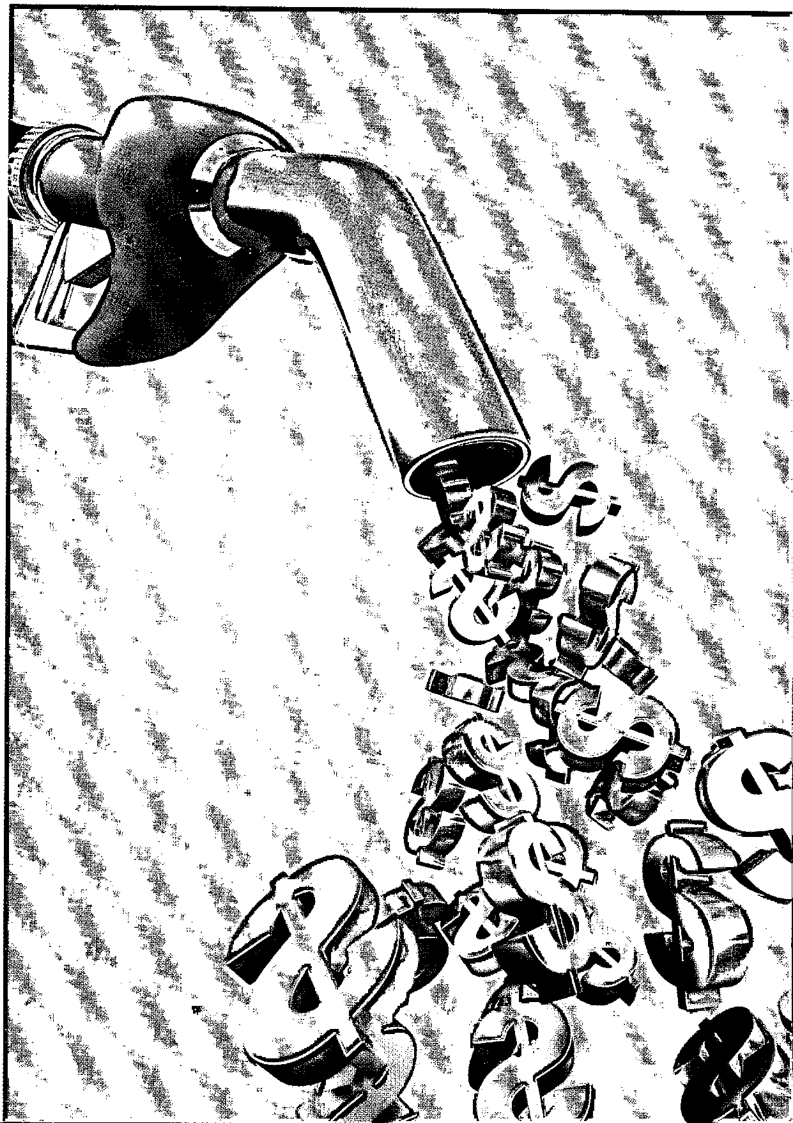
IMPACT AND POLICY RESPONSES TO OIL PRICE SHOCK IN THE SEACEN COUNTRIES

Piter Abdullah



The South East Asian Central Banks (SEACEN) Research and Training Centre

IMPACT AND POLICY RESPONSES TO OIL PRICE SHOCK IN THE SEACEN COUNTRIES

by
Piter Abdullah

The South East Asian Central Banks (SEACEN)
Research and Training Centre
Kuala Lumpur, Malaysia

Published by The South East Asian Central Banks (SEACEN)
Research and Training Centre
Lorong Universiti A
59100 Kuala Lumpur
Malaysia

Tel. No.: (603) 7958-5600
Fax No.: (603) 7957-4616
Telex: MA 30201
Cable: SEACEN KUALA LUMPUR

IMPACT AND POLICY RESPONSES TO OIL PRICE SHOCK IN THE SEACEN COUNTRIES

ISBN: 983-9478-58-3

Design & Printed in Malaysia by Yamagata (M) Sdn. Bhd.

FOREWORD

IMPACT AND POLICY RESPONSES TO OIL PRICE SHOCK IN THE SEACEN COUNTRIES

In the last five years, oil prices have escalated with prices reaching their highest level in August 2006. Even though the increase in oil prices in nominal terms has been significant, the impact on the SEACEN economies, as a whole, has been relatively smaller in comparison to the earlier oil shocks in the 1970s and 1980s but more asymmetric among the countries. This study highlights a number of possible explanations for the relatively limited and asymmetric economic impact of the recent oil price shock such as the different causes and nature of the shock, favourable global economic environment, changes in oil dependency with economic structural changes, prudent policy responses and improved resilience of the economies. While shocks in the 1970s and 1980s were caused mainly by sizeable disruptions to oil supply, the recent oil price shock is caused by both the distortions in the supply side and the rapid increase in demand.

To further investigate the impact of the recent oil price hike, this collaborative study analyses its effect on the economies of selected SEACEN countries. Considering the interrelationship between economic events and policy responses, the study also makes an attempt to evaluate the effectiveness of monetary policy in responding to the consequences of oil price shocks on the economy.

This collaborative study is divided into 2 Parts: Part I consists of the integrative report and regional analysis authored by Mr. Piter Abdullah, Visiting Research Economist from Bank Indonesia, who aslo served as Project Leader. Part II consists of country chapters authored by the country researchers from twelve participating member banks, namely, National Bank of Cambodia, Reserve Bank of Fiji, Bank Indonesia, The Bank of Korea, Bank Negara Malaysia, The Bank of Mongolia, Nepal Rastra Bank, Bank of Papua New Guinea, Bangko Sentral Ng Pilipinas, Central Bank of Sri Lanka, The Central Bank of the Republic of China (Taiwan) and Bank of Thailand. The Project Leader would like to express his deep gratitude to the country researchers for preparing their respective country chapters and to the Directors of Research of the SEACEN member central banks and monetary authorities for their useful comments and suggestions on the final draft paper. He would also like to thank Dr. Kurtubi, Director of the Petroleum and Energy Economics Studies (CPEES), Indonesia, for his valuable comments on the final draft of this paper. He gratefully acknowledges the support of The SEACEN Centre staff in completing this study successfully. The views expressed in this paper, however, are those of the authors and do not necessarily reflect those of The SEACEN Centre, or SEACEN member central banks/monetary authorities.

Dr. A. G. Karunasena
Executive Director
The SEACEN Centre
Kuala Lumpur

June 2007

Contents

PART I: INTEGRATIVE REPORT

1 CHAPTER 1: IMPACT AND POLICY RESPONSES TO OIL PRICE SHOCK IN THE SEACEN COUNTRIES
by Piter Abdullah

Introduction 1
Background
Objectives
Scope and Structure of the Integrative Report
The Causes and Prospect of the Oil Price Shock 3
The Role of Oil in the Economies of SEACEN Countries 5
Cambodia
Indonesia
Korea
Malaysia
Mongolia
Nepal
Papua New Guinea
Philippines
Sri Lanka
Taiwan
Impact of Oil Price Shock on the SEACEN Economies 20
Measuring the Impact
Monetary Policy Responses to Oil Price Shock
Factors Causing the Asymmetric Impact of Oil Price Shock 31
Methodology
Empirical Results
Conclusion 32
References

PART II: COUNTRY CHAPTERS

2 CHAPTER 2: THE ROLE OF OIL IN THE ECONOMY AND POLICY IMPLICATIONS: THE CASE OF CAMBODIA
by Nguon Sokha

Introduction 44
Energy Consumption and Production Situation 45
Recent Trends in Domestic Prices and Inflation 48
Dependency on Oil Imports 50
Petroleum Tax Regime in Cambodia 51
The Formation of Retail Prices for Petroleum Products 55
Policy Responses to Higher Oil Prices 56
Fiscal Policy
Monetary and Exchange Rate Policy
Conclusion 60
References

3 CHAPTER 3: THE ROLE OF OIL IN THE ECONOMY: THE CASE OF THE REPUBLIC OF THE FIJI ISLANDS
by Ariel Marr

Country Background 62
The Energy Sector in Fiji 62
Energy Supply and Demand
Energy Sector Institutions and Regulation
National Energy Policy Development
Oil Dependency 67
Domestic Fuel Retail Price Mechanism 72
Policy Responses to Higher Oil Prices 74
Concluding Remarks 75
References

4 CHAPTER 4: OIL DEPENDENCY AND ENERGY POLICY IN INDONESIA
by Ferry Syarifuddin

Introduction 77
Background
Objectives
Energy Intensity and Oil Dependency in Indonesia 79
Energy Intensity in Indonesia
Renewable Energy (RE) Development in Indonesia
Some Issues in Renewable Energy (RNE) Development in Indonesia
Measures of Oil Dependence and Vulnerability
Measures of Petroleum Dependence in Indonesia
Energy Policy in Indonesia 90
Indonesia's Energy Policy: Oil Subsidies Dilemma
Energy Policy in Indonesia
Other Issues Related to the Policies
Roadmap of the Energy Infrastructure in Indonesia
Energy Policy Implication
Concluding Remarks 103
References
Glossary

5 CHAPTER 5: IMPACT AND POLICY RESPONSES TO VOLATILE OIL PRICES IN KOREA
by Kyuil Chung

Developments of Energy Policy 109
Energy Policy Objectives
Major Developments in Energy Policy
Petroleum Product Pricing and Taxation
Energy Supply and Demand
Oil Supply and Demand
Evaluation

Impact of Oil Price Shock and the Response of Monetary Policy 121
Description of the Data
Correlation Analysis
VAR Analysis
Conclusion 131
References

6 CHAPTER 6: THE ENERGY DYNAMICS IN MALAYSIA: ASSESSING THE IMPACT OF ENERGY POLICIES ON THE MALAYSIAN ECONOMY

by Mohamed Rizwan Habeeb Rahuman and Dr. Norhana Endut

Introduction 133
Petroleum Macroeconomics in Malaysia 133
Malaysia's Macroeconomic Background
Evolution of the Petroleum Industry in Malaysia
Domestic Oil Retail Price Mechanism in Malaysia
Oil Dependency and Energy Diversity in Malaysia
Conclusion
The Impact and Policy Responses of Oil Price Shocks in Malaysia 152
Introduction
Macroeconomics Impact and Policy Responses
The Dynamic Relationships of Oil Price and the Economy
Conclusion
References

7 CHAPTER 7: COUNTRY PAPER OF MONGOLIA

by A. Chingunjav

Background 165
Thermal Power, Energy Supply System 165
Demand Forecasts for Electricity Consumption
Heat 168
Demand Forecast For Heat Consumption
Coal Sector 170
Liquefied Petroleum Gas (LPG) In Mongolia 171
Hydropower Sector 173
Solar Energy 175
Wind Energy 175
Geothermal Energy 176
Oil Energy 176
Oil Exploration and Mining
Consumption of Oil Products
Indexes of Oil Dependence 179
Share of Oil Imports in the Total Country Import
Oil Intensity of the Economy
Import Price Index
Conclusion 180

8 CHAPTER 8: THE IMPACT OF OIL PRICE SHOCKS IN THE NEPALESE ECONOMY

by Dila Ram Subedi

Introduction 182
Nepal at a Glance
Macroeconomic Situation
Energy Policies and its Impact on Oil Dependence 183
Issues of Energy Planning and Policies
Major Sources of Energy
Energy Export / Import Composition
Energy Consumption Pattern
Petroleum Product Pricing and Supply
Measuring Oil Dependence in Nepal
Oil Price Shocks in Nepalese Economy 196
Measuring the Impact 197
Methodology
Data
Empirical Results
Conclusion 199
References

9 CHAPTER 9: OIL DEPENDENCE, IMPACT OF OIL PRICE VOLATILITY AND POLICY RESPONSE IN PAPUA NEW GUINEA

by Dr. Gae Kauzi

Introduction 204
Development of National Energy Policy 204
The Energy Sector 206
Supply/Production of Energy in PNG
Demand for Energy in PNG
Oil Dependency 212
Price Determination Mechanism of Fuel Products 213
Impact of and Policy Responses to Volatile Oil Prices 213
Structural VAR Model Results 214
Conclusion 215
References

10 CHAPTER 10: POLICY CONSIDERATIONS IN THE LIGHT OF OIL PRICE VOLATILITY

by Jade Eric T. Redoblado

Introduction 218
Size and Nature of the Shock 218
State of the Economy 219
Econometric Estimation 221
Monetary Framework 226
Scope for Monetary Policy 226
References

11 CHAPTER 11: THE IMPACT AND POLICY RESPONSE TO OIL PRICE SHOCKS: THE CASE OF SRI LANKA

by D. M. Rupasinghe

Introduction 228
Energy Sector 228
Policy Changes in the Energy Sector 229
Petroleum Sector 231
Petroleum Consumption in Sri Lanka 232
Impacts of Oil Price Hike 233
Impact on Prices
Impact on the Balance of Payments
Impact on the Fiscal Sector
Policy Issues 236
Conclusion 238

12 CHAPTER 12: THE IMPACT AND POLICY RESPONSE OF OIL PRICE SHOCKS IN TAIWAN

by Jyh-Miin Lu

Introduction 239
The Impact of Oil Price Shocks on Taiwan's Economy 239
Methodology
Data
Empirical Results
Monetary Policy Responses to Oil Price Shocks in Taiwan 245
Conclusion 246

13 CHAPTER 13: IMPACT AND POLICY RESPONSE TO VOLATILE OIL PRICES: THAILAND'S RECENT EXPERIENCE

by Yunyong Thaicharoen, Watsaya Limthammahisorn and Jariya Premsin

Introduction 249
Thailand's Fundamentals on Energy Positions 250
Dependency on Imported Energy
Diversification of Energy Types and Sources
Energy Efficiency
Implication of Thailand's Energy Position on Economic Stability and Competitiveness
Lesson Learned from Thailand's Energy Pricing Policies 256
Current Pricing and Tax Structure for Petrol Products in Thailand
Price Control Schemes
Policy Recommendation 266

Executive Summary

In the last five years, oil prices have escalated with prices reaching their highest level of $77 per barrel in August 2006, or relatively the same level as the second oil price shock at the end of the 1970s. Even though the increasing oil price is significant, the impact on the economy as a whole is not the same as in the earlier oil shock. Whereas the previous oil price shocks had caused a severe economic slowdown in almost all countries, the current oil price shock coincides with the one of most favourable global economy in the past 35 years.

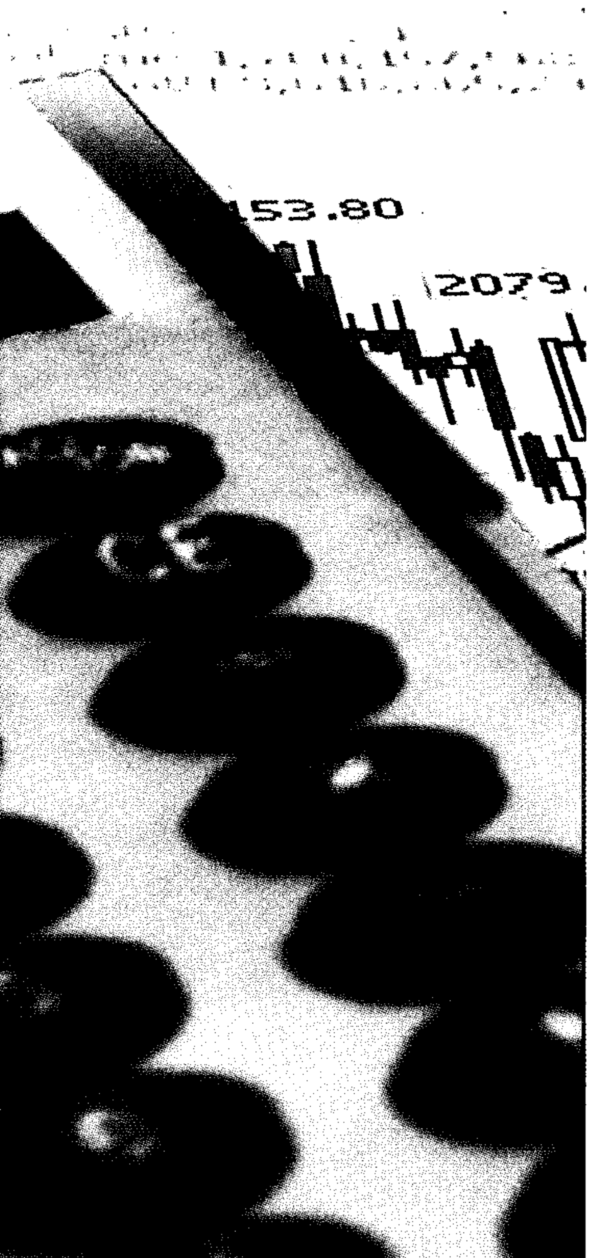
The muted impact of oil price shock in the recent times is in part related to the different causes and nature of the shock. While shocks in the 1970s and 1980s were caused mainly by sizeable disruptions to oil supply, the recent oil price shock is caused by both the distortions in the supply side and the rapid increase in demand. To a large extent, the current oil price shock has been driven by unexpectedly buoyant demand for oil, particularly in the US, and by the rapidly growing emerging market countries, especially China which has almost doubled its demand for oil in the past 10 years. In contrast with increase in oil demand, world oil production has stagnated. This unbalanced supply and demand is worsened by lower oil inventories in industrial countries and by transportation bottlenecks both for crude and refined oil products that have increased the pressure on oil tanker rates. Taking into account the increasing world oil demand and geopolitical concerns over the security of future oil supplies, the high oil price is perceived to be persistent in the intermediate future.

Similarly, the impact of the recent oil price shock has not been very significant in the SEACEN countries as well. Some of countries such as Korea and Taiwan experienced only a limited disruption during and after the shock. Other countries such as Malaysia and Papua New Guinea benefited as government revenue increased and further improved their economies. One plausible explanation for the limited impact of the oil price shock in Korea and Taiwan is that their economic structures have evolved and are now much less dependent on oil than they were in the 1970s.

The decreasing oil dependency in some SEACEN countries to some extent is a result of energy policies enforced by governments in the respective countries and has significantly reduced the impact of the oil price shock to the economy. However, empirical results show that subsidy policies in oil price cannot absorb the impact continually. In some countries such as Indonesia and Thailand, the prolonged higher oil price has increased the subsidy burden on the government budget.

With regard monetary policy, empirical results show that in some SEACEN countries, monetary policy indicators to some extent are endogenous to oil price hikes. However, such a response only generates a small portion of the output movement due to oil price shocks. This confirms that erratic and unpredictable fluctuations in monetary policies are not a primary cause of the business cycle. An aggressive monetary policy response to an oil price hike would not have succeeded in averting the downturn of the economy.

Considering the limited role of monetary policy to economic growth, in anticipation of oil price shocks, monetary authorities would do better to focus their policies on the second round effect rather than on the first round effect of the oil shock. Since domestic oil prices in most countries are determined directly by the international oil price market, the first round effect of such an oil price hike on inflation are likely to be small. However, the second round effect of that oil price hike could be higher and therefore should be estimated appropriately.



INTEGRATIVE REPORT
PART I

Chapter 1

INTEGRATIVE REPORT:
IMPACT AND POLICY RESPONSES TO OIL PRICE SHOCK IN THE SEACEN COUNTRIES

by Piter Abdullah[1]

1. Introduction

1.1. Background

Oil is one of the most important energy resource for almost every economic activity. Considering this important role of oil in the economy, it is easy to understand that increasing oil prices will have significant impacts on the economy. The drastic increase in oil prices at the beginning of the 1970s and 1980s had caused prolonged recessions in several countries. These phenomena has triggered deep concern for the shortage of energy especially oil. Since then, most industrial countries have been struggling to increase the effectiveness and the efficiency in energy use by imposing conservation and energy diversification policies, i.e., imposing high fuel tax, and trying to utilise other energy resources such as solar energy, wind energy, etc. On the other hand, starting from the oil crises in the 1970s, oil price has become one of the main indicators in economic analysis.

Starting from 2002, oil price has tended to increase. In August 2006, oil price hit the highest level of US$ 77 per barrel, in terms of real value. This level is relatively the same as that of the second oil price shock at the end of the 1970s. Even though the increasing oil price in the last four years is significant, the impact on the economy so far, has not been as large and symmetric across countries like the impact of the first oil price shock. There are several plausible explanations for the recent phenomenon of oil price shock, including the differences in factors causing the shock and the level of oil dependency, which has been decreasing in most of developed countries. While shocks in the 1970s and 1980s were caused mainly by distortions in supply side, the recent shock is caused by both supply and demand. In addition, most of developed countries that are net oil importers, had learned through the experience of the previous oil price shock. These countries seem to be better able to anticipate more appropriately the current oil price shock while also at the same time decreasing their oil consumption relative to their GDP. As a result, these countries did not experience any significant downturns in their economies. Only those countries which did not anticipate the volatility of oil price, experienced a significant impact on their economies or even experienced recessions. Other factors that make current situation *different include* the following:

1. The depreciation of the US dollar vis-à-vis the Euro and the Yen. If exchange rates vary drastically, higher oil prices will not affect economies with non-dollar appreciated currencies. The current high oil prices will not affect the economies of Europe and Japan as much as they did in the 1970s. The depreciation of the dollar limits the impact of high oil prices on the US economy.
2. The expansionary policies of the central banks and low interest rates. Since 2000, interest rates had been declining while oil prices increasing. Previous increases in oil prices were always associated with increases in interest rates.
3. The role of oil is mostly limited to the transportation sector. Since early 1970s, the shares of oil to electricity has been declining significantly.

---

1 Senior Economist seconded as a Visiting Research Economist to The SEACEN Centre from the Central Banking Education and Studies of Bank Indonesia.

The same phenomenon occurred in Asian countries. For example, some countries such as Malaysia and Taiwan, although differing in their natural resources (Malaysia is an oil exporter while Taiwan is an oil importer), were not affected significantly by the oil price shock. Meanwhile Indonesia, a member of OPEC, experienced significant effects from the oil price shock with inflation increasing sharply during the period of oil price shock.

1.2. Objectives

This study aims to analyse the impact of oil price shock on the economies in the selected SEACEN countries[2]. Considering that central banks are concerned with the effectiveness of its policies during the oil price shock, this study will also evaluate whether monetary policy response of the central banks can alleviate the consequences of oil shocks on the economy. This study will try to answer the following questions:

1. How did the oil price shocks affect the economies in SEACEN countries?
2. Were the effects of oil price shock symmetric across SEACEN countries? What factors caused the asymmetric effects?
3. How did monetary authorities in the SEACEN countries impose their policies? Were they independent or dependent on the oil price shock?
4. Did monetary policies, which were conducted in response to the rising oil prices, affect the economy significantly in the particular country?

The results of this study can hopefully be used by the monetary authorities in SEACEN countries in their choice of the appropriate policies to anticipate the impact of oil price shock on the macro economy.

1.3. Scope and Structure of the Integrative Report

The main focus of this study is to calculate and compare the impact of oil price shock across selected SEACEN countries. In line with that objective, considering the core function of central bank, this study will also investigate the independency and effectiveness of monetary policies imposed by monetary authority responding to the oil price shock. To meet these objectives, this report will cover the dynamics of international oil prices, domestic fuel pricing policy, monetary policy response to oil price shock, and economic development indicators such as economic growth, government revenue, exchange rate, and inflation.

To gain a better understanding on the impact of oil price shock on the economy, this report will highlight the role of oil in the selected SEACEN countries. These will be descriptive in nature, giving a comparative review on energy policy development and how it affects the country's dependency on oil.

The report is structured as follows: Section 1 is the introduction, followed by Section 2 that will highlight the cause and prospects of the recent oil price shocks. In Section 3, the role of oil price in the selected SEACEN country's economy is described. Section 4 analyses the impact of oil price shock. This Section also includes the assessment of whether monetary policies implemented by central banks in the selected SEACEN countries were endogenous or exogenous to the oil price shock and whether they were effective or not in reducing the impact of oil price shock on the economy. Section 5 investigates the factors causing the asymmetric impact of oil price shock across countries. Section 6 concludes the report with some recommendations.

---

2 There are eleven SEACEN member banks that participated in this project, namely, National Bank of Cambodia, Bank Indonesia, The Bank of Korea, Bank Negara Malaysia, The Bank of Mongolia, Nepal Rastra Bank, Bank of Papua New Guinea, Bangko Sentral Ng Pilipinas, . Central Bank of Sri Lanka, The Central Bank of the Republic of China, Taiwan and Bank of Thailand.

