

EMERGING ENERGY TRENDS IN EAST ASIA:
THE RELATIONSHIP BETWEEN PRODUCTION LEVELS
AND WORLD OIL PRICES

TÜRKAN ARSLAN

BOĞAZİÇİ UNIVERSITY

2019

EMERGING ENERGY TRENDS IN EAST ASIA:
THE RELATIONSHIP BETWEEN PRODUCTION LEVELS
AND WORLD OIL PRICES

Thesis submitted to the
Institute for Graduate Studies in Social Sciences
in partial fulfilment of the requirements for the degree of

Master of Arts
in
Asian Studies

by
Türkan Arslan

Boğaziçi University

2019

DECLARATION OF ORIGINALITY

I, Trkan Arslan, certify that

- I am the sole author of this thesis and that I have fully acknowledged and documented in my thesis all sources of ideas and words, including digital resources, which have been produced or published by another person or institution;
- this thesis contains no material that has been submitted or accepted for a degree or diploma in any other educational institution;
- this is a true copy of the thesis approved by my advisor and thesis committee at BoĖazii University, including final revisions required by them.

Signature.....

Date.....13.08.2013.....

ABSTRACT

Emerging Energy Trends in East Asia:

The Relationship Between Production Levels and World Oil Prices

This thesis looks at the emerging energy trends in East Asia between the nations of Japan, China, and South Korea and the importance they have in the global energy market. Even though the world supply-demand situation of oil has been simplified due to the alternative energy sources in the past several decades, still oil is the most needed input for production. Industrialized countries such as Japan, China, and South Korea are known to be huge consumers of the oil and petroleum products for meeting high demand. In microeconomics, supply and demand relationship is one of the economic models of price determination; the price of a product can differ in time significantly according to the market. Therefore, the question is whether the demand of East Asia for petroleum has any impact on this price determination. I have observed that some reports and economists claim that the increasing demand for oil from East Asia is the key factor for oil prices to fluctuate for the last couple of years.

ÖZET

Doğu Asya'da Gelişen Enerji Trendleri:

Üretim Düzeyleri ve Dünya Petrol Fiyatları Arasındaki İlişki

Bu tez, Doğu Asya’da Japonya, Çin ve Güney Kore ülkeleri arasındaki yükselen enerji eğilimlerine ve küresel enerji pazarındaki önemine bakmaktadır. Dünya petrol arz talebi durumu, son birkaç on yıldaki alternatif enerji kaynakları nedeniyle sadeleşmiş olsa da, petrol üretim için hala en çok ihtiyaç duyulan girdidir. Japonya, Çin ve Güney Kore gibi sanayileşmiş ülkelerin, yüksek talebi karşılamak için petrol ve petrol ürünlerinin büyük tüketicileri olduğu bilinmektedir. Mikroekonomide, arz-talep ilişkisi, fiyat belirlemenin ekonomik modellerinden biridir. Bir ürünün fiyatı, pazara göre zaman içinde önemli ölçüde değişebilir. Bu nedenle soru, Doğu Asya'nın petrol talebinin bu fiyat belirlemesi üzerinde herhangi bir etkisi olup olmadığıdır. Bazı raporların ve ekonomistlerin, Doğu Asya'dan gelen petrole olan talebin artmasının son birkaç yıl boyunca petrol fiyatlarındaki dalgalanmanın kilit faktörü olduğunu iddia ettiğini gördüm.

ACKNOWLEDGEMENTS

As fellow graduate students would agree, thesis-writing is a long and difficult process through which a student is likely to lose his/her way without the guidance and support of many benefactors. I feel utmost fortunate to have had the opportunity to meet with such valuable guides throughout my studies in Boğaziçi University.

I wish to extend my sincere thanks to, first and foremost, Professor Selçuk Esenbel who has enlightened my way. Her extensive knowledge, open-mindedness, and commitment to her field have created the most productive environment for me to complete this thesis. I would also like to acknowledge Prof. Arzu Öztürkmen for her encouragement for my thesis. I would also extend my sincere gratitude to Dr. Kadir Temiz who gave me a big support and allowed me to shape my thesis by his enlightening comments. I am thankful to the valuable assistance of Buket Köse, and Nazlı Vardar in Asian Studies Program.

I am also thankful to my family and friends who have not failed in supporting me even for a second. To my dear friends; İrem Cihan Muter and Zeynepcan Akar from Boğaziçi University, Nazlı Deniz Biçer from Yonsei University, I would like to extend special thanks for their efforts and guide.

Special thanks to my beloved Erdem Arslan for being one of my biggest supporters in this journey. And to my beloved brothers, Cengiz, Selçuk, Hakan and Erhan Yiğitoğlu; I am appreciate for your all supports. Last but not least, my deepest appreciation is to my parents; Behçet Yiğitoğlu and Nazan Yiğitoğlu, who always supported me and gave me happiness, it would not have been possible without you. I would like to dedicate this study to them.

ABBREVIATIONS

CCS	Capture and storage
CEMSAR	Center for Energy Management System Auditors Registration
COP3	3rd Conference of Parties
EI	Energy intensity
EPB	Economic Planning Board
FDIs	Foreign direct investments
GDP	Gross domestic product
GHG	Greenhouse Gas
GWh	Gigawatt hours
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IT	Information technologies
JNOC	Japan National Oil Corporation
JOGMEC	Japan Oil, Gas, and Metals National Corporation
KEMCO	Korean Energy Management Corporation
KOGAS	Korean Gas Corporation
LNG	Liquefied natural gas
NIEs	Newly industrializing economies

NRE	New & Renewable Energy
OPEC	Organization of Petroleum Exporting Countries
PV	Photovoltaics
R&D	Research and development
RE	Renewable energy
ROK	Republic of Korea
US	United States

TABLE OF CONTENTS

CHAPTER 1 : INTRODUCTION.....	1
CHAPTER 2 : OIL SHOCKS.....	11
2.1 The reasons of past oil supply breakdowns.....	11
2.2 The reasons behind 2000's energy crises.....	14
CHAPTER 3 : JAPAN.....	23
3.1 Economic power of Japan.....	23
3.2 Energy policies of Japan after oil shocks in the 1970s.....	27
3.3 Conclusion.....	39
CHAPTER 4 : SOUTH KOREA.....	41
4.1 Economic power of South Korea.....	41
4.2 Energy policies of South Korea after oil shocks in 1970s.....	45
4.3 Conclusion.....	54
CHAPTER 5 : CHINA.....	57
5.1 Introduction.....	57
5.2 Economic power of China.....	57
5.3 China's energy policies after oil shocks in the 1970s.....	60
5.4 Conclusion.....	71

CHAPTER 6: CONCLUSION	74
APPENDIX A: Energy conservation chronology of Japan	79
APPENDIX B: China's five-year plan on renewable energy	85
REFERENCES	86

LIST OF FIGURES

Figure 1. World Oil Prices from January 1960 to January 2016	13
Figure 2. World Crude Oil Production, January 2000 to December 2008	16
Figure 3. World Oil Reserves from 1980 to 2019.....	17
Figure 4. Asia Pacific Oil Demand and the Relative Shares of Japan, China and South Korea 1997-2005	21
Figure 5. GDP (current US\$) of Japan between 1960-2008	26
Figure 6. CO2 Emission Rate of Japan 1960-2008	37
Figure 7. Energy Intensity of Japan	38
Figure 8. GDP (current M US\$) of South Korea between 1960 and 2008.....	44
Figure 9. Energy Resources of South Korea.....	50
Figure 10. CO2 Emission of South Korea.....	54
Figure 11. GDP Growth of China, Japan, South Korea (in M USD)	59
Figure 12. CO2 Emission Rate of China (1960-2014).....	66

LIST OF TABLES

Table 1. GDP Share Distributions by Sector of Japan 1960-2005.....	24
Table 2. Energy Balance of Japan by 2019.....	29
Table 3. Energy Resource Distribution Changes of Japan 1990-2010.....	30
Table 4. Progress of Energy Conservation in Japan 1951-2014.....	36
Table 5. Sectoral Shares in GDP of South Korea 1960-2005.....	43
Table 6. Energy Balance of South Korea by 2019.....	48
Table 7. The 10 largest oil producers and share of total oil production 2008.....	62
Table 8. The 10 largest oil consumers and share of oil consumption in 2016.....	62
Table 9. Energy Conservation Policies of China 1988-2012.....	70

CHAPTER 1

INTRODUCTION

“Safety and security in oil lie in variety and variety alone.”

Winston Churchill

In the 19th and early 20th centuries, many unforeseen financial crises created panic and fear. The world economy runs globally by imports, exports and foreign exchange markets, so a financial crisis cannot occur in just one area. It will spread all over the world resulting in the collapse of large financial institutions and downturns in the stock markets. Many economists have offered theories on how to prevent an economic crisis, and there have been some developments such as increasing monetary reserves. Nonetheless financial crises are still a big problem for the global economy and all the nations tied to this economy. “Oil” can be counted as one of the factors in the world economic crises. The oil and international finance systems are tightly interrelated.

An energy crisis is a significant bottleneck in the supply of energy resources to the world economy. The world faced with serious energy crises in the past decades due to many factors including wars, market manipulations, and natural disasters. The worst oil crisis that has ever occurred was in the 1973. This oil crisis taught industrialised and industrialising countries to shape their energy policies in preparation for another crisis in the future. It taught highly oil consumer countries to not depend on specific energy suppliers and energy resources. Following the 2008-2009 periods, there was another oil shock which created substantial panic in the market. Through 2009 oil prices rose and mid-2009 oil prices decreased sharply.

During the initial research, it was observed that the high energy demand from East Asia was mentioned as a major factor in the 2000s wild swings of oil prices. So while the oil shocks in 1970s had impact on East Asia shaping their energy policies, there were some questions whether the increase of oil consumption in East Asia had any impact on the oil price fluctuations in 2000s.

The increase gross domestic product (GDP) share requires increase in energy demand as well since consumer energy and GDP rates have an interconnected relationship. Asia has a big share in the global GDP and reports claim that GDP share will exceed 40% in next two decades.¹ The rising importance of Asian economies in world crude oil trade supports the idea of studying the impact of oil price fluctuations in big Asian economies such as China, Japan, and South Korea. Especially since this region tends to procure their oil demand mainly from Middle East. Once the Middle East cuts their services, these regions will inevitable face hardships in transportation, production, and daily life. Furthermore, after the significant oil shocks in the 1970s, political factors were also involved in importing oil from the Middle East. The East Asian oil importers had to keep their oil resource by being diplomatically aligned with the Middle East political views and allies. For example; in order to meet the high oil demand, East Asian countries such as Japan and South Korea was threatened by the Organization of Petroleum Exporting Countries (OPEC) to revise its policies with Israel, according to the oil producers' will.² Japan and South Korea had to recall upon Israel diplomatically. After these oil crisis incidents Japan has tended to focus on energy conservation and renewable energy resources, whereas has China put more focus on producing their own energy

¹ IMF 2010

² Graf. *Making use of the "oil weapon": Western industrialized countries and arab petropolitics in 1973-1974*. 185.

in China borders and put emphasis on resource diplomacy with other regions, and South Korea has improved on its nuclear energy production and invested in overseas oil discovery projects.

The energy conservation and energy efficiency studies in Japan have found huge success leading Japan to become a permanent trend in the technology market. For instance; the number of Japanese cars exported to the United States and the United Kingdom before the 1973 oil embargo was low. The big and fine American cars were really popular back then that is until the series of oil price shocks in the 1970s. Western cars were huge containing big engines which consumed high amount of fuel. Whereas Japanese cars were not only fuel efficient but they were also well-made, strong and reliable. The Asian brand cars attracted the West's attention by not only being fuel-efficient but by being reliable as well. As a result, the success in Japanese cars continued even after the decrease in oil prices. The total sales of Japanese cars in the U.S. were incredibly high as it increased by 427 percent between 1971–1990 periods.³ These numbers from 1971 to 1990 are primarily imported, because Japanese car producers did not start setting up factories in the U.S. until the mid-1980s.⁴ It can be observed that the energy crises in the 1970s impacted international politics and global market structure.

Some reports stated that soaring energy demands of East Asia in the 2000s lead oil prices to dramatically rise through 2008 and slowing business in East Asia resulted in the global oil price going down in 2009.⁵ Many research studies are looking for the causes and consequences of oil shocks and understand the reasons for

³ Wojcik. *Learning by Consumers in the Demand for Japanese Cars*. 94.

⁴ Dalton, Goksel. *Reputation and learning: Japanese car exports to the united states. Japan & the World Economy*. 10.

⁵ Hamilton (2009), Kilian and Hicks (2013), Masih, Peters and Mello (2011)

oil price fluctuations in 2000s. Hamilton (2009), Kilian and Hicks (2013), Bildirici (2009), Masih, Peters, and Mello (2011), Vivado and Manicom (2011), Li (2015) present us with the most influential articles in this field. Hamilton (2009) is a specialist concerning oil shocks causes and point outs East Asia's impact on oil crises in 2000s. Hamilton (2009) stated that there mainly five reasons for the international oil price shock as stated here: stagnated oil production, market worry created by Peak Oil Theory, high oil demand especially from China, finding new oil resources, and economic crises in United States. Hamilton (2009) adds that the oil shocks in the 1970s were caused by physical distributions of supply. However in 2008-2009, the strong demand for oil was challenged by a global stagnant oil production, therefore, resulting in the oil prices to go up. Hamilton (2009) believes that there is an intricate relationship between increasing world income and rising oil prices. Hamilton (2009) details this relationship by stating that "Economic growth slowed significantly in the first half of 2008 but remained positive, and one can conservatively assume that economic growth would have added at least another 0.5 mbd to the quantity demanded in that period, more than enough to absorb the slight increase in global oil production that finally appeared in the first half of 2008. Under these assumptions, the price had to rise between 2005 and the first half of 2008 by an amount sufficient to reduce the quantity that otherwise would have been demanded by 5 mbd, that is, to 85.5 mbd."⁶ After Hamilton (2009) published his article, a large number of studies were carried out on this subject.

In a similar vein, Kilian and Hicks (2013) supports Hamilton's opinion; they indicate that rapid economic growth of Asian countries such as China has driven

⁶ Hamilton, *Causes and Consequences of the Oil Shock of 2007–08*. 220.

international industrial commodity market to boom.⁷ In addition, Masih, Peters, and Mello (2011) clearly point out that

The high oil prices in 2005 and 2006 reflect the booming demand from Asia (especially China and India) and the geopolitical risk in the Middle East.⁸

The global increasing economic growth through 2008 led to increase energy demand. Thus, the rise in world crude oil consumption by 6 percent in mid 2000s and to the shift in the demand curve by increasing GDP in world completely related. Bildirici (2009) mainly finds rising oil prices as a cause and as a result to global economic crisis. She states that in 2008, similar to the 1970s oil crisis case, oil prices soared according to the high demand. The unexpected increase in oil prices pushed many regions into financial crisis. Bildirici (2009) adds that “due to the fact that, at least in the short term, there was a low price elasticity of demand for oil.”⁹ This statement refutes the hypothesis about ‘slowing business in East Asia causing oil prices to go down in 2009’. The 2008 economic crisis caused financial problems not only in the United States (US) but all over the world. Despite having a strong economy, China had a low price elasticity of oil to supply its energy demand too. Against rising oil prices, China had to change its energy policy route and Chinese government decreased its oil imports for the short term. Nevertheless, China has managed to still meet its energy demand by diversifying its energy resources, which is referred to as energy mix and domestic oil supply.¹⁰ Vivado and Manicom (2011) explain that there have been many methods to avoid from energy shocks and diversification of

⁷ Kilian, Hicks. *Did Unexpectedly Strong Economic Growth Cause the Oil Price Shock of 2003–2008*. 386.

⁸ Masih, Peters, and De Mello. *Oil Price Volatility and Stock Price Fluctuations in an Emerging Market: Evidence from South Korea*. 975.

⁹ Bildirici. *The Great Recession of 2008 and Oil Prices*. 5.

¹⁰ The term “energy mix” refers to the combination of the various primary energy sources used to meet energy needs in a given geographic region. It includes fossil fuels (oil, natural gas and coal), nuclear energy, non-renewable waste and the many sources of renewable energy (wood, biofuel, hydro, wind, solar, geothermal, heat from heat pumps, renewable waste and biogas). These primary energy sources are used, for example, for generating power, providing fuel for transportation and heating and cooling residential and industrial buildings. Source : Planet Energies

energy resources is considered one of them.¹¹ Li (2015) connects energy security concerns with global oil price fluctuations and adds that changes in oil prices has been shaping energy policies of East Asia.¹²

This thesis aims to investigate the role of East Asian oil consumption levels in the global oil market. This thesis will focus on this region's energy consumption and investigate the changes in East Asia oil consumption levels. Energy conservation data of each country will be presented to support this study. Lastly, this thesis will explain the understanding of oil price changes. The collective argument from those studies indicates that East Asian countries have successfully developed ways to conserve energy. Efficient use of energy in plants, houses, and in daily life led to less demand for oil consumption. Also, using alternative energy resources in units is increasing. Consequently, the main reason for oil price going down in 2009 is not because of slowing business in East Asia. However, this thesis argues that growing energy demand from China, Japan and South Korea has impacted on oil price going up. In accordance with high oil demand, oil producers expect increase in oil exports. Therefore, while the forecast did not match with the reality, it has worried global business. Overall, the research problem is understanding the relationship between changes in oil price and East Asia oil consumption levels.

Therefore, this thesis will attempt to mainly this answer 'Is there any impact of East Asian oil consumption levels on the oil price going up in 2008 and oil price going down in 2009?' In order to answer this question there are other topics and sub questions that need to be studied. For example, 'Is there any other oil shocks that changed energy policies of oil importers in the past?', 'What were the reasons for

¹¹ Vivoda, Manicom. *Oil Import Diversification in Northeast Asia: A Comparison between China and Japan*. 223.

¹² Li. *China's Energy Security and Energy Risk Management*. 86.

previous oil shocks?', 'What is the relationship between previous oil shocks and East Asia?' 'What kind of approach did Japan, South Korea and China follow against previous oil shocks?', 'How did Japan, South Korea and China ensure their energy security after oil shocks?', 'How did Japan, South Korea and China create their energy mix through 2000s?' This thesis will present these questions in separate different chapters.

