Due to changes in temperature, some of the Association of Southeast Asian Nations (ASEAN) countries are suffering from the increasing vector-borne diseases incidence (Loevinsohn, 1994). The increase in global temperature is leading to a nature phenomenon which is global warming. Increase in greenhouse gases emissions, resulting from the increasing carbon dioxide concentrations, has become a major threat of global warming.

One of the main causes of global warming is carbon dioxide. Increasing amount of carbon dioxide generated by human activities into the environment is due to the deforestation and growing world-wide consumption of fossil fuels. Fossil fuels consumption such as coal, oil and gas, the main power of source of automobile and industry had attributed large part to the economic growth and developments.

The main causes of human-induced global warming are fossil fuels combustion and other smaller industrial sources. According to Oliver, Janssens-Maenhout, Munteen, and Peters (2013), the increase in global emissions of carbon dioxide (CO₂) from these sources has slowed down in 2012. Nevertheless, the global average annual growth rate of 2.4 ppm in atmospheric CO₂ concentrations in 2012 was rather high. Figure 1 shows the CO₂ emissions from fossil-fuel use and cement production in the top six emitting countries.

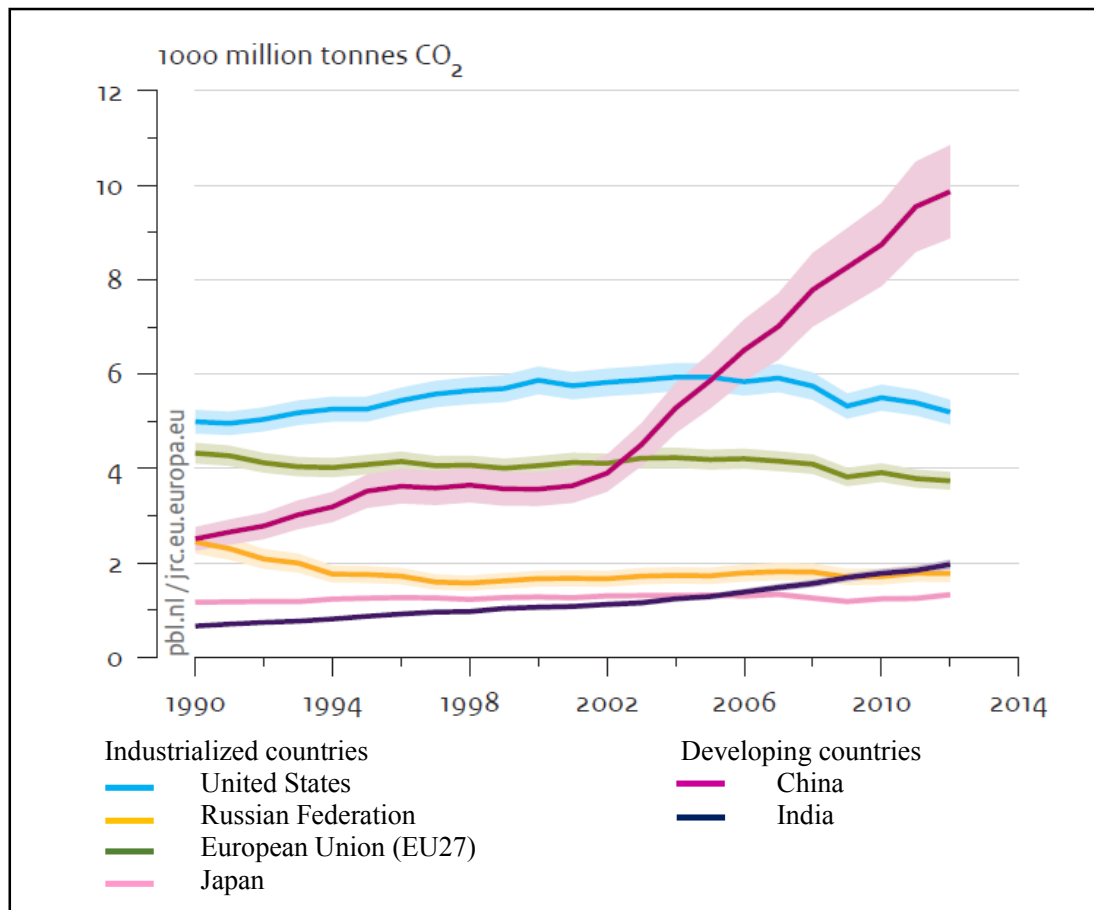


Figure 1: CO₂ emissions from fossil-fuel use and cement production

Source: Oliver, Janssens-Maenhout, Munteen, and Peters (2013).