2. The Causes and Prospect of the Oil Price Shock

Oil prices are indeed volatile. After the drastic increase in oil prices in the beginning of 1970s and 1980s, the world is once again facing a substantial rise in oil prices. Prices have nearly tripled since mid-2003 and have now reached nominal record levels (US$ 77 per barrel Brent Crude, 11 August 2006). Taking the lowest point of oil prices on 11 December 1998 (US$ 9.2 per barrel Brent Crude), and thus interpreting the development since 2002 as a single prolonged oil price shock, the scale of the shock is greatly magnified[3]. Figure 1.1 shows the recent oil price shock compared to other previous shock.

Considering the developments since mid-2002 as a single energy price shock, the current oil price hike is roughly comparable to the previous episodes in the 1970s and 1980s. From December 1973 to January 1974, the dollar price of oil increased by over 250%. Taking the average oil price over the 2 years of 1974 and 1975, the price hike amounted to over 160%. Again, from November 1978 to June 1979, the price increase was nearly 160%. Taking the oil price high in November 1979, the price jumped by roughly 180% within one year (Weber, 2006). On the other hand, in the recent oil price hike, from mid-2002 to August 2006, oil price increased by over 208%.

Even though the scale of current oil price development is comparable to its predecessor in real terms, the impact on economy, however, is not the same. Whereas the oil price shocks of the 1970s and 1980s (and also the shock in 1990s), had caused a severe slowdown in global growth and outright recession in many oil importing countries, the current oil price shock are coinciding with the most favourable scenario for the global economy ever experienced for the past 35 years. Global GDP growth is estimated by the IMF at 4.8% in 2005, slightly decreased from 5.3% in 2004, yet much higher than the historical average growth of 3.5%. More over, the real growth in advanced economies in 2004/2005 was above the long-term average and it is projected to stay at around 3% in the intermediate future (Weber, 2006).

There are several plausible explanations for the muted impact of oil price shock in the recent times. The differences in the impact of the oil price shock on today's economic performance and that of earlier shocks might, in part, be related to the different causes and natures of the shocks[4]. Shocks in the 1970s and 1980s were caused mainly by sizeable disruptions to the oil supply, which seriously dampened the confidence of companies and households. On the other hand, the recent oil price shock is caused by both the distortions on supply side and the rapid increase on the demand side.

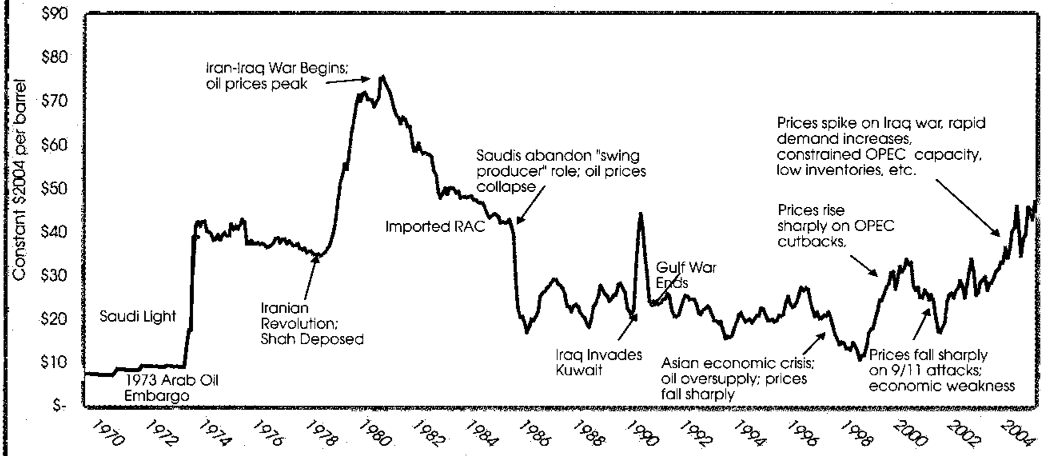
Unlike the previous experiences, the present oil price shock is caused by substantially different factors. To a large extent, the current oil price shock has been driven by unexpectedly buoyant demand for oil, particularly by rapidly growing emerging market countries such as China and also demand from the US. During the period 1995-2004, total world oil demand increased by 18%, from 69.8 million barrels per day in 1995, to 82.2 million in 2004. While US's share in global oil demand remains high (around 25%), China's share in global oil demand increased tremendously, almost doubling in the past 10 years (4.7% in 1995, 7.66% in 2004).

Contrast with this increase in oil demand, world oil production seems to be stagnant. Table 1.2 shows the world oil balance during the period from 2002 until the first quarter of 2006. Reflecting the world oil balance, OPEC's excess capacity is at its lowest level since the early 1990's, estimated to be just over 1 million barrels per day in 2005. This condition was made worse by natural disasters such as the hurricane in the Gulf of Mexico that reduced both US

3 Speech of Axel A Weber, President of Deutsche Bundesbank, at the Central Bank and Financial Services Authority of Ireland, Dublin, 11 May 2006.

4 To some extent, the decrease in oil dependency in most of developed countries has also contributed to the muted economic impact of the current oil price shock.

Figure 1.1
Major Events and Real World Oil Prices, 1970-2005
(Prices Adjusted by Quarterly GDP deflator, 2Q 2005 Dollars)



Source: EIA

Table 1.1: The World's Oil Demand (1995-2004)

	1995	%	2000	%	2004	%
United States	*18.00*	*25.79*	*20.00*	*26.25*	*20.50*	*24.94*
China	*3.30*	*4.73*	*4.60*	*6.04*	*6.30*	*7.66*
India	1.70	2.44	2.30	3.02	2.50	3.04
Dynamic Asia*	3.70	5.30	4.30	5.64	5.00	6.08
OECD (Excl. US)	26.90	38.54	27.80	36.48	28.80	35.04
Rest of the World	16.20	23.21	17.30	22.70	19.10	23.24
Total	69.80	100.00	76.20	100.00	82.20	100.00

* Includes: Taiwan, Hong Kong, China, Indonesia, Malaysia, Philippines, Singapore, and Thailand
Source: International Energy Agency

crude oil production and refining capacity, and also lower oil inventories in industrial countries as well as by the transportation bottlenecks for both crude and refined oil products. Days of forward cover of oil industry stocks have been trending down in the past ten years, from 65 days to be about only 50 days. In the meantime, as a result of unexpectedly high demand, transportation bottlenecks could not be avoided, increasing the pressure on oil tanker rates.

Taking into account the increasing world oil demand and geopolitical concerns over the security of future oil supplies, the high oil price is perceived to be persistent in the intermediate future. Despite higher oil prices, the high demand from US, China, and India is expected to persist because their developments are still ongoing[5].

5 Most international financial institutions such as Goldman Global Investment Research and Royal Bank Of Scotland, predict that oil price will continue to increase. A few such as Morgan Stanley predicts that the increasing oil price will be just for the short run since the economies of China and other developed Asian countries have reached their peak and will be decelerating.

Table 1.2
The World's Oil Balance, 2002-2006
(Million Barrels Per Day)

	2002	2003	2004	2005	2006
Oil Supply					
OECD					
United States	9.00	8.80	8.70	8.25	818
Total OECD	23.42	23.24	22.80	21.82	21.77
Non-OECD					
OPEC	28.99	30.56	32.85	34.22	33.84
Total Non-OECD	53.54	56.32	60.20	62.55	62.62
Total World Supply	**76.96**	**79.57**	**83.00**	**84.37**	**84.39**
Oil Demand					
OECD					
United States	19.76	20.03	20.73	20.66	20.38
Total OECD	47.88	48.60	49.37	49.42	50.05
Non-OECD					
China	5.16	5.58	6.40	6.90	7.15
Total Non-OECD	30.20	31.14	33.08	34.42	35.10
Total World Demand	**78.08**	**79.74**	**82.45**	**83.84**	**85.15**

Source: International Energy Agency

3. The Role of Oil in the Economies of SEACEN Countries

3.1. Cambodia

3.1.1. Oil Dependency

After several years of conflict, the Cambodian government in 1999 - the first full year of peace - made some progress on economic reforms. The US and Cambodia signed a Bilateral Textile Agreement, which gave Cambodia a guaranteed quota of US textile imports and established a bonus for improving working conditions and enforcing Cambodian labour laws and international labour standards in the industry. From 2001 to 2004, the economy grew at an average rate of 8.1%, driven largely by an expansion in the garment sector and tourism. The garment sector performed much better than expectation in 2005, leading to an economic growth of 13.4% in the same year. In addition to the growing economy, the number of business establishments in Cambodian had risen remarkably.

As the Cambodian economy grows, more energy is needed. Since power plays a prominent role in the industrialisation process and the country's development, a greater demand for energy is expected. The main source of energy in Cambodia is oil and petroleum products are used for mainly for generating electricity[6] and in transportation[7].

The critical issue facing Cambodia in terms of oil supply security is that there is no indigenous production of oil within Cambodia[8], and there is also no oil refinery in the country. Cambodia is entirely reliant on imports of refined oil for its domestic consumption of petroleum products. The share of petroleum in the total imports of Cambodia is high. The total import of petroleum

6 In 2004, diesel was used to generate 68.5 percent of total electricity power, while heavy fuel oil was used to generate the remaining 31.5 percent.
7 The transportation system in Cambodia consists primarily of private vehicle road transport.
8 In 2005, exploitable oil and natural gas deposits were found beneath Cambodia's territorial waters, representing a new revenue stream for the government once commercial extraction begins in the coming years (Source: CIA World Fact book. https://www.cia.gov/cia/publications/factbook).

products have virtually doubled over the past eight years since 1998 in terms of volume. During the period from 1999 to 2004, the volume of petroleum imports grew at an average annual rate of 12 percent.

Based on the data on energy consumption and petroleum import, oil dependency development[9] in Cambodia is shown in Table 1.3.

Table 1.3
Oil Dependency in Cambodia

Year	Total Energy Consumption	Petroleum Products Consumption		Total Petroleum Supply	Petroleum Import		Oil Dependency
	Unit	Unit	%	Unit	Unit	%	%
1998	NA	NA	NA	6,244,950.2	6,244,950.2	100%	NA
1999	NA	NA	NA	7,134,895.6	7,134,895.6	100%	NA
2000	NA	NA	NA	7,755,739.5	7,755,739.5	100%	NA
2001	NA	NA	NA	8,802,549.2	8,802,549.2	100%	NA
2002	NA	NA	NA	9,793,883.8	9,793,883.8	100%	NA
2003	NA	NA	NA	10,911,977.1	10,911,977.1	100%	NA
2004	NA	NA	NA	12,083,159.3	12,083,159.3	100%	NA
2005	NA	NA	NA	12,389,454.5	12,389,454.5	100%	NA

Source: Custom and Excise Department and National Bank of Cambodia's estimates

3.1.2. Domestic Oil Retail Price Mechanism

The price of petroleum products in Cambodia are determined by supply and demand in the market. In addition to the market mechanism, the Cambodian government impose a tax for each petroleum product for the purpose of revenue generation[10]. Fuel taxes in Cambodia have three characteristic features which are (i) tax instruments, (ii) compound feature, and (iii) taxable base. These three characteristics of petroleum taxes determine the level of tax rate that will be added to the price for each petroleum product[11] in Cambodia as can be seen in the Table 1.4 below.

Table 1.4
Official Tax Rate to Petroleum Product in Cambodia

	Gasoline	Diesel	Kerosene
Import Duties	35.0%	15.0%	7.0%
Additional Tax	8.7%	17.3%	0.0%
Excise	33.3%	4.4%	10.0%
Consumption/VAT	10.0%	10.0%	10.0%

Table 1.4 shows that gasoline carries the highest taxation of all petroleum products, while diesel fuel is taxed less in terms of customs reference value as well as retail price. Taxation on kerosene (used typically by rural households as an energy source for cooking and lighting) is generally lower than that on transport fuels and industry fuels.

9 There are many approaches that can be used to measure the oil dependency of a country. In this paper, oil dependency is defined as the average of the ratio of petroleum imports on total petroleum supply and the ratio of petroleum consumption on total energy consumption.

10 The purpose of imposing tax on oil is solely to gain revenue unlike other developed countries that impose tax mostly for environment reason. Another reason is that the consumption of fuel is relatively low in elasticity with respect to prices, but highly elastic with respect to income. Therefore, increasing tax rates and rising incomes will serve to ensure buoyant revenue.

11 There are six types of petroleum products that are imported and used in Cambodia: gasoline, diesel fuel, kerosene, fuel oil, jet fuel and gas.

3.2. Indonesia

3.2.1. Oil Dependency

Indonesia experienced a long period of high economic growth in the 1980s and 1990s. After a deep recession during the financial crises in 1998 -1999, the Indonesian economy seems to have recovered. GDP growth has picked up in recent years, from 3.8% in 2001 to 5.6% in 2005. Other indicators have improved commensurately: the fiscal deficit has narrowed to below 1% of GDP and public debt has declined to 52% of GDP, down nearly 30 percentage points over 4 years. The continuing recovery in 2005 was noteworthy because it was achieved in the face of several major difficulties, including the aftermath of the December 2004 earthquake and tsunami, a sharp increase in domestic fuel prices, and a surge in inflation and interest rate (Asian Development Bank Report, 2006).

Although the economy was slowing down during the crisis, energy demand in Indonesia has been steadily increasing. Final energy consumption increased by around 4% on average per year. In 1995, total energy consumption was only 558 millions barrels of oil equivalent while in 2003, it increased to reach 760 millions barrels of oil equivalent. Most of the demand came from transportation and industrial sector. Petroleum is the most important energy source, followed by bio-mass and natural gas. As the energy demand increases steadily, demand for petroleum in Indonesia has increased proportionately. The final demand for petroleum products for the period 1995-2003, grew at an average annual rate of 3.8%, slightly slower than the final energy demand increase.

Indonesia is an oil producer and a member of OPEC but its crude oil production has been decreasing since 1999. In 2003, crude oil production reached 1,146 million barrels per day (MBD) while in the following years of 2004 and 2005, it reached only 1.096 MBD and 1,062 MBD respectively[12]. The declining trend of crude oil production is caused by both aging oil fields and declining exploratory drilling. While crude oil production is decreasing, domestic oil product consumption is steadily increasing. In 2004, total demand for petroleum product was 1.20 MBD, which is slightly above oil production. Since 2004, Indonesia has been net oil importer. Indonesia imports crude oil for domestic oil refinery production and petroleum products for domestic demand. During the period of 2000-2004, crude oil and petroleum product imports increased by 22.5 % and 13.9% respectively.

As petroleum product consumption, crude oil and petroleum imports increased steadily, oil dependency in Indonesia seems to have worsened. Table 1.5 shows the development of oil dependency in Indonesia.

Table 1.5
Oil Dependency in Indonesia

Year	Total Energy Consumption*	Petroleum Products Consumption		Total Petroleum Supply	Petroleum Import		Oil Dependency
	Unit	Unit	%	Unit	Unit	%	%
1995	558,356	245,233	43.92	238,277	40,767	17.11	30.51
1996	583,208	264,441	44.83	265,999	61,530	23.13	33.98
1997	612,526	275,273	44.94	290,723	92,719	31.89	38.42
1998	610,040	271,936	44.58	277,798	55,397	19.94	32.26
1999	664,116	290,415	43.73	299,883	67,315	22.45	33.09
2000	709,857	307,581	43.33	331,958	91,994	27.71	35.52
2001	734,040	319,170	43.48	334,250	89,383	26.74	35.11
2002	754,563	328,173	43.49	331,780	106,756	32.18	37.83
2003	760,031	329,525	43.36	328,088	107,935	32.90	38.13

* Including Bio-mass
Source: Energy and Mineral Resources Department, Republic of Indonesia

12 In July 2006, Indonesian Crude Oil production recovered to 1,028 million barrels per day.

3.2.2. Domestic Oil Retail Price Mechanism

As an oil exporter, Indonesia had for several years, granted subsidies on oil price to maintain lower domestic fuel price, making it affordable for the general public. However, in the recent years, considering that Indonesia has turned into a net importer of oil, the Indonesian government is trying to lighten the burden of increasing oil prices by the significant reduction in government subsidies for oil prices in several stages. The government stated that the main goal of cutting subsidies is to reduce the budget deficit and to encourage non-oil energy sources development, especially renewable resources. However, the unexpected surge of oil price during the last four years has increased the total amount of subsidies needed to maintain the affordability of domestic oil prices. In 2005, the Indonesian government was forced to revise the oil subsidy budget to Rp 89.2 trillion. In 2003, total oil subsidies was only Rp 30 trillion. In the same year, the government tried to completely phase out subsidies for industrial fuel users and high-octane transportation fuels. According to Presidential Decree No. 55/2005, subsidised fuels are for the use of the following categories:

- Households (kerosene)
- Fishing boats of a maximum of 30 tons in size with a maximum gas oil consumption of 25 kilolitres per month.
- Transportation, including private and government vehicles, public transport and domestic route ships (premium and gas oil)
- Public services facilities, including hospitals, places of worship, education facilities, crematoriums and government offices (gas oil)

In July 2005, the government began to set its industrial fuel prices according to market forces. The market price is calculated by adding 15% to the average monthly Mid- Oil Platt Singapore (MOPS) price, plus 10% for the value added tax and plus 5% fuel tax.

3.3. Korea

3.3.1. Oil Dependency

Korea is one of the most developed country in Asia and had experienced a sustained period of high economic growth. After the crisis in 1997-1998, the Korean economy has rebounded to record rapid economic growth and reflecting this high growth, energy consumption in Korea also increased tremendously and is one of the world's 10 major energy consumers.

During the period of 1980-2004, final energy consumption increased almost four times, from 47 Mtoe in 1980 to 166 Mtoe in 2004. Oil has the highest share of total final consumption, reaching 58 percent in 2004. Power generation of electricity takes up 16 percent, coal 13 percent and gas 10 percent. While the share of oil in final energy consumption is gradually decreasing, the use of electricity and town gas is continuously increasing. From the energy user perspective, the industrial sector has the largest share of final energy consumption at 56% in 2004. The residential, commercial, and public sector accounts for 23% and transportation 21%.

Korea has very limited natural resources. To meet total energy demand that is increasing steadily, Korea has to import most of its primary energy from overseas. The share of imported energy to total primary energy consumption increased from 47.5% in 1970 to 96.7% in 2004. The main imported items are petroleum, coal, nuclear and LNG. Table 1.6 shows the amount of oil imports and oil consumption in Korea. Oil dependency in Korea is calculated based on data energy consumption and oil import.

As can be seen in the Table 1.6, oil dependency in Korea has been decreasing in the last ten years. This decrease is mostly due to the energy policy implemented by the Korean

Table 1.6
Oil Dependency in Korea

Year	Total Energy Consumption	Petroleum Products Consumption		Total Petroleum Supply	Petroleum Import		Oil Dependency
	Thou. TOE	Thou. TOE	%	Thou. Bbl	Thou. Bbl	%	%
1995	121,962	82,876	67.95	972,069	849,449	87.39	77.67
1996	132,033	88,714	67.19	1,111,174	952,845	85.75	76.47
1997	144,432	97,901	67.78	1,294,538	1,063,488	82.15	74.97
1998	132,128	86,526	65.49	1,2895,142	998,460	77.09	71.29
1999	143,060	92,821	64.88	1,363,709	1,065,810	78.16	71.52
2000	149,852	93,596	62.46	1,410,403	1,104,110	78.28	70.37
2001	152,950	93,357	61.04	1,38,028	1,073,018	78.44	69.74
2002	160,451	96,159	59.93	1,268,172	1,029,045	81.14	70.54
2003	163,995	96,155	58.63	1,241,470	1,032,391	83.16	70.90
2004	166,009	95,513	57.53	1,261,290	1,025,784	81.33	69.43

Source: Korea Energy Economics Institute

government which has made efforts to diversify energy sources. The government has also been encouraging the switching from oil to natural gas. Judging from its declining trend of oil dependence, the implementation of energy policies in Korea has been successful so far. This relatively low oil dependence makes the Korean economy less sensitive to volatile crude oil prices and ensures sustainability of Korean economic growth.

3.3.2. Domestic Oil Retail Price Mechanism

Before 1997, prices for all petroleum products in Korea was determined by using a system called the Petroleum Price Fluctuating System. Under this system, the government determined prices for certain petroleum products on the basis of average costs calculated with cost data from domestic refineries. The products covered by this mechanism were reduced gradually. Jet and solvent prices were deregulated in 1983, followed by asphalt in 1998, premium gasoline and naphtha in 1989, and regular gasoline and kerosene in 1991. A price-setting mechanism was reintroduced for gasoline and kerosene in 1994. In January 1997, all petroleum-product price controls were lifted.

Recently, prices for all petroleum products are determined by the market, but the government imposes a 5 per cent tariff on crude oil imports, and 8 per cent tariff on imported petroleum products. A transportation tax or special excise tax is levied on the consumption of petroleum products. Surcharges are also charged on imports and sales of petroleum products to finance the Energy Project Special Account.

The prices of petroleum products differ considerably as a result of their different tax rates. The basic price formula is:

Retail Price = Crude Oil Import + Production Cost + Sales Expenses

Where:

a. Crude Oil Import = (Crude oil price X average exchange rate) + (Usance cost (interest rate + profit and loss of foreign exchange)) + Tariff

b. Production Cost = Production cost (refining + storage + transportation) + Tax

c. Sales Expenses = Dealer's commission + Value Added Tax

The primary objectives of the Korean energy tax system are to raise revenues, to enable cross-subsidisation, and to stabilise prices. Table 2 in Chapter 5 of Korea shows the energy tax system. The tax rates vary for each product and as indicated in the last row, tax accounts for 28% – 57% of retail prices of petroleum products. The tax share in gasoline retail price is the highest with 57%, followed by diesel with 47%, LPG (car) with 42%, and kerosene with 28%.

In order to encourage the switching from petroleum to LPG, the Korean government subsidised LPG especially for cars. The LPG subsidy generated a rapid increase in the number of LPG-fuelled vehicles and LPG service stations. The subsidy is gradually being decreased.

3.4. Malaysia

3.4.1. Oil Dependency

Malaysia experienced a long period of high growth economy before it was interrupted by the financial crisis in 1997. However, it only took a short time for Malaysia to recover from the crisis and starting from 1999, Malaysia has returned to its high growth path. After having a negative growth (-7.4%) in 1998, Malaysia recovered with a growth rate of 6.1% in 1999 and 8.9% in 2000. Despite the slowdown in 2001 and 2002, Malaysia still posted an average annual growth of 5.5% during the period from 2000-2005, with trade surplus rising from 18.0% to 20.1% of GDP.

In line with these high economic growths, energy demand in Malaysia has been steadily increasing. During the period of 1980-2005, Malaysia's consumption of energy grew at an annual average of 7.8%. The bulk of the growth came from the industrial and transportation sectors. Petroleum is the most important energy source and with the steady increase in energy demand, demand for petroleum in Malaysia has increased proportionately. The final demand for petroleum products, for the period 1980-2005, grew at an average annual rate of 6.5%. In 1980, total final petroleum product demand was 5,522 ktoe and in 2005, it increased by more than 4.1 times to 22,873 ktoe.

Malaysia is an oil producer with enough crude oil production to more than satisfy domestic demand. Malaysia's crude oil production (including condensates) have risen over the years. During the period of 1980-1994, crude oil production rose at a faster rate compared to domestic consumption, thus during that period, Malaysia's net oil exports were generally on the uptrend. For the next period (1998-2004), due to the strict implementation of the National Depletion Policy by the government and the rise in domestic consumption (as a result of the economic growth), oil production growth decreased to a level which was lower than consumption growth, meaning that the net export of oil has been decreasing. Nevertheless, in terms of export value, net exports of oil have started to increase again from 2001. While higher oil prices since 2003 can partially account for the rise in value, another reason is the exponential increase in the export of petroleum products. The substantial rise in LNG exports in the last 15 years means that Malaysia would remain as a net energy exporting nation for the foreseeable future.

Based on energy and petroleum consumption data, as well as petroleum production described above, the oil dependency in Malaysia is shown in Table 1.7.

Table 1.7
Oil Dependency in Malaysia

Year	Total Energy Consumption	Petroleum Products Consumption		Total Petroleum Supply	Petroleum Import		Oil Dependency
	Thou. TOE	Barrel per Day	%	Barrel per Day	Thou. Bbl	%	%
1985	Na	194,250	Na	446,378	Na	Na	43.52
1990	Na	266,250	Na	622,648	Na	Na	42.77
1992	Na	302,145	Na	659,017	Na	Na	45.85
1994	Na	378,250	Na	659,932	Na	Na	57.32
1996	Na	435,250	Na	715,689	Na	Na	60.82
1998	Na	465,175	Na	725,035	Na	Na	64.16
2000	Na	485,000	Na	680,762	Na	Na	71.24
2002	Na	493,250	Na	698,462	Na	Na	70.62
2004	Na	519,000	Na	762,318	Na	Na	68.08
2005	Na	517,000	Na	703,514	Na	Na	73.49

Source: Various Sources

3.4.2. Domestic Oil Retail Price Mechanism

The domestic retail price of petrol, diesel and LPG are determined by the government through a pricing system called "Automatic Pricing Mechanism" or APM. The system, which has been implemented since 1 March 1983, was jointly developed by the government and the petroleum industry in Malaysia. The objective of the APM[13] is to ensure price stability for both retailers and consumers of petroleum products by using a systematic adjustment to accommodate any changes in the product cost of petrol, diesel and LPG, as well as operating expenses. From the perspective of oil refineries and retailers, the system provides a better mechanism to predict retail prices, thus helping in the planning of future business plans and investment activities, such as refining capacity expansion and building new plants to meet demand.