This thesis is important because it focuses on energy security of East Asia, causes and consequences of oil price changes, and emphasis the relationship between these two objectives. This thesis provides information about recent developments in energy policies and investigates if oil consumption levels have any impact on oil price determination. This thesis is significant for understanding how international finance systems and growing energy demand interrelated. This thesis will not only present recent energy policies of China, Japan and South Korea but will point out future challenges and development plans for Asia-Pacific region as well.

This study focuses only on East Asia because its high importance and role in the world economy. However, it can be easily applied to many other developing countries which consume oil in an increasing pace. China is the world's most populous country with the fastest economy pushing it to be the second largest energy consumer in the world. Rapidly increasing energy demand; especially for petroleum and other liquids has made China influential in world energy markets. As for Japan, after World War II, the nation rapidly industrialized and increased its energy consumption exponentially. Similar to Japan, after the Korean War, heavy chemical industry drive led to the *big push* in South Korea. While output in heavy industry has been growing for the last decades, the need for input such as oil, coal, and alternative

energy resources has also been growing. Therefore, China, Japan, and Korea have been playing leading roles in energy consumption around the world.

Data was gathered from numerous resources such as articles, books, publications from Ministry of Energy of each country and comparatively analysed these three nations. The primary data will mainly focus on official announcements and documentation from the Japanese government, South Korean government and Chinese government. Additionally, the secondary data, scholar written articles, analysis and news will be used to answer the thesis question.

The scope of this study is to first understand how past energy shocks have shaped East Asia energy policies. Numerical data obtained from different sources will help this study in examining the oil consumption of China, Japan, and Korea from the last four decades. Furthermore, this thesis will present the change in alternative and renewable energy resources consumption levels, and how the dynamics in economy and resource diplomacy greatly influence international politics. It is believed that the series of oil shocks and energy scarcities affected East Asian governments to take look at different energy resources, new business partnerships, and new methods in energy supply and energy management. Additionally, energy conservation and energy efficiency programs of Japan, South Korea and China will be examined. Demand – Supply theory will be applied in this analysis while trying to determine if this theory has any impact on oil pricing.

Chapter two will present a background analysis for understanding energy crisis. The 1970s series of oil shocks will be presented briefly. History repeats itself, thus, this thesis will focus on previous major turning points of oil price changes to understand the present situation. There will be a brief summary about the 1970-1980

energy crises and the 2000's oil shock when oil prices became a bubble and broke a record in history of oil's high demand. In Chapter two, this thesis will be presenting other major factors for oil price determination such as changing oil reserve levels and peak oil theory to see if they have more of an effect on price fluctuations. One of the other reasons for the oil shock in the 2000s is thought to happen because of the growing energy demand of East Asia. Thus, this thesis will shed light on the oil consumption of Japan, South Korea and China in chapters three, four, five respectively.

In Chapter three, this thesis will discuss Japan's economic power and then the Japanese government's approach to previous oil shocks. The thesis will also provide brief summary on Japan's current energy policy establishment by presenting energy resource consumption levels. Lastly, in the conclusion the relationship between oil prices and Japan's oil demand will be discussed. Similar to this chapter, Chapter four and Chapter five adequately detail South Korea and China's history and present oil consumption.

Following the energy crises, this thesis will be helpful to understand current energy mix of Japan, South Korea and China. According to this study, thesis will define future challenges and outlooks of energy policies of Japan, South Korea and China in different chapters. For better understanding, there will be total energy consumption charts. Because, if use of alternative energy resources rises as opposed to petroleum products, it refutes the hypothesis that slowing business of East Asia is the major reason for price changes. There will be oil reserve reports for each country, and whether they have started to produce their own oil internally will be discussed. Also, yearly oil consumption will be analysed to check if it has a slight or dramatic impact on the world economy.

The conclusion of the thesis reveals a new perspective on the importance of energy diversification and world oil market. It will also highlight unanswered further questions about energy security of East Asia. The conclusion chapter will be summarizing all the data and views regarding the oil price change and compare China, Japan and South Korea with each other because each country's production and consumption can differ in volumes. The study will conclude that China, Japan, South Korea's oil demand tends to getting lower by years and energy demand of this region is met by an energy mix. On the contrary, the business is not getting slower; however the growth in economy is not reflected in increasing the oil demand and therefore the price of oil. The additional demand can be met by energy conservation practices and the moving to alternative energy resources instead. The results of this research is important for providing analysis about how East Asia makes policies for ensuring an energy security and its effects on global economy.

CHAPTER 2

OIL SHOCKS

“The single most important fact for understanding short-run changes in the price of oil is that income rather than price is the key determinant of the quantity demanded.”¹³

The series of oil scarcities in the 1970s and 1980s created the current energy policies in East Asia. After these two decades, the oil market sharply increased and then decreased in price of oil in the 2007-2008 periods. The first part of this chapter will briefly discuss information about the previous energy crises. In the second part, the focus will be on the reasons and consequences of the more recent oil shocks that occurred in the period between 2008 and 2009. This part discusses the three main reasons behind the oil shocks such as the market worry, energy resource diversification and soaring energy demand from East Asia to make a general assessment on energy policies of three East Asian countries namely Japan, South Korea and China.

2.1 The reasons of past oil supply breakdowns

Before the 2000s energy crises, four main political conflicts in Middle East created dramatic economic results all over the world, and the oil prices were affected deeply. Starting from 1967 to 1990 there were a series of global oil crises. The first and the most serious one was the oil embargo enacted by Arab oil producers in 1973. The problems and tensions between the Israelis and the Arabs stem long back, but issues

¹³ Hamilton, *Causes and Consequences of the Oil Shock of 2007–08*. 220.

had recently arose and escalated after Israel declared independence as a new state in 1948. The Yom Kippur War began by a coalition of Arab states, which were led by Egypt and Syria against Israel on October 6, 1973. After losing this war against Israel and its supporters, Organization of Petroleum Exporting Countries (OPEC) imposed upon Israel an oil embargo that same year. OPEC members unanimously agreed to cut back oil exports in order to be aligned with their diplomatic perspective. In the next two months oil supplies globally dropped by about 9.8 percent.¹⁴ When the OPEC cancelled their embargo regime in March 1974, the Israeli forces did not withdraw from the occupied territories in Egypt. The embargo set by the Arab nations did not reach its first goal, causing political scientists to deem it as a failure.¹⁵ This series of political discrepancies in Middle East caused OPEC to lose power internationally. The price of crude oil has rose to 3 USD per barrel to 12 USD. This dramatic rise in price per barrel of oil was a big shock for the oil market. Ikenberry (1988) adds that

These shocks confronted Western importing countries with immediate demands to adjust their economies and address matters of energy security. Regarding issues of security of access, Western Europe and Japan were more threatened than the United States, even though the 1973 embargo was directed primarily at America. Almost all of Japan's petroleum came from foreign (mostly Middle Eastern) sources, and almost 70 percent of the energy Japan required came in the form of petroleum. (p.5)

According to demand-supply theory, if supply of a product decreases, the price of that product rises eventually. Oil output's decrease affected international oil prices additionally. The crude oil price per barrel fluctuated around 12\$-18\$ between 1973 and 1979 (see Figure 1). In 1979, the world witnessed another energy shock when the Iranian Revolution occurred. The fall of the Shah in Iran led to the 1979 oil shock.

¹⁴ Ikenberry. *The Oil Shocks and State Responses. In Reasons of State: Oil Politics and the Capacities of American Government.* 5.

¹⁵ GRAF. *Making use of the "oil weapon": Western industrialized countries and arab petropolitics in 1973-1974.* 185.

Reportedly after the Iranian Oil Shock, global oil supply decreased by only 3.3 million bbl/d which was around 4% of the total world oil production during that period.¹⁶ Despite Iran having a small share in world oil production, the panic and fear in the oil market resulted in the rise of oil price. The price of crude oil reached to \$39.50 per barrel in one year. Ikanberry (1988) states that,

In 1979, after several years of relative stability, prices again rose sharply. The second oil crisis began in late 1978 with a disruption in Iranian production sparked by domestic political upheaval. A short-term cutback in production by Saudi Arabia in January 1979 helped reduce world supply on a scale similar to 1973, and as before, prices moved rapidly higher. In the early months of 1979 spot market prices rose from \$19 a barrel to \$31 a barrel. By mid- 1980 the weighted average of OPEC oil had moved to about \$32 per barrel. (p.6)

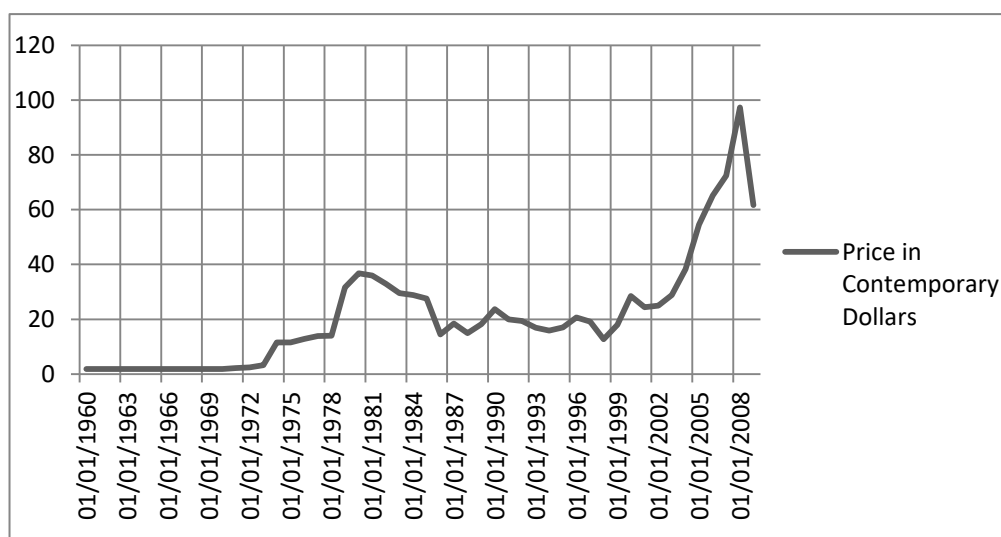


Figure 1. World Oil Prices from January 1960 to January 2016

Source: Quandl

The third conflict that affected oil prices was the Iran-Iraq war in 1980. During the war, the oil production in Iran almost stopped. Consequently, the decrease in oil production resulted in widespread panic in the market and resulted in crude oil prices

¹⁶ EIA

going up. Furthermore, the rising oil prices led to the worsening of the global economy.

Since the 1990s, there have been only slight changes in oil prices. In the beginning of 1990s, the major conflict was Iraq's invasion of Kuwait, which affected oil prices.¹⁷ These series of issues raised oil prices to high costs per barrel once again. Hamilton (2009) adds that Iraq's invasion of Kuwait caused a dramatic and prompt disruption of the flow of oil from the big global producers. Before 2000s, the oil crises mainly occurred by politics related physical disruptions. However, in 2000s, many reasons were behind the energy crises complicatedly.

2.2 The reasons behind 2000s' energy crises

The price of oil oscillated strongly between 2008 and 2009. Numerous reports and studies analysed and discussed the reasons behind the changes in oil price. According to Hamilton (2009), they can be listed as: the market worry created by Peak Oil Theory, high demand from China, stagnated crude oil production levels during the mid-2000s, finding new oil resources, economic crises in United States, discovering shale gas etc. The reasons of fluctuation in prices of oil during 2007-2008 were examined and organized in three different episodes listed below.

2.2.1 The market worry

The increasing of global energy consumption, the decreasing output in discovered oil reserves, and the prevalence of peak oil theories all created the oil price hike in the

¹⁷ Johnson. *Learning Large Lessons: The Evolving Roles of Ground Power and Air Power in the Post-Cold War Era*. 23.

2000s. King Hubbert in 1956 introduced his Peak Oil Theory. He forecasted that the United States would face oil scarcity in 1960s. His theory argues that since the world oil resources have already been discovered, the proven reserves were finite. Thus, according to the theory, the world oil production would have a peak and oil prices would increase accordingly.¹⁸ In his study, named “Nuclear Energy and the Fossil Fuels”, he introduced his theory by stating that

...for the petroleum industry the last century has been a period of bold adventure and discovery. Whole petroleum provinces analogous to the continents have been discovered and partly explored; a few tens of very large fields, corresponding to the large islands, and hundreds of small fields, the small islands, have been discovered. But how far along have we come on our way to complete exploration? (p.2)

Even though Peak Oil Theory was forecasted for United States in the 1960s, the idea awakened again to the 2000s’ dilemma. Since the oil production and consumption was increasing day by day, the theory reminded economists this question “what if world had to face an energy scarcity?” Technically, if any proven oil reserve had been used for oil extraction over a long time, there would be a lack of increasing output because of depletion of oil resource.

After Hubbert’s theory, there have been many proven reserves discovered and actively used. The increasing oil demand has been supplied by different oil reserves. It can easily be observed that oil production does not decline in the beginning of 2000s. Although during this time the world witnessed natural disasters and political conflicts such as hurricanes in the Gulf of Mexico in 2005 or turmoil in Nigeria in 2006-2008, the crude oil supply levels were particularly stable. Therefore, summarily, according to Hamilton (2009) the 2000s oil price shock did not experience a dramatic

¹⁸ Hubbert . *Nuclear energy and the fossil fuels*. 2.

decrease in the supply of crude oil (see Figure 2); instead, the forecasted levels of increasing oil production have not been reached.

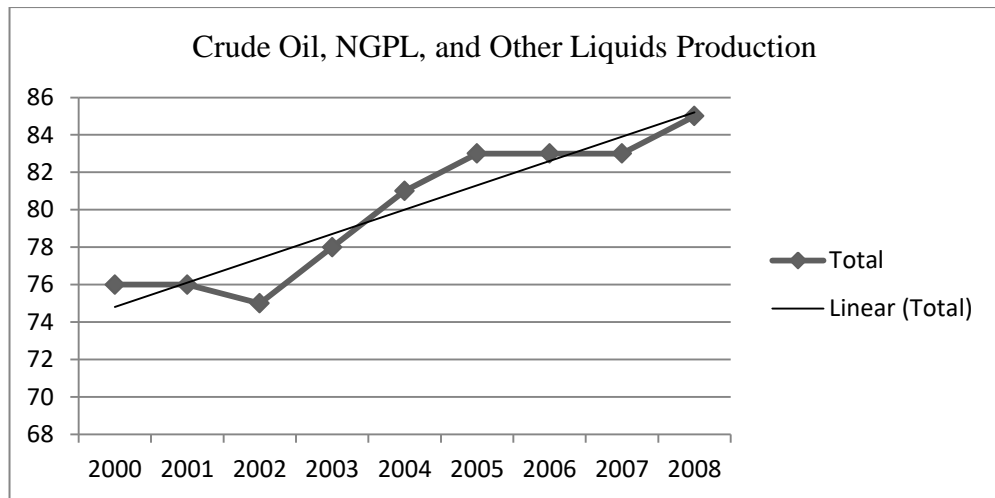


Figure 2. World Crude Oil Production, January 2000 to December 2008

Source: EIA

The geologic observations indicate the world is not getting close to the end of oil reserves. The new oil reserve discoveries refutes Hubbert's theory and Vijay (2007) point outs that

The World Is Running Out of Oil? Hardly. The world has more proven reserves of oil today than it did three decades ago, according to official estimates. Despite years of oil guzzling and countless doomsday predictions, the world is simply not running out of oil. It is running into it. Oil is of course a non-renewable resource and so, by definition, it will run dry someday. But that day is not upon us, despite the fact that a growing chorus of deflationists argue that we've already reached the global peak of oil production. Their view, however, imagines the global resource base in oil as fixed, and technology as static. In fact, neither assumption is true. Innovative firms are investing in ever better technologies for oil exploration and production, pushing back the oil peak further and further. The key is understanding the role of scarcity, price signals, and future technological innovation in bringing the world's vast remaining hydrocarbon reserves to market. Thanks to advances in technology, the average global oil recovery rate from reservoirs has grown from about 20 percent for much of the 20th century to around 35 percent today. That is an admirable improvement. But it also means that two thirds of the oil known to exist in any given reservoir is still left untapped. (p. 24)

The Peak Oil Theory forecasted that the global oil supply would become scarce in 1960s. However, even in the 2000s, oil scarcity is far from becoming a reality thanks to the new discovery of oil reserves in South America. The Peak Oil Theory might create confusion and market worry according to many economists; yet, geologists are still unable to prove the idea of upcoming scarcity with scientific findings. As oil consumption increases rapidly, starting from early nineteenth century, there has been many crude oil exhaustion reports forecasted. Nonetheless, the majority of these reports have been proven wrong. Many of these reports ignored the possibility of finding new oil reserves in other regions and focused on existing oil reserves, claiming oil production would decline by this time.¹⁹ Figure 3 indicates that oil reserves have almost tripled within the last 40 years.

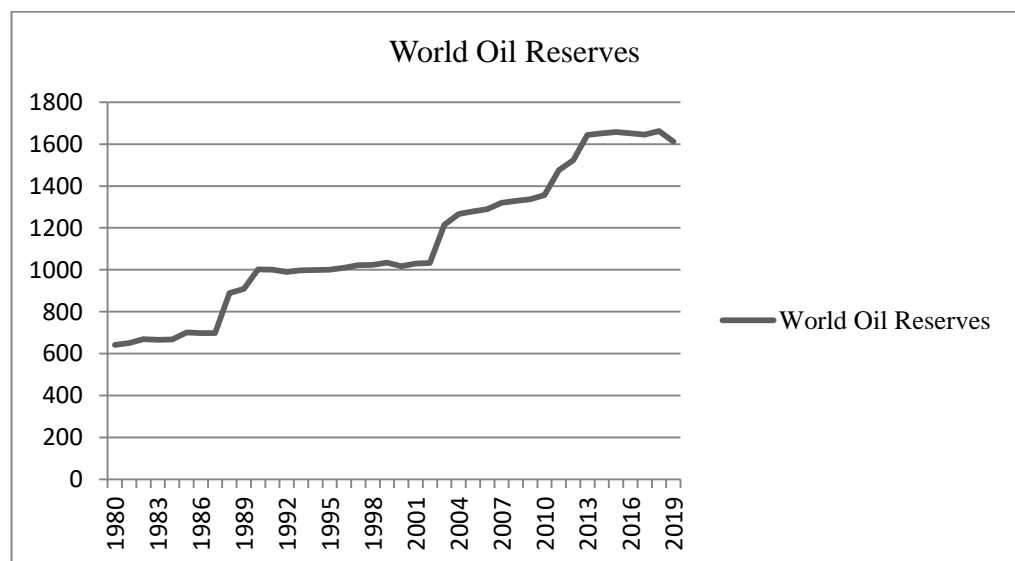


Figure 3. World Oil Reserves from 1980 to 2019

Source: EIA

¹⁹ Bentley. *Oil Forecasts, Past and Present. Energy Exploration & Exploitation*. 482.