Based on Figure 1, the six largest emitting countries/ regions in year 2012 are China (29%), the United States (15%), the Europe Union (EU27) (11%), India (6%), the Russian Federation (5%) and Japan (4%). After a 1% decline in 2009, the global CO₂ emissions show a 4.5% recovery in 2010 and a 3% increase in 2011. The year 2012 was a remarkable year for global CO₂ emissions. This is because the emissions only increased by 1.1% which is less than half of the average annual increase of 2.9% (34.5 million tons) seen over the last decade. This had include a downward correction of 0.3% for it being a leap year.

The steam of research on the relationship between environmental pollution and economic growth can be categorized into three strands. The first strand mainly concentrates on the economic growth-environment pollution nexus, which is on testing the validity of the EKC hypothesis (Managi and Jena, 2008; Stern, 2004; Martínez-Zarzoso and Bengochea-Marancho, 2004). The relationship of the environmental Kuznets curve (EKC) for carbon dioxide (CO₂) emissions has become a central topic of the past studies. The environmental Kuznets curve is a hypothesized relationship between economic development and environmental quality. Various indicators of environmental degradation are likely to get worse as economic growth occurs until an average income reaches a certain point over the course of development. As a result, an inverted U-shaped relationship exists between income and environmental pollutants. The second strand of the research examines the economic growth-energy consumption nexus (Tang and Tan, 2013; Fallahi, 2011; Ozturk and Acaravci, 2010). A higher economic development needs more energy consumption. Therefore, economic growth is closely related to energy consumption.

In the same way, more efficient energy use requires a higher economic development level. Finally, the third strand of the research is the combination of the first two strands, which investigate the dynamic relationship between economic growth, energy consumption and pollution emissions (Soytas and Sari, 2009; Ang, 2007; Lean and Smyth, 2010).

1.2 Research Background

As one of the factor of global warming, carbon dioxide (CO₂) emissions has been a popular topic for numerous researches in order to reduce the increasing threat of global warming. A stream of researchers (Sharma, 2011; Iwata, Okada and Samreth, 2010; Friedl and Getzner, 2003) has analyzed several determinants of CO₂ emissions such as energy consumption, electricity consumption, economic growth, urbanization, trade openness and transportation.¹

Over the past decade, the CO₂ emissions trend mainly reflects energy-related human activities. These were determined by economic growth, particularly in emerging countries. In 2012, there was a 'decoupling' of the increase in CO₂ emissions from global economic growth in GDP. This points to a shift towards less fossil-fuel intensive activities, more use of renewable energy and increased energy saving (Oliver et al., 2013).

¹ There are other determinants of CO₂ emissions such as cold climate, hot climate and availability of renewable energy sources (Neumayer, 2004). However, this study only focus on energy consumption, electricity consumption, economic growth, urbanization, trade openness and transportation.

Greater economic growth may involve a higher energy consumption while lower energy consumption may result in lower economic growth. To produce energy, the burning of fossil fuel is needed because it is used in the production processes of goods and services. In order for a higher level of energy to be produced to cover the energy consumption, more carbon dioxide gas emissions are produced and these eventually pollute our surrounding environment.

Continuous growth in urbanization and industrialization leads to increases in energy consumption and consequently to greater atmospheric pollution. Over the last 150 years, factors like the increase in life expectancy, reduced child mortality, and improved farming methods have resulted in rapid and exponential growth of the world population.

Since roads are built at where people live, big countries have a larger road network, but the road length depends on how scattered the population is over the whole land areas. Countries with populations spatially scattered across a big land area need to have higher transportation requirements as goods and people need to move over longer distances. Therefore, these countries have higher emissions compared to smaller countries or those with highly concentrated clusters of population.