The APM governs all retail prices of petrol, diesel and LPG in three anchor locations:
Kuala Lumpur (for states in Peninsular Malaysia), Kota Kinabalu (for the state of Sabah), and Kuching (for the state of Sarawak). Prices of petrol, diesel and LPG cannot be higher or lower than the level set by the APM for the respective anchor locations. The price of petrol, diesel, and LPG, under the APM system, will be reviewed monthly, yearly, or occasionally as deemed necessary. Any revision to the elements of the APM in determining prices of the petroleum products is at the sole discretion of the government.

The APM formula in determining the domestic retail price of petroleum products is:

Product Cost + Operating Expenses + Company Margin + Dealer's Commission + Sales Tax – Subsidy Paid by Government = Retail Price of Petrol, Diesel and LPG

Before June 2005, Product Cost referred to the price of the finished product quoted by the six large oil refineries in Singapore[14]. However, considering that using the SP is inefficient, as it included a pricing bias in favour of these refinery companies, since June 2005, the Malaysian government decided to use the Mean of Platts Singapore (MOPS) as the basis

13 Presently, the APM falls under the Ministry of Domestic Trade and Consumer Affairs. (DTCA).
14 The oil refineries, better known as the 'Singapore Posting (SP) Price' are Shell (2 refineries), Exxon, ConocoPhillips, Caltex and Singapore Petroleum Corporation (SPC).

for Product Cost[15]. The product cost is quoted in US dollar by using current (or 'spot') month quotes. The exchange rate used in determining the product cost in Malaysian Ringgit is a 3-month average rate.

Operating Expenses refer to the costs incurred by the refinery in transporting the petroleum product from the plant to the service station (petrol station). Currently, the operating expenses have been fixed by DTCA at 9.54 cent per litre for both petrol and diesel.

The Company Margin refers to the profit margin earned by the oil distribution company (purchases product from the refinery and sells it to the public through its service stations). Since February 2006, DTCA has set the margin at 5 sen for petrol and 2.25 sen for diesel.

The Dealer Margin refers to the profit margin earned by the operator of the service station. Since 2006, the dealer margin for petrol has been set by DTCA at 9.5 cent per litre while dealer margin for diesel has been set at 4.50 cent per litre.

The Sales Tax refers to the tax imposed on the sale of petrol and diesel in Malaysia. The rate is 58.62 per litre for petrol, and 19.64 sen per litre for diesel. However, due to the persistent rise in crude oil prices since 2001, the government has decided to exempt the collection of these sales taxes to keep the retail price at a manageable level.

Subsidies are paid by the government to the distribution companies to compensate for the reduced sales collection. These subsidies reflect the social responsibility of the government in fixing the retail price at a reasonable level.

3.5. Mongolia

3.5.1. Oil Dependency

Economic activity in Mongolia has traditionally been based on herding and agriculture. Mongolia has extensive mineral deposits of copper, coal, molybdenum, tin, tungsten and gold which account for a large part of industrial production. After the dismantling of the USSR which ended Soviet assistance in 1990, Mongolia experienced a deep recession due to political inaction and natural disasters, and later economic growth because of reforms, the initiation of free-market economy and extensive privatisation of the formerly state-run economy. Severe winters and summer droughts in 2000-2002 resulted in massive losses of livestock and consequently led to zero or negative GDP growth. This was compounded by falling prices for Mongolia's primary sector exports and widespread opposition to privatisation. In the following years, Mongolia's economy receded. In 2004 and 2005, the economy grew 10.6% and 5.5% respectively, largely because of high copper prices and new gold production.

Mongolia is one of the coldest countries in the world and most energy sources are therefore, used to provide heat for urban residents and electricity for about half the country's population. Maintaining adequate thermal and electricity supply is essential for the country's economic development and the well being of the population. Taking into consideration the nature of energy demand and Mongolian economic activity, it is quite apparent that energy demand is low and relatively constant despite of the volatility of economy.

The actual energy demand in Mongolia is comparably low due to the small population in a huge country and the rather low level of industrialisation. Coal is the main primary energy source, accounting for around 94.2% of energy production. At the moment, Mongolia has no oil refinery

15 This pricing method is used in many Asia Pacific countries such as Australia, the Philippines, India, and Thailand. Platts is a company that specialises in providing unbiased, daily market price quotes of many petroleum products, including petrol, diesel and LPG. Platts's division in Singapore, based on its fair assessment of the market, publishes both the highest and lowest price of a product in a given day. MOPS would take the simple average of these two prices to determine the price of a petroleum product in a given day.

and domestic oil demand is completely covered by imports mainly from Russia with a small portion from Kazakhstan and China. Crude oil exploited in the south of the country is exported to China.

3.6. Nepal

3.6.1. Oil Dependency

Nepal's economy is mainly agrarian, with agriculture providing a livelihood for over 80% of the population and accounting for 40% of GDP. Industrial activity mainly involves the processing of agricultural products including jute, sugarcane, tobacco, and grain. As the industrial sector has not been much developed, energy demand has increased quite slowly. In the last ten years, from 1996 to 2005, energy consumption increased only by 2.58 % per year on average. The major share of energy consumption was from households (90.28%), followed by transportation (3.78%), industry (3.47%), commercial (1.45%), agriculture (0.84%) and others (0.18%).

Energy sources in Nepal are largely dominated by the traditional non-commercial forms of energy, i.e., fuel woods, agricultural residues, and animal waste[16]. However, the share has been decreasing and in 1995, the share of traditional forms of energy was 91% of total energy consumption. In 2005, the share decreased to about 87%. In contrast with traditional energy sources, the usage of commercial energy, i.e. petroleum fuels, coal and electricity is very limited. Recently, renewable energy such as bio-gas and micro-hydro has become an important alternative energy source.

To meet the national energy demand, Nepal has been importing petroleum products from the international market and transported and exchanged with India[17]. Although the amount of petroleum usage is limited and has been decreasing in the recent years, petroleum imports have been increasing steadily. During the period 1995-2005, total import of petroleum product increased by 5.67% on average per year. This expansion is much higher than energy consumption growth which was only 2.58% on average.

In Table 1.8, it would seem that oil dependency in Nepal is quite low and consistent (Table 1.8).

Table 1.8
Oil Dependency in Nepal

Year	Total Energy Consumption	Petroleum Products Consumption		Total Petroleum Supply	Petroleum Import		Oil Dependency
	000 GJ	000 GJ	%	000 GJ	000 GJ	%	%
1995	283,315	19,119	6.75	19,119	19,119	100.00	53.37
1996	291,828	21,615	7.41	21,615	21,615	100.00	53.70
1997	297,139	23,623	7.95	23,623	23,623	100.00	53.98
1998	306,339	26,619	8.69	26,619	26,619	100.00	54.34
1999	314,455	28,180	8.96	28,180	28,180	100.00	54.48
2000	330,706	30,224	9.14	30,224	30,224	100.00	54.57
2001	335,420	31,286	9.33	31,286	31,286	100.00	54.66
2002	347,369	32,305	9.30	32,305	32,305	100.00	54.65
2003	353,542	32,116	9.08	32,116	32,116	100.00	54.54
2004	361,911	31,596	8.73	31,596	31,596	100.00	54.37
2005	367,255	30,063	8.19	30,063	30,063	100.00	54.09

Source: Water and Energy Commission Secretariat, Nepal

16 Energy use and economic welfare are closely intertwined. Historically, Nepal's rural population has been meeting their energy needs from traditional sources like fuel wood, and other biomass resources. Use of modern forms of energy such as electricity, fossil fuel etc., are comparatively new and making them accessible in rural areas is still a great challenge to the Nepalese government.

17 The Nepal Oil Corporation (NOC) – Nepal state owned corporation - and the Indian Oil Corporation (IOC) have bilateral agreements. Nepal exports energy in form of electricity to India.

3.6.2. Domestic Oil Retail Price Mechanism

The prices of petroleum products are fixed by the government through the Nepal Oil Corporation (NOC), a government owned enterprise which has sole authority to import and supply all petroleum products. The NOC distributes petroleum products to the private petroleum dealers and determines their retail prices. To normalise the direct impact of international oil price volatility, government impose a tax and grants subsidies. Table 1.9 shows the price mechanism for petroleum products.

Table 1.9
Expected Retail Selling Price Calculation at Kathmandu
(when at Par with Cost)

	Details of Cost Components	Petrol	Diesel	Kerosene
1.	**NOC EX.DEPOT PRICE (W/O VAT)**	**68,117.13**	**56,482.44**	**55,047.21**
2.	VAT 13%			
3.	SHRINKAGE (0.4%, 0.3% & 0.3% PER KL)	272.47	169.45	165.14
4.	SUB TOTAL 6	68,389.60	56,651.89	55,212.35
5.	TRANSPORTATION LOCAL PER KL	139.71	139.71	139.71
6.	SUB TOTAL 5	68,529.30	56,791.60	55,352.05
7.	INSURANCE (0.15%)	102.79	85.19	83.03
8.	DRUM DEPRECIATION, PER KL	0.00	0.00	163.22
9.	SUB TOTAL 4	68,632.10	56,876.78	55,598.30
10.	DEALERS' COMMISION (3%), PER KL	2,058.96	1,706.30	1,667.95
11.	SUB TOTAL 5	70,691.06	58,583.09	57,266.25
12.	WORKING LOSS 0.15%	106.4	87.87	85.90
13.	EXPECTED SELLING PRICE PER KL	70,797.10	58,670.96	57,352.15
14.	VAT 13%	9,203.62	7,627.22	
15.	EXPECTED SELLING PRICE PER KL	80,000.72	66,298.19	57,352.15
16.	**EXPECTED R.S.P. PER LTR.**	**80.00**	**66.30**	**57.35**
17.	CURRENT OPEN MARKET RETAIL PRICE	67.25	53.00	47.00
	WILL BE HIKED BY (%)	**19.0%**	**25.1%**	**22.0%**

Source: Nepal Oil Corporation - Exchange rate: 1US$=74.9 Rs. (27 August,2006)

In the last four years, the price of petroleum products has increased sharply with price of petroleum increasing by 19.80%, diesel oil by 39.40%, and kerosene by 47.44%. According to the price mechanism in Table 1.9, the increases in the prices of petroleum products were much lower than expected, the difference between expected price and current open market price being the amount of subsidies paid by the government.

3.7. Papua New Guinea

3.7.1. Oil Dependency

Papua New Guinea is the second-largest country in the Oceania or the South Pacific region in terms of population and third in terms of land area[18]. Papua New Guinea is richly endowed with natural resources that includes major gold and copper deposits, large oil and natural gas reserves, and extensive forests and maritime fisheries. Despite these abundant resources, the economy still struggles to achieve sustainable economic

18 The exact scope of Oceania is defined variously, with interpretations including Australia, New Zealand, New Guinea, and various islands of the Malay Archipelago.

growth. Natural resources exploitation has been hampered by the rugged terrain and the high cost of developing infrastructure. Agriculture is the mainstay for the livelihood of 85% of the population. As a result, real GDP growth has mostly been low to moderate since independence in 1975. Only in the 1990s, particularly in the first half of the decade, did the economy experience high real GDP growth which was due to the mineral boom with new mines and the first crude oil production coming into being. Since then, mineral deposits, including oil, copper, and gold, account for nearly two-thirds of export earnings.

The PNG economy is now going into its 5th year of macroeconomic stability and economic recovery, supported by sound economic policies and high export commodity prices. Continued high export commodity prices have significantly strengthened the external position since 2004, which has led to a sharp increase in net foreign assets, while disciplined macroeconomic policies and low interest rates have spurred business confidence, which has led to the increase in private sector credits and net domestic assets since 2005 (IMF, 2007).

As the economy is improving, energy consumption has increased steadily over the years. Demand for petroleum products has increased along with the rise in total energy demand. The demand for petroleum products was met mainly through imports. In 1993, production and export of crude oil commenced, following the successful exploration and subsequent negotiations between foreign investors, the government and the landowners for the Kutubu oil project in the highlands region. As the crude oil is all exported, the economy's dependence on imported refined oil product has continued. However, as a share of total energy consumption, demand for petroleum products declined slowly as the other forms of energy consumption such as hydro electricity and gas increased their share.

In 2004, the situation changed remarkably. A new era dawned in Papua New Guinea when the first oil refinery- the Napa oil refinery- outside of Port Moresby began producing refined oil products from crude oil. Some of the refined products are exported while some go towards meeting the demand in the domestic market. Consequently, the overall oil dependency of the economy declined markedly to around 60 percent in 2005 (see Table 1.10).

Table 1.10
Oil Dependency in Papua New Guinea

Year	Total Energy Consumption 1/	Petroleum Products Consumption 2/		Total Petroleum Supply	Petroleum Import		Oil Dependency
	Thou. TOE	Thou. TOE	%	Thou. TOE	Thou. Bbl	%	%
1980	456	410	89.9	600	NA	100	95.0
1985	562	477	84.9	650	NA	100	92.4
1990	547	448	81.9	655	NA	100	91.0
1995	724	579	80.0	670	NA	100	90.0
2000	949	745	78.5	780	NA	100	89.3
2005	1139	889	78.1	1250	NA	40	59.0

Notes
1/ An estimation is assumed for hydro and gas energy, which is added onto the consumption of petroleum products.
2/ The total consumption of petroleum is obtained by the summation of industries' comsumption of oil products.

Source: Department of Petroleum and Energy's Draft National Energy Policy 2005 & PNG Power Data on forms of energy/electricity generation 2006.

3.7.2. Domestic Oil Retail Price Mechanism

The project agreement signed in 1997 by the government and InterOil Ltd for the latter to build and operate an oil refinery in PNG has embedded in it, a provision for the pricing of fuel products from the refinery. The fuel products are to be sold to domestic distributors at Import Parity Price (IPP). This means that the products would be treated as if they were imported. The IPP is the CIF price (in kina) of importing equivalent products from Singapore. It is calculated monthly based on the previous month's Singapore prices.

Upon becoming operational in mid-2004, the refinery has since supplied all of PNG's requirements for petrol, diesel and kerosene. The Independent Consumer and Competition Commission (ICCC) regulates and monitors the prices of the fuel products ex-Napa to ensure they are consistent with the IPP. This comes under the Petroleum Pricing Review Final Report issued in August 2004. Under the Report, the calculation of the retail prices for fuel product is based on a framework that is effective until 2009. An indicative retail price is announced on the 8th of each month and is arrived at by adding freight charges, taxes and the retailers profit margin to the IPP. Prices may differ across provinces/centres due to differences in freight costs. There is no government subsidy for the prices of petroleum products. In sum, the price mechanism can be expressed as follows:

IPP + Excise Duty + Freight Charge + Retailer's Margin + General Sales Tax (10%) = Retail Price of Petrol, Diesel and Kerosene

3.8. Philippines

3.8.1. Oil Dependency

The recent oil price hike has not influenced the Philippines economy very much because the country has an energy infrastructure in place to adequately deal with oil shocks. When the first oil shock hit the country in 1973, the domestic economy was completely dominated by local affiliates of multinational oil companies which in turn were dependent on their mother companies for crude oil supply. Difficulties in procuring supplies were experienced by these local affiliates such that the country resorted to government-to-government based procurement contracts which were deemed more reliable vis-à-vis the very fluid and volatile commercial oil market. The situation became the basis for the creation of the Philippine National Oil Company which was tasked with the provision and maintenance of an adequate and stable supply of oil and refined petroleum products for domestic use and to promote and engage in oil exploration activities. The sale of an equity position in its subsidiary Petron to the Saudi Aramco Group in 1994 also helped to ensure an adequate supply of crude oil for the local market. The country also was able to broaden its supply base with the establishment of cooperation agreements with oil producing neighbours in ASEAN particularly Indonesia and Malaysia.

The utility of imported oil in Philippine energy consumption has declined significantly from the time of the first oil shock in 1973. At that time, imported oil accounted for 92 percent of total primary energy consumption. By 2005, this had been effectively reduced to 37 percent. This is a good case of how a country has reduced its use of imported oil in power generation and even for transportation. The Philippines serves as a showcase of how to successfully wean power generation off from imported crude oil. As late as 1990, oil-based power plants accounted for 47.2 percent of the power generating mix. By 2005, their contribution to power generation had been reduced to 10.9 percent. Even in transportation, great strides have been made since the 1970s. Currently, almost all rail passengers are transported on electric-powered trains which utilise power from non-oil sources. The recent rise in gasoline prices has encouraged a shift by taxi operators to LPG or CNG powered cabs. More are being retooled as part of a programme by the Department of Energy. Furthermore, legislation on the use of alternative fuels is in the works. Renewable energy initiatives have also been supported by the Department of Energy. With only 20 MW of generating capacity installed, Ilocos Norte's wind energy potential of 2,000 – 3,000 MW remains largely undeveloped while the rest of the country's 74,000 MW wind electricity potential has not even been begun to be tapped.

3.9. Sri Lanka

3.9.1. Oil Dependency

Sri Lanka is a small open developing economy. Since the economic liberalisation in the late 1970s[19], Sri Lanka has experienced an average economic growth of 5 per cent per year. Along with the improving economic activities, the demand for energy has increased rapidly especially in the areas of transportation, electric power generation, industry, and households. The major sources of energy in Sri Lanka are the bio-mass (47 per cent, used mostly by households), petroleum (45 per cent), and hydropower (8 per cent). Sri Lanka imports all of its petroleum requirements. Until the 1990s, Sri Lanka's power system was predominantly based on hydro power. However, due to harnessing of almost all major hydropower sources in the country and also considering the vulnerability to vagaries of weather, the reliance on hydropower has reduced to around 50% of the capacity.

Starting from 1990s, the Sri Lanka government has been introducing measures aimed at diversifying energy sources, liberalisation and improving the efficiency of energy use. Within this policy framework, the government has encouraged private sector participation in the energy sector. Distribution of lubricant oil and LP Gas were privatised in 1990s. Further, the government in 2002, invited the government of India to enter the downstream industry of petroleum in Sri Lanka. In the following year 2003, the government also opened the local retail petroleum market for competition, thus ending the government's monopoly[20] on the distribution of major petroleum products. As the increasing demand for energy is mainly met through petroleum products, the share of petroleum in the total energy supply has been increasing rapidly from 32 per cent in 1996 to around 45 per cent in 2005. Petroleum consumption, which was only 12.4 million barrels in 1995, increased to 27.1 million barrels by 2005. During 1995-2005, petroleum consumption increased by 119 per cent, the largest user being the transportation sector (50 per cent) followed by power generation (25 per cent). Industries and households consumed the remaining 25 per cent.

To meet domestic consumption, Sri Lanka currently imports around 30 million barrels of oil per year, approximately half of which is crude oil imported from Iran, Malaysia, and Saudi Arabia by the Ceylon Petroleum Corporation (CPC), a state owned entity. The balance is imported in refined form by the CPC, Lanka IOC (LIOC), and other private sector companies. Refined petroleum products are imported from Singapore and the Middle East. Due to the increasing demand and the oil price hike, the value of petroleum imports has increased rapidly in the last two years. In 2003, the total expenditure on petroleum imports was USD 838 million, which increased by 44 per cent to USD 1,210 million in 2004. In 2005, it further increased to USD 1,655 million.

19 In 1977, a package of economic reforms was introduced. These reforms included relaxation of exchange control regulations, relaxation of imports control, rationalisation of trade policies, liberalisation of the financial sector, gradual disengagement of the government from direct investment in commercial activities, encouragement of private sector investment (both local and foreign) and setting up free trade zones

20 Oil supply, distribution, and imports were brought under government monopoly by creating the Ceylon Petroleum Corporation (CPC) in 1961.

Oil dependency in Sri Lanka is shown in Table 1.11 below.

Table 1.11
Oil Dependency in Sri Lanka

Year	Total Energy Consumption	Petroleum Products Consumption		Total Petroleum Supply	Petroleum Import		Oil Dependency
	Mn barrels	Mn barrels per year	%			%	%
1995	40.69	12.40	30.47	-	17.44	-	30.47
1996	41.80	15.20	36.36	-	19.24	-	36.36
1997	45.59	16.65	36.52	-	19.95	-	36.52
1998	46.23	17.66	38.20	-	20.50	-	38.20
1999	47.43	19.12	40.31	-	19.51	-	40.31
2000	53.02	22.90	43.19	-	24.38	-	43.19
2001	52.31	22.91	43.80	-	25.51	-	43.80
2002	53.14	22.83	42.96	-	27.38	-	42.96
2003	52.91	21.93	41.45	-	23.84	-	41.45
2004	52.38	27.33	52.18	-	28.97	-	52.18
2005	52.19	27.13	51.98	-	29.06	-	51.98

Source: Ceylon Petroleum Corporation
Lanka IOC Ltd
National Energy Conservation Fund

3.9.2. Domestic Oil Retail Price Mechanism

A petroleum pricing formula was introduced in 2002. The Minister in charge of Petroleum was empowered to decide the domestic prices of petroleum products in consultation with the Minister of Finance prior to the introduction of a pricing formula in January 2002. The main objective of the pricing formula was to pass any benefit or cost arising from the changes in the cost of petroleum products to consumers in a transparent way and maintain commercial viability of the petroleum sector. According to the new system, price adjustments were to be implemented monthly, based on the average international prices of the previous month and other cost components. However, domestic prices have not been adjusted strictly according to the formula when the required adjustments were excessive during sharp rises in international prices from February 2004. However, the government decided in June 2006 to allow CPC and LIOC to determine their retail prices in commercial terms from July 2006.

As international oil prices had increased sharply in 2004 and 2005, domestic prices should also have been adjusted accordingly. However, these adjustments have not taken place as scheduled on a monthly basis since 2004. This caused severe losses for CPC and LIOC, requiring the government to intervene with heavy subsidies. Total subsidy obligations of the government was Rs 17.5 billion in 2004 and Rs 26 billion in 2005. (RS 9.4 billion for January - June 2006). The delays and inadequate adjustments in prices led to a continued increase in domestic consumption of petroleum products, raising the losses incurred by the oil distributors which led to both the increase in the subsidy payments by the government and deterioration in the Balance of Payments (BOP).

3.10. Taiwan

3.10.1. Oil Dependency

Like most developed economies in Asia, Taiwan's domestic economy continued to perform impressively. After the financial crisis in 1998 and the SARs episode in 2003, Taiwan's economy has been improving supported by the steady strengthening of the global economic recovery. The rapid economic development of Taiwan from 1984 to 2004 has created substantial changes in the economic structure. Agriculture dropped from 7% to 2% of the GDP, industry dropped from 43% to 21% while services rose from 50% to 77%. GDP rose from USD 60.4 billion to USD 322.2 billion, per capita GNP increased from USD 3,233 to USD 14,770 and foreign trade increased from USD 52.6 billion to USD 351.1 billion.

As Taiwan's economy grew, demand for energy increased sharply. Energy consumption in Taiwan increased from 29.58 million kiloliters of oil equivalent in 1980 to 107.94 million kiloliters of oil equivalent in 2005. The average annual energy consumption growth rate during this period was 5.3%, while the average annual economic growth rate was 6.4%. Energy demand elasticity was 0.83 while per capita energy consumption increased from 1,677 liters of oil equivalent in 1980 to 4,770 liters of oil equivalent in 2005, with an annual average growth rate of 4.3%.

Taiwan is a densely populated island with only limited natural resources. Most of the energy demand in Taiwan is met by importing energy from overseas. Imported energy increased from 86 percent in 1980 to 98 percent in 2005. Prior to 1966, coal was the main energy source in Taiwan but since 1967, it has been replaced by oil as the major energy source[21].

To maintain the supply of petroleum products, the government established the Chinese Petroleum Corporation (CPC), a state-run company charged with the responsibilities of exploring, producing, importing, refining, and marketing petroleum and natural gas in Taiwan. The CPC operates three oil refineries with a total refining capacity of 770,000 barrels per day. In addition, the private Formosa Petroleum Corporation (FPCC) operates an oil refinery with a refining capacity of 450,000 barrels per day. Taiwan's total refining capacity has reached 1,220,000 barrels per day, exceeding the local demand for petroleum products. The CPC and FPCC export their surplus oil for adjustments in the market. Taiwan imports crude oil mostly from the Middle East (83% in 2005) to supply its refineries. The remaining 17 percent comes from other sources.