2.2.2 Shifting to alternative energy resources and increasing energy conservation

The shift in alternative energy resources and increasing energy conservation is another factor affecting oil price fluctuations in 2000s. The states and governments need energy policies that implement alternative energy resource and increase energy conservation. Energy policy is one of the global challenges of the 21st century since it is complicatedly linked to other key factors such as global poverty and climate change. Though energy supply-demand equilibrium has become simpler in recent decades compared to the tighter supply period in the 1970s, many countries are still searching for increasing their energy supply for the sake of meeting both the internal and external demands. There are many scientific studies dealing with discovering and inventing new world energy sources. The energy sources available and used widely are listed here: solar both directly from the Sun (photovoltaics (PV) and solar thermal) and indirectly (such as wind, hydro, biomass, and wave energy), fossil fuels (coal, oil, and gas) with carbon capture and storage (CCS), nuclear (fission and fusion), geothermal, and tidal.²⁰

The countries are dependant to energy imports and consuming high amount of energy are trying to diversify energy resources such as China, South Korea and Japan. Due to the rapid growth and increasing energy demand, countries are relying on renewable energy resource. For example, China is currently a leading player in renewable energy development. Jiang (2017) emphasis the growing renewable energy industry in China as

Annual capacity increases for renewable energy in China account for one-third of the global total. Industry growth has been especially strong since 2011, with annual growth in wind energy of 22 per cent and 110 per cent for

²⁰ Blakers. *Sustainable energy options*. 320.

solar energy. Since 2015, China has been the world's largest consumer of modern renewable energy.²¹

Many types of energy resources have been used to meet rapid economic growth such as nuclear energy and renewable energies. Many countries are continuously searching for new oil and natural gas reserves, and some are actually succeeded in finding new reserves like shale gas. However, the discovery of shale gas has not created a tight supply and demand relationship internationally yet. On the contrary, it has led to an increasingly alarming global economic crisis as those countries which traditionally depended on oil reserves.

Additionally, energy crises indicate that too much dependency on specific energy suppliers is risky for the states. After the series of oil crises in 1970s, the states have started to focus on using renewable energy resources since oil and petroleum products are not renewable.

The other factor of decreasing oil consumption is the rise of energy efficiency and energy conservation globally. Efficient use of energy in plants, houses, and in daily life has been leading to a decrease in oil demand. East Asian countries such as Japan have great energy conservation power. Oil demand has slowly been declining due to the increase energy conservation and alternative energy resource use. The demand of oil would have been higher today without energy conservation implementation and energy diversification methods.

²¹ Jiang. *Technological Progress in Developing Renewable Energies*. 316.

2.2.3 Soaring energy demand from East Asia

The challenge in energy market conditions has led researchers to understand the causes of oil price hike. Many studies show that energy consumption levels in East Asia may have heavily impacted the oil price hike. Starting from the 1950s, the world economy has been dealing with the rise of Asian economic power. While Asia's share in world GDP was around 20%, according to the forecast reports of International Monetary Fund (IMF) (2010) it will exceed 40% in the 2030s. The rising GDP means that total income and consumption to increase as well.²²

Starting from the 1990's, China rapidly industrialized. With China's rapid industrialization the demand for crude oil increased consecutively. However, China's demand for crude oil could not be covered by only domestic oil supply. In 2012, China's dependency on foreign oil reached 56.4%.²³ Therefore, China optimized its international crude oil trade. High demand for crude oil pushed the producers to increase their production levels since the beginning of 2000. This increase in production was derived from China's desire to meet its demand, so it could continue its industrialization projects. In accordance with China's high demand, it was widely forecasted that the world oil output would increase substantially in mid-2000s.

The total energy demand of China, Japan, and South Korea is almost fixed. While the demand from Japan is decreasing, South Korea continued its pace, whereas there growing demand from China can be observed as image in below (Figure 4).

²² Juncal Cunado, Soojin, Fernando Perez de Gracia, *Macro economic impacts of oil price shocks in Asian economies*.

²³ Zhong, An. *The role of china in the international crude oil trade network*. 2943.

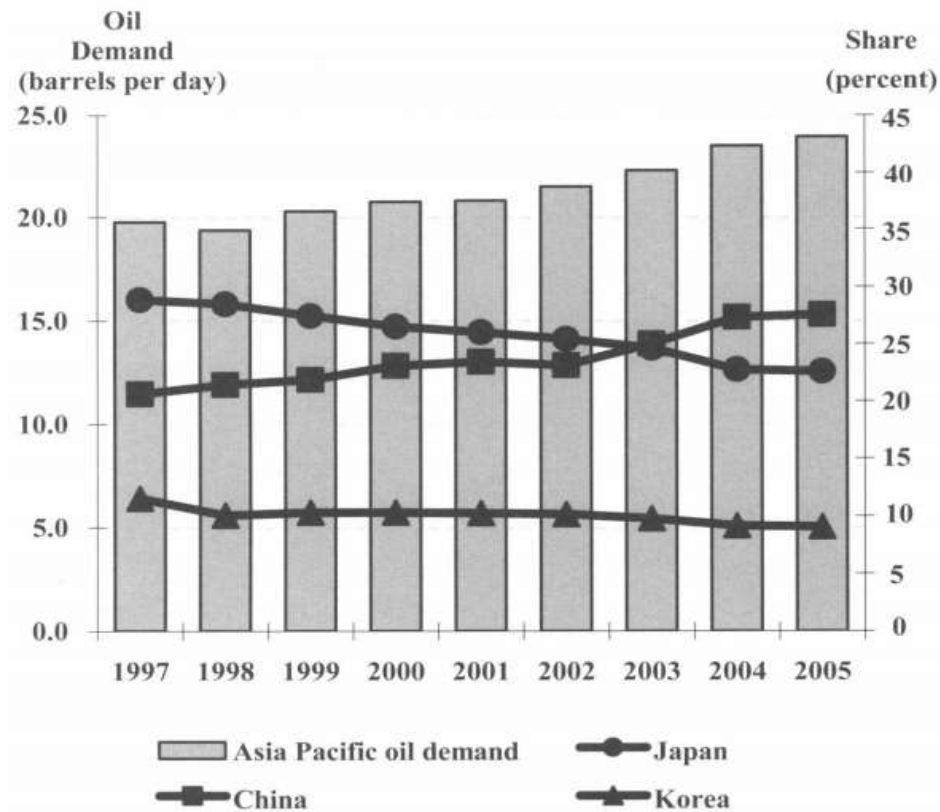


Figure 4. Asia Pacific Oil Demand and the Relative Shares of Japan, China and South Korea 1997-2005

Source: Data from International Energy Agency, Oil Market Report, Various issues.

Towards 2006, the world witnessed the same levels of oil production in contrast to China's daily oil consumption increase. The main reason for the lack of increasing output was due to the depletion of oil resources which continues to decrease because of daily oil extraction. As an example, the Saudis were only producing 850.000 barrels a day in 2007. This is actually lower than their production in 2005 than what World Energy outlook projected them to be producing, which was 12 million barrels a day by 2010 according to Hamilton (2009).

Hamilton (2009) claims in his research that soaring oil demand from China meant that other regions had to decrease their oil consumption. For instance,

Hamilton (2009) adds that oil consumption by the barrels in the USA in 2007 was less than the 2005 level. The crude oil producers realised that oil demand from China was increasing daily; China was now dependent on this oil monopoly since the domestic oil production in China could not catch up with its demand.

The dynamics in oil prices have greatly influenced international politics. Studies show oil shocks and energy scarcities affect energy policies of governments. The different energy resources, new business partnerships, and new methods for energy supply and energy management are the methods for ensuring energy security. The energy policies of Japan, South Korea and China will be investigated in different and separate three chapters.

CHAPTER 3

JAPAN

3.1 Economic power of Japan

In 1945 with the end of World War II, Japan took a new start towards economic reconstruction. These market oriented economy policies led Japan to be the second largest economy from 1978 until 2010, when China took this position. Having the second largest economy globally for a period of time influenced other East Asian newly industrializing economies (NIEs) positively as well. This famous Japanese Economic Development has been studied and became a good example. These studies indicate what the driving key factors for Japanese economic accomplishment were; (1) well-built economic development plans, (2) an educated and decent labour force, (3) high saving ratio, and (4) innovation and technologies.²⁴ The well-educated Japanese labour force was one of the important factors for economic development. For instance, the aging population and of non-farm self-employed families tended to save more to secure their national pension in the future. Therefore this structure led Japan to have a higher saving ratio than other developing countries.²⁵

The economic development plans applied simultaneously. One of the most efficient economic development plans of Japan was changing the industrial structure. This was done by shifting the focus from the primary sector such as agriculture and textile manufacturing towards advanced industries. Akkemik (2009) states that the Japanese government considered iron, steel, electric power industries having priority

²⁴ Akkemik, *Industrial Development in East Asia A Comparative Look at Japan, Korea, Taiwan, and Singapore*, 5.

²⁵ Mizoguchi, *On the High Personal Saving Ratio in Japan*. 62.

first, because the obtained outputs would use as input in automotive and heavy industry.²⁶ The well-built Japanese automotive products became a world-wide phenomenon because they were fuel efficient and safe. Later, Japan successfully followed technologic and innovative trends. Japanese technologic products had a high market value internationally. Following knowledge-based service sector, service sector had big share in Japanese economy (see Table 1). Akkemik also (2009) states that Japanese economy was constantly shaped by information technologies (IT), and its related services, research and development (R&D), telecommunication services, medical technologies etc. The share of primary sector in total GDP distribution decreased constantly. The current Japanese industrial structure was highly built by knowledge-based.

Table 1. GDP Share Distributions by Sector of Japan 1960-2005²⁷

	1960	1970	1975	1980	1985	1990	1995	2000	2005
Primary Sectors	9.0	5.0	4.5	3.2	2.6	2.1	1.7	2.0	1.6
Industry	43.0	32.9	31.2	31.1	30.4	30.7	29.4	34.6	29.7
Manufacturing	16.5	25.8	22.5	22.0	22.1	21.1	19.1	23.8	21.0
Services	48.0	36.3	41.8	43.7	44.9	46.1	49.8	63.4	68.7

Source: IMF International Financial Statistics (various years), and World Bank World Development Report (various years).

²⁷ This table based on Ali Akkemik's article titled "Industrial Development in East Asia a Comparative Look at Japan, Korea, Taiwan, and Singapore."

Generally investments and exports can be considered as the main engines of economic growth. However, the Japanese government did not rely on only export oriented economic policies initially. The government prioritized outbound investments first.²⁸ After 1980, NIEs in Asia-Pacific region started to receive foreign direct investments (FDIs) from Japan. According to Shujiro, (1993) Japan invested in drilling in Indonesia, iron ore mining in Malaysia, and copper mining in the Philippines. Therefore Japan influenced the setting of economic structure in this region as well.²⁹ In following years, Japanese economy focused on exporting more. In 1970, total export value of Japan was around 22 Billion USD, whereas in 1995 this amount reached to 488 Billion USD.³⁰

The Japanese economy bloomed non-stop for three decades starting from the 1960s. The GDP growth of Japan for the last five decades indicates the Japanese economic power (see Figure 5). The jump in Japan's economic developments made it economy to known as the "Miracle". However, for this miracle to occur Japan relied on energy imports because this region is known to be a natural resource poor country. The GDP rate and energy demand contains a linear relationship.

²⁸ Shujiro, *Japanese Foreign Direct Investment and Its Effect on Foreign Trade in Asia*, 275.

²⁹ Tamamura, *Structural Changes in International Industrial Linkages and Export Competitiveness in the Asia-Pacific Region*. 52.

³⁰ Worldbank

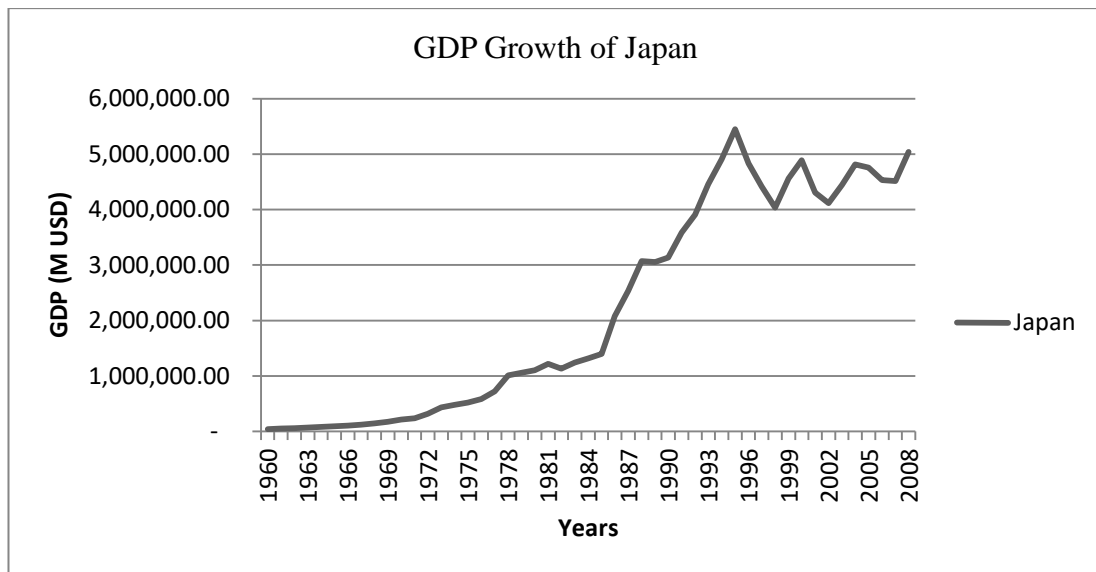


Figure 5. GDP (current US\$) of Japan between 1960-2008

Source: World Bank

The studies illustrate when there is an evident increase in energy demand there is also a rapid economic growth. For receiving any output some specific input is needed. The Japanese nation's rapid industrial growth led to substantial increase in its energy consumption. The oil and its products have been main inputs for Japanese economic bloom for last decades. However, oil price is not always stable. Contrary, to common understanding on the economic growth and oil prices, it was observed that oil price changes and economic growth in Japan captures a nonlinear relationship.³¹ The world faced energy scarcities and oil prices fluctuated wildly especially in 1970s. However, GDP growth of Japan increased constantly despite energy shocks in 1970s thanks to well done energy policies. Being dependant on specific energy resources and suppliers was significant for changing Japan's energy policies. The series of oil shocks starting from 1970s affected Japan and the origin of all these oil shocks was

³¹ Zhang, *Oil shock and economic growth in japan: A nonlinear approach*. 2375.

from the Middle East. Therefore Japan has implemented energy policies not for only different resources but also for suppliers as well.

3.2 Energy policies of Japan after oil shocks in the 1970s

Japan is the world's largest importer of liquefied natural gas (LNG), importing almost 84 million tons in 2017, and it is one of the main oil importing countries. Japan's oil consumption share in the world is around 4%. It is the world's fourth-greatest oil consumer (behind the United States, China and India) in 2018.

Regardless of the decrease in share of total energy consumption in Japan from 80% in 1970s to 42% in 2015, oil is still the greatest energy source Japan consumes..³² To meet the high demand for crude oil Japan has been known to be dependent on the Middle East. The Middle East covered t 80% of Japan's total crude oil imports in 2018. In 1967 just before the first oil shock, Japan's dependence on Middle East for crude oil reached to a 91.2% of its total imports.

Following oil shocks in Middle East in 1970s, the problems in oil supply changed Japan's energy policies later. Japan followed four key methods to produce this change: (a) a focus on diversifying energy resources such as natural gas, coal, nuclear power etc. (b) an extension of business partnerships with other oil-rich geographic countries (c) studies on energy conservation and decreasing energy intensity, and (d) an increase of exports as numerous as possible for building a better economy, so they could afford energy demands from overseas..³³ Therefore, in case of any unforeseen events such as wars, revolutions, or embargos these four new set policies would protect Japan and avoid any conflicts in production.

³² U.S. Energy Information Administration (EIA)

³³ Yorke. *Oil, the Middle East and Japan's Search for Security*. 428.

3.2.1 Diversifying energy resources

Japan suffered a lot from energy insecurity, resulting from their dependence on specific energy suppliers and resources and growing energy demand. This energy demand was likely to accelerate even more in the coming years due to goals of economic growth. Japan had a low energy self-sufficiency ratio which means having high dependence on other countries for energy resources. The historical oil crises have been re-constructed Japanese energy policies. Japan has set goals to reduce domestic energy consumption and ensure their energy security.

Japan has also focused on diversifying its energy resources by launching nuclear energy plants and increasing LNG imports and coal.³⁴ Japan has put significant emphasis on changing its energy mix by developing nuclear energy industry. For instance, from 1980 to 2011, electric power produced from nuclear energy plants contributed to Japan's energy supply remarkably. Also, by Japan's use of nuclear power, its CO2 emissions rate was reduced as well. However, unforeseen disasters in nuclear plants have devastated Japan and its economy. In 2011, Tohoku earthquake and tsunami hit nuclear energy plants, having dramatic results.³⁵ Thus, Japan revamped its energy policy once again after 2011.

One of the other important developments for energy resource diversification was focusing on natural gas. Concerning natural gas, Japan focused on expanding its business relationships with Russia after oil crises.

For electricity, Japan relied on renewable energy resources. Hence, electricity production was successful in supplying domestic demand. Comparing between Europe, the recent energy consumption and production balance of both

³⁴ The Federation of Electric Power Companies of Japan,

³⁵ World Nuclear Association

regions can be observed below. (see Table 2). Both regions were deeply affected by WWII and later on both areas went through industrial re-construction they were successful in meeting their domestic electricity demand. Just like Japan, Europe is also an oil resource poor region. Therefore Japan and Europe depended on energy imports and energy efficiency. Thus, understandably European countries such as Italy having great achievements in lower energy intensity compare to other countries as well.