Due to rapid globalization, trade increased significantly associated with growing agriculture, extraction of minerals, drilling of oil, and transportation. These activities increase the energy consumption and then carbon emissions. Gases

emissions are related directly to global warming and this eventually affect the environment with the increasing economic growth and trade openness.

Association of Southeast Asian Nations (ASEAN) was formed since 1967, consisting of Indonesia, Malaysia, Philippines, Singapore and Thailand and later expanded to include Brunei, Cambodia, Laos, Myanmar and Vietnam. Having a total land area of 4.436 million square kilometers (3.3% of world land area) and a total population of 584 million (8.7% of the world population), ASEAN is one of the fastest growing economic regions and rank as the eighth largest economy in the world. At an average annual rate of 4.8% for 1994 to 1999, the economy has experienced a rapid GDP growth again in period of 2000 to 2008 with an annual rate of 6.5%. Energy consumption had been increased substantially by the continuous growth in urbanization and industrialization. ASEAN Centre for Energy (ACE) had estimated the increase of 4.4% in final energy consumption in 2030. The increase is very much higher than world's average growth rate of 1.4% per year in energy demand over 2008 to 2035. Besides, CO₂ emissions are also increasing in a similar way. As ASEAN is moving toward single entity, ASEAN Economic Community (AEC), thus it is justifiable to investigate the determinants of CO₂ emissions.

Decisions had been made to establish the ASEAN Economic Community (AEC) in the Declaration of ASEAN Concord II in Bali, Indonesia on 7 October 2003 and AEC Blueprint was adopted on 20 November 2007 to serve as a coherent master plan guiding the establishment of the AEC by 2015. The AEC aims to transform ASEAN into a region with free movement of goods, services, investment,

skilled labor, and freer flow of capital (Association of Southeast Asian Nation, 2014a). As the goal of regional economic integration by 2015, AEC envisages the following key characteristics: (i) a single market and production base; (ii) a highly competitive economic region; (iii) a region of equitable economic development; and (iv) a region fully integrated into the global economy.

To deal with mutual issues and concerns in energy security, natural gas development, oil market studies, oil stockpiling, and renewable energy, ASEAN have gone into partnership with the People's Republic of China (PRC), the Republic of Korea and Japan. Hence, this study embarks the research of the CO₂ emissions determinants on ASEAN+3 due to lack of existing research in ASEAN+3.

Extensive researches on the relationship between carbon dioxide emissions and economic growth had focused in various countries including ASEAN countries. However, as far as this research is concerned, there is no studies on the determinants of CO₂ emissions in ASEAN+3 countries yet although ASEAN+3 have been formed in 1997. ASEAN+3 is formed to increase the cooperation among the East Asia countries in terms of economy, finance, human resource and social development, scientific and technical development and infrastructure development. On this note, this study on CO₂ emissions is deemed very important in policy-making processes.

1.3 Background of ASEAN+3

Association of Southeast Asian Nations Plus Three (ASEAN+3) member countries are made up of members of ASEAN and the three Northeast Asian countries. They are Brunei Darussalam (BRN), Cambodia (KHM), Indonesia (IDN), Lao People's Democratic Republic (LAO), Malaysia (MYS), Myanmar (MMR), the Philippines (PHL), Singapore (SGP), Thailand (THA) and Vietnam (VNM) plus Japan (JPN), People's Republic of China (CHN) and Republic of Korea (KOR).

According to Ministry of International Trade and Industry (2013), the sluggish growth in Japan had been absorbed by the expansion of China, Korea and ASEAN and this had increased the share of ASEAN+3 in global GDP. The ASEAN+3 countries' share in global GDP overtook USA (21.47%) by 2.05 percentage point in 2011 and EU (23.13%) by 1.49 percentage point in 2012. As the share of EU and US decrease further, ASEAN+3's around 25% share of global GDP is estimated to increase to 27% by 2018.