Oil dependency in Taiwan is shown in Table 1.12.

Table 1.12
Oil Dependency in Taiwan

Year	Total Energy Consumption	Petroleum Products Consumption		Total Petroleum Supply	Petroleum Import		Oil Dependency
	Unit	Unit	%	Unit	Unit	%	%
1995	66,630.4	28,975.2	43	43,251	43,188.4	100	71.67
1996	70,019.6	30,286.0	43	44,518	44,457.7	100	71.56
1997	73,649.5	30,941.1	42	45,254	45,203.5	100	70.95
1998	77,190.7	31,634.8	41	47,483	47,429.3	100	70.43
1999	81,875.9	33,533.8	41	50,923	50,876.0	100	70.43
2000	87,269.5	34,020.2	39	53,499	53,461.7	100	69.46
2001	91,281.0	36,697.2	40	54,668	54,627.6	100	70.06
2002	96,608.5	39,249.6	41	55,771	55,719.8	100	70.27
2003	96,728.0	40,292.1	40	61,526	61,479.7	100	70.16
2004	104,735.9	42,188.4	40	68,416	68,371.5	100	70.11
2005	107,941.7	43,072.5	40	69,449	69,416.5	100	69.93

Source: Bureau of Energy, Ministry of Economics Affairs, Taiwan

21 Since the second oil crisis, the Taiwan government has advocated the substitution of coal and nuclear energy for oil. Nuclear power supply increased from 5.9% in 1980 to 7.3% in 2005.

3.10.2. Domestic Oil Retail Price Mechanism

Liberalisation in the petroleum product market in Taiwan started in 1987, when the government allowed the establishment of privately operated gas stations for the marketing of gasoline and diesel oil. Since then, competition in the petroleum market has become more intense[22]. The market was further opened up in January 1999 to allow imports of fuel oil, jet fuel, and LPG. In the next step, in June 2001, the government dropped the regulation on gasoline and diesel oil wholesale businesses. In the October 2001, the Petroleum Administration Law was promulgated and all petroleum product imports were deregulated at the end of December 2001.

In line with the liberalisation of Taiwan's petroleum product market, the prices of petroleum products have been determined by supply and demand in the market since September 2000. Instead of subsidies, the government impose a tax on petroleum products, in order to increase tax revenues as well as to stabilise energy supply, conserve energy, increase energy efficiency and reduce greenhouse gas emissions. To simplify taxation, the government is promoting an energy taxation reform to integrate excise taxes on petroleum products and gas, air pollution control fees, soil and ground water pollution remediation fees, and the petroleum fund into energy tax.

4. Impact of Oil Price Shock on the SEACEN Economies

It is quite obvious that increasing oil prices will affect the real economy since almost all economic activities depend on the availability of energy in which oil is one of the main energy resource. The increasing oil price (first round) will directly cause higher inflation because oil is one of the commodities included in the computation of inflation. Moreover, since oil is used as an energy source in manufacturing industries, increasing oil prices will also cause the prices of other commodities to rise (second round). In sum, in the short run, increasing oil prices will cause higher inflation and slow economic activities down.

Although it is apparent that oil price shocks will decelerate economic growth, the size of the impact on growth will depend on many factors. These factors include the size and the persistence of the shock, the dependency of the economy on oil and energy including oil import dependency, and the policy responses of monetary authorities (Roubini, 2004) as well as energy/fuel pricing policy of the government.

The size of the shock can be seen in terms of the new oil price and in the percentage increase in oil prices. From this perspective, the oil price at the time of this study (US$ 77 on August 11, 2006) can be considered as very high - well above the levels during the first oil price shock of US$ 43. However, it remains well below the peak real oil price of US$ 82 in 1980. The recent 208% increase in oil prices (compared to the 2002 average price) is much bigger than the increases in 1973 (210%) and 1979-1980 (135%).

The persistence of the shock, on the other hand, will depend on many things, as much as political as economical since the current high oil price reflects both booming Asian demand and geopolitical risks in the Middle East (the "fear" "premium" is estimated to add between US$ 4 and US$ 8 to current prices).

With regard to the dependency of the economy on oil and energy, most developed countries, i.e., U.S., Euro Area, Japan, and Korea, are now much less energy intensive than it was in the 1970s. The first oil crises at the beginning of 1970's had led most industrial countries

22 At the end of June 2006, there were 2,549 gas stations in Taiwan. Of this total, 669 were owned by the state-run CPC, 1,206 were owned by private investors with the oil supply from the CPC, while 674 were also privately run with the oil supply from the FPCC.

to implement oil policies to increase the efficiency of oil use and to utilise other energy resources. As a result, these countries have been successful in their energy diversification policies and are now less oil dependent and therefore, will not experience a major impact from the current increase in oil prices. On the other hand, oil dependent countries will suffer an economic downturn as a result of increasing oil prices.

The oil price shock may also dampen the economy through monetary policy responses. Realising that oil price shocks may lead to higher inflation, monetary authorities will increase its operational target rate and through the transmission mechanism of monetary policy, will affect the real economy as reflected in GDP.

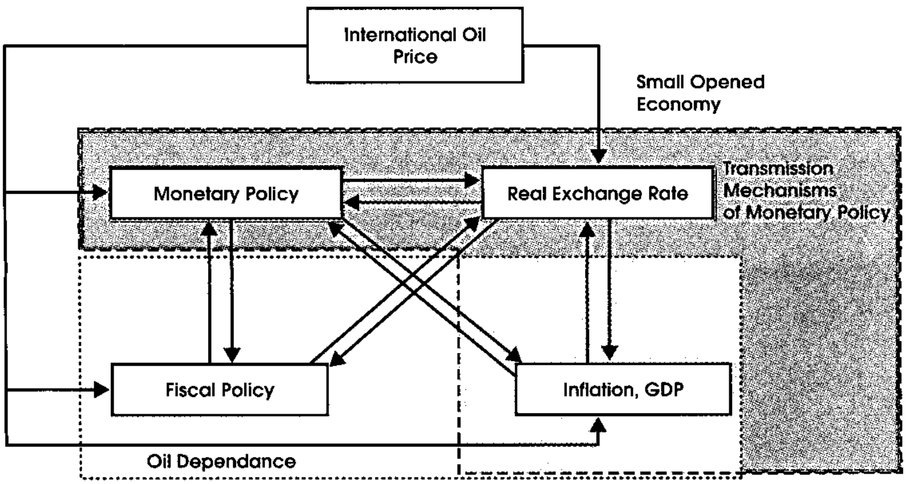
4.1. Measuring the Impact

4.1.1. Methodology

To analyse the size of the impact of increasing oil prices on the real economy, this study will look at two factors: oil dependency of the economy and the size of the subsidy paid by government to stabilise prices. Our hypothesis is that the higher the subsidy granted by the government to maintain domestic oil price, the lower the impact of oil price shock on the real economy.

Channels through which oil price shocks might affect real output will be simplified as seen in Figure 1.2. To represent the entire economy, we use four variables, namely, monetary policy interest rate, real equilibrium exchange rate, fiscal revenue, and GDP. While these four variables are endogenous, we assume that the economy is small and open and hence oil price is exogenous.

Figure 1.2
Logical Framework
Impact and Policy Responses to Oil Shock



Analysis of the impact of an oil price shock and the role of monetary policy responses in generating recessions have largely been based on empirical vector auto regression (VARs) models. These studies employ VARs models as it can explain each variable's response to the oil price shock through the use of the Impulse Response Function. Furthermore, through the use of variance decomposition, it can calculate the impact magnitude contributed by each variable on the other variable. It means that through the model, it is possible to examine the economy's response to an oil price shock and to quantify the relative importance of both the oil price shock and monetary policy as contributing factors to recessionary episodes.

Like other analyses, this study will apply the same approach. However, in this study, we will impose some restrictions on the model based on theoretical grounds or by a priory. Following the logical framework, this model (a structural VARs Model) includes the GDP, government revenue, real exchange rate, and operational target rate of monetary authority as endogenous variables while the international oil price is an exogenous variable.

The model has the following structure:

$$A_0Y_t = C + A_1Y_{t-1} + A_2Y_{t-2} + \ldots + A_qY_{t-q} + S\varepsilon_t \qquad (1)$$
$$E(\varepsilon_t\varepsilon_t') = I$$

Where Y_t is a (5) - dimensional vector of variables of GDP, government revenue, real exchange rate, operational target rate of monetary authority and oil price. A_0 is a (5x5) dimensional matrix with contemporaneous coefficients, C is a (5) - dimensional vector of constants and $A_1 \ldots A_q$ are (5x5) dimensional autoregressive coefficient matrices. ε_t is a vector of pair wise uncorrelated structural innovations with unit variance. E $(\varepsilon_t\varepsilon_t')$ is the variance-covariance matrix of structural innovations which is equal to the identify matrix. S is a (5x5) matrix that specifies the extent to which variables are directly affected by structural shocks.

The coefficients of the structural and reduced forms are related as follows:

$$B_i = A_0^{-1}A_i,\ i = 1\ldots.q$$
$$B_0 = A_0^{-1}\,C \qquad (2)$$
$$A_0^{-1}\,S\varepsilon_t = u_t$$
$$V = A_0^{-1}SIS'(A_0^{-1})'$$

Respectively:

$$A_i = A_0B_i,\ i = 1\ldots.q$$
$$C = A_0B_0 \qquad (3)$$
$$S^{-1}\,A_0\,u_t = \varepsilon_t$$

If all eigenvalues of B(L) lie inside the unit circle, the Moving Average (∞) representation is given by:

$$Y_t = B(L)^{-1}\,B_0 + B(L)^{-1}\,A_0^{-1}SS^{-1}A_0u_t \qquad (4)$$
$$= \mu + \Phi(L)\,\varepsilon_t$$

Consequently, the impulse response functions can be derived from the following relationship:

$$\frac{\partial Y_{t+s}}{\partial \varepsilon_t'} = \Psi_s A_0^{-1} S = \Phi_s \qquad (5)$$

We define $\varphi_{i,j}(s)$ as the row i, column j element of Φs. The coefficient $\varphi_{i,j}(s)$ is termed the impact multiplier and quantifies the consequences of a one unit increase in the error term $\varepsilon_{j,t}$ of variable Y_t for the value of $Y_{i,t+s}$. All other innovations are held constant and $\varphi_{i,j}(s)$ is a function of s termed the impulse response function. The sum:

$$\sum_{s=0}^{S} = \varphi_{i,j}(s) \qquad (6)$$

reflects the effect of a one-unit shock in $\varepsilon_{j,t}$ on Y_i up to time t+s. As a function of S, this sum is known as the cumulative impulse response function. For S → ∞ the sum is finite since Y_i is assumed to be stationary.

In terms of the lag-polynomial $\Phi(L) = 1 + \Phi_1 L + \Phi_2 L^2 + \ldots$ we can write:

$$\sum_{s=0}^{S} = \varphi_{i,j}(s) = \Phi(L)_{i,j} \qquad (7)$$

Where $\Phi(L)_{i,j}$ denotes the row i, column j element of $\Phi(L) = 1 + \Phi_1 + \Phi_2 + \ldots$ E.g., if $\Phi(L)_{i,j}$ is restricted to 0, then the overall impact of shock j on variable i is zero.

4.1.2. Data

Considering the availability of data in investigating the impact of an oil price shock on the economy, this study only includes four country cases of Korea, Taiwan, Malaysia, and Indonesia. Tables 1.13 summarises the data used for each country.

Table 1.13
Variable Used in the Study

Country	State of economy	Notation	Information	Sample Range
Korea	Economic growth	IPG	Industrial Production Growth	1976:M08-2006:M05
	Oil Price Volatility	OILPG	Producer Price Index for Coke and Petroleum	1976:M08-2006:M05
	Inflation	INFL	CPI Inflation	1976:M08-2006:M05
	Monetary Policy	MPR	Call Rate	1976:M08-2006:M05
Taiwan	Economic growth	DLGDP	Real GDP Growth, in logarithm	1995:Q2-2005:Q4
	Inflation	INFL	CPI Inflation	1995:Q2-2005:Q4
	Oil Price Volatility	DLPOIL	International Oil Price Growth, in logarithm	1995:Q2-2005:Q4
	Exchange Rate	LEXR	Exchange Rate, in logarithm	1995:Q2-2005:Q4
	Monetary Policy	LMPR	Central's Bank Repo Rate, in logarithm	1995:Q2-2005:Q4
Malaysia	Economic growth	DLDGP	Real GDP Growth, in logarithm	1995:Q2-2005:Q4
	Inflation	DINFL	CPI Inflation growth	1995:Q2-2005:Q4
	Oil Price Volatility	DLPOIL	International Oil Price Growth, in logarithm	1995:Q2-2005:Q4
	Exchange Rate	DGREV	Government Revenue Growth	1995:Q2-2005:Q4
	Monetary Policy	DLMPR	Central's Bank Policy Rate Growth, in logarithm	1995:Q2-2005:Q4
Indonesia	Economic growth	DLRGDP	Real GDP Growth, in logarithm	1996:Q2-2005:Q4
	Inflation	DINFL	CPI Inflation Growth	1996:Q2-2005:Q4
	Oil Price Volatility	DLPOIL	International Oil Price Growth, in logarithm	1996:Q2-2005:Q4
	Exchange Rate	DEXR	Exchange Rate Growth	1996:Q2-2005:Q4
	Monetary Policy	DLMPR	SBI Rate Growth, in logarithm	1996:Q2-2005:Q4

Basically, the variables used represents the state of economy, i.e., the economic growth (GDP), the volatility of oil price (International Oil Price (POIL)) and other variables considered as having significant effects on the state of economy, i.e., exchange rate (EXR) and monetary policy rate (MPR). Considering that the nature of economy and data available in each country are different, the impact of an oil price shock in each SEACEN country is analysed by using different variables and time coverage.

All data is quarterly from 1996:2 – 2005:4 except for Korea for which monthly data is used from 1976:08 - 2006:06. Benefiting from the long data series of Korea, this study investigates whether there was a structural change in the Korean Economy, and how this structural change is related to the impact of the oil price shock.

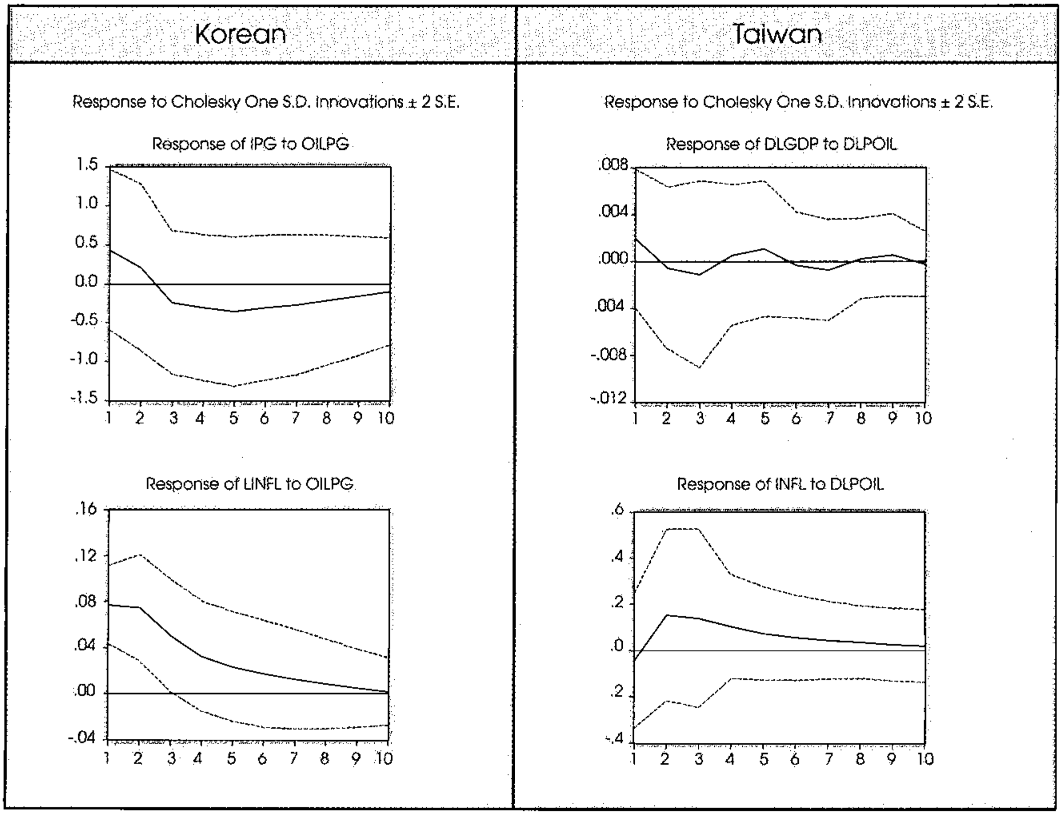
4.1.3. Empirical Results

Some of the important findings can be summarised as follows. First, the impact of the recent oil price shock is not large and symmetric across the SEACEN countries. Some of the SEACEN countries experienced only a limited disruption during and after the shock. On the other hand, some countries benefited as government revenue increased and further improved economic growth. Second, structural changes have taken place in each country that lessened the impact of the recent oil price shock compared to the first oil price shock.

4.1.3.1. Limited and asymmetric impact of oil price shock

Korea and Taiwan are not oil producing countries and the first oil price shock affected their respective economies tremendously. However, the impact of the recent oil price shock, as shown by the impulse response function results below, has not been significant. The impact on the Korean Economy as represented by the response of industrial growth and inflation to one standard deviation innovation of oil were only limited and short. Industrial growth decreased by around 1.2 SD and after 6 months, it bounced back and reached its normal condition only by 20 months. Inflation was affected by the oil price shock only for two months

Figure 1.3
Impact of Oil Price Shock on the Economies of Korean and Taiwan



where it increased by 2 SD and since then, it started to decrease and reached the previous inflation level in 20 months.

Taiwan experienced a limited and short impact from the oil price shock. As shown by the impulse response function results below, one SD oil price shock caused the GDP growth of Taiwan to decrease slightly by 0.04 SD with almost no effect at all. On the other hand, inflation increased almost 2 SD but went back to normal in 10 quarters.

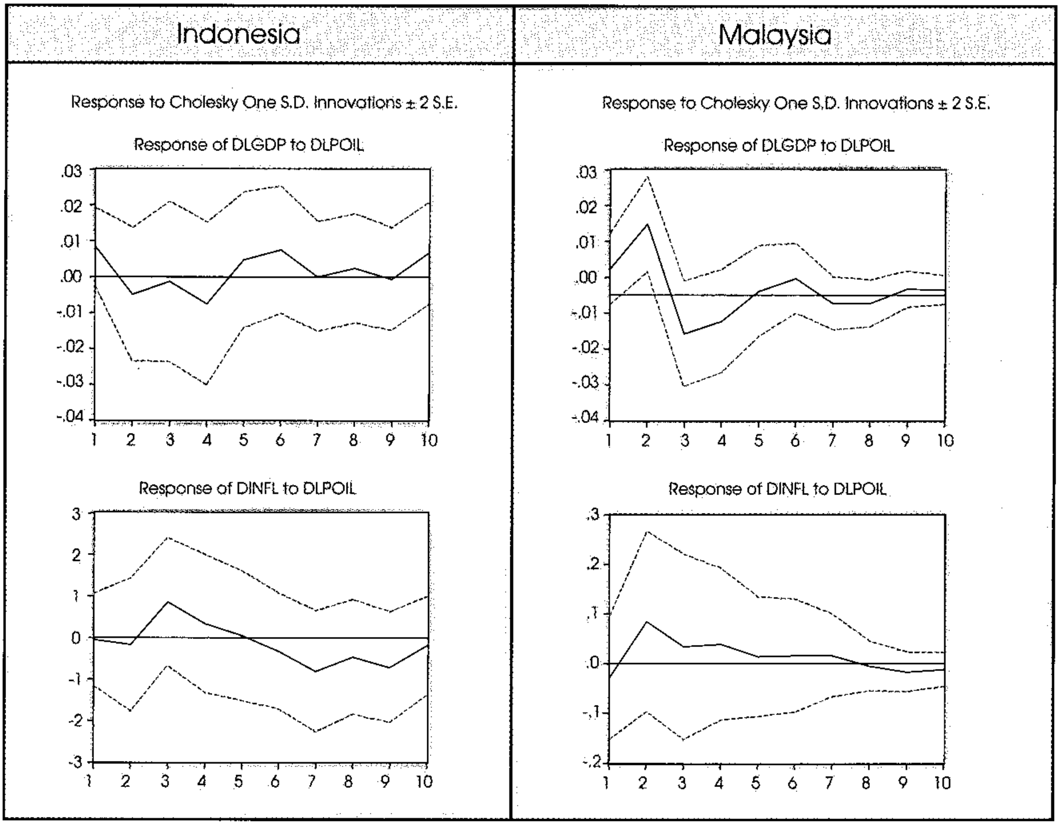
Although Indonesia and Malaysia are both oil producing countries, the impact of the oil price shock in these 2 countries were not the same. Fuel prices have a significant contribution to inflation in Indonesia as every 10% increase in fuel prices (premium, diesel, and kerosene) will contribute 3.74% to inflation. Considering this important role of fuel prices, the Indonesian government had for a long time subsidised fuel prices. However, the situation changed considerably when Indonesia became a net oil importer. Due to the sharp hike in global oil prices in the recent years, the budgetary requirements for oil subsidies has increased substantially and has added pressure on fiscal sustainability. In this situation, the government decided to raise domestic fuel prices in March and October 2005, in order to lower the pressure on the fiscal side, resulting in a marked increase in inflation by the end of 2005.

This higher fuel prices, as predicted, hampered economic growth and as shown by Figure 1.4, a one SD innovation in international oil price decreased GDP growth by 0.2 SD. The Indonesian economy recovered after 4 quarters. Along with the slowdown in the economy, inflation increased by 1 SD in the 3rd quarter but returned to normal after 5 quarters.

Malaysia, on the other hand, benefited from the oil price shock with higher economic growth in the first quarter, before it decreased and returned to normal in 5 quarters. As a net oil exporter, the rise in oil prices increased oil revenue. Government revenue doubled during the recent oil price hike from 2.3% of GDP in 2000 to 4.5% of GDP in 2006. The accelerated economic growth to some extent, was attributable to this increased government revenue.

In contrast to the impact on economic growth, the oil price shock also caused slightly higher inflation albeit not significantly. In the first quarter after the shock, inflation increased slightly by around 0.1 SD and returned to its normal level in 5 quarters. To illustrate the impact of the oil price shock on inflation in Malaysia, we can take two increases in prices of retail petrol, diesel and petrol products in 2005 (May and August) that led petrol prices to increase from RM1.42 to RM1.62 per litre, a total of about 14% increase in prices. These increases contributed approximately 0.39 percentage points to the inflation rate for the year. In February 2006, another removal of the subsidy led to an increase of 18% in retail petrol price to RM1.92 per litre. Consequently, the inflation rate increased to 4.8% in March and 4.6% in April 2006, as the higher fuel price was translated to higher transportation costs. Although there were concerns that the increase in domestic oil prices in 2005 and 2006 would cascade down to the prices of other goods, the subsequent outturn for inflation was moderate. This could be attributable to several factors, including the increase in labour productivity and the intensification of competition amongst producers and from imports which may have contained the secondary effects of higher oil prices.

Figure 1.4
Impact of Oil Price Shock on the Economies of Indonesia and Malaysia



The impulse response function from the SVAR model as described above, have shown how the oil price shock affected the economies in selected SEACEN countries. However, neither the historical perspective nor how much the oil price shock has impacted cyclical fluctuations on economic growth and inflation have been analysed. Table 1.14 summarises the changes that can be explained by an oil price innovation for GDP growth in the selected SEACEN countries. The variance decomposition results in Table 1.14 provide evidence that the variation in GDP growth that is attributable to the innovation in the oil price over the last ten years, is small and a large part of the variation in GDP growth is mostly attributable to its own innovation, and to other shocks such as exchange rate, inflation, and monetary policy shocks.