Table2. Energy Balance of Japan by 2019

Electricity	Total	Japan per capita	Compared to Europe per capita
Own consumption	943.70 bn kWh	7,443.26 kWh	5,514.73 kWh
Production	989.30 bn kWh	7,802.92 kWh	5,929.23 kWh
Crude Oil	Barrel	Japan per capita	Compared to Europe per capita
Production	3,841.00 bbl	0.000 bbl	0.005 bbl
Import	3.21 m bbl	0.025 bbl	0.020 bbl
Natural Gas	Cubic meters	Japan per capita	Compared to Europe per capita
Own consumption	127.20 bn m ³	1,003.27 m ³	904.00 m ³
Production	3.06 bn m ³	24.12 m ³	456.91 m ³
Import	116.60 bn m ³	919.66 m ³	854.66 m ³
Export	169.90 m m ³	1.34 m ³	399.02 m ³

Source: World Data Info, Energy Balance of Japan

3.2.1.1 Increasing renewable energy resource usage

Japan has considered renewable energy resources as a new kind of energy resource and emphasizing it. Renewable energy resources are eco-friendly, economically, sustainable and they reduce fossil fuel usage. Despite having a smaller share of Japan's total energy consumption, the importance of renewable energy resources in Japan's economic and environment plans is big. The demand of oil has been decreasing significantly whereas the supply of coal, natural gas, nuclear energy is rapidly increasing (see Table 3). If Japan did not start energy diversification policies in the past, today the oil demand for oil would be higher, leading to a more fragile Japanese economy due to oil price fluctuations.

Table 3. Energy Resource Distribution Changes of Japan 1990-2010

Year	Coal	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Oil
1990	76,117	44,120	52,704	7,575	2,750	4,567	250,387
1995	83,964	53,164	75,889	6,891	3,951	4,543	265,070
2000	96,722	65,629	83,913	7,263	3,948	4,891	255,169
2005	110,072	70,652	79,407	6,614	3,831	7,865	243,141
2010	114,710	85,880	75,101	7,206	3,508	9,966	202,693

Source: IEA, Units: ktoe

3.2.2 Launching new business partnerships with other oil-rich nations

Japan has had many difficulties and disadvantages in searching for new energy reserves due to its geopolitical setbacks as a small island country and logistical difficulties in transporting energy sources. Thus, due to the lack of energy resources,

the Japanese government and private companies led overseas oil-discovering projects through their contribution of engineering, construction, R&D, financial aid, project management services etc.³⁶ In 1967, state controlled Japan National Oil Corporation (JNOC) was assigned to make investments in overseas petroleum projects and give financial support in exploring new oil reserves. The corporation's aim was ensuring a stable, inexpensive supply of oil.³⁷ However, other developing countries such as South Korea influenced Japan, encouraging Japanese private companies to take active role in overseas energy projects as well. In 1980s the Japanese government let the private sector to be involved in overseas production and exploration events, allowing them to buy oil freely. In 1990s, it was observed the main overseas subsidiaries of JNOC were not doing well financially, and this negative result led the Japanese government to close JNOC. Later, the company was replaced by the Japan Oil, Gas, and Metals National Corporation (JOGMEC). By 2009, more than 70 non-state controlled Japanese firms such as; INPEX Corporation, Japan Petroleum were taking roles in this overseas oil reserve exploration activities.³⁸

3.2.3 Focusing on energy conservation

Being a resource poor country impacted Japan's focus on energy conservation, energy self-sufficiency and reduction of oil usage. Hence, aside from only studying on finding new energy resources as its competitors did, Japan focused on energy conservation as well, leading Japan to be one of the most successful cases in world history. Since 1973 with the significant oil crisis, Japan has impressively achieved

³⁶ EIA

³⁷ JOGMEC, Japan Oil Gas and Metals National Corporation

³⁸ Crane, Goldthau, Toman, Light, Johnson, Nader, Dogo. *Oil as a Foreign Policy Instrument. In Imported Oil and U.S. National Security.* 25.

energy conservation. This achievement is mostly due to the combined efforts made by both public and private sectors.³⁹ It is believed that energy conservation policies in East Asia, especially in Japan, became the main topic after previous energy crises. Being dependant on specific suppliers created huge problems back then, so government led projects for energy efficiency shaped Japan's energy policy.

Energy-rich countries, such as Saudi Arabia or Russia, have an economic power allowing them to influence the world politics according to their interests. These countries were able to influence the buyer countries thanks to their strong position as energy suppliers. They could also manipulate the energy market by changing the prices and pose challenge to buyer countries such oil embargo imposed by Middle East in 1973. Japan's energy efficiency programs are conducted to prevent national economy from energy market manipulations and create a more eco-friendly environment.

The studies and revisions in social areas, work places, production plants, and houses for decreasing energy consumption define energy conservation. It can be provided and used by low energy consumption or consuming less energy from traditional energy resources. Thus, actually energy conservation differs from efficient energy use, which refers to using less energy for a constant service. Japan is known to lead in many renewable, carbon-abatement and energy-efficient technologies globally.⁴⁰ Additionally, it is among the world's most energy efficient nations. The success of the Energy Conservation Act is explained as "The Energy Conservation Act (law concerning the rational use of energy) was enacted in 1979 and has subsequently been revised several times. It has contributing to the sound

³⁹ Japan Energy Conservation Handbook 2013, 3.

⁴⁰ Dent. *Asia and Europe: Meeting Future Energy Security Challenges*. 127.

development of Japan's economy by setting up necessary measures for the rational use of energy by factories, buildings, transport, and machinery and equipment. It also strives to reduce Japan's CO₂ emissions and ensure the effective use of fuel resources. These measures have successfully reduced Japan's energy consumption per GDP to just one while the EU consumes 1.8 times more energy per GDP in comparison.”⁴¹ The government of Japan established The Energy Conservation Centre in Tokyo. Their activities are stated below:⁴²

- Promotion of energy conservation in the industry
- Promotion of energy conservation for households, local communities, etc.
- Development of human resources engaged in energy conservation
- Promotion of international cooperation and activities
- Implementation of national examinations, training and seminars

In 1979, the Energy Act firstly introduced, its concern was to build energy management and conservation for designated factories such as vehicle, refrigerator, and air condition producers. These factories consumed 3,000 kilolitre of crude oil or 12 Gigawatt hours (GWh) electricity annually. The factories were described as “Designated Energy Management Factories” (Type 1 Designated Energy Management Factories). Under this act, regulatory standards called “Judgment of Standards” were developed for these designated factories to refer to when practicing energy management requirements.⁴³ The present designated energy management factory system originated from the designated heat management factory system under the Heat Management Regulations (1947), the predecessor of the Heat

⁴¹ Shiel, Jeffers, Dyar. *Energy Conservation Measures in Japan*

⁴² ASIA EEC

⁴³ EIA

Management Act.⁴⁴ The requirement of this regulation was appointing an energy manager who had been qualified by a national license. Consequently, it would be easier to follow the status of that factory through receiving energy consumption reports. This act has been revised many times: in 1993, 1998, 2002, 2005 and 2008 respectively. Therefore, the act was revised in 1993, so the Japanese government could guarantee the implementation of energy conservation efforts by requiring periodic reports from those mentioned factories. In 1998 revision, “Type 2 Designated Energy-Management Factories” term was created following the first plan. “Type 2 Designated Energy-Management Factories” indicated the plants with an annual fuel consumption equivalent of over 1,500 kilolitre of crude oil or annual electricity consumption over 6 GWh. One of the major programs was introduced during this period named Top Runner Program which was set for strengthening the scope of this project in residential and commercial sector. Thus, the companies and firms that import or produce products which consumed high energy had to follow certain rules according to the regulation. The “Top Runner Program” purpose was to increase the efficiency of the most effective product of the same group on the market. July 2009, the number of target appliances and automobiles reached to 23 which included: passenger vehicles, freight vehicles, air conditioners, TV sets, video recorders, fluorescent lights, copying machines, computers, magnetic disc units, electric refrigerators, electric freezers, space heaters, gas cooking appliances, gas water heaters, oil water heaters, electric toilet seats, vending machines, transformers, microwave oven, electric rice cookers, DVD recorders, routers and switches (as cited in Shiel, Jeffers and Dyar 2011). In 2002, Type 1 Designated Energy Management rule expanded to all types of industries. Following the implementation of Kyoto

⁴⁴ Ogawa, Noda, Yamashita. *Japan's Energy Management Policy Experiences and Their Implications for Developing Countries*. 3.

Protocol for global warming prevention in February 2005, Japan released Kyoto Protocol Target Achievement Plan to replace the Climate Change Policy Program. They also revised “Global Warming Prevention Act” with the aim of calculating, reporting greenhouse gas emissions more effectively. According to the Kyoto Protocol Target Achievement Plan, Japan was planning to save 11.9 million kl energy consumption by implementing action plans. In 2005, the transportation sector was promoted to increase energy conservation. In this case, transportation enterprises, carriers, passengers, and vehicle owners were targeted; in turn, eco-driving brought good economic and environmental results. The revision in 2008 strengthened measures for the industry and commercial sectors. This revision introduced a system for energy management obligation per whole enterprise. Even if the enterprise was small or big, all had to follow the regulation even, for instance, convenience stores. After the 2008 revision, buildings, houses, offices owners started to report about consumed energy. In order to protect itself from the energy market risks, Strategic Energy Plan of Japan was conducted and revised in April, 2014 (see Table 4). It covers the energy policies plans for 2018-2020. Then a long term period that for 20 years, supported by Government of Japan. Below are the historical data of energy conservation policies of Japan summarized. The purpose of this regulation was to reduce energy usage in every field in the country. Efficient usage would bring economic and environmental friendly results. Ultimately, Japan achieved what they aimed in the following years.

Table 4. Progress of Energy Conservation in Japan 1951-2014

Years	Subject
1951	Enforcement of the Heat Management Act
1960	Change of energy policy from coal to oil
1978	Establishment of the Energy Conservation Center, Japan
1979	Enforcement of the Act on the Rational Use of Energy (the ECA). (First Oil Shock 1979)
1988	The 1st Intergovernmental Panel on Climate Change (IPCC) held in Geneva
1997	The 3rd Conference of Parties (COP3) held in Kyoto. Adoption of the Kyoto Protocol, Public commitment to reduce greenhouse gases by 6% (Japan)
1998	Enforcement of the Act on Promotion of Global Warming Countermeasures
1999	Establishment of the system for designating Type 2 Designated Energy Management Factories. Introduction of the Top Runner Standard (enforcement of the Revised ECA)
2000	Introduction of the energy saving labelling system (JIS standard)
2002	Ratification of the Kyoto Protocol (Japan). Enforcement of the Basic Act on Energy Policy
2003	Enhancement of the measures for office buildings, etc. (Revised ECA)
2005	Effectuation of the Kyoto Protocol
2006	Establishment of the measures for transportation and the integrated control of heat and electricity (enforcement of the Revised ECA)
2008	Start of the 1st commitment period of the Kyoto Protocol. Summit (G8) held in Toyako, Hokkaido
2009	At the United Nations Summit on Climate Change, the target aiming at 25% reduction of greenhouse gas emission was announced.
2010	Introduction of the system for regulating the energy use as a whole enterprise (Revised ECA)
2011	Due to Great East Japan Earthquake, electricity use in summer is limited, electricity saving measures are promoted.
2011	Establishment of Center for Energy Management System Auditors Registration (CEMSAR)
2014	Announcement of the commitment to SE4ALL (Sustainable Energy for All) activities

Source: The Energy Conservation Center, Japan

In addition, the Energy Conservation Act did not just create energy efficiency but also resulted in a decrease of CO₂ emission as well. The big efforts to create energy conservation since the oil crises in the 1970s have led to an approximate 40% decrease in Greenhouse Gas (GHG) emissions in a 40 year timespan (see Figure 6). These efforts achieved good results and Japan gained international respect. However, Japan still is willing to carry out further reductions of GHG emissions by constantly implementing energy-saving policies.⁴⁵

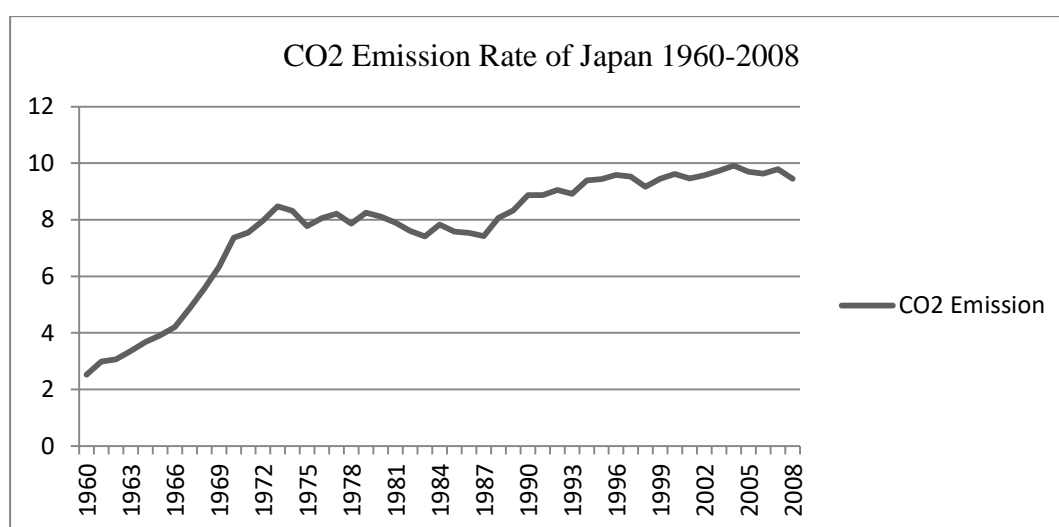


Figure 6. CO₂ Emission Rate of Japan 1960-2008

Source: Worldbank; CO₂ emissions (metric tons per capita) per selected countries by 2019 update.

The success of energy conservation can be measured by the energy intensity of that region as well. The term energy intensity is an indicator of energy conservation efficiency. Energy intensity (EI) is defined as energy consumption per dollar of gross economic output.⁴⁶ The lower EI rate indicates that less energy is used to produce one unit of output. It provides the rate of primary or total energy

⁴⁵ Top Runner Program. *Ministry of Economy, Trade and Industry Agency for Natural Resource and Energy*. 2015.

⁴⁶ Bernstei, Fonkych. *State-Level Changes in Energy Intensity and Their National Implications*

consumption of a country to Gross Domestic Product (GDP). Primary energy intensity shows how much energy is required for producing one unit GDP for countries or regions. Doblin explains this term as “Since the first oil price shock of 1973-74, there has been considerable reduction in total energy use per unit of total output. This development has many names: increasing energy conservation, demand elasticity, increasing energy productivity, or, conversely, decreasing energy intensity.”⁴⁷ At the national level, energy intensity is the ratio of total domestic primary energy consumption or final energy consumption to GDP or physical output (EEA, 2002). The energy intensity value is calculated by taking the ratio of total primary energy use to GDP. The lower energy intensity is wanted globally as it indicates effective energy consumption. Despite having slower speed in 2000s, the total picture portrays how much effort was spent by Japanese government to decrease energy intensity (see Figure7).

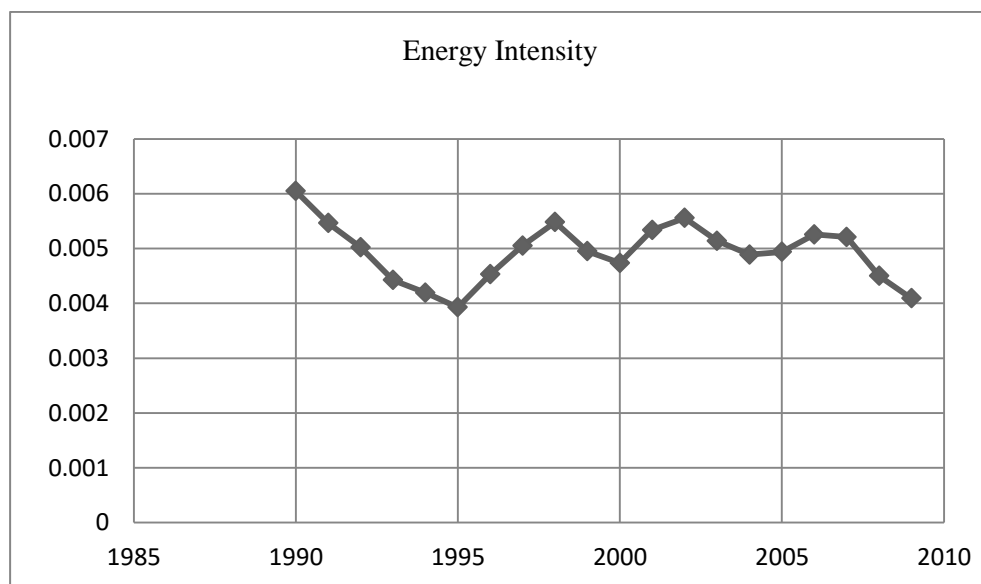


Figure 7. Energy Intensity of Japan

Source: EIA

⁴⁷ Doblin. *Declining Energy Intensity in the U.S. Manufacturing Sector*. 109.

3.3 Conclusion

Japan has gone through a period of rapid industrial development which has resulted in a huge demand for energy sources, in turn making it one of the biggest consumers of petroleum and its products. As a small island-nation lacking natural resources, inevitably Japan would heavily depend on import from oil-rich countries. Japan's main goal was reducing the share of oil in its energy mix. The oil never had a stable price and fluctuating oil prices have been deeply affected the supply chain of Japanese economy. In the 1960s and in 2000s oil was still the most consumed energy resource in Japan; however, the consumption rate of it significantly decreased by implementing successful energy policies. The increasing energy efficiency and energy resource diversification resulted in a decline in oil consumption quantity. The other key factor plays a high role in total crude oil demand levels is renewable energy resources such as solar and hydroelectric. The obtained energy from renewable energy resources fills a big room in total energy demand levels of Japan. Also, Japan shaped its energy mix by building nuclear energy plants and increasing coal and LNG use.

As stated before, the relationship between energy demand and energy conservation is non-linear. If a region achieves a high energy conservation it will tend to consume lower energy levels than before. The Japanese government's successful attempts on energy efficiency were because of private and state-controlled companies consumed less energy. Energy Conservation act in Japan is a great example not only successful policy implementation but also the proponents of efficient energy conservation. Japan's dependence on foreign imports resulted in the need to focus on energy conservation, and it succeeded in promoting conservation through the implementation of strong policies and regulations. The policy-makers

were victorious in changing the behaviour of investors and business circles as well as common people.

Japan's oil demand has been decreasing for the last decades, but it does not mean that Japan has been slowing business. The reasons for this are shown here: 1.) energy resource diversification, 2). fuel substitution, 3). aging population and 4). government-led energy efficiency targets. The impact of energy efficiency policies may be slight or big on the total energy demand of Japan. Nonetheless, it can be said that without the studies, today's oil demand is higher.