ASEAN+3 began to cooperate in December 1997. When a Joint Statement on East Asia Cooperation is issued at their Third ASEAN+3 Summit in Manila, ASEAN+3 institutionalized in 1999. East Asia cooperation decided to strengthen and deepen at various levels and in various areas by the ASEAN+3 leaders. These include the areas of political and security, transnational crime, trade and investment, finance, tourism, public health, food, agriculture, fishery and forestry, minerals, small and medium enterprises, environment and sustainable development,

networking of track II, poverty alleviation, promotion development of vulnerable groups, culture and people-to-people contact, education, science and technology, disaster management, energy, transport, and information and communicating technology (ICT) (Association of Southeast Asian Nation, 2014b).

Therefore, ASEAN Plus Three (APT) Cooperation Work Plan 2013-2017 have been adopted by the 14th APT Foreign Ministers' Meeting on 30 June 2013. Based on the assessment and recommendations of the Mid-Term Review of the APT Cooperation Work Plan 2007-2017, this work plan is revised from the APT Cooperation Work Plan 2007-2017.

The objective of the work plan is to enhance ASEAN+3 relations and cooperation in a comprehensive and mutually beneficial manner from year 2013 to 2017. Listed in the Work Plan, one of the activities is to strengthen cooperation in environment and sustainable development. There is also an activity which is to strengthen cooperation in addressing the impact of climate change. Therefore, it will be interesting to find out the determinants of CO₂ emissions in ASEAN+3.

1.4 Background of Carbon Dioxide Emissions in ASEAN+3

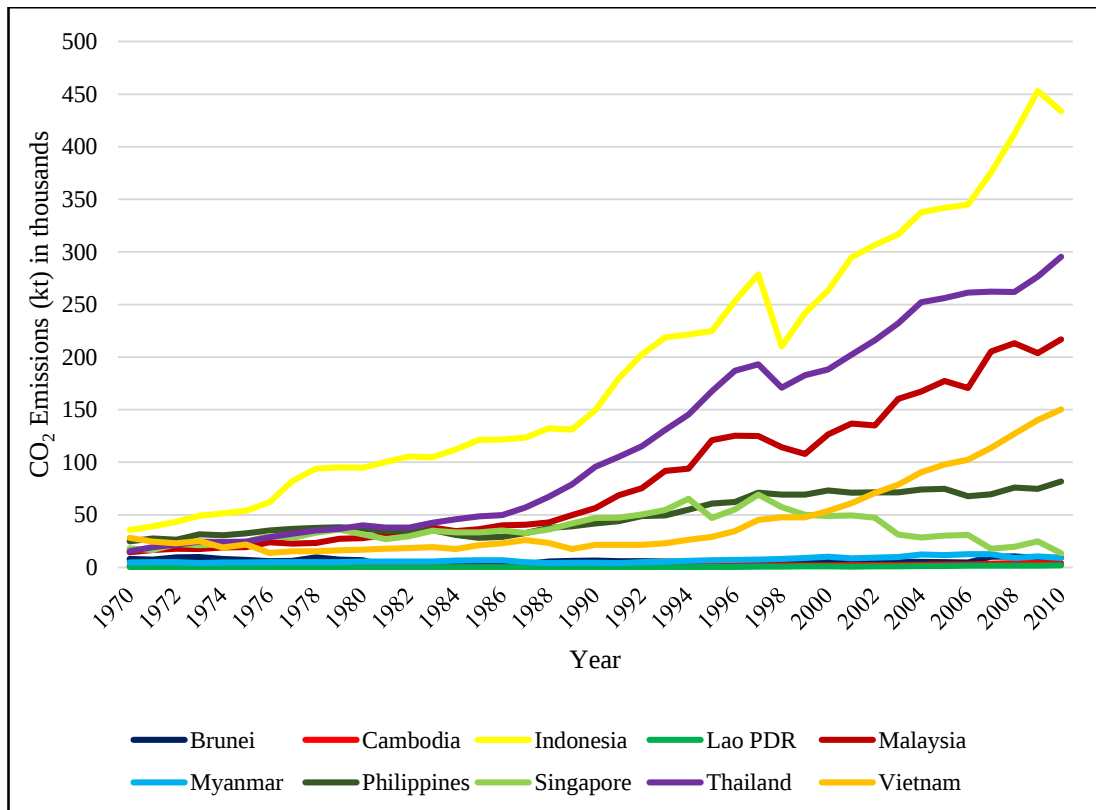


Figure 2: Carbon Dioxide Emissions in ASEAN countries from year 1970 to 2010

Source: World Bank (2014)