Table 1.14
Variance Decomposition of Output
in Selected SEACEN Countires

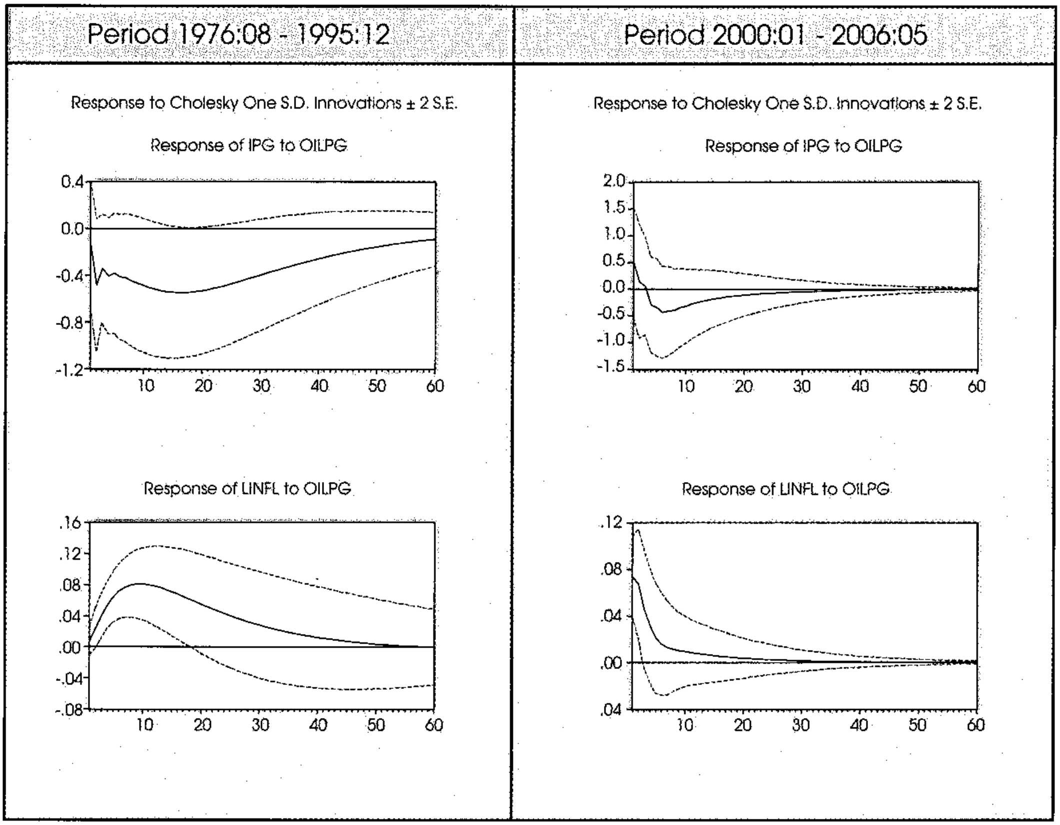
Country	Period	Variance Decomposition of Ouput			
		POIL	EXR	MPR	INFL
Korea	1	1.16	6.04	22.78	-
	2	1.16	7.67	21.90	-
	3	0.95	13.33	20.64	-
	4	1.19	16.16	19.51	-
	5	1.48	19.33	18.46	-
Taiwan	1	1.03	0.50	0.01	5.55
	2	0.99	8.08	3.38	5.17
	3	0.87	6.99	2.73	3.47
	4	0.84	13.29	2.81	4.08
	5	0.87	11.39	2.44	4.06
Malaysia	1	5.04	6.61	0.86	15.52
	2	25.93	13.06	1.86	10.86
	3	27.90	13.80	1.91	9.58
	4	28.31	14.72	4.57	9.09
	5	27.51	14.44	5.17	8.82
Indonesia	1	2.77	18.47	17.12	3.38
	2	1.83	16.60	12.48	10.92
	3	1.57	11.39	26.27	21.24
	4	1.61	11.89	24.71	20.35
	5	3.09	12.47	25.51	19.06

4.1.3.2. Structural changes lower the impact of oil price shock

As described in Subsection 3 above, oil dependency in some countries has been decreasing, which to some extent, is due to the structural changes of the economies, making them more resilient to the recent oil price shocks. The structural change in Korea has reduced the impact of the oil price shock on its economy. Figure 1.5 compares the response of the Korean economy, for both industrial production growth and inflation, to the oil price shocks for the periods of the first and second shocks (1976-1995) and the recent shock (2000-2006).

In the period of the first and second shocks (1976-1996), the rise in the oil price was immediately followed by decreasing industrial production growth. The negative impact of the oil price shock remained for 5 years. In the meantime, inflation skyrocketed in the first 10 months and took more than 3 years to return to normal levels. In contrast, during the recent oil price hike, the Korean economy seemed little affected. Indeed, while the oil price shock caused industrial production to decrease and inflation to increase, it took less than one year for the economy to recover. These differences in the impact of the shocks implies that there has been a structural change in the Korean economy.

Figure 1.5
Impact of Oil Price Shocks on the Korean Economy



4.2. Monetary Policy Responses to Oil Price Shock

4.2.1. Methodology and Data

This study computes the endogeneity of monetary policy by measuring the difference between the total effect of the exogenous non-policy shocks on the system variables with the estimated effect when the policy response is shut down. More specifically, steps of analysing the endogeneity of monetary policy of an oil price shock are as follows:

- Baseline scenario: shows impulse response of a 1 SD innovation in the nominal price of oil in the all variable system. This is intended to show the effects on the economy of an oil price shock, including the endogenous response of monetary policy.

- No monetary policy response scenario: set monetary policy rates at its baseline level (the value it would have taken in the absence of an oil price shock) and then put restrictions on shut down monetary policy response. Having an impulse response of a 1 SD innovation in the nominal price of oil in all variable system, we can see the effects on the economy of an oil price shock, excluding the response of monetary policy.

4.2.2. Empirical Results

The variance decomposition results in Table 1.15 show how monetary policy responded to the innovation of oil price. As the response was very limited, the variation in monetary policy can be mostly explained by its own innovation, and by other shocks such as exchange rate and inflation. This finding shows that the monetary policy indicator to some extent, is endogenous to an oil price hike. However, such a response only generates a small portion of the output movement due to oil price shocks (see Table 1.14). This result confirms the findings of Bernanke, et al (1997), Sims and Zha (1998) which state that erratic and unpredictable fluctuations in monetary policies are not a primary cause of the business cycle. The result also agrees with Hamilton and Herrara (2000) - that even aggressive monetary policies responses to oil price hikes would not have succeeded in averting a downturn of the economy.

Table 1.15
Variance Decomposition Monetary Policy Response
in Selected SEACEN Countries

Country	Period	Variance Decomposition of Monetary Policy Rate			
		POIL	EXR	INFL	GDP
Korea	1	0.38	-	0.32	0.00
	2	0.66	-	0.15	0.26
	3	0.41	-	1.26	0.76
	4	1.02	-	5.17	0.94
	5	2.90	-	10.48	1.14
Taiwan	1	6.28	25.89	0.00	0.00
	2	8.15	21.62	1.00	0.89
	3	9.21	18.44	3.55	2.20
	4	10.13	16.84	6.92	2.14
	5	10.70	16.76	9.84	1.75
Malaysia	1	0.00	1.88	0.00	0.00
	2	2.70	2.61	13.24	0.20
	3	14.27	2.45	10.87	2.89
	4	13.18	2.18	15.74	3.42
	5	12.49	2.28	19.77	4.11
Indonesia	1	5.81	3.32	0.00	0.00
	2	10.86	10.99	4.52	0.13
	3	13.92	28.19	8.49	0.12
	4	13.76	26.18	14.48	0.12
	5	0.38	-	0.32	0.00

Following the approach of Sims and Zha (1998), by setting monetary policy rates at its baseline level (the value it would have taken in the absence of an oil price shock) and shutting down the endogenous monetary response, we would have the effects of an oil price shock on the economy, excluding the response of monetary policy. Figure 1.6 shows the differences of the impact of an oil price shock to the economy with and without monetary policy responses.

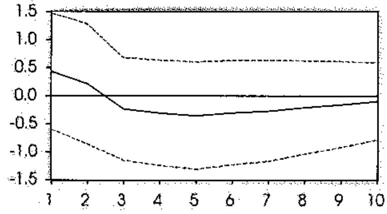
The Figures illustrate that there are no significant differences between GDP growth with and without monetary policy response, thus confirming that monetary policy response, as reflected in changes in the monetary policy rate, does not have a significant contribution to economic growth.

Figure 1.6
Impact of Oil Price Shock on GDP Growth
With and Without Monetary Policy Responses

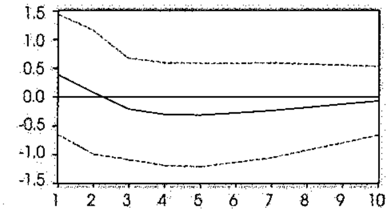
Country	With Monetary Policy Responses	Without Monetary Policy Responses

Korea

Response of IPG to Cholesky One S.D. OILPG Innovation

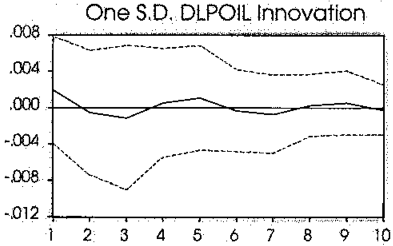


Response of IPG to Cholesky One S.D. OILPG Innovation

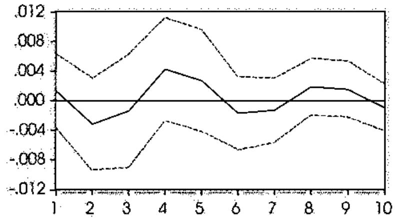


Taiwan

Response of DLGDP to Cholesky One S.D. DLPOIL Innovation

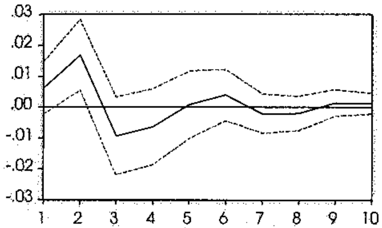


Response of DLGDP to Cholesky One S.D. DLPOIL Innovation

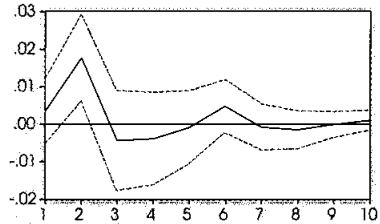


Malaysia

Response of DLGDP to Cholesky One S.D. DLPOIL Innovation

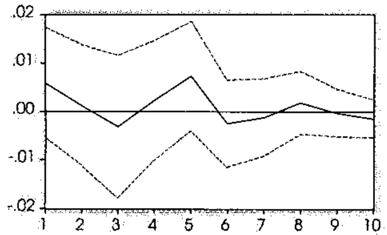


Response of DLGDP to Cholesky One S.D. DLPOIL Innovation

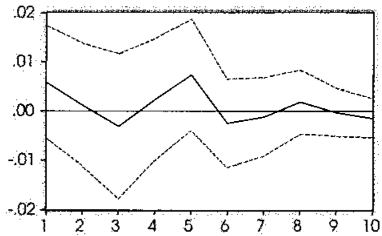


Indonesia

Response of DLGDP to Cholesky One S.D. DLPOIL Innovation



Response of DLGDP to Cholesky One S.D. DLPOIL Innovation



5. Factors Causing the Asymmetric Impact of Oil Price Shock

5.1. Methodology

According to the logical framework described above, the impact of an oil price shock on the real economy will be asymmetric across countries due to the differences in oil dependency and government spending (subsidy) to stabilise domestic oil price. To prove this hypothesis, this study constructs a panel data model as follows:

$$DLGDP_{i,t} = \alpha - \beta_0 DLPOIL_{i,t} + \beta_1 D^1_{i,t} * DLPOIL_{i,t} + \beta_2 D^2_{i,t} * DLPOIL_{i,t} + \beta_3 DLGDP_{i,t} + \beta_4 DLINFL_{i,t} + \beta_5 DLEXR_{i,t} + \beta_5 DLMPR_{i,t} + \varepsilon_{i,t} \quad (8)$$

where i is denotes countries and t is denotes time. The i subscripts, denote the cross-section dimension whereas t denotes the time series dimension. D^1 is the dummy variable for oil dependence. D^2 is the dummy variable for government spending (subsidy) to stabilise domestic oil price.

If $\beta_1 \neq 0$ and $\beta_2 \neq 0$, we can conclude that government policy to grant subsidies on oil and oil vulnerability have a significant role in absorbing the impact of oil price shock on the real economy. On the other hand, if $\beta_1 = 0$ and $\beta_2 = 0$, it means these two factors do not have any relationship with the asymmetric effect of an oil price shock.

5.2. Empirical Results

The following are the results of the panel of the four selected SEACEN countries of. Korea, Taiwan, Malaysia, and Indonesia.

$$\begin{aligned} \mathbf{DLGDP} = {} & 0.010990 + 0.045202\ \mathbf{DLPOIL\ (-1)} + 0.000932\ \mathbf{DUM1*DLPOIL} \\ & \qquad\qquad (2.788289) \qquad\qquad (2.250324) \\ & - 0.036182\ \mathbf{DUM2*DLPOIL} + 0.197931\ \mathbf{DLGDP\ (-1)} \\ & \qquad (-1.040653) \qquad\qquad (2.359859) \\ & - 0.073063\ \mathbf{DLEXR\ (-1)} + 0.003551\ \mathbf{DLMPR\ (-4)} \\ & \qquad (-2.659554) \qquad\qquad (0.176510) \end{aligned} \quad (9)$$

Adjusted R2 = 0.100852

Since the main purpose of this study is to investigate the role of oil dependency and oil subsidies, the model used here pools all the data and an ordinary least squares regression model (pooled regression model) is estimated. The results show that the t-statistics for Dummy 1 is statistically significant meaning that we can reject the null hypothesis and conclude that oil independency does have a significant role in absorbing the impact of oil price shock on the real economy. On the other hand, the t-statistics for Dummy 2 is statistically insignificant, meaning that we accept the null hypothesis and conclude that oil subsidies do not have any relationship with the asymmetric effect of an oil price shock. Variables that have significant effects on GDP growth is oil price, one lag GDP growth, and exchange rate while monetary policy does not have any impact.

The results with regard to the role of oil dependency verify that the structure of the economy in some countries has changed, reflecting the successful diversification of their energy resources, making them less vulnerable to the shortage of oil.

6. Conclusion

Oil prices have increased significantly over the last four years, starting from 2002. While decreasing slightly after hitting the highest level in August 2006, it nonetheless, is still at a relatively high level. Factors causing the previous increase and recent hikes are different in that the recent increase is caused mainly by distortions in both supply and demand. While oil demand has been increasing rapidly, world oil production seemed to have stagnated. This situation is worsened by lower oil inventories in the industrial countries and transportation bottlenecks for both crude and refined oil products and by geopolitical factors and natural disasters. Considering these phenomenon, the high oil price is perceived to be persistent for the intermediate future.

Even though the scale of current oil price developments is comparable to its predecessor in real terms, the impact on economy, however, is not the same. During the recent oil price shock, most countries did not experience any significant downturn in their economies. Empirical results show that the impact is not large and symmetric across the selected SEACEN countries, with some experiencing only a limited disruption during and after the shock, while others actually benefited as government revenue increased and further improved their economies.

There are some plausible explanations for the limited and asymmetric impact of the oil price shock on the SEACEN economies. One factor is the change in the structure of the economy. Oil dependency in countries such as Korea, Taiwan, and Papua New Guinea has been decreasing gradually in the last ten years, while in others, it has remained the same or worsened. In the case of Korea and Taiwan, results confirm that the industrial countries are now much less dependent on oil than it was in the 1970s, meaning their energy policies have succeeded in increasing the efficiency of oil usage.

Considering that some countries have very limited natural resources, the respective governments have emphasised the delivery of a safe supply of energy by imposing energy policies persistently. The general objectives of these energy policies can be summarised as follows:

- To maintain a stable energy supply by increasing oil stocks and raising emergency preparedness;
- To expand the energy infrastructure in a timely manner through other resources such as coal, LNG, and nuclear; and promote energy co-operation with other countries;
- To strengthen market mechanisms by privatising public utilities;
- To establish environment-friendly energy systems by reforming the tax system, inducing the use of low-polluting energy, encouraging energy-efficient technologies and developing new and renewable energy sources.

While the decrease in oil dependency significantly reduces the impact of oil price shock on the economy, empirical results show that oil subsidy policies cannot absorb the impact continually. In some countries such as Indonesia and Thailand, the prolonged oil price hike has increased the subsidy burden on government budgets. The Indonesian government has tried to lighten the subsidy burden by significant reductions in government oil subsidies in several stages which resulted in the rapid increase in inflation and slow down in economy growth.

With regard to monetary policy, empirical results show that the monetary policy indicator to some extent, is endogenous to an oil price hike. Aggressive monetary polices in response to oil price hikes would not succeed in averting a downturn of the economy[23].

Considering the limited role of monetary policies on economic growth in anticipating an oil price shock, monetary authorities should focus their policies on the second round effect rather than on the first round effect of a shock. Since domestic oil price in most countries are determined directly by the international oil market, the first round effect of a hike on inflation is quite small, while on the other hand, the second round effect of that same oil price hike could be higher that anticipated.

23 Although the methodology and findings are highly useful, some concerns should be addressed including the instability of the results and difficulty of identifying the variables that can represent monetary policy stance.

References

1. Bernanke, Ben S., Mark Gertler, and Mark Watson, (1997), "Systematic Monetary Policy and the Effects of Oil Price Shocks", *Brooking Papers on Economic Activity,* 1: 1997, pp.911-42,

2. Hamilton, James D., (1999), "What Is an Oil Shock?", *Working Paper,* UCSD,

3. Hamilton, James D., (1996), "This is What Happened to the Oil Price - Macro Economy Relationship", *Journal of Monetary Economics,* 38: 215-220.

4. Hamilton, James D., (1983), "Oil and the Macro Economy Since World War II", *Journal of Political Economy,* 91, pp. 228-48

5. Leduc, Sylvan, and Keith Sill, (2001), "A Quantitative Analysis of Oil Price Shocks, Systematic Monetary Policy and Economic Downturns", *Working Paper,* Federal Reserve Bank of Philadelphia.

6. Roubini, Nouriel, and Brad Setser, (2004), "The Effects of The Recent Oil Price Shock on the U.S. and Global Economy".

7. Weber, Axel A., (2006), "Oil Price Shocks and Monetary Policy in The Euro Area", *BIS Review,* BIS.

Appendix 1.1

Estimation Results for the Impact of Oil Price Shock to Korean Economy

Structural VAR Estimates
Date: 03/01/07 Time: 10:11
Sample: 2000:01 2006:05
Included observations: 77
Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 15 iterations
Structural VAR is just-identified

Model: Ae = Bu where E[uu']=I
Restriction Type: short-run pattern matrix

A =

1	0	0	0
C(1)	1	0	0
C(2)	C(4)	1	0
C(3)	C(5)	C(6)	1

B =

C(7)	0	0	0
0	C(8)	0	0
0	0	C(9)	0
0	0	0	C(10)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.000330	0.000611	0.540137	0.5891
C(2)	-0.021905	0.004537	-4.828551	0.0000
C(3)	-0.307856	0.162257	-1.897329	0.0578
C(4)	0.419249	0.844106	0.496679	0.6194
C(5)	-19.22646	26.49309	-0.725716	0.4680
C(6)	8.101554	3.571049	2.268676	0.0233
C(7)	3.498948	0.281953	12.40967	0.0000
C(8)	0.018769	0.001512	12.40967	0.0000
C(9)	0.139023	0.011203	12.40967	0.0000
C(10)	4.356413	0.351050	12.40967	0.0000

Log likelihood -188.7437

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000
0.000330	1.000000	0.000000	0.000000
-0.021905	0.419249	1.000000	0.000000
-0.307856	-19.22646	8.101554	1.000000

Estimated B matrix:

3.498948	0.000000	0.000000	0.000000
0.000000	0.018769	0.000000	0.000000
0.000000	0.000000	0.139023	0.000000
0.000000	0.000000	0.000000	4.356413

Appendix 1.2

Estimation Results for the Impact of Oil Price Shock to Taiwan's Economy

Structural VAR Estimates
Date: 02/21/07 Time: 16:02
Sample(adjusted): 1995:4 2005:4
Included observations: 41 after adjusting endpoints
Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 12 iterations
Structural VAR is just-identified

Model: Ae = Bu where E(uu')=I
Restriction Type: short-run pattern matrix

A =

1	0	0	0	0
C(1)	1	0	0	0
C(2)	C(5)	1	0	0
C(3)	C(6)	C(8)	1	0
C(4)	C(7)	C(9)	C(10)	1

B =

C(11)	0	0	0	0
0	C(12)	0	0	0
0	0	C(13)	0	0
0	0	0	C(14)	0
0	0	0	0	C(15)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-0.080950	0.547617	-0.147823	0.8825
C(2)	0.065444	0.086734	0.754533	0.4505
C(3)	0.280214	0.728474	0.384659	0.7005
C(4)	-0.007874	0.014555	-0.540981	0.5885
C(5)	-0.000463	0.024729	-0.018728	0.9851
C(6)	-0.633685	0.206270	-3.072110	0.0021
C(7)	-0.002653	0.004563	-0.581485	0.5609
C(8)	-1.573438	1.302676	-1.207851	0.2271
C(9)	-0.003026	0.026438	-0.114452	0.9089
C(10)	-0.000928	0.003115	-0.298043	0.7657
C(11)	0.171381	0.018926	9.055385	0.0000

C(12)	0.600939	0.066363	9.055385	0.0000
C(13)	0.095154	0.010508	9.055385	0.0000
C(14)	0.793701	0.087650	9.055385	0.0000
C(15)	0.015829	0.001748	9.055385	0.0000
Log likelihood	78.21203			

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000
-0.080950	1.000000	0.000000	0.000000	0.000000
0.065444	-0.000463	1.000000	0.000000	0.000000
0.280214	-0.633685	-1.573438	1.000000	0.000000
-0.007874	-0.002653	-0.003026	-0.000928	1.000000

Estimated B matrix:

0.171381	0.000000	0.000000	0.000000	0.000000
0.000000	0.600939	0.000000	0.000000	0.000000
0.000000	0.000000	0.095154	0.000000	0.000000
0.000000	0.000000	0.000000	0.793701	0.000000
0.000000	0.000000	0.000000	0.000000	0.015829

Appendix 1.3

Estimation Results for the Impact of Oil Price Shock to Malaysia's Economy

Structural VAR Estimates
Date: 02/13/07 Time: 15:09
Sample(adjusted): 1995:4 2005:4
Included observations: 41 after adjusting endpoints
Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 12 iterations
Structural VAR is over-identified (1 degrees of freedom)

Model: Ae = Bu where E(uu')=I
Restriction Type: short-run pattern matrix

A =

1	0	0	0	0
C(1)	1	0	0	0
0	C(4)	1	0	0
C(2)	C(5)	C(7)	1	0
C(3)	C(6)	C(8)	C(9)	1

B =

C(10)	0	0	0	0
0	C(11)	0	0	0
0	0	C(12)	0	0
0	0	0	C(13)	0
0	0	0	0	C(14)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.921380	0.404487	2.277898	0.0227
C(2)	-0.183327	0.164256	-1.116105	0.2644
C(3)	0.003095	0.025036	0.123611	0.9016
C(4)	0.009189	0.012894	0.712672	0.4760
C(5)	-0.014407	0.060079	-0.239808	0.8105
C(6)	-0.008185	0.009028	-0.906671	0.3646
C(7)	0.092824	0.681866	0.136132	0.8917
C(8)	-0.163236	0.102409	-1.593962	0.1109
C(9)	-0.010807	0.023450	-0.460841	0.6449
C(10)	0.169712	0.018742	9.055385	0.0000
C(11)	0.439551	0.048540	9.055385	0.0000

C(12)	0.038518	0.004254	9.055385	0.0000
C(13)	0.168171	0.018571	9.055385	0.0000
C(14)	0.025252	0.002789	9.055385	0.0000

Log likelihood 172.9889
LR test for over-identification:
Chi-square(1) 0.182401 Probability 0.6693

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000
0.921380	1.000000	0.000000	0.000000	0.000000
0.000000	0.009189	1.000000	0.000000	0.000000
-0.183327	-0.014407	0.092824	1.000000	0.000000
0.003095	-0.008185	-0.163236	-0.010807	1.000000

Estimated B matrix:

0.169712	0.000000	0.000000	0.000000	0.000000
0.000000	0.439551	0.000000	0.000000	0.000000
0.000000	0.000000	0.038518	0.000000	0.000000
0.000000	0.000000	0.000000	0.168171	0.000000
0.000000	0.000000	0.000000	0.000000	0.025252

Appendix 1.4

Estimation Results for the Impact of Oil Price Shock to Indonesia's Economy

Structural VAR Estimates
Date: 02/13/07 Time: 15:20
Sample(adjusted): 1996:4 2005:4
Included observations: 37 after adjusting endpoints
Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 10 iterations
Structural VAR is just-identified