CHAPTER 4

SOUTH KOREA

4.1 Economic power of South Korea

South Korea has a dynamic economy which has been growing for the past 50 years. Before the establishment of the Republic of Korea (ROK), Koreans dealt with many national problems, such as Japanese colonization that lasted around fifty years, military occupation of the U.S., China and Russia, and diplomatic disagreements with North Korea. After all the dramatic events, South Korea gained their independence in 1945. The main factor for economic growth lies in the Korean history. The long war era, being ruled under the Japanese and U.S. management, facing poverty, and economic scarcities made South Koreans ambitious. Other fundamental reasons for South Korea's economic development are an educated populace, labor force, and productive, boosting economic development reforms. Syngman Rhee who was the first president of ROK was not so effective in economic development of Korea.⁴⁸ However, Park-Chung Hee who served as the President of South Korea from 1963 until 1979 successfully reformed South Korea's economic plans for the country.

Park Chung Hee is mainly known by his successful economic development policies for South Korea. One of the fruits of this development was "chaebol". This means the economy had numerous enterprises with a hierarchy system under one roof that controlled mainly by a certain family members. At first it was portrayed as

⁴⁸ Haggard, Kim, Moon, *The Transition to Export-Led Growth in South Korea, 1954-66*. 24.

an organization supported by the state for national interests.⁴⁹ According to Kim and Vogel (2011) the structure of chaebols illustrates a great state-business relationship in Park's period such as giving incentives to designated enterprises and establishing Economic Planning Board (EPB) to encourage chaebols to take risk in their projects through government support. It was a costly method but effective in South Korea's economic exponential growth. The state controlled chaebols such as Samsung, LG, SK, and Hyundai enterprise groups brought great achievement and helped South Korea to rapidly industrialize after the 1960s.

The other result of Park's economic plans was an evident increase in manufacturing firms during the 1960s. From diverse sectors such as textile, light, steel, electricity, many enterprises took a role in industrial development. Later, by Park's economic reforms, the resource-poor South Korea shifted its textile and food based light industry to heavy and chemical industry.⁵⁰ "Heavy Chemical Industry Drive" was announced by Park Chung Hee in 1973. These heavy chemical industries formed of led metal, petrochemical, machinery sector development in South Korea. The contribution of primary sector activities such as agriculture, fishing dropped significantly in GDP, whereas light and heavy industry and also knowledge-based service sector has shaped South Korea's current economic structure. Therefore, the industrial structure shaped again based on advanced industries by taking focus away from primary sector (see Table 5). The given data illustrates that the South Korean economy rapidly industrialized after the 1960s.

⁴⁹ Kim, Vogel. *The Park Chung Hee Era*. Cambridge, Massachusetts; London, England: Harvard University Press.

⁵⁰ Akkemik. *Industrial Development in East Asia A Comparative Look at Japan, Korea, Taiwan, and Singapore*. 4.

Table 5. Sectoral Shares in GDP of South Korea 1960-2005

	1960	1970	1975	1980	1985	1990	1995	2000	2005
Primary Sectors	36.9	26.9	24.5	14.2	12.6	8.5	6.2	4.6	3
Manufacturing	14	20.5	25.3	26.1	29.2	28.8	29.4	31.5	25.3
Industry	15.9	22.4	27.5	37.8	40.9	43.1	43.2	42.7	35.8
Services	47.4	50.7	48	48.1	46.5	48.4	50.6	52.7	61.1

Source: IMF International Financial Statistics (various years), and World Bank World Development Report (various years).

The South Korean economy had negative annual GDP rates only a few times in the last fifty years (see Figure8). South Korea's average annual growth rate was around 7.2% until 1998 when it remarkably decreased following the Asia financial crisis.⁵¹

This phenomenal growth is often called "Miracle on the Han River".

South Korea followed the export-oriented economic policy. Export-oriented industrialization strategy was the most effective way of economic achievement in South Korea.⁵² In the 1980s and 1990s, growth continued as South Korea transformed itself from an exporter to a major global producer of automobiles, electronics, ship building, and steel. Presently South Korea is known by its high-technology products such as electronics, telecommunications, mobile phones, and IT products.

⁵¹ Ahn. *Republic of Korea's Energy Security Conundrum: The Problems of Energy Mix and Energy Diplomacy Deadlock*. 68.

⁵² Gibson, Liebler, Ward. *Export Orientation: Pathway or Artefact?* 332.

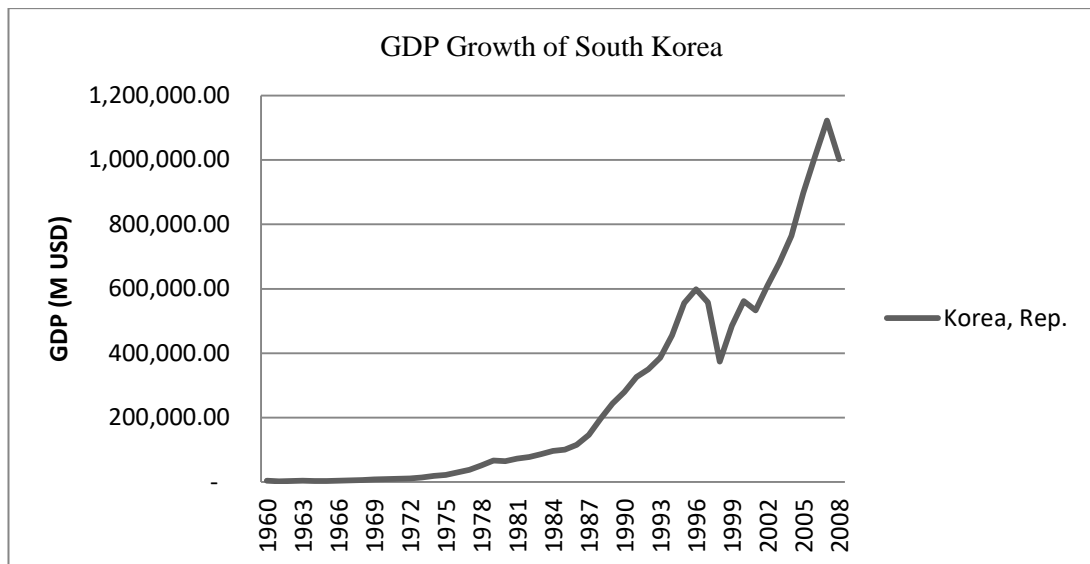


Figure 8. GDP (current M US\$) of South Korea between 1960-2008

Source: Worldbank

Foreign direct investment policy was introduced in the 1960s to ease the balance-of-payments problems and supply needed technology from developed countries.

However, the South Korean government let FDIs flow into only designated industries with limitations to block market being dominated by foreign powers.⁵³

However, the difficulties in the 1998 Asia Economic Crises led the South Korean government to make changes in FDI policies. Fortunately, FDI was actively promoted and more power was given to foreign investors.

The most imported materials in South Korea are crude oil and petroleum products which are the main inputs in industrializing countries. Korea is still a developing country and energy use continues to grow rapidly. Similar to other poor-resource countries, South Korea is heavily dependent on imports of oil, natural gas and coal to drive its economy. South Korea highly relies on the Middle East for its

⁵³ Kim, Hwang, *The Role of Foreign Direct Investment in Korea's Economic Development Productivity Effects and Implications for the Currency Crisis*. 268

oil supply, with the Persian Gulf accounting for nearly 75 percent of South Korea's 2010 total oil imports (EIA 2019). Therefore, the high dependence of oil imports made Korean energy policy more fragile. However, despite having high dependence on energy imports South Korea has been able to continue having strong economic power even in the serious oil shock events of the 1970s.

4.2 Energy policies of South Korea after oil shocks in 1970s

South Korea is one of the oil-resource lacking countries, making it to be the fifth top oil importer in the world, with 64% of its oil coming from OPEC members according to EIA (2019) data. Being the fifth largest importer of crude oil, South Korea is also the fourth largest importer of coal and the second largest importer of liquefied natural gas (LNG) in 2019.⁵⁴ South Korea had high speed in industrialization after 1960s when a series of oil shocks happened in Middle East where the major oil reserves exist. The main oil crises occurred in 1973 when OPEC members put an embargo on oil exporters that followed a pro-American and pro-Israeli policy. Later, the cut in oil imports was observed once again when the fall of the Iranian Shah and Iranian Revolution took place in 1978. Due to the economic and political crises impacted South Korea's energy policies. Its oil dependency on these countries led to a serious of shortcomings with its oil supplianee. In turn, the South Korean government made radical changes in its energy policies which had not occurred in years.

During President Park Chung Hee's period, South Korean policy makers followed separate energy policies according to the energy market. Additionally, according to Ahn (2015) South Korean energy security was endangered since the

⁵⁴ EIA

energy policies were ill-made and implemented with no concrete aims; there was not any logistical and organized plan for the energy mix. First, the South Korean government followed a laissez-faire attitude against rising oil prices in 1973-1974. This approach meant that the market dealt with a large increase in the cost of imported oil to energy consumers. On the macro policies, the Korean government tried to follow the expansionary monetary growth policy. As a result the Korean government let oil prices go up. However, in 1980, 30 percent of South Korean foreign money reserves were used to import oil to the country. Khairy (1991) states that the resource diplomacy of South Korea as:

In the political arena, both nations (South Korea and Taiwan) became resource diplomacy. The South Korean government strengthened Arab oil-producing nations and distanced itself from Israel. To reduce imbalances with its oil suppliers, the country engaged quite actively Middle Eastern construction boom by carrying out project-related exports had a beneficial effect on the chronically negative current account. Korea, but on a smaller scale, Taiwan also expanded its construction activities the Middle East. It should be added here that the total exports of both nations continued expand briskly between 1973 and 1978 at an annual average of 31.2 South Korea and 23.1 percent in Taiwan. This expansion had allowed nations to weather the first oil shock rather easily. During this 1974 and 1975, GNP growth rates reverted to the double-digit growth experienced in 1973.⁵⁵

The Ministry of Commerce and Industry did not have enough experience in dealing with energy problems. Unfortunately, they were in charge of South Korea's energy policies before the 1980s energy crises. By the five-year energy plans of the government Ministry of Energy and Resources was established. The domestic and international strategies developed under Ministry of Energy and Resources' roof. One of the strategies they enacted dealt with distributing energy to the industries and shifting to less energy consumer industries that have high value-added products, i.e. information technologies sector. In addition, the other important strategy was about

⁵⁵ Khairy. *The Journal of Energy and Development*. 259.

supporting the idea of energy efficiency in production and adopting energy conservation.

South Korea's goals are: (a) diversifying energy resources and focusing on renewable energy resources, (b) leading for exploring new oil reserves in other regions, (c) introducing energy intensity, and lastly (d) increasing its economic power to purchase energy easily from overseas. Despite introducing new energy policies later than Japan South Korea also had similar main subjects to be concerned about such as energy crises in the future. One thing South Korea was not good at compared to Japan's successful energy policies was the introduction of energy conservation. Because they introduced these policies late, South Korea put too much emphasis on CO2 emission reduction in the following years. South Korea was successful in its energy policy economically but not environmentally before the 2000s. Air pollution became one of the main topics in South Korea. South Korea was late in announcing a long-term official energy plan which only was introduced in August 2008. South Korean energy policy makers included "policies to enhance energy efficiency to reduce energy imports dependence and respond to oil costs, move toward sustainable energy systems and pursue regional energy cooperation."⁵⁶

4.2.1 Diversifying energy resources

One of the remarkable methods for decreasing the risks of oil import dependence for South Korea was its diversification energy types and the rise of energy efficiency in every field. Being dependent on one specific energy supplier and supply material drove the South Korean government to pursue a new energy policy. South Korea

⁵⁶ Hippel, David, Hayes. *Growth in Energy Needs in Northeast Asia: Projections, Consequences and Opportunities*. 5.

diversified its energy resources by launching nuclear energy plants and increasing LNG imports and coal and developing renewable energy industry.⁵⁷

South Korea put a significant emphasis on changing its energy mix by developing its nuclear energy industry. Concerning electricity, nuclear energy was the new brand energy resource only possible with the help of Canadian and French companies. Khairy (1991) adds that with this nuclear energy deal between these three countries South Korea got assistance from Canada and France in international politics as well as North Korea being shunned by France diplomatically. The active 24 reactors has been providing about 30% of South Korea's electricity currently. Basically from 1980 to the 2000s, electric power produced from nuclear energy plants contributed to South Korea's energy supply remarkably. Compare to Europe's consummation and production electricity power per capita is way higher in South Korea (see Table 6). South Korea was able to supply its electricity demand domestically mainly from nuclear energy plants.

Table 6. Energy Balance of South Korea by 2019

		South Korea	Compared to
Electricity	Total	per capita	Europe
Own consumption	507.60 bn kWh	9,862.78 kWh	5,514.73 kWh
Production	526.00 bn kWh	10,220.30 kWh	5,929.23 kWh
		South Korea	Compared to
Natural Gas	Cubic meters	per capita	Europe
Own consumption	45.28 bn m ³	879.80 m ³	904.00 m ³
Production	339.80 m m ³	6.60 m ³	456.91 m ³
Import	48.65 bn m ³	945.28 m ³	854.66 m ³

Source: World Data Info, Energy Balance of South Korea

⁵⁷ The Federation of Electric Power Companies of Japan

After Japan, South Korea is known to be second largest LNG natural gas importer in the world. Compared to Europe, consumed natural gas per capita is lesser, but South Korea successfully created a big natural gas market domestically. Ahn (2015) adds that South Korea highly promoted natural gas use by a series of energy policies. In the 1980s South Korea announced that government would give tax incentives to natural gas user companies. According to Ahn (2015) starting from 1987 to 2000s, natural gas industry of South Korea was developed successfully by fast expansion and high consumption. Moreover she mentioned that ROK constructed a natural gas trunk pipeline network around the country. Consequently, South Korea has become one of the biggest LNG markets worldwide. Ahn (2015) added that a well-built LNG pipeline let the natural gas industry grow more and more for being convenient and environmental friendly. According to her statement, therefore, it is expected that gas demand in South Korea would grow by 150%, from 20 billion cubic meters in 2000 to 53 billion cubic meters by 2020. Korean Gas Corporation (KOGAS) is known to be the world's largest natural gas importer. It imports all gas from overseas and then distributes the gas through LNG domestically. The main LNG supplier of South Korea was Indonesia. However, due to the increasing purchase of LNG from South Korea Indonesia had to import LNG overseas to meet South Korea's demand. In turn, South Korea had to expend its energy contacts between the Middle East once again, but this time it is not for oil but LNG. Ahn (2015) adds:

KOGAS has a monopoly over the all of ROK's gas imports, which thus far are entirely in the form of LNG, which generates some social agenda at home from the energy security aspect. Thanks to privatization efforts started in 1999, ROK has allowed POSCO (a large steel maker) to make a rare "spot" purchase of 500,000 tons of LNG in 2006. POSCO and K-Power have also signed a long term LNG contract in 2004 for 550,000 and 600,000 million tons respectively of LNG from Indonesia's Tangguh project delivered by the end of 2008. KOGAS' imports have traditional came from Southeast Asia, but purchased a great deal of volume from Qatar and Oman, and additionally made a contract with the U.S. shale gas in 2012.

To be able meet its high demand for energy, South Korea expanded its energy mix with nuclear power, LNG, coal and renewable energies (Figure 9).

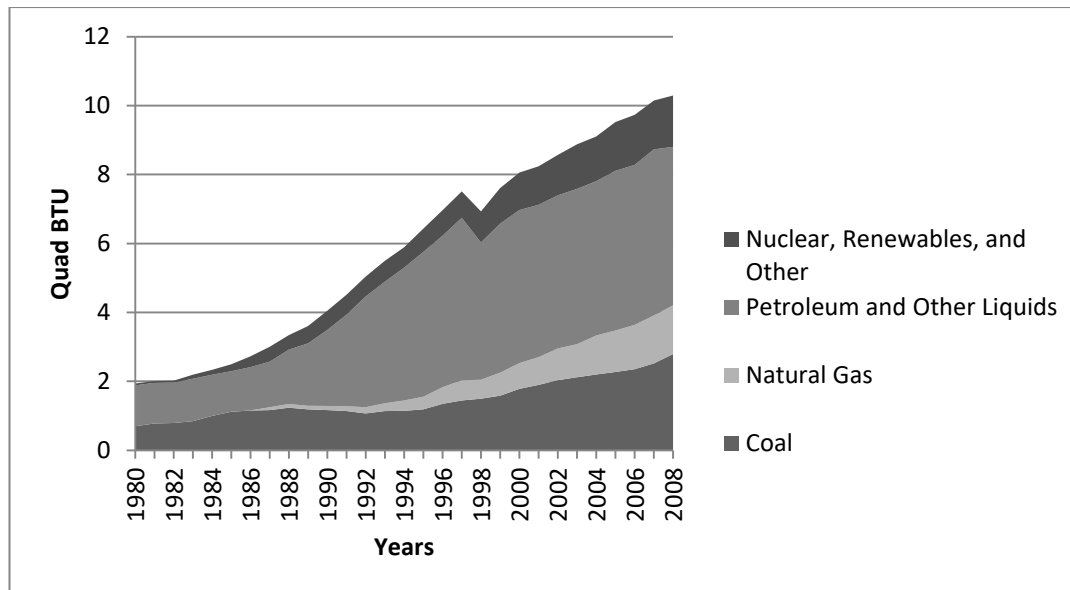


Figure 9. Energy Resources of South Korea

Source: EIA

4.2.1.1 Increasing renewable energy use

Since the first oil crises in 1973, there have been many R&D studies and experiment developed for renewable energy technologies worldwide. Renewable energy resources have been receiving global attention for being an answer to the problems of non-eco-friendly side effects of petroleum and its products use. Moreover, renewable energy sources are economical, and they are the key for climate change. Renewable energy (RE) has also been given much focus for being a significant and prospective industry that can speed up national economic growth.⁵⁸ As oil's alternative energy

⁵⁸Huh, Lee. *Diffusion of Renewable Energy Technologies in South Korea on Incorporating their Competitive Interrelationships*.249.

source, renewable energy sources have gained considerable attention among industrializing and resource lacking countries such as South Korea.