Figure 2 shows the carbon dioxide emissions in all ten ASEAN member countries from 1970 to 2010. From the figure above, we can see that Indonesia has the highest carbon dioxide emissions among the ten ASEAN countries. This is because of the oil palm's method of growth that makes it such a high-emissions crop. Indonesia and Malaysia grow and produce 90 percent of the world's palm oil. For the purpose of plantations, rainforests are cleared or burned and this will be multiplied the emissions when the clearing occurs on peat lands, which store vast quantities of carbon. In Malaysia, oil palm plantations cover 11% of the Malaysia land area and

have a more than 13 million tons of crude palm oil (CPO) yearly production. Carlson et al. (2013) expected that by 2020, Indonesian palm oil plantation expansion will release more than 558 million metric tons of CO₂, which is more than Canada's yearly carbon dioxide emissions. According to Malaysian Department of Environment (MDOE), the main contributors to Malaysia growing emissions are the industries including power stations, motor vehicles and open burning. The highest contributor was the emissions from motor vehicles.

Emitting 4.2 tonnes of carbon into atmosphere per person per year, Thailand is the 7th largest emitter of carbon dioxide in Asia (Irin, 2008). Thailand's new government plan to cut CO₂ emissions by 15-20 percent from major industrial companies because of problems related to environmental pollution. Thai government even wants to taxing vehicles based on CO₂ emission starting from 1 January 2016 (Fuels & Lubes Weekly, 2013).

In Vietnam, the CO₂ emissions come from coal-fired electric power plants, according to an international conference in Hanoi. In 2000, with Vietnam's agricultural sector as main contributor (65 million tonnes or 43%), about 150.9 million tonnes of carbon dioxide were discharged into the environment (VietnamNet, 2011). There was a 113% increase in CO₂ emissions from burning fossil fuels and 54% of it was from coal fired plants. With 18.5 percent fired by coal and 36.6 percent by burning oil and gas, the thermal power plants are the source for more than half of Vietnam's electricity in 2010. In Vietnam, each 1KWh of electricity averagely creates 0.52kg of carbon dioxide.

In Philippines, energy consumption mainly are came from transport sector, followed by residential and industry sectors. Statistics from Philippine Department of Energy (2014) show that the road transport fuel consumption and corresponding CO₂ emissions have slowed down with a 0.5% annual growth rate from 2000 to 2010.

Contributing global emissions by less than 0.2%, Singapore still manages to reduce the carbon emissions by focusing on researches, although Singapore has to import almost all its energy needs (National Climate Change Secretariat, 2013). Myanmar has one of the highest rates of forest loss on earth as its yearly deforestation corresponding to approximately 116 million ton of CO₂ (UNEP Risø Centre, 2013). CO₂ emissions in Brunei increased by 2% annually, along with total energy consumption. Because of unreasoned use of wood for domestic cooking, deforestation in Cambodia has made its forest cover rate reduce from over 70% in 1970 to 3% in 2007. To reduce carbon emissions, Laos cooperates with Japan and transfers low carbon technologies to the country.

Figure 3 shows the carbon dioxide emissions in ASEAN, China, Japan and Korea from 1970 to 2010. Among the ASEAN+3 member countries, China has the highest carbon dioxide emissions for the period from year 1970 to 2010. China's growth rates of the previous decade were about 10%, but in 2012, its CO₂ emissions increase only 3% (Oliver et al., 2013). A continued high economic growth rate had caused the in CO₂ emissions with related increases in fossil fuel consumption. This increase in fuel consumption was mainly driven by the increase in building

construction and infrastructure expansion.