Model: Ae = Bu where E(uu')=I
Restriction Type: short-run pattern matrix
A =

1	0	0	0	0
C(1)	1	0	0	0
C(2)	C(5)	1	0	0
C(3)	C(6)	C(8)	1	0
C(4)	C(7)	C(9)	C(10)	1

B =

C(11)	0	0	0	0
0	C(12)	0	0	0
0	0	C(13)	0	0
0	0	0	C(14)	0
0	0	0	0	C(15)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.188648	0.127298	1.481939	0.1384
C(2)	-0.234453	0.149775	-1.565371	0.1175
C(3)	0.057667	0.028351	2.034028	0.0419
C(4)	-2.129533	1.934327	-1.100917	0.2709
C(5)	-0.044551	0.187929	-0.237063	0.8126
C(6)	0.015950	0.034477	0.462618	0.6436
C(7)	-5.559810	2.237308	-2.485044	0.0130
C(8)	-0.155473	0.030137	-5.158778	0.0000
C(9)	6.064732	2.556943	2.371868	0.0177
C(10)	-98.35331	10.63753	-9.245876	0.0000
C(11)	0.137073	0.015934	8.602325	0.0000

C(12)	0.106139	0.012338	8.602325	0.0000
C(13)	0.121330	0.014104	8.602325	0.0000
C(14)	0.022242	0.002586	8.602325	0.0000
C(15)	1.439193	0.167303	8.602325	0.0000

Log likelihood 99.39972

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000
0.188648	1.000000	0.000000	0.000000	0.000000
-0.234453	-0.044551	1.000000	0.000000	0.000000
0.057667	0.015950	-0.155473	1.000000	0.000000
-2.129533	-5.559810	6.064732	-98.35331	1.000000

Estimated B matrix:

0.137073	0.000000	0.000000	0.000000	0.000000
0.000000	0.106139	0.000000	0.000000	0.000000
0.000000	0.000000	0.121330	0.000000	0.000000
0.000000	0.000000	0.000000	0.022242	0.000000
0.000000	0.000000	0.000000	0.000000	1.439193

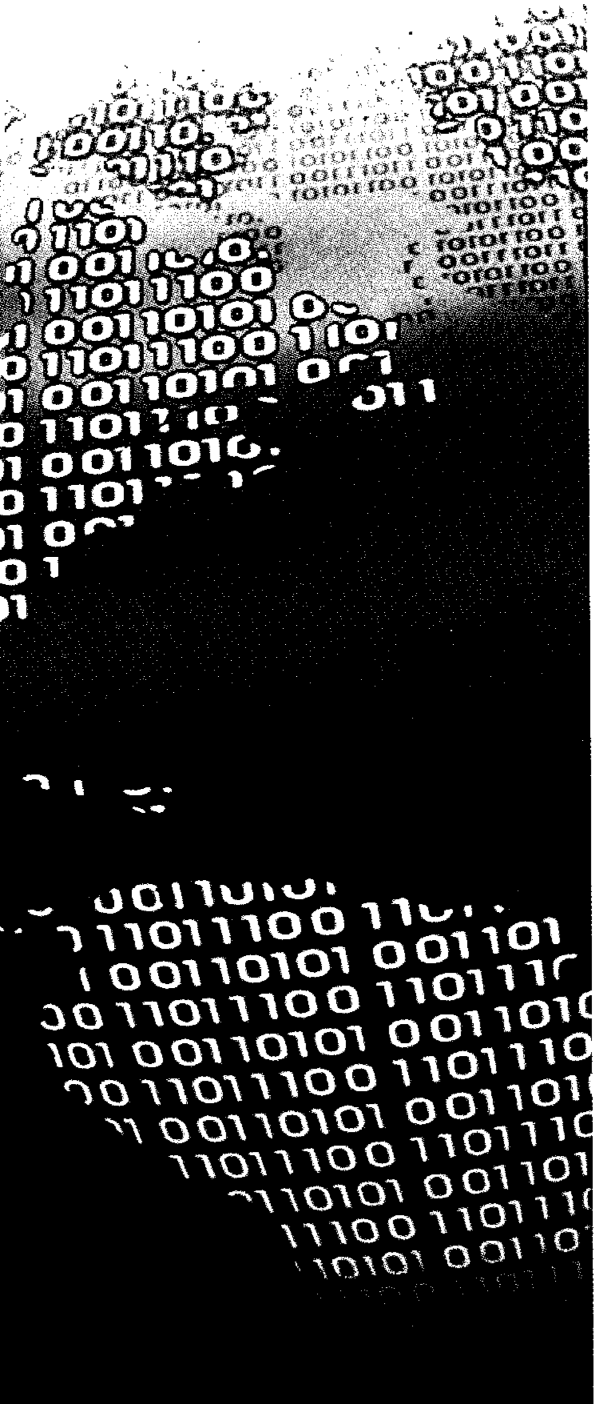
Appendix 1.5

Estimation Results for Role of Oil Dependency and Oil Subsidy

Dependent Variable: DLGDP
Method: Panel Least Squares
Date: 02/14/07 Time: 21:01
Sample (adjusted): 1996Q3 2005Q4
Cross-sections included: 4
Total panel (balanced) observations: 152

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.010990	0.002937	3.741424	0.0003
DLPOIL(-1)	0.045202	0.016211	2.788289	0.0060
DUM1POIL	0.000932	0.000414	2.250324	0.0259
DUM2POIL	-0.036182	0.034768	-1.040653	0.2998
DLGDP(-1)	-0.197931	0.083874	-2.359859	0.0196
DLEXR(-1)	-0.073063	0.027472	-2.659554	0.0087
DLMPR(-1)	0.003551	0.020118	0.176510	0.8601

R-squared	0.136580	Mean dependent var	0.010055
Adjusted R-squared	0.100852	S.D. dependent var	0.03405
S.E. of regression	0.032289	Akaike info criterion	-3.983232
Sum squared resid	0.151172	Schwarz criterion	-3.843974
Log likelihood	309.7256	F-statistic	3.822807
Durbin-Watson stat	2.206962	Prob(F-statistic)	0.001441



COUNTRY CHAPTERS
PART II

Chapter 2

THE ROLE OF OIL IN THE ECONOMY AND POLICY IMPLICATIONS:
THE CASE OF CAMBODIA

by Nguon Sokha[1]
National Bank of Cambodia

1. Introduction

The role of energy in the economic development and prosperity of a nation is an indisputable fact. Energy is a fundamental input into our economy, essential for running the country's factories, modernising agriculture, transporting national outputs, and increasing sales. Energy is also a final product in itself and therefore represents an indispensable component of people's life in a modern society. It provides various comforts that people have grown accustomed to as such electricity for lighting, cooking , maintaining a comfortable room temperature, fuel for vehicles and etc.

However, energy has to be produced at costs that vary among countries depending on the availability of the national resources or the financial resources to import energy products, the level of technological advances, and the existence of legal and institutional infrastructure necessary to support an efficient and reliable energy sector management.

At the moment, Cambodia is poorly positioned with respect to all of the above-mentioned factors relative to other countries in the region. Cambodia is a small developing country situated in the Indochina region. Its neighbouring countries are Thailand in the west, Vietnam in the east, Laos in the north, and the Gulf of Thailand forms its natural boundary in the southwest. In 2004, around thirteen million people were living in an area of 181,035 square km. About 80 percent of the population earns their living from agricultural related occupations in rural areas, where production contributes about 32 percent of GDP in 2005. Per capita GDP was about US$ 400 in 2004-05. The overall poverty rate was an estimated 35 percent in 2004 and rural poverty remains high.

For nearly 20 years, Cambodia was isolated from the international community by war and internal strife and also poorly designed government policies. A rebuilding effort that was initiated in the early 1990s was carried out in the face of dire macroeconomic conditions - the dilapidated state of the country's social, institutional and physical infrastructure, an underdeveloped financial system, and a general inability to meet the basic needs of the population as witnessed by the generally low level of income and domestic savings and an absolute dearth of funds and materials.

In the last decade, as an outcome of a complex policy combination, especially a good fiscal and monetary policy mix, the Cambodian economy has performed relatively well. Annual GDP growth averaged 9 percent in real terms. However, despite this economic success, growth has a very narrow base; it is driven largely by the development of the textile industry and thus remains fragile. Private sector development and industrialisation is slow, partly due to high input costs. A crucial component of these expenses is the high cost of electricity and diesel fuel to run the factories. After decades of war and devastation, investment in the energy sector has been neglected. This has significant economic and social implications because of the economy's high dependency on petroleum imports at a time when the country's financial resources are scarce and external assistance is necessary to fill the gap in government expenditure.

1 The opinions expressed in this paper are solely those of the author and do not necessary reflect the views of the National Bank of Cambodia.

Cambodia has already felt the impact of the rapid increase in the global oil prices in the recent years on its socio-economic life. The price hike, should it continue on a permanent basis, would pose enormous threats to the sustainable development of the Cambodian economy, while the government's attempt to reduce people poverty would suffer a significant setback.

This Paper examines the impacts of the recent global oil price hike on the economy of Cambodia and identifies the fiscal and monetary policy responses adopted by the Cambodian authorities. Since historical data is not readily available for a meaningful quantitative analysis, descriptive analyses have been drawn from studies conducted on recent aggregate data; much data was obtained from secondary sources; others are primary information obtained through interviews with Cambodian officials.

2. Energy Consumption and Production Situation

Energy consumption in a given economy is influenced by various factors, the relationship of which is very complex and difficult to quantify. Just as spending depends on disposable income, the availability of energy resources in the economy or the ability to import energy at affordable prices, greatly affects energy consumption. However, this is only part of the story. Changing preferences, demographics, the structure of the economy, the degree of mechanisation in the agricultural sector, the level of existing technology in the country and the resulting energy efficiency are crucial determinants of such consumption. In many countries, the climatic and topographical conditions can have also a significant impact on levels of residential energy consumption.

By reviewing the above-cited factors one by one for the case of Cambodia, it will be obvious to everyone that Cambodia currently cannot be regarded as a petroleum intensive country, by either international or regional standards. A closer look at the structure of the economy will confirm this statement (Table 1). As a matter of fact, economic patterns affect energy consumption in industrial and commercial sectors. The Cambodian economy entered a path of rapid development at the end of 1990s and continued on this path during the 2000s. Although the growth rate in 1999 of 12.6 percent was almost similar, with growth being a shade higher in 2005 at 13.4 percent, the sectoral composition of growth is quite different during this period. By the year 2000, the services sector had become the dominant sector of the economy, accounting for 37 percent of the GDP, and has held steady at this level until present. The increase of the relative importance of this sector was reflected in the growth in trade, restaurants and hotels. The strength of those sub-sectors is, in turn, not very surprising, given the tourism potential of the country and given the fact that it is more

Table 1
Shares of Real GDP by Sector, 1997-2006

	1999	2000	2001	2002	2003	2004	2005	2006E
Agriculture, Fisheries & Forestry	39.4	**35.9**	34.9	32.2	33.2	30.6	31.4	**29.4**
Industry	18.1	21.8	22.6	25.0	25.8	27.3	27.0	**28.8**
Textile, apparel & footwear	5.9	9.2	11.0	12.5	13.5	15.3	14.9	16.3
Construction	4.1	5.2	4.7	5.7	5.8	6.0	6.3	6.9
Services	37.0	**37.1**	37.5	37.5	36.1	36.7	36.2	**36.3**

Note: These sectoral contributions do not total to 100% because imputed bank charges are not included.
Source: Calculated from NIS 2006.

flexible in adjusting to market demand. The industry sector, on the hand, represented the fast growing sector; its share in the GDP reached 22 percent and 27 percent in 2000 and 2005, respectively, from 13.6 percent in 1993, and appears to be expanding. However, the share of services and industry sector in employment remained significantly lower than that of agriculture.

On the whole, despite the fact that over the last decade since the second General Election in 1998, growth specifically in manufacturing has resulted in a decline in Cambodia's reliance on agricultural production (especially farming), the Cambodian economy remains basically agricultural. About 80 percent of the economically active population in 2005 was engaged in agriculture and the private sector is just emerging. The fact that over the years agriculture's relative contribution to GDP is lower than its contribution to employment indicates that labour productivity in agriculture is still inadequate and there is high dependence of agricultural production on the traditional fuel due to the energy-neutral cultivate and harvest technique.

With respect to the availability of resources in the world, energy consumption by source of energy includes primary fuels that are consumed directly such as wood, natural gas, and energy; and sources that need to be converted (coal into electricity) or processed (oil into gasoline and petroleum products). Nevertheless, in Cambodia the principal forms of energy currently used in households are still fuel wood and charcoal which are produced locally. At present, most of the existing energy sources in Cambodia are used by people living in rural areas. They use wood and charcoal, which is the only source of energy for cooking. Fuel wood is also used for traditional industries, such as brick and tile making. In 2004, about 66 percent of households were using kerosene as a source of lighting, while firewood was used by about 85 percent of households as their main energy source for cooking.

Figure 1: Sources of Lighting

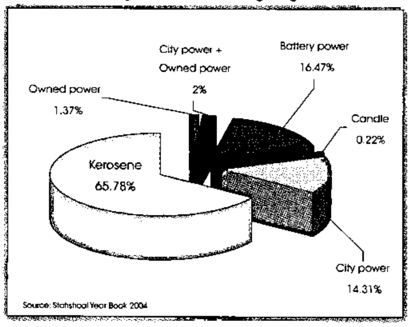
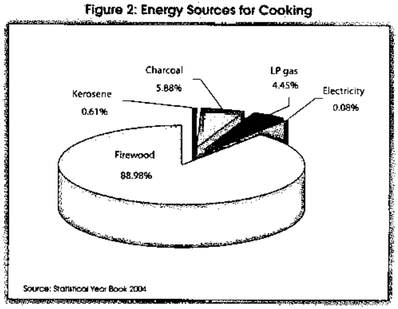


Figure 2: Energy Sources for Cooking



Cambodia is totally dependent on oil for its power. The main energy source for electricity generation is diesel fuel. Currently, the major portion of Cambodia's installed electric generation capacity is composed of diesel-fired generators. In 2004, diesel was used to generate 68.5 percent of total electricity power, while heavy fuel oil was used to generate the remaining 31.5 percent. Reflecting the present level of the country's socio-economic development, the current electrification rate is low. Only around 15 percent of the population has regular access to electricity via a reliable public grid, and majority of this group is in the capital city, Phnom Penh. For the rural population, less than 9 percent have access to grid-quality power, although an increasing number have access to either private part-time mini-grids or battery charging services. The total installed electricity generating capacity in Cambodia in 2004 was 641,623,972 KWH. Reflecting such infrastructure, electricity costs in Cambodia are considered to be expensive when compared with its neighbouring countries, even before the resurgence of the oil price hike. Facing the high costs of electricity, Cambodian households have long developed energy saving habits. As a combination of income and substitution effect, people have tried to use substitutes for electricity. As a result, per capita consumption of electricity is an extremely low 47.5 KWH.

Transportation represents another important sector that relies on petroleum products. This is because the majority of transportation also runs on gasoline and diesel fuel. While developed countries have a far more evolved rail system, supported by ferry services and an established road network, the transportation system in Cambodia consists primarily of private vehicle road transport. The increased motorisation and vehicle use has further exacerbated the country's reliance on oil. The estimated number of motor vehicles, including cars, pick-ups, buses, trucks, motorcycles and other vehicles, in Cambodia in 2004 was 918,130, an increase of 5.1 percent compared to 873,495 vehicles in 2003, and an increase of 78.6 percent on the estimated 513,977 vehicles in 1994. An estimated 235, 298 vehicles were on the roads in 2004, up 57.5 percent from 1994.

In addition, reflecting the Cambodian fast population growth rate of 2.2 percent, a significant number of homes that are electrified have been increasing every year in the cities, adding to the country's housing stock. With GDP growing on average by about 9 percent in real terms over the last ten years, the number of business establishments has also risen remarkably. As power plays an increasingly larger role in the country's industrialisation process and the country's development, a greater demand for energy is expected.

As far as production is concerned, Cambodia's petroleum industry is in the very early stages of development. There is no oil refinery in the country and refined petroleum has to be imported.

Until recently, Cambodia's mineral resources appear to be limited and the exact amount of coal, petroleum and gas available in Cambodia is unknown since there have not been many studies or research conducted in this area in the past given the scarcity of capital and lack of expertise. Similarly, there has been no development of fossil fuel resources and little is known of them.

In late 1969, the Cambodian government granted a permit to a French company to explore for petroleum in the Gulf of Thailand. By 1972, there was still no discovery of fuel deposits. Exploration ceased entirely when the Khmer Republic fell in 1975. The political turmoil and security issues in the ensuing two decades prevented the development of a mineral sector in Cambodia. However, recent oil and gas discoveries in the Gulf of Thailand and the South China Sea have sparked a renewed interest in Cambodia's offshore area, especially as the country is on the same continental shelf as its Southeast Asian oil-producing neighbours.

With the objective of ensuring that development in the oil sector within Cambodia serves as a catalyst to support industrialisation and economic development, the Cambodian National Petroleum Authority (CNPA) was established in 1998 by the Council of Ministers. The CNPA is the primary Government body responsible for promoting investment and administering both upstream and downstream activities of the petroleum industry in Cambodia.

With licenses given by the CNPA, some companies began exploring petroleum and gas in offshore of Cambodia in the 1990s and early 2000s. In recent years, significant progress has been made. Current major activities in Cambodia's oil and gas sector include:

- Ongoing offshore exploration and drilling programme by Chevron Texaco.
- Acceleration of negotiations over Overlapping Claims Area with Thailand.

Chevron Texaco, the second largest oil company in the USA, discovered oil in wells drilled offshore of Cambodia not long ago and is now in the process of determining the potential commercial value of the finds. Provisional estimates are that drillings in part of one of six oil exploitation blocks may hold as much as 400 million barrels of crude oil and 3-5 trillion cubic feet of gas. If the findings of other wells are positive, oil production may commence in 2008.

Besides promoting oil exploration and activities within Cambodian territory, the government of Cambodia has also placed great attention on accelerating negotiations with the government of Thailand concerning petroleum resources in contiguous or overlapping zones in the Gulf of Thailand to foster exploration and the development of petroleum resources. Earlier, Cambodia had awarded exploration rights for the area to BHP, Shell, and Conoco Phillips. According to Conoco Phillips, this area may contain as much as 3 billion barrels of oil equivalent.

3. Recent Trends in Domestic Prices and Inflation

The sharp rise in international oil prices since 2003 contributed to the weakening of consumer price inflation in Cambodia over the recent period, though the magnitude was relatively modest. Following a long period of low and stable inflation of below 2 percent annually on average between 1999 and 2003, inflation pressures were visible for the first time again in the economy since the Asian crisis in mid-2004 and the upward trend remained in 2005. The annual average inflation rate reached 3.9 percent in 2004 and increased to a peak of about 6 percent a year later, its highest point since 1999.

As can be seen from Figure 3, the two primary factors affecting inflationary pressures in the period under review were the CPI subgroups *Food, Beverages & Tobacco and Transportation and Communication*, indicating that a first round effect of high oil prices and a second round of cost increases were at play. As a matter of fact, in general, the price of oil has had a strong direct impact on transportation costs (fares & tariff), utilities (electricity & gas), and indirectly, food items (since transportation and other costs rise).

In Cambodia, the effect of oil price fed through to the CPI primarily though the increase in prices of transport fuels, which reflected the change in the CPI subgroup of *Transportation and Communication*. This subgroup is weighted at 8.7 percent in the overall consumer basket. In 2004, the index for the sub-group of Transportation & Communication accelerated remarkably, rising by nearly 15 percent, an almost threefold increase from the 4.9 percent mark recorded in 2003.

Though the adverse impact of the oil price increase appeared to remain under a manageable span with respect to changes in the CPI, changes in the retail prices of petroleum products sold in the local markets were high. Reflecting the dependency on external supply, the domestic oil price has been adjusting promptly with changes in the world market price. And as shown in Figure 4, the movements of the CPI seem to follow changes in the retail petroleum prices. As of the end of June 2006, the local pump price for gasoline reached slightly above US$ 1 per litre. Meanwhile, the price for cooking gas has doubled over the last two years. The energy saving attitude of consumers has been strengthened, and increasingly they are endeavouring, wherever possible, to switch their consumption to other cheap alternative energy resources. A swap from using cooking gas to charcoal might be partly responsible for the 11.8 percent increase in the retail price of charcoal between November 2005 and October 2006. Meanwhile, the consumers' response to the price change was reflected in the change of their intensity of use. When the oil price became high relative to their income, local consumers chose to take fewer and shorter trips, which in turn indirectly affected the local tourism sector.

Nevertheless, the effect on the overall inflation rate remains contained. As mentioned earlier, on a year-on-year basis, the inflation rate was kept within 6 percent in June 2006, which was still well below that of the 13 percent mark observed during the Asian crisis. While the temporary feature of the global oil price hike represented a crucial determinant of such containment, other factors also played important role. This included the low inflation rate in Cambodia's trading partners that did not drive imported inflation, the strength of the local currency vis-à-vis the US dollar, and the better agricultural performance that provided ample supply to the local food markets. In addition, the labour market in Cambodia is at a very early stage of development, and this contributes to strong rigidity in the nominal wages of workers and employees in the short- and even medium term, and therefore helped to prevent the kind of rise in prices that feeds high inflation expectations through to wages. Moreover, CPI's development that suggests that inflation expectations are generally well-anchored, reflecting the commitment of the government and the monetary authority, the National Bank of Cambodia (NBC) as to price stability.

Figure 3: CPI Subgroups
(Annual Percent Change)

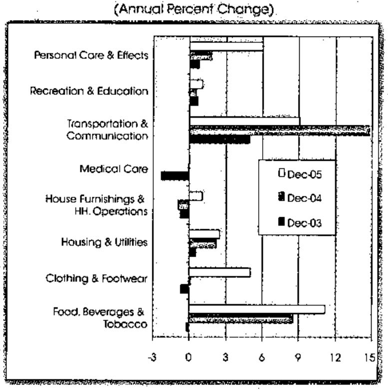
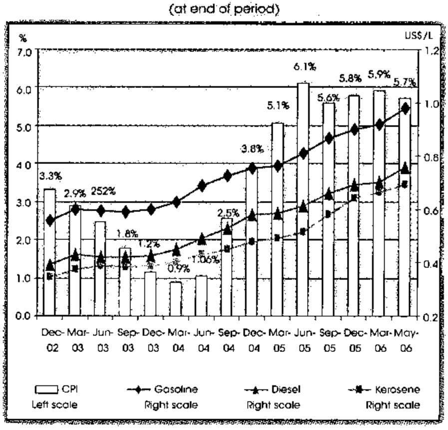


Figure 4: CPI and Retail Petroleum Price
(at end of period)



Recent changes in oil prices have affected the CPI also through changes in electricity tariffs. With the move from a centrally planned economy to a market-oriented system, the government of Cambodia lifted most price controls in 1989. Prices for goods and services are currently freely determined by the market, except for electricity and water. However, the electricity tariffs have been adjusted twice during the previous two years. With the persistent increase in the import bill on petroleum products, coupled with the fixed tariffs set by the authorities at which consumers pay for electricity consumption, the Electricity du Cambodge, the autonomous state-owned company responsible for power supply, reportedly incurred substantial losses in the past few years.

The current tariff, which has been effective since October 2005, was an 11 percent and 105 percent increase on the tariff in 2004 and 2003, respectively. The improvement of the electricity tariff for both retail and wholesale levels was necessary for transparency and also to reflect the actual supply costs.

4. Dependency on Oil Imports

The critical issue facing Cambodia in terms of oil supply security is that there is presently no indigenous production of oil within Cambodia and an absence of oil refinery in the country. Cambodia is entirely reliant on imports of refined oil for its domestic consumption of petroleum products. The oil products are from regional sources, primarily Thailand, Singapore and Vietnam. The vast portion of petroleum products into Cambodia are ultimately sourced from the Middle East. This situation is likely to continue for the immediate future.

Spending for petroleum product imports represented the second largest expenditure for a single commodity group imported into Cambodia (garments are first), a substantial amount of which are used as supplies for the exporting garment industry. From 1999 up to now, oil imports have been and are still a higher fraction of constant imports than autos, all consumer goods, or all industrial supplies and materials (excluding oil).

Imports of energy products (not including the embodied energy in non-energy products) are a significant component of Cambodia's trade balance. On average, they accounted for about 76 percent of the commodity trade deficit over the eight year period since 1999.