South Korea has invested in alternative energy resources to make energy resource diversification for the creation of a new energy mix. Therefore, to promote renewable energy resource diplomacy “Promotion Act for New & Renewable Energy (NRE) Development, Utilization, and Deployment” act was enacted in 1972 by the government.⁵⁹ According to Ahn (2015) However, due the Korean government’s limitations, it failed to what it had aimed for at first. According to Chen, Kim and Yamaguchi (2014), Korea wanted to deploy NRE in the following decades listed: (a) mid-1980s, great emphasis was put on solar thermal heating devices and waste incineration which was known as the most cost-effective action during that period, (2) the 1990s, a 10-year (1997– 2006) national plan for NRE research and development plans was set, and (3) early 2000s, NRE deployment was more aggressively and strategically promote, i.e. implementing policies in public sector. In 1987, Korea officially enacted the ‘NRE Development Promotion Act,’ and supported the new renewable energy technology development projects. According to Ahn (2015) importance of alternative energy was ignored because of the 1998 Asia crisis on the Korean government delayed its alternative energy plan. Even though South Korea failed in achieving its expectations in renewable energy industry, the total alternative energy consumption grows bigger day by day.

⁵⁹ Chen, Kim, Yamaguchi. *Renewable Energy in Eastern Asia: Renewable Energy Policy Review and Comparative SWOT Analysis for Promoting Renewable Energy in Japan, South Korea, and Taiwan*. 320.

4.2.2 Launching new business partnerships with other oil-rich regions

South Korea focused on discovering new oil reserves through joint venture energy agreements. Korea was the first country that found Indonesian oil resources and supported oil extraction and production there financially. Later, South Korea joined many oil reserve discovery activities in other countries as well. South Korean private and state controlled companies and organizations supported discovery activities financially and studiously. It gave monetary support and conducted R&D studies. According to Khairy (1991) around 61 percent South Korea's energy demand was supplied from Saudi Arabia by 1980. Khairy (1991) adds that in an effort to make supplier diversification to prevent any other oil scarcity Korea start importing its oil from Libya and Iran. Therefore, by 1984 new business contracts led Saudi oil imports to decrease by 19 percent. Later, ROK's new resource diplomacy was also extended to Latin America especially the oil-rich countries of Mexico and Ecuador. South Korea finally agreed with foreign companies to invest in Australian coal to develop it too. However, after the second energy crises, the South Korean government aimed to increase energy efficiency in order to consume less energy.

4.2.3 Focusing on energy conservation

Although petroleum and its products accounted for the biggest share in the energy mix of South Korea, its petroleum share has been decreasing since the 1990s when the oil consumption share reached to 66% according to EIA (2017). Increasing natural gas, coal, alternative energy resource consumption and energy conservation acts have reduced the petroleum share in the energy mix in years. The energy conservation policies are set to prevent the national economy from energy price

fluctuations, and, thus, it hopes to create a more eco-friendly environment. The studies claim that transportation systems, production plants, offices and houses for decreasing energy consumption can all be defined as energy conservation. The success in energy conservation can be provided by low energy consumption or consuming less energy from traditional energy resource. With energy conservation policies, energy efficiency can be obtained and ultimately prevent energy wasting.

South Korean policy makers made energy conservation policies as well at the beginning. The Korean Energy Management Corporation (KEMCO), established in 1980 implemented energy conservation programs nationally. The Rational Energy Utilization Act (1979) developed in 2002, 2003 and 2008 helped also implement new energy-saving measures respectively.⁶⁰ However, implementing energy conservation requires cooperation from all citizens and sectors. Due to internal and external factors, South Korea could not achieve the expected outcome they had with their energy efficiency programs explained by Ahn (2014).

Therefore total energy intensity which is the total energy consumption of per unit GDP is also higher than Europe's average.⁶¹ Although South Korea having a remarkably decline in total energy intensity in 2000s, it still almost same with 1990 data. Higher energy intensity indicates and correlates with higher carbon dioxide emission. The climate change, increasing CO₂ emission and air pollution, is the global problem for all nations. Many studies on decrease CO₂ emissions suggest that the world is trying to solve this problem. The effective methods are increasing energy efficiency, increasing renewable energy resource use and decreasing fossil fuel use for decreasing CO₂ emission. ROK introduced several policies and as well

⁶⁰ The Korean Energy Management Corporation

⁶¹ South Korea, Energy Efficiency Report

supported R&D studies for CO₂ emission reduction. Developing renewable energies is considered one of the better economic ways to reduce emissions.⁶² The carbon dioxide emission rise is one of the main problems in the world. Burning fossil fuels, crude oil, natural gas are result in increasing carbon dioxide emission more. Growing energy demand and failed energy policies can be observed in South Korea's five-decade carbon dioxide emission rate (see Figure 10.). As a result, nowadays, South Korea is promoting environmental projects broadly.

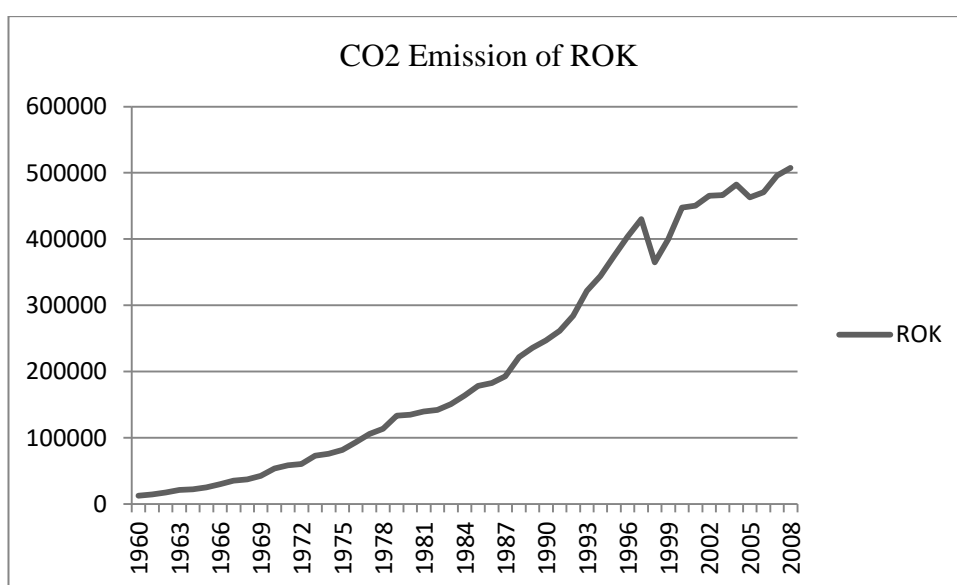


Figure10. CO₂ Emission of South Korea

Source: world Bank, (CO₂ emissions in kt)

4.3 Conclusion

This chapter has attempted to answer these questions: “What is the relationship between oil prices and South Korea?”, “Is there any impact of energy consumption levels of South Korea on 2000s oil price fluctuations?”, “Does energy mix of South Korea one of the keys for oil price hike in 2008?”. The given historical and

⁶² Jun. *The Assessment of Renewable Energy Planning on CO₂ Abatement in South Korea*. 472.

numerical data in this chapter sheds light on energy policies and oil consumption levels of South Korea. The below analyses will answer the questions mentioned above.

If a country has a sustainable energy policy or energy security, that country does not rely on its importers and, in turn, becomes independent and confident in its economic growth plans. South Korea, China, Japan have common major problem; energy security and lacking energy-resource. The series of oil shocks and upswings in oil prices was the main factor for East Asia and other developing regions to make strong energy policies in the 1970s. Japan significantly emphasized setting goals for energy policy change and has achieved them step by step. Because Japan was already a developed country, and its strong economy was a way ahead of its competitors, it was easier for Japan to implement energy policies. Consequently, Japan was able to decrease its dependency on oil imports over time. However, unlike Japan, South Korea was dealing with the residue and chaos war leaves and having unstable domestic politics, lack of democracy. So it was not that simple to set new policies in every field in a short time. Compare to South Korea Japan had four main subjects in its new energy policy: 1). energy resource diversification, 2). business extension with other oil rich countries, 3). decreasing energy intensity and 4). increasing exports to have a better economy. South Korea also introduced similar policies officially but not in 1970s. All of the policies were independent from each other and set in separate periods. Until 2000s, South Korea was not that successful in implementing energy policies unlike Japan did. The most known energy policy named The “Low Carbon, Green Growth” policy was introduced in 2008 according to the EIA (2009).

South Korea’s separate energy policies were mainly about developing its energy security. At first, South Korea had an export-led growth strategy, so it could

meet its high oil demand financially. Therefore, by growing its economy, South Korea was able to purchase crude oil easily despite oil's high prices. The government decided to distribute more imported energy to high-value product producing companies. Secondly, ROK extended its business with other energy resource rich regions. Then, Korea invested in oil reserve discovery projects overseas. South Korea emphasized nuclear energy, renewable energy resource, and energy efficiency. Unfortunately, due to the external and internal factors, South Korea was not able to handle all energy policies concurrently. Emphasis on energy efficiency programs and renewable energy resources was executed later than expected. The effects of energy programs mainly became evident in 2000s. The oil demand has been almost fixed in the 2000s despite South Korea being the ninth largest oil consumer worldwide.

Although, South Korean energy policies were not implemented as well as Japan's were, the effects of energy policies to decrease oil consumption still took place in the 2000s. Some think that without previous energy policies such as increasing LNG consumption, energy efficiency programs, increasing nuclear energy plant numbers would make South Korea to be a bigger oil consumer in the 2000s than before. This thesis supports this argument. The oil importers expected to sell more crude oil in coming years due to soaring demand from East Asia. Nevertheless, East Asian countries such as South Korea has managed to make its energy mix with other resources and increased fuel substitution. Though South Korea still has high oil consumption levels, these levels were smaller than what sellers expected. The worry that created in the market widespread must be one of the reasons for oil price fluctuations.

CHAPTER 5

CHINA

5.1 Introduction

In this chapter an analysis will be presented for understanding the relationship between oil consumption levels in China and global oil prices. Firstly there will be a summary of rapid economic growth of China. Thus, secondly, this study will shed a light growing energy demand of China as well. In conclusion, the study will be helpful to find answers for thesis question with given numerical and historical data.

5.2 Economic power of China

China has successfully become the second largest economy behind the United States thanks to its well-built economic development reforms and sheer populace size.⁶³ After the death of Mao Zedong in 1976, Premier Hua Guofeng introduced the first ten-year economic development plan.⁶⁴ By government led projects and economic reforms China transformed itself to be a fast-growing economy. Moreover, these economic reforms led the Chinese market structure to make big amendments. The Soviet-type economic market which is state-planned was replaced by a "socialist market economy."⁶⁵ The standard of market economy is where the private sector builds and operates it and it is shaped by demand-supply dynamics. However, in the Chinese socialist market economic structure the state controls it. Cheng (1997) points out that Chinese socialist market structure requires five main goals:

⁶³ EIA

⁶⁴ Bhardwaj, *China's Economic Reform: The Role and Significance of SEZs*. 332.

⁶⁵ Cheng. *China Review International*. 396.

First, a modern enterprise system, making state enterprises integral to the market, second, an open, unified, and ordered market system such that the entire sphere of production can enter the market, third, a macroeconomic management system appropriate to the socialist market economy that will precipitate the transformation of governmental functions, fourth, a social security system fit for the socialist market economy, and lastly market discipline and a legal framework appropriate for the socialist market system.⁶⁶

One of the other fruits of Chinese economic reforms was introducing the “open-door” policy in China. Cheng (1997) adds that by the “open-door” policy China established free economic zones in coastal cities. This open-door policy was helpful for China to receive foreign investments, earning foreign exchanges, learning trends in foreign economic developments, and being introduced to foreign technologies, gathering information about international market. At first, after open-door policy some developments in light industry, which requires low energy demand, were witnessed. The open-door policy led China to be active in exporting. China exported coal and oil to gain foreign exchanges. China succeeded to export 90 billion USD worth of materials in 1993 which is higher than other developing countries.⁶⁷ John (1995) adds that by implementing an open-door policy China managed to become one of the main international strong economies from generating trade and investment actively.

The other change in China’s market structure was a focus on the commodity market and emphasis on heavy industry production. The heavy industry production consumes high amount of energy. This consumption, in turn, rapidly increased China’s energy demand for oil and coal, and it has made China influential as well in world energy markets. While China’s end-use consumer product levels has been growing for the last decades and need for input such as oil, coal, and alternative energy resources has also been growing. Therefore, China has been playing a global,

⁶⁶ Cheng. *China Review International*. 396.

⁶⁷ Wong. *China's Economic Reform and Open-Door Policy Viewed from Southeast Asia*. 270.

leading role in energy consumption. According to EIA (2017), China overtook the United States and became the world's largest net importer for oil and other liquid energy resources in 2013.⁶⁸

The positive effects of economic development reforms can be clearly observed in China's GDP growth after the 1980s. Compared to Japan and South Korea, China's jump in economic welfare is visualized (see Figure 11). The high speed in economic growth has led to imbalances in energy production-consumption levels. After the 1990s, the decline in oil production levels in China created serious problems. China's main energy security problem is its growing oil deficiency. Dependency on foreign oil puts China in a difficult position. In 2009, oil imports reached to 52% of the country's total oil consumption, exceeding the 50% threshold. Crude oil imports reached 204 million tons, a rate 14% higher than previous year. Lastly, in 2010, oil imports covered 56% of oil consumption in China.⁶⁹

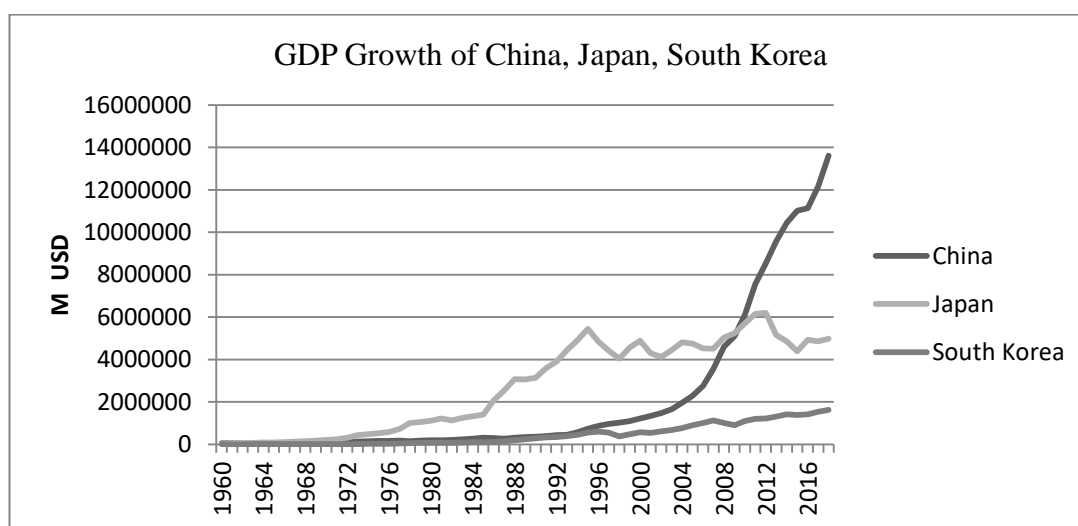


Figure 11. GDP Growth of China, Japan, South Korea (in M USD)

Source: Worldbank

⁶⁸ Being net importer: imports minus exports

⁶⁹ China Oil : <http://data.chinaoilweb.com>

5.3 China's energy policies after oil shocks in the 1970s

The oil shocks in 1970s brought economic and politic challenges to states. The oil importer countries in East Asia such as Japan and South Korea had to align them with the Arab position and called Israel to end its occupation in Arab territories.⁷⁰ Because, Japan and South Korea are known to be natural resource poor countries, therefore they affected deeply from oil crises in the 1973 oil crises due to the dependence on energy imports. Whereas China is richer in natural resource compare to these two. Additionally, China has already had Arab stance. Moreover, China didn't have a rapid growing industrialization rate in 1970s. Therefore, China wasn't affected by oil crises negatively in political and economic aspect in 1970s.

China has profited from oil crises that occurred in Middle East by taking it as an advantage. The most consumed energy resource was coal in China. So, the self-sufficient China was able to produce its own oil and has started to export produced oil to overseas in the period of oil shocks. Japan had to buy oil from China as well. According to the Carlson (1975), the exported oil price to Japan had big jump as well; from \$4.59 per barrel in 1973 to \$14.80 per barrel in early 1974. One the reasons for expensive oil price in China was due to the high costs of oil extraction in China which is more than Middle East and Russia. Additionally, the international oil prices affected domestic oil prices too.⁷¹ This vis-a-vis relationship has been explained by Yanan, Chu, and Limin (2010)

The correlation between oil price shocks and macro-economy is also significantly affected by a country's domestic oil pricing mechanism. With the foundation of the People's Republic of China in 1949, the oil industry was put into the central planning system because of its strategic importance. Before 1980, oil field development and refinery construction were primarily

⁷⁰ Carlson. *Responses to the Oil Crisis: The U.S.S.R and Selected Asian Countries*. 85.

⁷¹He, Wei, Du. *The Relationship between Oil Price Shocks and China's Macro-Economy: An Empirical Analysis*. 4143.

financed by the central government, and both wholesale and retail prices for crude oil and petroleum products were determined by the central and local governments (Wang, 1995). Thus, the impact of the world oil price on China's macro-economy was negligible for that period. Along with the general market-oriented economic reforms initiated in 1979, the oil industry has also experienced a series of deregulation reforms, and the domestic oil prices of China have been increasingly correlated with that of the world oil markets.

Despite having high oil price, still China has managed to become a significant role in oil supply in East Asia. Almost two decades China was able to export its produced oil. Carlson (1975) indicates China's importance as,

However, as China wants to sell its oil to Japan, the price was reduced to \$12.10 per barrel at the end of February 1975. China's exports to Japan were expected to reach about 4.9 million tons in Japan's fiscal 1974. According to the contract China signed with Japan's International Oil Trading Company, it will export 5.4 million tons of oil to Japan in 1975. Peking also promised to provide Hong Kong with oil and two oil storage tanks and is selling some oil to Thailand and the Philippines. The oil crisis thus gives China a new political leverage over Japan, Hong Kong, the Philippines, and Thailand.

Between China's domestic supply of oil and demand, there was big deficiency due to the high demand that occurred by rapid growth in following years. The open-door policy was a stepping stone for China's economic growth. The rapid economic growth made China hungry for energy. Thus, China's energy demand has not covered by its domestic oil and coal production. Therefore China has started to rely on imported oil, natural gas and coal to drive its economy. In 1993 China became an oil importer and a crude oil importer in 1996. China is highly dependent on the Middle East for its oil supply (EIA 2019). The deficit between oil production and consumption amounts in China visualized as in separate tables (see Table7 and Table8).