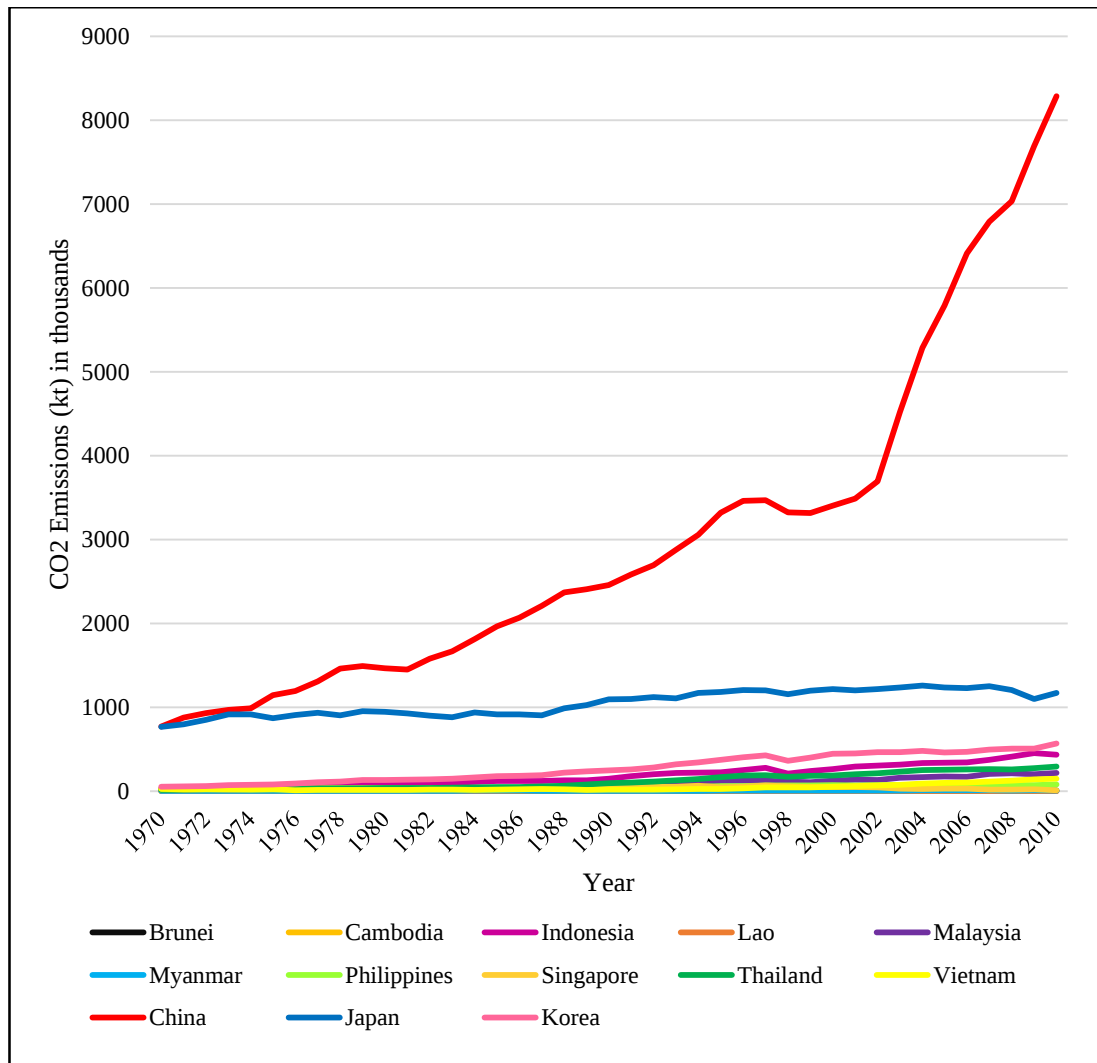


Figure 3: Carbon Dioxide Emissions in ASEAN, China, Japan and Korea from year 1970 to 2010

Source: World Bank (2014)

On the other hand, the decrease in China's CO₂ emissions annual growth was primarily due to a decline in electricity and fuel demand by the basic materials industry with the aid of an increase in the use of renewable energy and also by energy efficiency improvements. These were because the economic growth slowed