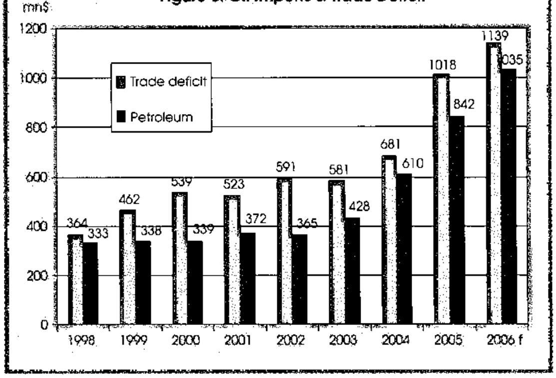


Figure 5: Oil Imports & Trade Deficit

In terms of the percentage share of imports, the share of petroleum in the total imports of Cambodia is high and has been on an increasing trend since 2003, at 19.3 percent and 22 percent, respectively, in 2004 and 2005. In fact, the value of oil imports rose substantially in 2004 and 2005, with an annual growth rate of around 40 percent. Oil import is expected to break through the US$ 1 billion high in 2006, though the growth rate would be smaller than in 2005 (around 23 percent), as price hikes would suppress demand to some extent. Nonetheless, the share of petroleum imports is estimated to reach about 23.7 percent in 2006.

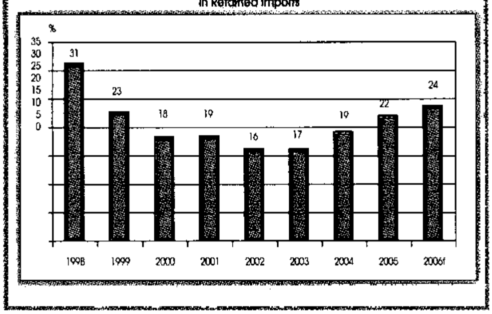


Figure 6: Share of Petroleum Imports in Retained Imports

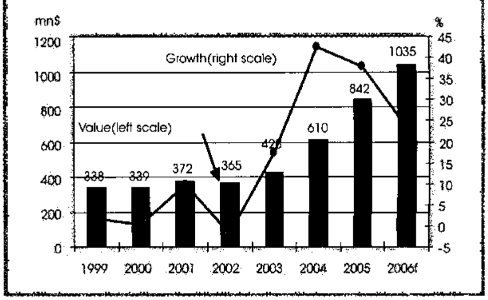


Figure 7: Petroleum Imports

As can be observed in Table 2, reflecting the sustained growth in private consumption, the imports of petroleum products have virtually doubled over the past eight years since

1998 in terms of volume. During the period from 1999 to 2004, the volume of petroleum imports grew at an average annual rate of 12 percent, with an increase of 10.7 percent in 2004. Import of oil products increased to 1.53 million tons in 2005, from 1.5 million tons in 2004, a very marginal growth rate of just 2.2 percent on 2004. The significant slowdown in 2005 may be attributable to two factors: (1) a slower local demand for petroleum resulting from higher prices as consumers try to cut down their fuel consumption and/or substitute with other products, and (2) structural changes in the electricity sector associated with the electricity imports from Vietnam and the increasing use of the power supply produced by the state-owned electricity company, the Electricity du Cambodge, by private households in several suburbs of Phnom Penh and other cities in place of private mini-grids.

Table 2
Petroleum Imports (in tons)

In tons	1998	1999	2000	2001	2002	2003	2004	2005
Gasoline	22,084	472,030	509,832	552,746	598,815	667,484	760,447	843,032
Diesel	289,464	325,681	352,892	380,528	405,776	443,982	495,101	415,571
Jet fuel	8,110	11,954	17,365	16,781	16,826	16,837	19,672	20,033
Heavy oil	4,410	11,856	23,250	92,223	122,468	118,531	142,354	179,950
Motor oil	3,886	4,839	4,271	5,034	5,027	7,486	7,854	9,656
Kerosene	29,931	37,116	29,551	28,315	50,407	79,614	47,829	33,452
LPG	4,604	9,952	14,225	16,705	20,150	21,754	27,574	31,537
Total	**762,489**	**873,426**	**951,385**	**1,092,331**	**1,219,468**	**1,355,687**	**1,500,832**	**1,533,231**
% change	-	14.5%	8.9%	14.8%	11.6%	11.2%	10.7%	2.2%

Source: Customs and Excise Department and National Bank of Cambodia's estimates

Among all the imported petroleum products, gasoline imports occupied the largest share, and virtually doubled between 1999 and 2005. During the same period, diesel fuel rose by nearly 45 percent and represented the second largest energy import.

5. Petroleum Tax Regime in Cambodia

Cambodia belongs to countries that tax petroleum consumption. Since the early 1990s, petroleum taxes have been levied mainly for the purpose of revenue generation rather than sumptuary reason, i.e, it is not done to regulate consumer behaviour on health or environmental grounds as is in various industrialised economies. And this still holds true for present day Cambodia. In fact, in the early 1990s, with the low domestic resource mobilisation capacity, the government depended heavily on international trade taxes as a major source of current budget revenues. In 1994, international trade taxes amounted to 280.8 billion riel (108 million US dollar), approximately 47.7 percent of current revenue. About 16.5 percent of this amount was attributed to revenues from petroleum imports (7.8 percent of current revenue in 1994). In 1999, customs duties and taxes on gasoline and diesel contributed 5.3 and 5.5 percent of current budget revenue, or 0.5 and 0.6 percent of GDP, respectively.

Table 3
Role of Fuel Taxation in Government Financinng

	1999	2000	2001	2002	2003	2004	2005
Customs duties on fuel/ international trade taxes	34.8%	41.5%	42.2%	27.9%	24.9%	25.9%	21.6%
Fuel tax/ current revenue	11.2%	10.4%	9.3%	22.0%	22.6%	19.4%	17.5%
Gasoline/ current revenue	5.3%	4.5%	3.7%	8.7%	8.2%	6.4%	7.4%
Diesel/current revenue	5.5%	5.6%	5.4%	11.8%	12.5%	11.0%	8.1%
Fuel tax/GDP	1.1%	1.1%	0.9%	2.3%	2.1%	1.9%	1.7%
Gasoline/GDP	0.5%	0.5%	0.4%	0.9%	0.8%	0.6%	0.7%
Diesel/GDP	0.6%	0.6%	0.5%	1.3%	1.2%	1.1%	0.8%

Sources: Author's calculation based on data from Excise Office of Customs and Excise Department of Cambodia.

Despite the fact that fuel taxation remains a major source of government financing, as can be seen from Table above, the official statistics showed that there has been a significant reduction of import duties on fuel in terms of international trade taxes since 2002. This could suggest an increase in fuel smuggling as a result of high petroleum prices.

The important role of fuel taxation in Cambodia is not surprising considering that this country belongs to a group of low income countries where the agriculture makes up nearly 50 percent of the GDP and the private sector is slowly emerging. On the other hand, given the lack of appropriate instruments and relatively weak tax administration during the period of transition from a planned economy to market-oriented one, fuel taxes represented the surest way for the government to raise revenue. Collecting petroleum tax is relatively straightforward. Besides, the consumption of fuel has relatively low elasticity with respect to the prices but high elasticity with respect to income, therefore increasing tax rates and rising incomes will serve to ensure buoyant revenue.

There are six types of petroleum products that are imported and used in Cambodia, namely, gasoline, diesel fuel, kerosene, fuel oil, jet fuel and gas. Fuel taxes in Cambodia have the following characteristics:

a. Tax instruments: total tax on each petroleum product is made up of different tax instruments.

b. Compound feature: taxes are compounded.

c. Taxable base: tax bases are an administered value set by the Customs and Excise Department of Cambodia.

a. ***Tax Instruments***: The first feature of fuel taxation in Cambodia is that petroleum products are subject to different taxes. From 1994 up to now, tax instruments have been changed and tax rates have been revised a number of times. The important events in Cambodia's taxation history are the introduction of VAT in 1999 and the tax reform of July 1, 2001.

In general, import duties are applied to all refined petroleum imports, except for kerosene, which was duty-free until 2004. The import duty on gas was removed in 1999. Among all imported energy sources, gasoline and diesel fuel are the dominant imported products. These two items are also subject to the highest taxes. The import duty on gasoline was raised from 45 percent in 1994 to 50 percent in 1995. Also in 1995, a 20 percent excise tax was introduced for gasoline. Between 1994 and 2001, a social fund of three riel per litre was levied on all petroleum products, with the exception of gas. From 1994 to 2001, a 20 percent import tariff was applied to diesel. In 1994, a consumption tax of 4 percent was introduced uniformly for all imported fuel items. This tax was later removed and replaced by a VAT at a uniform rate of 10 percent in 1999. Following the tax reform of July 1, 2001, the import duty on gasoline and diesel fuel was reduced to 35 percent and 15 percent, respectively. To compensate for such a reduction, a 4.35 percent excise tax was levied on diesel fuel, while at the same time this tax rate on gasoline was raised to 33.33 percent. Moreover, since 2002 an additional per unit tax has been applied to gasoline and diesel at US$ 0.02 per litre for gasoline and US$ 0.04 per litre for diesel fuel.

The tariffs below applied to gasoline and diesel oil imported to Cambodia:

Table 4: Official Tax Rates for Gasoline (as a Percent of Customs Reference Values)

	1994	1995	1996	1997	1998	1999	2000	2001[2]	2002	2003	2004	2005	2006
Import duties	45%	50%	50%	50%	50%	50%	50%	50/35%	35%	35%	35%	35%	35%
Military tax	0.8%	0.6%	0.5%	0.4%	0.3%	0.3%	0.3%	0.3%					
Additional Tax									8.7%	8.7%	8.7%	8.7%	8.7%
Excise		20%	20%	20%	20%	20%	20%	20/33.3%	33.3%	33.3%	33.3%	33.3%	33.3%
Consumption/VAT	4%	4%	4%	4%	4%	10%	10%	10%	10%	10%	10%	10%	10%

Note: Tax reform was introduced in July 1, 2001. Since 2002 an additional tax has been introduced for gasoline at US$ 0.02 per litre (equivalent to 8.7 percent of customs reference value).

Sources: Excise Office of Customs and Excise Department of Cambodia and Wafa Fahmi Abdelati & Koji Nakamura, IMF, staff paper, 2005.

Table 5: Official Tax Rates for Diesel Fuel (as Percent of Customs Reference Values)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Import duties	20%	20%	20%	20%	20%	20%	20%	20/15%	15%	15%	15%	15%	15%
Military tax	0.7%	0.6%	0.5%	0.4%	0.3%	0.3%	0.3%	0.3%					
Additional Tax									17.3%	17.3%	17.3%	17.3%	17.3%
Excise								4.35%	4.35%	4.35%	4.35%	4.35%	4.35%
Consumption/VAT	4%	4%	4%	4%	4%	10%	10%	10%	10%	10%	10%	10%	10%

Note: Since 2002 an additional tax has been introduced for diesel fuel at US$ 0.04 per litre (equivalant to 17.3 percent of customes reference value).

Sources: Excise Office of Customs and Excise Department of Cambodia and Wafa Fahmi Abdelati & Koji Nakamura, IMF, staff paper, 2005.

Table 6: Official Tax Rates for Kerosone (as Percent of Customs Reference Values)

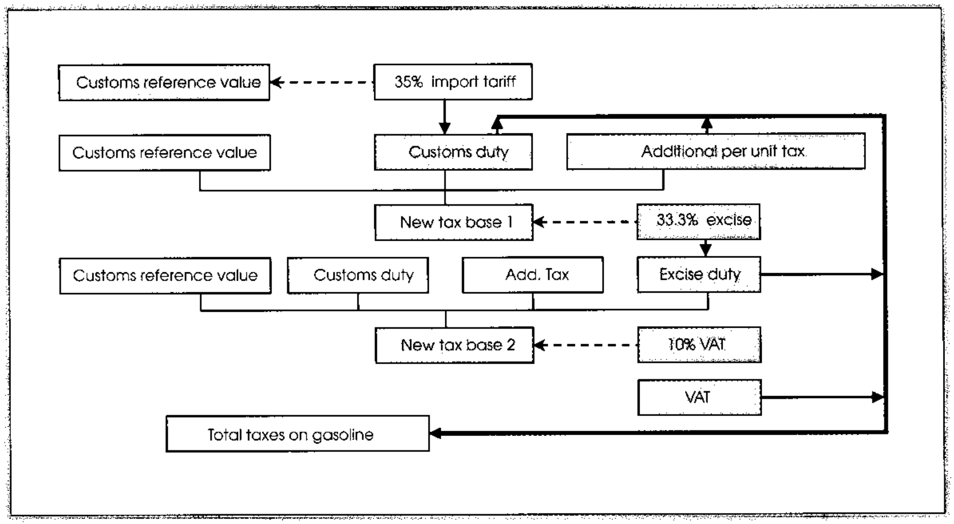
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Import duties											7%	7%	7%
Military tax	0.6%	0.7%	0.6%	0.6%	0.4%	0.4%	0.4%	0.4%					
Excise											10%	10%	10%
Consumption/VAT	4%	4%	4%	4%	4%	10%	10%	10%	10%	10%	10%	10%	10%

Sources: Excise Office of Customs and Excise Department of Cambodia and Wafa Fahmi Abdelati & Koji Nakamura, IMF, staff paper, 2005.

2 The import duty and excise tax for gasoline and diesel was changed in July 1, 2001. The two figures in the respective cell represent tax rates applicable before and after the change.

b. ***Compound Feature***: The third feature of petroleum tax is that fuel taxation is computed using the practices of compound calculation following a sequence as follows: customs duty, additional tax, excise tax, and VAT, wherever each tax is applicable to a specific product. For instance, the tax structure for gasoline in 2005 is in fact a sum of the import duty based on administered values of US$ 309 set by the government for that year, a social fund of US$ 0.02 per litre, a 33.33 percent special excise tax calculated on the customs reference value plus the import duty and additional tax, and a 10 percent VAT on the customs reference value plus all other levies.

Diagram 1
Schematic Illustration of Tax Structure for Gasoline in 2005



Sources: Computation by author based on information provided by Excise Office of Customs and Excise Department of Cambodia.

c. ***Taxable Bases***: As mentioned above, some fuel taxes are per unit taxes, while the majority are computed based on customs-determined prices known as "customs reference" or "administered values," but not on market or actual import prices. These customs reference prices, depending on which import tariffs, excise taxes and VAT are used for computing, are notional c.i.f. values of import that are set by the government with the objective of simplifying tax calculation, creating a fair valuation basis for the same products of various importers.

Table 7: Customs Reference Values for Dutiable Valuation (In US$ Per Ton)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Gasoline	200	275	320	320	320	320	320	320	320	320	309	309	309
Diesel	200	200	275	275	275	275	275	275	275	275	267	267	267
Kerosene	230	230	230	230	230	230	230	230	230	230	230	230	230
Fuel oil	109	120	129	129	129	129	129	129	129	129	129	129	129
Jet oil	235	235	235	235	235	235	235	235	235	235	235	235	235
Gas	325	325	325	325	325	325	325	325	325	325	325	325	325

Sources: Excise Office of Customs and Excise Department of Cambodia

As can be seen from Table 7 above, during the reviewed period from 1994 until present, the customs reference values have rarely been adjusted. Significant changes were made during 1995 and 1996. While customs reference values for kerosene, fuel oil, and gas have been remained constant over the entire period under consideration. The values for gasoline were raised from US$ 200 per ton in 1994 to US$ 275 in 1995 and further to US$ 320 in 1996. The per ton value of diesel was administratively set at US$ 200 in 1994, but was increased to US$ 275 in 1996, while that of fuel oil changed from US$ 109 in 1994 to US$ 120 and US$ 129 in 1995 and 1996, respectively. In 2004, as a policy intention of the government to mitigate the impact of global oil price rise, the customs reference values for the two major imported petroleum products, gasoline and diesel, were even reduced when the value of gasoline and diesel was brought down to US$ 309 and US$ 267, from US$ 320 and US$ 275 in 2003, respectively.

6. The Formation of Retail Prices for Petroleum Products

The three characteristics of petroleum taxes described above determined the level of tax rate for each petroleum product in Cambodia. According to Wafa Fahmi Abdelati & Koji Nakamura and the author's calculation, the total cumulative tax rate on gasoline in 1994 amounted to 52 percent of the customs reference value, but rose to 111 percent in 2004. This figure also represents the statutory tax rate for 2005 and 2006 due to the fact that the tax structure, including the official rates and the customs reference prices have not been adjusted since 2004 (see Table 8 below). Whereas the higher cumulative tax rates for gasoline in diesel in 2002 and 2003 in terms of customs reference value reflected the introduction of excise duty and VAT under the tax reform in 2002, their increase since 2004 up to the present, mirror the cuts in the administered prices (Table 7).

In sum, gasoline carries the highest taxation of all petroleum products, while diesel fuel is taxed less in terms of customs reference value as well as retail price. Taxation on kerosene that is typically used by rural households as an energy source for cooking and lighting is generally lower than that on transport fuels and industry fuels. Nevertheless, since 2004, the tax rate for kerosene has also increased as an import duty of 7% and an excise tax of 10% were introduced in 2004.

Table 8: Total Cumulative Tax Rates (as a Percent of Customs Reference Values)

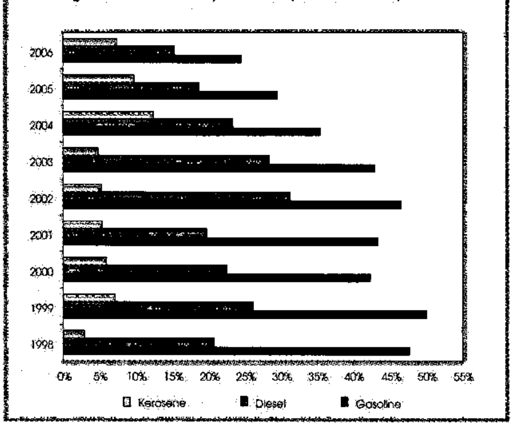
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Gasoline	52%	88%	88%	88%	87%	98%	98%	99%	110.7%	110.7%	111%	111%	111%
Diesel	26%	25%	25%	25%	25%	32%	32%	32%	51.9%	51.9%	52.5%	52.5%	52.5%
Kerosene	5%	5%	5%	5%	4%	10%	10%	10%	10%	10%	29%	29%	29%
Fuel oil	12%	12%	12%	12%	12%	18%	18%	18%	18%	18%	18%	18%	18%
Jet oil	12%	12%	12%	12%	12%	18%	18%	18%	18%	18%	18%	18%	18%
Gas	11%	11%	11%	11%	11%	10%	10%	10%	10%	10%	10%	10%	10%

Sources: Excise Office of Customs and Excise Department of Cambodia, Wafa Fahmi Abdelati & Koji Nakamura, IMF, staff paper, 2005, and author's calculation.

Market forces and the economics of supply and demand determined the swings in the pump price of petroleum products distributed locally within Cambodia.While several countries in Cambodia's neighbourhood have until very recently provided or still provide subsidies for fuels, fuel taxation is important for Cambodia as a country which faces a hard budget constraint.

In terms of retail price, taxation appeared also to be very high in international comparisons, moving between 40-50% during 1998-2003. However, as can be seen from the Figure 8 above, taxation of oil products in percent of retail price has decreased since 2004, reflecting that retail prices moved faster than the tax rates.

Figure 8: Taxation of oil products as percent of retail price



7. Policy Responses to Higher Oil Prices

7.1. Fiscal Policy

When faced with rising oil prices, the policy intentions of the authorities are to contain aggregate demand for oil and to dampen eventually arising adjustment costs throughout the economy as industries, transports, etc., respond to higher energy prices. These secondary, or indirect, impacts occur when producers and service suppliers pass on some part of higher oil costs to the price of final goods and services. However, it should be noted that the Cambodian authorities continue to refrain from imposing price controls and continue to pursue a current pricing mechanism that allows prices to fluctuate according to the market forces to provide an appropriate signal to the economy.

Instruments to achieve the above-mentioned aims have included the general appeal to the private consumers and public entities to conserve energy and a continuation of the utilisation of the existing taxable base. The second measure aims to release price pressure on consumers through taxable bases maintained below the market price. Global oil prices have been on a constant rise for the last several years. Although administered prices are supposed to be the subject of review by customs in line with changes in the market prices, social considerations restrained the government from making further upward adjustments to the customs references values.

Table 9: Market Prices and Customs Reference Prices in Cambodia

USD/ton	Market prices[3] A				Cambodia's customs reference prices: B					A / B			
	2002	2003	2004	2005	2002	2003	2004	2005	2006	2002	2003	2004	2005
Gasoline	255	298	428	559	320	320	309	309	309	0.8	0.9	1.4	1.8
Diesel	218	260	358	501	275	275	267	267	267	0.8	0.9	1.3	1.9
Kerosene	221	259	370	525	230	230	230	230	230	1.0	1.1	1.6	2.3
Fuel oil	152	184	211	289	129	129	129	129	129	1.2	1.4	1.6	2.2
LPG	230	275	306	317	325	325	325	325	325	1.0	1.2	1.3	1.3

Source: Energy Policy and Planning Office of Thailand; Cambodia's CED

3 Petroleum import prices in Thailand are used as proxy for Cambodia's market prices.

Except for the price of gasoline and diesel in 2002 and 2003, customs reference prices in general, have been maintained well below market import prices. As can be seen from the illustration below, the impact on the domestic petroleum retail price would be much more intense if taxation were to be based on current market price.

Table 10: Price Structure for Gasoline (USD / Litre)

Based on customs reference value				Based on market value			
2005	Tax rate	Tax rate	Tax	**2005**	Tax rate	Tax rate	Tax
Import duties	35%	0.22	0.078	Import duties	35%	0.40	0.141
Additional Tax	0.02	0.30	0.020	Additional Tax	0.02	0.54	0.020
Excise	33.33%	0.32	0.107	Excise	33.33%	0.56	0.188
VAT	10%	0.43	0.043	VAT	10%	0.75	0.075
Total tax per litre			0.247				0.423
Market import price			0.402				0.402
After tax cost			0.649				0.825
Retail price in Phnom Penh			0.835				
Distribution margin			0.186				
Total tax in % of retail price			30%				51%

Given that total cumulative tax rates in terms of customs reference values have remained unchanged since the tax reform in mid-2002, annual customs revenue collection depends entirely on the quantity of petroleum imported into Cambodia during each reference year. Whereas the fuel sector may represent a heavy burden for the state budget in some countries which subsidise oil prices, presently the government of Cambodia has continued to secure a smooth run of the economy, the national budget, and the social sector.

7.2. Monetary and Exchange Rate Policy

Given countries' specific conditions, the increase in the global oil prices has caused different impacts on each individual economy. Net oil exporting countries may gain from the change but may also have to face the risk of currency appreciation, while net importing countries may find themselves confronted with internal and external imbalances or even move into recession. Sustained high oil price require the immediate attention of the concerned authorities and necessitate appropriate policy responses from them. In some countries, the authorities not only conduct fiscal and monetary policy adjustments to bring stability back in the price level, but they have even taken broader steps toward addressing the root causes of inflation through the adoption of various restructuring measures to deal with the supply/demand shocks in their respective countries. Nonetheless, structural measures such as policies to enhance efficiency in oil usage or to diversify the demand for energy will generally take a long time to implement before manifesting the desired effects. For the short-run, experiences in various economies have indicated that when a price shock suddenly raised the general price level, an inflation stabilisation policy led to monetary tightening by increasing the policy rate.

As has been indicated in the early sections of this Paper, the economy of Cambodia also experienced inflationary pressure during the period from mid-2004 to mid-2006. Like most other central banks in the world, the principal mission of the National Bank of Cambodia (NBC) is to maintain stable and low inflation. However, the high degree of dollarisation of the economy imposes constraints on monetary policy, because NBC's operations in local currency, the riel, have limited impact on monetary aggregates. The interest rate channel, which represents a key link in the transmission of the monetary policy by the monetary authorities or central banks in many countries around the world, is fundamentally absent. Furthermore, the economy is also characterised by a very thin financial market and a significant use of cash for transactions purposes, which clearly place further restraints on the transmission mechanisms of NBC's monetary policy since the channels are through the banks.

Therefore, attempts to control liquidity growth by NBC are severely hampered by the limitations of available policy instruments. Currently, in addition to restraints on credit to government and public enterprises, the most effective monetary instrument is the flexible use of foreign exchange market intervention to influence growth in riel liquidity and to smooth fluctuations in the exchange rate.

Cambodia has pursued a managed floating exchange rate system and has relied on a prudent monetary policy to ensure stability in the foreign exchange market. Given the current market environment, maintaining the stable value of the local currency is seen as a crucial means for achieving low and stable inflation.

Interventions in the foreign exchange market are used to smooth out the riel exchange rate fluctuations. Due to dollarisation, the supply of riel currency in circulation, (represented by the term *Currency Outside Banks* (COB)) through its link to domestic price levels and inflation rates, is closely linked to the exchange rates, and change in the supply of COB may eventually have immediate effect on the movements of the exchange rate.