Table 7. The 10 largest oil producers and share of total oil production in 2018

Country	Million barrels per day	Share of world total
United States	17.87	18%
Saudi Arabia	12.42	12%
Russia	11.4	11%
Canada	5.27	5%
China	4.82	5%
Iraq	4.62	5%
Iran	4.47	4%
United Arab Emirates	3.79	4%
Brazil	3.43	3%
Kuwait	2.87	3%
Total top 10	70.96	70%

Source: Energy Information Administration

According to EIA 2018 data, 5% of world oil supply was produced in China.

However EIA 2016 data indicates that China has 13% share in of world oil consumption.

Table 8. The 10 largest oil consumers and share of world oil consumption in 2016

Country	Million barrels per day	Share of world total
United States	19.69	20%
China	12.79	13%
India	4.44	5%
Japan	4.01	4%
Russia	3.63	4%
Saudi Arabia	3.30	3%
Brazil	2.98	3%
South Korea	2.61	3%
Canada	2.47	3%
Germany	2.38	2%
Total top 10	58.31	60

Source: Energy Information Administration

Although China's oil consumption percentage is low compared to coal, it corresponds 17.5% in China's total energy consumption.⁷² The coal reserves in China are much more than existing oil reserves of China. Therefore, China's most imported materials are crude oil and other petroleum products such as natural gas. These products are the main inputs in after coal in China. Consequently, the increase in oil and natural gas imports drove Chinese policy makers to focus on creating more efficient energy policies.

China firstly transcended Japan in 2002 and then the United States in 2013, emerging as the most oil importer in the world. On the contrary, China's first long-term national energy policy that was released under Premier Wen Jiabao indicated China's plans on energy security in strategic terms and as a part of national security. Dependency on foreign oil renders China highly susceptible and vulnerable to price changes. As it is claimed by Downs (2004) "Chinese analysts consider oil price volatility and physical supply disruptions to be the main threats to security."⁷³

Thus, similar to Japan and South Korea, China also has introduced energy policies and methods through the years to ensure its energy security. However, the reasons for creating energy policies in China are quite different from South Korea and Japan cases. As this chapter indicates, the 1973 and 1978 oil crisis has not affected China negatively. Instead, it created a new international market for oil supply and demand. The critical point for China to have a secure energy policy was firstly economic growth in 1990s.

Aside from energy security, the second important reason for setting energy policies was because of increasing CO₂ emission in China due to rising coal

⁷² Zhang. *China's Low Carbon Strategy: The Role of Renewable Energy Law in Advancing Renewable Energy* 135.

⁷³ Downs. *The Chinese Energy Security Debate*. 31

consumption. Zhang (2011) adds that “It is calculated that fossil fuel accounted for nearly 91% of total energy consumption in China in 2009 which about 69.5 % came from coal, 17.5% from oil, 4% from gas, and around 9% from nuclear and renewable energy sources.” Zhang (2011) adds that the overconsumption of coal has created environmental problems not only in China and its surrounding countries. Therefore the international pressure on China made Chinese energy policy makers to focus on more sustainable and efficient energy policies.

Therefore China had to deal mainly two separate subjects in its energy policies; finding new energy suppliers and energy resources to meet the increasing energy demand and changing coal-oriented industry by shifting to other sources.

5.3.1 Diversifying energy resources

One of the most remarkable methods for meeting energy demand of China was increasing its energy source diversification. Being dependent on one specific energy supplier and supply material drove Chinese government to pursue a new energy policy. For instance, Li (2015) adds that China and Russia have a strategic partnership. Nonetheless, this strategic partnership still has not been able to meet China’s high demand for energy resources. Because the oil logistics of natural gas between Russia and China relies on rail transportation, the imported natural gas quantity was not being high enough to meet China’s demand.

The recent agreement that signed in 2014 between China and Russia for new natural gas pipeline promises to feed China’s natural gas demand. China significantly emphasized on changing its energy mix. For example, it has started doing R&D

studies for developing renewable energy resources, nuclear energy industry. The electricity produced from nuclear energy plants have been increasing as well.

5.3.1.1 Increasing renewable energy use

One of China's main problems is the increasing CO₂ emission that illustrated by Figure 12. The increase in coal and fuel energy resources used led China to be a threat to the global environment. Increasing renewable energy resource use and declining energy intensity helps decrease CO₂ emission. One of China's recent goals is decreasing CO₂ emission because of its rising air pollution. According to EIA 2017 report,

China also increases the direct use of renewables in end-use sectors, via bioenergy in industry, solar thermal for heating and biofuels for transport. By 2040, electricity becomes the leading source of final energy consumption in China, overtaking coal in the late 2020s, and oil shortly thereafter.

For example, China is currently a leading player in renewable energy development;

China is followed by United States, Brazil, Germany and Canada.⁷⁴ Jiang (2017)

states that

Annual capacity increases for renewable energy in China account for one-third of the global total. Industry growth has been especially strong since 2011, with annual growth in wind energy of 22 per cent and 110 per cent for solar energy. Since 2015, China has been the world's largest consumer of modern renewable energy. (p. 316)

Additionally, aside from environmental problems, China wants to decrease its coal and oil consumption by reducing energy intensity and developing renewable energy resources in every field.

⁷⁴ Jiang. *Technological Progress in Developing Renewable Energies*. 316

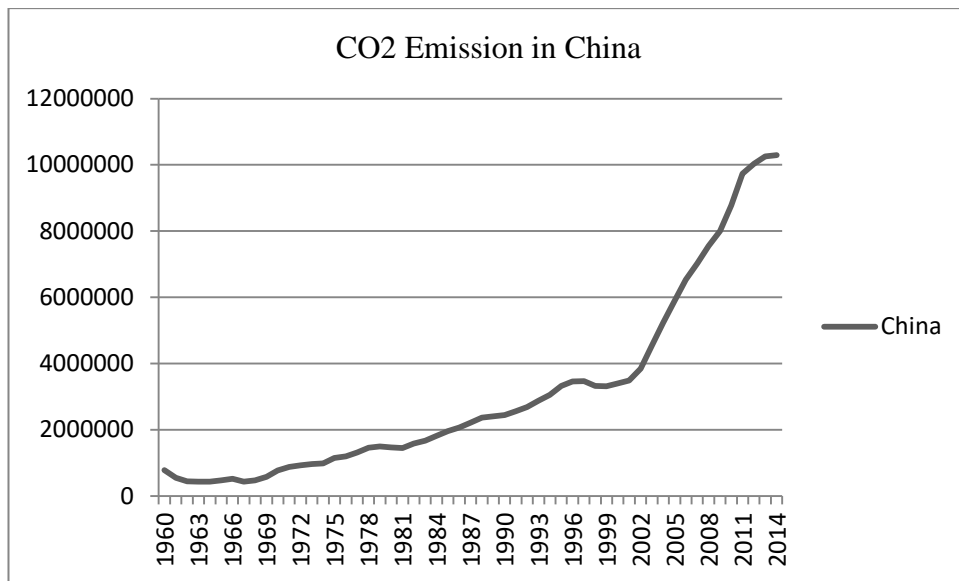


Figure12. CO2 Emission Rate of China (1960-2014), CO2 emissions (kt)

Source: EIA

5.3.2 Launching new business partnerships with other oil-rich regions

In 1993 China became an oil importer and a crude oil importer in 1996, but the first national energy policy was only introduced until 1997 under Premier Li Peng entitled “New Energy Policy”. The New Energy Policy addressed the need for China’s involvement in both domestic and international oil exploration and production. Three regions were selected as target regions; Russia and Central Asia, Middle East and lastly Latin America. Dr. Jaewoo Choo interprets the New Energy Policy as generated in economic terms not strategic terms.⁷⁵ Li (2015) adds that

In recognition of its growing need for oil and gas, China has invested enormous amounts of money in oil exploitation in West Africa (Nigeria), South America (Venezuela) and other regions. Moreover, initial public offerings and joint exploitation of overseas energy projects have become important strategic components for Chinese energy companies in their quest to “go global.” However, the volume of oil produced by these investments remains relatively low. In short, China’s oil imports face a series of important

⁷⁵ Ibid. 96

risks, such as political instability of oil-producing regions and intense competition from other countries, which will need to be mitigated in order to allow for increasing consumption. (p. 86)

China aimed to diversify its oil suppliers, so it could meet and ensure its energy policy. Thus, China has started to import oil from separate channels. Nonetheless, even after this energy supplier diversification, the Middle East was still meeting almost half of China's oil demand in the 2000s. The oil producers in Middle East have no conflict with China; however, the political tension and chaos in the Middle East led China to expand its energy business with other regions as well such as Russia and Central Asia. The significant cooperation that should be promoted is with oil producing nations (Middle Eastern states, Russia and Central Asia), or transit nations (Kazakhstan, Pakistan, Russia). The new natural gas pipeline project with Russia and the new oil pipeline project with Kazakhstan are the China's recent energy resource ventures.

In China, due to rapid economic growth, total primary energy consumption increased from 602.8 Mtce in 1980 to nearly 4260 Mtce in 2014.⁷⁶ China used to be a net oil exporter until 1993 when China began industrializing rapidly. Its main suppliers can be listed by import ratio shown by 2014 data: Saudi Arabia 16%, Angola 13%, Russia 11%, Oman 10%, Iraq 9%, 9% Iran, Venezuela 4%, UAE 4%, Kuwait 3%, Colombia 3%, Congo 2%, Brazil 2%, South Sudan 2%, Kazakhstan 2%, and others 9%⁷⁷.

⁷⁶ Chen. *Energy Efficiency Policies and Measures in China*

⁷⁷ FACTS Global Energy, Global Trade Information Services, Inc, 2014.

5.3.3 Focusing on energy conservation

Aware of the rapidly increasing demand of oil imports, the Chinese government started viewing energy security as a high, national security priority. According to a recent policy statement about energy policy in China, General Work Plan for Energy Conservation, the Chinese government aims to cut energy consumption per unit of GDP by 20% in the 11th five year plan ending in 2010. This document calls for energy efficiency and a decrease in energy consumption, revealing that the Chinese government is highly aware of the threat to energy security and high consumption rates. China's main energy security problem is its growing oil deficiency. The other driving force for energy conservation policy support is environmental protection and climate change. Because coal is the most abundant energy source within China's borders, coal consistently supplied more than 70 percent of the total energy used over the past 30 years, resulting in a series of environmental problems. For example, one problem is acid rain, which is caused by emissions of sulphur dioxide and nitrogen oxide; these are closely related to coal combustion. China's energy mix is dominated by coal, and coal is the most carbon intensive fossil fuel compared to oil and gas. According to estimation of Global Carbon Project, China is the largest GHGs emitter in terms of absolute emissions, accounting for about 27% of the world total missions in 2014.⁷⁸ China put forth many policies and measures to implement enhanced actions on climate change.⁷⁹

⁷⁸ TRENDS IN GLOBAL CO2 EMISSIONS, PBL Netherlands Environmental Assessment Agency, 2014.

⁷⁹ The following 15 aspects below showcase China's environmental measures:

- A. Implementing Proactive National Strategies on Climate Change
- B. Improving Regional Strategies on Climate Change
- C. Building Low-Carbon Energy System
- D. Building Energy Efficient and Low-Carbon Industrial System
- E. Controlling Emissions from Building and Transportation Sectors
- F. Increasing Carbon Sinks

The Chinese government supports energy conservation implements in every area it can. China in 1980 announced that it would place equal emphasis on development of energy supply and energy conservation (see Table 9). After that announcement each five-year economic plans continually focused on this conservation. Even though the required result has not been secured yet, China seems to shift more and more focus on it because of both internal and external pressure.

-
- G. Promoting the Low-Carbon Way of Life
 - H. Enhancing Overall Climate Resilience
 - I. Innovating Low-Carbon Development Growth Pattern
 - J. Enhancing Support in terms of Science and Technology
 - K. Increasing Financial and Policy Support
 - L. Promoting Carbon Emission Trading Market
 - M. Improving Statistical and Accounting System for GHG Emissions
 - N. Broad Participation of Stakeholders
 - O. Promoting International Cooperation on Climate Change

Table 9. Energy Conservation Policies of China 1988-2012

2012	CECEP defined four main business segments: energy conservation, environmental protection, resource recycling, and clean energy and established the strategic development objective for the “12th Five-Year Plan”. All business indicators of the China Energy Conservation and Environmental Protection Group increased anyway in a sluggish economy: compared with the end of 2009, the asset size in 2012 was increased by 92.3%, business income 63.4%, total profit 55.2%, and net profit 53.1%.
2010	On May 19, 2010, China Energy Conservation and Environmental Protection Group was established officially, and a normative Board of Directors was set up at the same time.
2010	The State Council approved the merge between China Energy Conservation Investment Corporation and China New Era Group Corporation on March 10, 2010. China Energy Conservation Investment Corporation, as the parent company, was renamed China Energy Conservation and Environmental Protection Group and registered to the State Administration for Industry and Commerce on May 5, 2010.
2007	From 2007 to 2010, various business indicators of CECEP were increased rapidly. Compared with the end of 2006, the size of assets was increased by 3 times, the operating income by 2.5 times, the total profit by 2.6 times, and the net profit by 3 times.
2003	In 2003, China Energy Conservation Investment Corporation was put under the State Assets Supervision and Administration Commission of the State Council, and it entered the stage of market-oriented development.
2000	The China Energy Conservation Investment Corporation obtained the qualification of UNIDO project appraisal institution.
1999	The Government reformed the economic system, separating administrative functions from enterprise management; the China Energy Conservation Investment Corporation was then put under the CPC Work Committee.
1998	On March 24, the China Energy Conservation Investment Corporation was entitled with import and export operation right after being approved by the Ministry of Foreign Trade and Economic Cooperation.
1995	The State Development Planning Commission approved the China Energy Conservation Investment Corporation as a comprehensive Class A engineering consulting agency and issued the qualification certificate.
1994	In July, the Energy Conservation Company under the State Energy Investment Corporation was put under the State Development Planning Commission. On September 1, the Company was renamed as China Energy Conservation Investment Corporation.
1989	On June 22, the Energy Conservation Company under the State Energy Investment Corporation was registered after being approved by the State Administration for Industry and Commerce.
1988	On September 20, the Energy Conservation Company under the State Energy Investment Corporation was established after being approved by the State Council.

Source: China Energy Conservation and Environmental Protection Group. (2012). <http://www.cecep.cn/g3659.aspx>

5.4. Conclusion

This chapter of thesis aimed to provide adequate information about China's recent energy policies and relationship between oil consumption of China and world oil prices. Some economists claimed that the increasing oil demand from East Asia; especially from China, was the reason for increasing oil prices in 2008. Also some reports mentioned that the China's slowing business was the reason for declining oil prices in 2009.

Therefore, this chapter initially focused on relationship between China's oil imports and previous oil crisis. Because in previous chapters for Japan and South Korea, this thesis illustrates that previous oil shocks shaped recent energy policies of these countries. However, unlike Japan and South Korea, China was not dependant to Middle East for oil. Instead, China was able to produce its own oil, coal domestically. Therefore, in 1970s oil crisis was not a crisis for China, it was opportunity.

The self-sufficient China was able to sell and export it to energy-needed countries. But it lasted until 1993 when the rapid economic growth in China required oil export since produced oil levels was insufficient.

The coal-oriented industry also brought politic and environmental problems. A few reasons have shaped China's recent energy policy. One of these is to reduce the use of coal. China has been particularly dependent on coal. However, increasing coal consumption has put great international pressure on China. As a country that has signed the Kyoto Protocol, China wants to reduce coal use. Although the oil crises are a reason to determine China's energy policy, the main impact is the environmental factors and pressures exerted by increasing CO₂ emissions. Because

China was a developing country in the period of energy crises and it was not seen that it had a dependence on oil in this period. This can be understood by China's export of oil until 1993. After 1993, China became a net importer of oil. In this case, we cannot say that China's energy policy is shaped by the energy crises especially in the 1970s. Unlike Japan and South Korea, which are insufficient in terms of natural resources, China discovers the importance of establishing an efficient energy policy in the 1990s. China, which became a net importer in 1993, has remained dependent on foreign sources after this date. Additionally, domestic oil production continued in the same period. Compared to oil, coal is always the most consumed energy source in China. The high amount of coal consumed has caused environmental problems in China and surrounding countries. Especially in the early 2000s, China has made developments in its energy policy and began to implement in the following years.

Thus, China focused on diversifying energy resources, expanding business relationships between energy resource rich countries, focusing on alternative energy resources and increasing energy conservation. China has become influential in renewable energy industry and the success in energy conservation policies continue.

The widely spoken Chinese economic success and increasing energy demand is one of the key factors for oil price changes. The increasing oil demand led oil prices to increase oil prices as well. Despite rising oil prices, China may have slowed oil imports for some time. Because, China is a country with proven oil reserves in itself and has oil stocks to protect the economy against rising prices. In addition, thanks to the policies that established to reduce its dependence on coal, it increased renewable energy sources and energy conservation.

Therefore, the need for oil in general would have been greater without these policies. In summary, China had impact oil prices to go up in 2008, but the decrease in oil prices in 2009 is not because of slowing business of China. Instead, it is slowness in oil imports for a short time because of its high price.

CHAPTER 6

CONCLUSION

This main aim of this thesis was understanding the relationship between changing oil prices and the change in oil consumption levels in East Asia. The thesis was significant to shed a light on understanding international oil prices and energy policies of energy importer countries such as China, Japan and South Korea.

The main aim of the thesis was finding answer for this question: “Is there any impact of East Asian oil consumption levels on oil price fluctuations between 2008 and 2009?” So, this thesis firstly focused on whether there any other oil shocks that changed energy policies of oil importers in the past. The thesis emphasised energy policies of East Asia which created after oil shocks. Secondly, the thesis point outs more recent relationship between oil consumption levels in Japan, South Korea, China and global oil prices.

Therefore, previous energy crises were investigated to find out which factors behind the energy crisis in Chapter two. Chapter two states that in the past there have been dramatic oil shocks and mainly they occurred in 1970s. The price of a good can differ in time according to the change in its demand and supply.

The price of oil has also had its fluctuations. In 1970s, the political conflicts and wars were the reasons for physical distributions in oil supply. However, in 2000s, price of oil was affected by high demand. Some analysts and economists indicate East Asia to being one of the major factors in oil prices firstly going up and then sharply going down. In next three chapters, thesis firstly points outs how previous

energy crises affected East Asia to ensure an energy security. And, secondly thesis indicates recent energy policies of this region.

In Chapter three, economic development of Japan was investigated. Because economic growth and energy demand are interconnected. The rapid industrializing led Japan to become a net oil importer. Being dependant to oil rich countries made Japan's energy policies fragile. Therefore, after 1970s, firstly Japan started to invest in overseas oil extraction projects. Secondly, Japan expanded its business with other oil rich regions. Thirdly, Japan focused on alternative energy sources such relying on nuclear power for generating electricity. And, lastly Japan decreased its energy intensity by promoting energy conservation projects. Japan has gone through a period of rapid industrial development which resulted in huge demand for energy sources making it one of the biggest consumers of petroleum. These methods have led Japan to ensure its energy security. Energy Conservation act in Japan is a great example not only for successful policy implementation but also proponents of the efficiency of energy conservation. Without implementing these steps, in 2000s, oil demand of Japan would be higher than actual one.

In Chapter four, similar to previous chapter, thesis provided brief information about economic transformation of South Korea. South Korea is lack of natural resource lacking country as well. To be able to meet its domestic demand South Korea was dependant to Middle East oil reserves. After the series of oil shocks in 1970s, South Korea also tended to implement effective energy policies. In that period, Japan was already a developed country, and its strong economy was a way ahead of its competitors, so it was easier for Japan to implement energy policies. However, unlike Japan, South Korea was dealing with the residue and chaos war leaves, and it was not that simple to set new policies in every field in a short time. The separate

energy policies of South Korea might be not that effective unlike Japan's, but still South Korea has managed to make an energy mix other resources and increased its oil supplier number.

In Chapter five, thesis presented China's economic development briefly. Economic development of China has accelerated by open-door policies after 1978. The economy of China has become influential in the world. By rapid economic growth the oil demand of China has increased as well. China firstly transcended Japan in 2002 and then the United States in 2013, emerging as the most oil importer in the world. China has been consuming coal and oil in high volumes to meet its growing energy demand. The thesis indicates that discussions for creating strong energy policies for China have placed almost in 2000's which is few decade later than Japan and South Korea had. The main reason for Japan and South Korea for energy policy implementation was for ensuring energy security. On the other hand, global pressure on China for decreasing CO₂ emission was one of the main causes for setting energy policies.

In conclusion, the oil crises in 1970's mainly have occurred by physical disruption in Middle East. The oil importer countries started to set new energy policies to secure their energy after the oil crises such as by changing their oil suppliers or by decreasing oil consumption. Therefore, the previous oil crises were driven factor for Japan and South Korea to shape their energy policies. On the other hand, this study indicates that oil shocks in 1970s were actually an opportunity to China. China did not start industrialization before 1990's. Also China had adequate oil reserves. The chaos in world energy market gave China a chance to export its oil to oil-hungry regions. This trade has lasted until 1990's until when China started to

develop rapidly. Due to the open-door policies and economic developments China became a net oil importer in 1993.

The oil shocks in 1970's impacted oil importer countries to make energy policies and energy policies of importer countries impacted oil prices in 2000's. Thanks to oil crises in 1970s, Japan and South Korea was able to decrease their oil dependency on Middle East and for the crude oil. China was late than South Korea and Japan in building energy policies. The well-built energy policies of South Korea and Japan led a stable energy demand in 2000's. However, as for China, the unexpected and increasing oil pushed oil producer to increase their capacity through 2000's. The high demand for oil and global economic growth had high speed in through 2008, in accordance with high demand oil prices were increasing as well. The total demand from East Asia, especially from China, led oil prices to go up. The high levels in oil consumption alarmed a global worry and reminded peak oil theory. Increasing demand for oil, re-born Peak Oil Theory, shifting to other energy resources (i.e. shale gas) led oil prices going up in 2008. However, this study shows that Hubbert's "Peak Oil Theory" proven to be wrong in years thanks to the proven new oil reserves. The oil reserves have almost tripled within the last 50 years.

Additionally, all governments have a price elasticity to afford the price of good. The unexpected high increase in oil prices challenged oil importer countries. The global market shrink due to global financial crises and increasing oil prices led oil importers to pause oil imports for a short period. Thus oil prices went down in 2009.

Between 2008 and 2009, due to the high price of crude oil, China decreased its energy imports. Because, China could produce its own oil and had adequate oil

stocks in the country. In that short period, the worry and fear and declining demand in oil led oil prices to have sharp decrease through 2009. Thus, to summer up, high demand from East Asia impacted oil prices to go up through 2008. But global worry and fear were the reasons for oil prices to go down again.. The pause in oil imports from East Asia in 2009 has impact on oil prices to go down. The decreasing oil prices in not because of slowing business in East Asia. China still managed to have high economic growth rate. It was due to the global worsening economy and overprice of oil.

APPENDIX A

ENERGY CONSERVATION CHRONOLOGY OF JAPAN

Chronicles of Revisions of Energy Conservation Law (1979 to 2013)⁸⁰

	Promulgation Date	Effective Date	Summary of Legislation and Measure Revision	Note
Legislation	June 1979	Oct 1979	Provides specific criteria for energy conservation regarding factories, buildings, equipment.	Thorough energy conservation initiatives were required after oil crisis
			Obliges designated factories whose energy consumption is very large to appoint energy managers and record energy utilization	Designated factories count 3,000
			Establishes a new test scheme to qualify energy managers	
Revision (1)	Dec 1983	Dec 1983	Streamlines the process of license approval and license issuance (transfer clerical work to private	ECCJ starts the examination and training scheme for energy managers in

⁸⁰ Japan Energy Conservation Handbook 2013, ECCJ publication, pp. 26-28

			sector)	1984
Revision (2)	March 1993	Apr 1993	Guarantees the implementation of energy conservation efforts	The '92 Earth Summit raised concerns over global environmental issues
			Adopts a mandatory periodic report to be made by the designated energy management factories	
Revision (3)	June 1998	Apr 1999	Adopts the Top Runner program (to strengthen measures for the residential and commercial sector)	The amendment of long-term prospect on energy supply and demand (1994)
			Obliges the Type I designated Factories to submit a medium to long term energy plan Creates a new category as to Type II designated factories	
Revision (4)	June 2002	Apr 2003	The category of Type I designated energy	Strengthens measures for the commercial

			management factory that had targeted five manufacturing industries	sector as a result of remarkable increases in energy demand trends
			was expanded to all industries	
			Obliges the Type II designated factory to make periodic reports	
			Obliges the designated buildings to report energy conservation measures	
Revision (5)	August 2005	Apr 2006	The regulatory divisions of heat and electricity for factories and offices are abolished and integrated into one energy measure thus expanding the number of designated factories.	Additional measures are necessary to achieve the GHG reduction target
			Strengthens energy conservation measures for residential buildings and construction sector	
			Additional three products of the Top Runner	

			program were designated	
			New obligations were imposed on consigners and carriers (both cargo and passengers) for the transportation sector	
			Obliges energy suppliers and equipment retailers to make efforts to promote and disseminate energy saving information	
Revision (6)	May.08	Apr 09/Apr 10	1. Industry and Commercial Sectors	Strengthens measures for the commercial sector including offices, convenience stores, etc. and household sector
			Introduces a system for energy management obligation per whole enterprise	
			Treats a franchise chain such as convenience stores as a single	
			Wholly in 2010	

	enterprise	
	2. Buildings and House Sector	
	Strengthens measures for large residences and buildings (introduction of orders in addition instructions and notices)	
	Adopts a report on energy-saving methods by owners of small to medium sized residences and buildings above a certain size	
	Adopts energy-saving measures by businesses engaged in the construction and sales of residences (recommendations and Orders for those engaged in construction and sales of a large number of residences)	

May.13	Promotion of indication of the energy saving performance of residences and buildings	1
--------	---	---

APPENDIX B

CHINA'S FIVE-YEAR PLAN ON RENEWABLE ENERGY

The development indicators and the achievement of renewable energy during the period of Tenth Five-Year plan⁸¹

Contents	2000	The target of Tenth Five-Year plan	2005	Average growth rate per Year (%)
Generator electricity				
1. Hydropower	7935	10000	11000	6.7
2. Grid power	34	120	126	30
3. Small off-grid power	15		25	11
4. Photovoltaic power	1.9	5.3	7	30
5. Biomass power	170		200	3
Gas				
Methane (100 million cubic meters)	35	40	80	18
The rural household biogas (1000 households)	850	1000	1800	16
Heating				
1. Solar water heater (million square meters)	2600	6300	8000	25
2. Geothermal (million tons of standard coal/year)	120		200	11
Fuel				
1. Fuel ethanol			102	
2. Biodiesel			5	
The total utilization (million tons of standard coal/year)	12000	13600	16600	6.7

⁸¹ Li, Wei. *Framework of Laws and Policies on Renewable Energy and Relevant Systems in China Under the Background of Climate Change*. 825.

REFERENCES

- Ahn, S., H. (2015). Republic of Korea's energy security conundrum: The problems of energy mix and energy diplomacy deadlock. *Journal of International and Area Studies*, vol. 22, no. 2, 67–87.
- Akkemik, K., A. (2009) *Industrial development in East Asia a comparative look at Japan, Korea, Taiwan, and Singapore*. Singapore: World Scientific Publishing.
- Bentley, R. W. (2002). Oil forecasts, past and present. *Energy Exploration & Exploitation*, 20(6), 481–491. Retrieved from <https://doi.org/10.1260/014459802321615108>
- Bernstein, M., Fonkych, K., Loeb, S., & Loughran, D. (2003). *State-level changes in energy intensity and their national implications*. Santa Monica, CA; Arlington, VA; Pittsburgh, PA: RAND Corporation. Retrieved from <http://www.jstor.org/stable/10.7249/mr1616doe>
- Bhardwaj, R., D. (1992). China's economic reform: The role and significance of SEZs. *The Indian Journal of Political Science*, vol. 53, no. 3, 1992, 332–373.
- Bildirici, M., (2009). The great recession of 2008 and oil prices. *The Journal of Energy and Development*, vol. 35, no. 1/2, 1–31. JSTOR, Retrieved from www.jstor.org/stable/24812712.
- Blakers, A. (2017). Sustainable energy options. *Learning from Fukushima: Nuclear power in East Asia, Australia: ANU Press*. 319-348. Retrieved from <http://www.jstor.org/stable/j.ctt1ws7wjm.19>
- Caia, W.G., Wub, Y., Zhonga, Y., Rena, H. (2009). China building energy consumption: Situation, challenges and corresponding measures. *Volume 37, Issue 6*, 2054–2059.

- Chen, W. M, Kim, H., Yamaguchi, H. (2014). Renewable energy in Eastern Asia: renewable energy policy review and comparative SWOT analysis for promoting renewable energy in Japan, South Korea, and Taiwan. *Energy Policy*, vol. 74, no. C, 319-329.
- China Energy Conservation and Enviromental Protection Group. (2012). History. Retrieved from <http://www.cecep.cn/g3659.aspx>
- Energy Efficiency Policies and Measures in China. (2014). *China Energy Efficiency China Energy Efficiency Report*
https://energycharter.org/fileadmin/DocumentsMedia/EERR/EER-China_ENG.pdf
- Cheng, C., Y. (1997). China review international. Vol. 4, no. 2, 1997, 396–400.
- Crane, K., Goldthau, A., Toman, M., Light, T., Johnson, S., Nader, A., . . . Dogo, H. (2009). Oil as a foreign policy instrument. In *Imported Oil and U.S. National Security*, Santa Monica, CA; Arlington, VA; Pittsburgh, PA: RAND Corporation, 25-42. Retrieved from <http://www.jstor.org/stable/10.7249/mg838uscc.11>
- Cunado J., Jo, S., Gracia F., (2015). Macro-economic impacts of oil price shocks in Asian economies. *Energy Policy Volume 86*, 867-879
- Dalton, J. T., & Goksel, T. (2013). Reputation and learning: Japanese car exports to the United States. *Japan & the World Economy*, 25-26, 10-23.
doi:10.1016/j.japwor.2013.01.004
- Doblin, C. (1988). Declining energy intensity in the U.S. manufacturing sector. *The Energy Journal*, 9(2), 109-135
- Energy Information Administration. (2015). *China*. Retrieved from <https://www.eia.gov/beta/international/analysis.php?iso=CHN>
- Energy Information Administration. (2017). *Japan*. Retrieved from <https://www.eia.gov/beta/international/analysis.php?iso=JPN>

- Energy Information Administration. (2018). *South Korea*. Retrieved from <https://www.eia.gov/beta/international/analysis.php?iso=KOR>
- FACTS Global Energy. (2014) *Global Trade Information Services*.
<https://www.fgenergy.com/oil-products/oil-multi-client-studies/the-outlook-for-oil-a-guide-for-strategic-planning.aspx>
- Gibson, M. L., Michael D. W. (1992). Export orientation: Pathway or artefact? *International Studies Quarterly* 36.3, 331-43.
- Graf, R. (2012). Making use of the "oil weapon": Western industrialized countries and Arab petro-politics in 1973-1974. *Diplomatic History*, 36(1), 185-208.
doi:10.1111/j.1467-7709.2011.01014.x
- Haggard, S., Kim, B., Moon, C. (1991). The transition to export-led growth in South Korea: 1954-1966. *The Journal of Asian Studies*, 50(4), 850-873.
- Hamilton, J. D. (2009). Causes and consequences of the Oil Shock of 2007–08. *Brookings Papers on Economic Activity*, vol. 2009, no. 1, 215-261.
- Hippel, D., Hayes P. (2008). Growth in energy needs in Northeast Asia: Projections, consequences and opportunities. 5. *2008 Northeast Asia Energy Outlook Seminar, Korea Economic Institute Policy Forum, Washington, DC*.
Retrieved from http://s3.amazonaws.com/zanran_storage/www.keia.org/ContentPages/44539229.pdf
- Hubbert, M., K. (1956). Nuclear energy and the fossil fuels. *Drilling and Production Practice*, Vol. 95, 1-57.
- Huh, S.Y., Lee, C.Y. (2014). Diffusion of renewable energy technologies in South Korea on incorporating their competitive interrelationships. *Energy Policy*, vol. 69, 248-257.
- Ikenberry, G. (1988). *Reasons of state: Oil politics and the capacities of American government*. Ithaca; London: Cornell University Press. Retrieved from <http://www.jstor.org/stable/10.7591/j.ctt207g7cv>

- Japan Energy Conservation Handbook. (2013). Retrieved from <https://www.asiaeec-col.eccj.or.jp/wpdata/wp-content/uploads/handbook13.pdf>
- Jiang, L. (2007). Energy policies, energy conservation investments: A comparison between China and the US. *Volume 35, Issue 2*, 916–924.
- Johnson, D. (2007). *Iraq, 1991. In learning large Lessons: The evolving roles of ground power and air power in the post-cold war era*. Santa Monica, CA; Arlington, VA; Pittsburgh, PA: RAND Corporation.
- Jun, S. (2010). The assessment of renewable energy planning on CO2 abatement in South Korea. *Renewable Energy*, vol. 35, no. 2, 471-477.
- Tourk, K. (1991). Oil price shocks and the Asian newly industrialized countries' response: A case study of South Korea and Taiwan. *The Journal of Energy and Development*, 16(2), 255-266.
- Kilian, L., Hicks, B. (2013). Did unexpectedly strong economic growth cause the Oil Price Shock of 2003–2008? *Journal of Forecasting*, vol. 32, no. 5, 385-394.
- Kim, B., Vogel, E. (2011). The Park Chung Hee era. *Cambridge, Massachusetts; London, England: Harvard University Press*. Retrieved from <http://www.jstor.org/stable/j.ctt24hjkq>
- Lifan L. (2015). China's energy security and energy risk management. *Journal of International Affairs*, vol. 69, no. 1, 86–97.
- Masih, R., Peters, S., D. M. Lurion. (2011). Oil price volatility and stock price fluctuations in an emerging market: Evidence from South Korea. *Energy Economics*, vol. 33, no. 5, 975-986.
- Mizoguchi, T. (1968). On the high personal saving ratio in Japan. *Hitotsubashi Journal of Economics*, 8(2), 59-70. Retrieved from <http://www.jstor.org/stable/43295489>

- Ogawa, J., Noda, F., Yamashita, Y., (2010) Japan's energy management policy experiences and their implications for developing countries. *IEEJ*, 1-42. Retrieved from <https://eneken.ieej.or.jp/data/3357.pdf>
- Shiel, P., Jeffers, N., Dyar, M. (2011). *Energy conservation measures in Japan*. Trinity College Dublin, Published by: International Research Center for Energy and Economic Development (ICEED).
- Shujiro U., (1993). Japanese foreign direct investment and its effect on foreign trade in Asia, trade and protectionism. *NBER-EASE Volume 2*, 273-304. Retrieved from <https://core.ac.uk/download/pdf/6851935.pdf>
- Tamamura, C. (2002). Structural changes in international industrial linkages and export competitiveness in the Asia-Pacific region. *ASEAN Economic Bulletin*, 19(1), 52-82.
- Kim, J., K., (2000). The role of foreign direct investment in Korea's economic development productivity effects and implications for the currency crisis. *NBER-EASE Volume 9*. 267-294
- Vaitheeswaran, V. (2007). Oil. *Foreign Policy*, (163), 24-30. Retrieved from <http://www.jstor.org/stable/25462227>
- Vivoda, V., Manicom, J. (2011). Oil import diversification in Northeast Asia: A comparison between China and Japan. *Journal of East Asian Studies*, vol. 11, no. 2, 223-254.
- Wojcik, C. (2001). Learning by consumers in the demand for Japanese cars. *Review of International Economics*, vol. 9, no. 1, 94-107.
- Yanan, H., Chu W., and Limin D. (2010). The relationship between oil price shocks and China's macro-economy: An empirical analysis. *Energy Policy*, vol. 38, no. 8, 4142-4151.
- Yorke, V. (1981). Oil, the Middle East and Japan's search for security. *International Affairs (Royal Institute of International Affairs 1944-)*, 57(3), 428-448.

Zhang, D., (2008) Oil shock and economic growth in Japan: A nonlinear approach. *Energy Economics Volume 30, Issue 5*. 2374-2390.

Zhang, Z. X. (1995). Energy conservation in China: An international perspective. *Volume 23, Issue 2*, 159-166.

Zhong, W., & An, H. (2014). The role of China in the international crude oil trade network. *Energy Procedia, 61*, 2493-2496.