As can be clearly observed in Figures 9 and 10, movements of the exchange rate broadly followed the pattern of the local currency in circulation, while price developments also largely reflect changes in local currency in circulation.

Over the period from the beginning of 2003 to mid 2004, currency outside banks grew on average by 20 percent, while the riel exchange rates against the US dollar depreciated about one percent annually. The inflation rate was broadly stable and low, moving in a range below three percent until the second half of 2004.

Figure 9: Exchange rate & currency outside banks

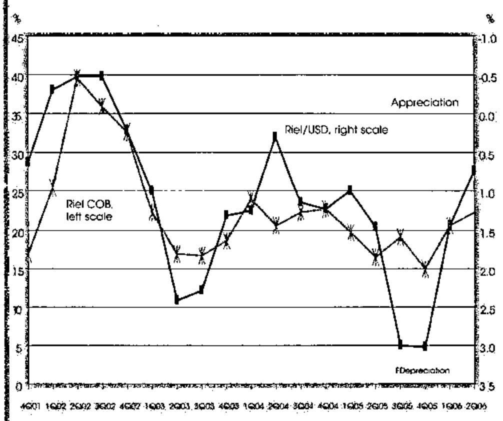
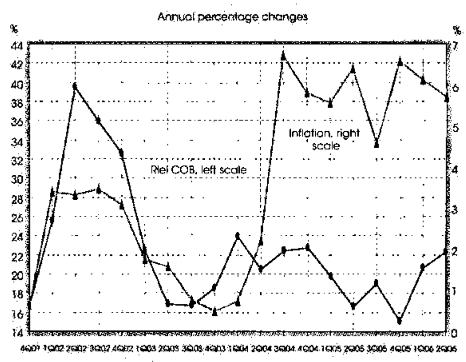


Figure 10: Inflation & currency outside banks



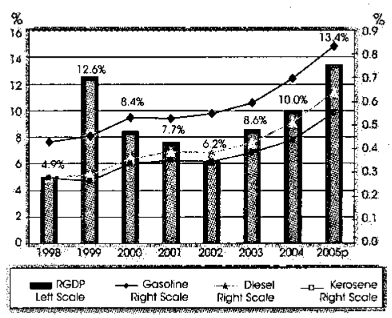
However, as can be seen from Figure 10, a remarkable divergence from the pattern of the close relationship between COB and inflation movements observed in the past period before the occurrence of the oil price hike became clearly obvious for the period since the third quarter of 2004 until the second quarter of 2006. During the latter period, despite the fact that the annual average growth rate of COB continued to fluctuate around 20 percent, the inflation rate as measured by the annual change in the three-month moving average CPI, recorded a high of about 6 percent.

Nevertheless, recent oil price increases seem not to have become a trigger for NBC to adopt a monetary policy stance differing from what has been pursued so far. In other words, it appeared that the central bank remained largely in a neutral stance and did not implement absorption of the local money supplied into the economy or tightening of monetary policy.

In fact, despite higher global oil prices, macroeconomic conditions in Cambodia have remained broadly stable:

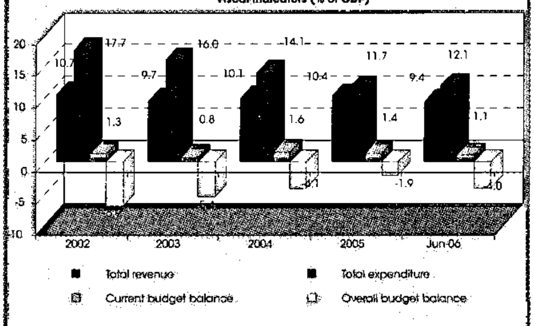
- Following a strong adjustment in mid-2004, when it reached 6.7 percent, the inflation rate as measured by the overall consumer price index has subsequently been contained, fluctuating between 5 - 6.5 percent in 2005 and during the beginning of 2006.
- The external position remained strong, with the deficit on current account to GDP ratio down to 9.5 percent in 2005 from 11.4 percent in 2000.
- The country's net international reserves continued to increase, up by about 12 percent annually during the period from 2003 to 2005, with momentum continuing into 2006. Meanwhile, debt service in terms of domestic exports of goods and services is estimated to have been kept at about one percent.

Figure 11: GDP & retail petroleum price



- Overall, the fiscal performance seems to be less affected by the oil price hike. Reflecting strengthened tax collection efforts, the government revenue-to-GDP ratio increased to about 10 percent in 2004 and 2005 from 9.7 percent in 2003. The fiscal position improved during 2004, and further in 2005, with a current account surplus and an overall budget deficit at 1.6 percent and -4.18 percent of GDP, respectively, in 2004 (1.4 percent and -1.9 percent in 2005).
- GDP growth in the last three years has been remarkable, rising above the average of the last decade, with growth in 2005 posted at 13.4 percent, largely driven by continued high export growth, healthy tourism receipts, robust construction activity, and strong agriculture production bolstered by favourable weather conditions and conducive government policies.

Figure 12: Fiscal Indicators



Source: Ministry of Economy and Finance of Cambodia

8. Conclusion

Overall, despite facing some inflationary pressure caused by high oil prices, various other key macroeconomic indicators available for the recent period since the beginning of the oil price increase have demonstrated that the Cambodian economy has remained broadly healthy. Though inflation has emerged, it has remained largely under control. Under this circumstance, there has been no strong case for NBC as the monetary authority in Cambodia, to force a reduction in aggregate demand to lead the inflation back to the level before the oil price rise. It should be noted that while the highly dollarised economy limits the capacity of NBC to control interest rates, the exchange rate policy has proved to be an effective instrument for price stability though the maintenance of stable value of the local currency. Since the stability of the local currency over recent period has been broadly sustained, and growth outlook remains optimistic, it seems appropriate for NBC to not restrain money growth and to continue to take a neutral and easy stance on money supply. Therefore, the local currency outside banks, an important monetary factor of change in inflation, is expected to maintain its normal current growth path.

However, although Cambodia is not regarded as fuel intensive country, with its presently insignificant consumption of energy by regional standards, it is obvious that over the next decade there will be a strong increase in domestic demand for oil in line with the increasing need of industrialisation and the potential growth of the economy. The combination of increasing demand and reliance on external supply sources (at least until domestic oil industry is established) will increase the potential adverse impact on the national economy from sustained increases in global oil prices and any disruption to oil supply. Therefore, due to the volatility in the global oil market, fiscal and monetary authorities need to remain vigilant and look out for appropriate solutions if and when the issue emerges.

With respect to structural measures, the recent discovery of offshore oil and gas would be a great blessing for the government and people of Cambodia. The successful development of indigenous oil and gas production could do much to reduce the country's reliance on oil imports and to transform Cambodia's economic situation by providing the needed resources to support the Cambodia's poverty reduction programmes. Moreover, diversification of energy sources to the extent applicable, is without a doubt another area of crucial importance in Cambodia's long-term strategy with respect to ensuring long-term energy security and reliability. A detailed energy master plan needs to be developed. However, all of these issues will require their own special attention and studies.

References

1. James D. Hamilton, (2005), Oil and the Macroeconomy, Department of Economics, 0508, University of California, San Diego, (August).
2. ADB: Asian Development Outlook 2005 Update, "The Challenge of Higher Oil Prices".
3. Ben S. Bernanke, Mark Gertler, and Mark Watson, (1997), "Systematic Monetary Policy and the Effects of Oil Price Shocks." *Brookings Papers on Economic Activity.*
4. Ben S. Bernanke, Mark Gertler, and Mark Watson, (200q4), "Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy: A Reply," *Journal of Money, Credit, and Banking*, Vol. 36, No. 2, 287–91.
5. Charles T. Carlstrom and Timothy S. Fuerst, (2005), "Oil Prices, Monetary Policy, and the Macroeconomy", Federal Reserve Bank Of Cleveland, *Policy Discussion Papers*, Number 10, (April).
6. Excise Office of Customs and Excise Department of Cambodia, International Trade Statistics, Various Issues.
7. Gerhard P. Metschies, International Fuel Prices 2005, 4th Edition – Federal Ministry for Economic Cooperation and Development.
8. Hamilton, James D., and Ana Maria Herrera, (2004), "Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy," *Journal of Money, Credit, and Banking*, Vol. 36, No. 2 (April).
9. Il Houng Lee, "Impact of Oil Price Increase in Vietnam and Policy Response", Seminar at the Institute for Price and Market Research, October 21, 2005.
10. IMF, "The Impact of Higher Oil Prices on the Global Economy", December 8, 2000.
11. International Energy Agency: "Analysis of the Impact of High Oil Prices on the Global Economy", May 2004.
12. Kingdom of Cambodia, Ministry of Industry, Mines and Energy: "Renewable Energy and Energy Efficiency", Conference Bonn, Germany, June 2004.
13. Lars E.O. Svensson, "Monetary-Policy Challenges, Monetary-Policy Responses to Oil-Price Changes"; Princeton University, CEPR, and NBER, January 2006.
14. Mork, K. A., (1989), "Oil and the Macroeconomy when Prices Go Up and Down: An Extension of Hamilton's Results", *Journal of Political Economy* 91, 740-744.
15. National Bank of Cambodia, Statistics and Economic Review, Various Issues.
16. Owen F. Humpage and Eduard Pelz, (2003), "Do Energy Spikes Cause Inflation?", Federal Reserve Bank of Cleveland, *Economic Commentary*, April 1.
17. Petroleum Pricing in Cambodia, Fifth Roundtable with Local and International NGOs, April 21, 2005, IMF Resident Office in Phnom Penh.
18. Wafa Fahmi Abdelati & Koji Nakamura, IMF, Staff Paper, 2005.

Chapter 3

THE ROLE OF OIL IN THE ECONOMY: THE CASE OF THE REPUBLIC OF THE FIJI ISLANDS

by Ariel Marr
Reserve Bank of Fiji

1. Country Background

The Republic of the Fiji Islands comprise over three hundred islands that lie in the South West Pacific, about 2000 kilometres north of New Zealand and between neighbouring island countries of Vanuatu and the Kingdom of Tonga. Fiji's land area in relation to its total area is just around 10 percent, reflective of the wide expanse that separates all its islands. The last census (1996) indicates that 94 percent of the population lives on the two main islands of Viti Levu and Vanua Levu.

With a population of around 800,000 and an estimated per capita GDP of around US$3,400, Fiji is one of the larger and economically developed island countries in the Pacific region. In spite of her smallness, Fiji has a good supply of natural resources and relatively skilled people, with her major sectors being agriculture, tourism and manufacturing (garments). Nevertheless, being a small and open economy, Fiji remains vulnerable to international shocks. Inherent attributes such as remoteness of geographic location, limited land resources, exposure to frequent and damaging natural disasters and a narrow production base, makes Fiji and her Pacific island neighbours all very vulnerable.

Fiji's population growth has averaged between one to two percent per annum in recent years, with a rise in the rural-urban drift becoming a key challenge. The Fiji economy has evolved since independence in 1970 when the agricultural sector was a much larger contributor to economic growth and foreign reserves earnings. As years have progressed since then, a light manufacturing sector has sprung up together with an even larger tourism industry. The growth in manufacturing and the services sector and the diminishing role of the agricultural sector has inadvertently affected Fiji's vulnerability to international shocks such as the persistent oil price hikes since mid-2002.

2. The Energy Sector in Fiji

Being a small island nation with unique geographical characteristics has played an important influence in the supply, regulation and demand of energy in Fiji.

2.1. Energy Supply and Demand

Given a growing urban population and the growth of the industry and services sectors, energy demand in Fiji has been growing at unexpected rates over recent years. This increase in demand of energy has placed Fiji in a vulnerable situation given its limited capacity in the provision of energy.

Fiji's primary energy supply are from **biomass** (fuelwood and woodwaste, coconut residue, bagasse), **hydro, wind, solar, coal** and **petroleum products**. Latest data from a 2000 survey, indicates that total primary energy supply in Fiji from **indigenous sources** (fuelwood and wood waste, coconut residue, bagasse and hydro) was around 54 percent, while the remaining 46 percent (coal and petroleum products) was **imported** (Table 1). The imported energy such as coal and petroleum are bought largely from Australia, New Zealand and Singapore.

Some of the primary energy supplies like biomass, hydro, wind and petroleum products are converted to produce a final energy supply for consumption like electricity, while some of them are actually consumed as a final energy supply (wood, coconut residue, coal, petroleum products).

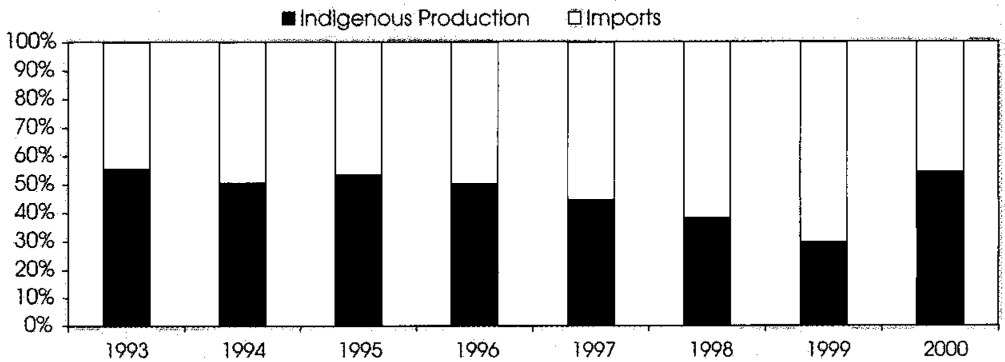
Table 1
Primary Energy Supply (Terajoules)

YEAR	Indigenous Production				Imports			TOTAL
	Wood	Baggase	Hydro	Total	Petroleum Products	Coal	Total	
1993	3635.5	7333.7	1363	12332.2	465.2	9422.9	9888.1	**22220**
1994	3669.8	8406.1	1399	13474.9	398	12793.4	13191.4	**26666**
1995	3712.3	8475.5	1384	13571.8	60.3	11771.7	11832.0	**25404**
1996	3732.0	8648.3	1314	13694.3	34.9	13540.0	13574.9	**27269**
1997	3780.5	7140.6	1454	12375.1	38.9	15283.8	15322.7	**27698**
1998	3827.7	3739.3	1505	9072.0	71.1	14639.8	14710.9	**23783**
1999	3861.6	7528.0	1620	13009.6	41.3	30857.9	30899.2	**43909**
2000	3908.7	7247.6	1492	12648.3	0.6	10684.4	10685.0	**23333**

Source: Energy Statistics Year Book, 1993 – 2000, Department of Energy

Imported energy was forming an increasingly larger share of the total primary energy supply in Fiji throughout the 1990s (Chart 1). In 2000, political instability led to an economic downturn and so a switch to the use of more indigenous sources was noted. Nevertheless, the strong growth in import of fuels since 2000 suggests that the growing dependence on imported energy, in particular petroleum products, is on the rise. This development is of concern for the Fiji economy because of it smallness and the fact that it has little recourse to find alternative fuel products when faced with oil price shocks.

Chart 1: Primary Energy Supply: Indigenous Production vs. Imports



Source: Energy Statistics Year Book, 1993-2000, Department of Energy

Hence, it is necessary to understand the nature of energy demand in Fiji. The three main consumers of energy in Fiji are the industrial & commercial, the transport and the residential & community sectors (Table 2). Final energy products consumed by these three sectors are coal, wood fuel, petroleum products and electricity. The industrial & commercial sector consumes coal, petroleum products and electricity, while the transport sector mainly consumes petroleum products. The residential & community sector's main energy supply are from electricity, fuelwood and coconut residue.

Table 2
Final Energy Consumption (Terajoules)

Year	Industrial & Commercial	Transport	Residential & Community	Agriculture	Government	Non-energy	Total
1993	3170	6751	3842	662	629	202	**15256**
1994	3192	8783	4003	668	606	235	**17487**
1995	2785	7592	5258	676	594	185	**17090**
1996	2769	8248	4210	679	659	248	**16813**
1997	2668	9515	4296	688	626	232	**18025**
1998	2553	10367	4380	696	593	731	**19320**
1999	2887	13331	4476	702	522	240	**22158**
2000	2407	8586	4159	710	577	464	**16903**

Source: Energy Statistics Year Book, 1993 – 2000, Department of Energy

The largest final energy consumer is the transport sector. This is partly due to classification reasons, as the sector includes all energy consumption for transport purposes which covers domestic, commercial and government transportation. This sector is the main consumer of petroleum products as a final energy supply source.[1] The growth of energy consumption by the transport sector during the 1990s is aptly explained by the growth in the number of vehicles as well as the increase in international shipping and flight services into and out of Fiji during those years.

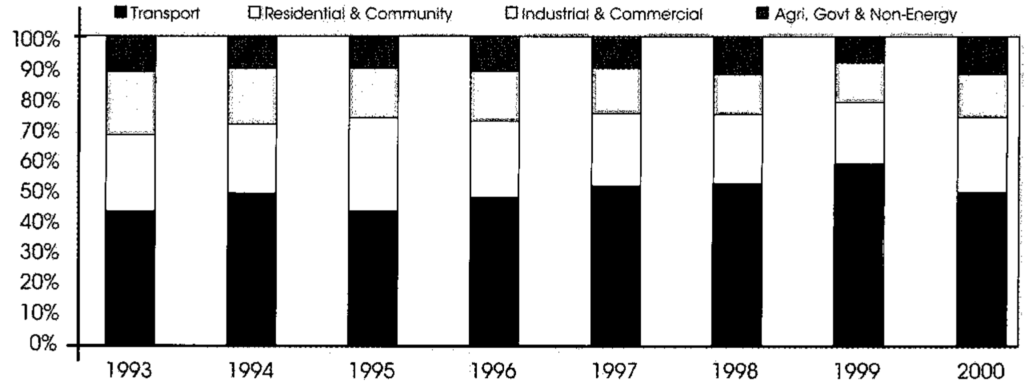
The second largest consumer of energy is the residential & community sector, which consumes energy mainly for the purpose of lighting, cooking and other household appliance use.[2] This sector's energy usage has also been growing and it generally reflects the increasing rural-urban drift as well as a growing middle-income class which typically leads to a greater need for lighting and usage of electrical household appliances (lamps, TVs, fridges, toasters, blenders, vacuum cleaners, lawn mowers).

The third largest consumer of energy, the industrial & commercial sector, has been showing a decreasing appetite for energy over the 1990s. This trend could have changed since 2000 as the construction and tourism industry has been on the increase over the last 5 years, thus possibly raising the demand for final energy (both electricity and petroleum products). However, the last 5 years have also seen the decline of the gold and manufacturing (especially garments) sectors, which most likely has offset to some extent the higher demand for fuel in the other sectors.

1 Final energy supply is that which is consumed in the course of everyday economic activity by both firms and private individuals. This is quite distinct from primary energy supply which goes through a conversion process to produce final energy supply. Products such as petroleum products can be used as both for final energy consumption to fuel vehicles and machinery or as a primary energy supply to be used to covert to a final energy supply like electricity.

2 Excludes energy consumption for transportation as it is already captured under the transport sector.

Chart 2: Final Energy Consumption by Sectors



Source: Energy Statistics Year Book, 1993-2000, Department of Energy

From a macroeconomic viewpoint, the growth in final energy demand is reflective of increased economic activity in Fiji. This is indeed true as consumer demand has been on a steep climb since 2001, supported by higher wage and salary increments, an increase in personal remittances and easy and cheap access to credit. Furthermore, in spite of the decline in industrial and manufacturing activity over the last decade, the services sector has grown quite strongly and now accounts for the largest share of Fiji's gross domestic product (GDP). This has ultimately led to a higher demand for electricity in terms of final consumption.

2.2. Energy Sector Institutions and Regulation

The smallness and remote location of the Fiji economy has shaped the supply, regulatory framework and management of the energy sector. The lack of economies of scale and distribution challenges posed by isolated and dispersed population centres, makes the provision and distribution of energy very difficult.

The Fiji government is the main supplier of electricity via the **Fiji Electricity Authority (FEA),** a commercial statutory authority responsible for urban, peri-urban and rural grid electricity supply. The Electricity Act (Cap. 180) gives the FEA its statutory authority to secure the supply of energy at reasonable prices and to advise the Energy Minister on all matters relating to the generation, transmission, distribution and use of energy. FEA supplies electricity through the national grid with its main source for national power supply from the Monasavu Hydro Scheme. Over recent years, the demand for electricity has grown substantially such that electricity consumption has surpassed the capacity of the Monasavu Hydro Scheme. As a result, FEA has begun supplementing its generation capacity with diesel generation. Currently, FEA has a total installed capacity of about 170 MW of which 57 percent comes from diesel and the remaining 43 percent from hydro. FEA also purchases surplus electricity from the **Fiji Sugar Corporation (FSC), Tropik Woods Ltd.** and **Emperor Gold Mines (EGM),** which are all independent power producers that are engaged in co-generation (produce energy for their use in their own plants and sell off surplus electricity to FEA).[3]

Electricity consumers that are far from the national grid are catered for through stand-alone diesel systems or through renewable energy systems such as solar photovoltaic home

3 FSC produces its electricity from its bagasse waste that comes out of its sugar mills, while Tropik Woods generates thermal electricity from the burning of wood waste from its mills. EGM produces electricity from diesel generators.

systems. These are typically for remote rural communities on the two main islands as well as for those villages and settlements on the smaller outer islands. The **Rural Electrification Unit** under the **Department of Energy (DOE)** is responsible for rural electrification programme.[4] The Rural Electrification Policy (1993) provides the guidelines for the provision of electricity to rural areas, under which any village or settlement is entitled to request government assistance for electricfication. The **Public Works Department (PWD)** is the government department that, amongst other responsibilities, manages extension of mini grids from government stations.

In terms of regulation of the electricity sector, the **Commerce Commission** is established with a statutory mandate through the Commerce Act to independently authorise adjustments to FEA's tariff and oversee non-discriminatory access to FEA's grid. However, FEA is also involved with non-commercial activities like technical regulation and licensing as well as the monitoring of operators and safety standards. At the moment, there is no independent utilities regulator in Fiji that carries out these non-commercial services. The **Ministry of Public Enterprises** oversees the business performance of FEA as a state owned enterprise and has broad regulatory powers to scrutinise FEA's corporate plan and statement of corporate intent.

Aside from electricity, the other primary and final energy source is petroleum products. International oil companies such as **Total (Fiji) Ltd, Mobil Oil Fiji** and **BP South-West Pacific Ltd** supply fuel products such as diesel, gasoline and other products. Also, liquid petroleum gas (LPG) is imported and distributed by **Fiji Gas Limited** and **BlueGas** who are the main suppliers of gas for industrial, commercial and residential users. Furthermore, **BOC (Fiji) Limited** is the only supplier of gases for industrial, medical and laboratory applications.

Regulation of the fuel market is handled by the **Prices and Incomes Board (PIB)** via their powers mandated in the Counter-Inflation Act. The PIB regulates wholesale and retail prices of motor spirit (i.e. gasoline or petrol), kerosene and automotive diesel oil and influences to some degree the technical specification of fuels. The international oil companies in Fiji apply their respective internal technical regulation and safety standards.

2.3. National Energy Policy Development

In efforts to develop a national energy policy, the Department of Energy conducted an examination of all the legislation in the energy sector. This stock take revealed that an appropriate legal and institutional framework largely exists for the smooth and proper functioning of the energy sector. However, it was noted that the regulatory powers tend to be discretionary and regulatory bodies lack the capacity in terms of resources and staff complement to provide effective regulatory services.

For a long time, Fiji was without a national energy policy that provided an overarching direction for all the various stakeholders in the energy sector. Each regulatory agency and energy supplier operated within the framework of their respective legislations but without an integrated approach that could ensure optimum utilisation of energy resources.

In the Strategic Development Plan (SDP)[5] for 2003-2005, the energy sector goal of the Fiji government was "to facilitate the development of a resource efficient, cost effective and environmentally sustainable energy sector" and one of the key indicators of energy sectors objective was the formulation of "a comprehensive national energy policy to address renewable energy, effectively and affordably, and with environmental sustainability". Out of

4 While the DOE is responsible for rural electrification, FEA is involved with some rural electrification programmes which are conducted on a cost sharing basis with government. Wherever technically and economically feasible, Fiji's National Energy Policy states that extensions of the existing FEA grid will be used as a means of rural electrification.

5 The SDP is the Fiji government's development plan which is developed after wide ranging consultations in the private sector, amongst non-state actors and within government ministries and departments. It serves as a guide in government decisions making and budget preparation.

this direction, the **National Energy Policy (NEP)** was developed. The NEP focuses on:

1. **National Energy Planning** - this involves the institutional strengthening of the DOE, development and review of appropriate frameworks, coordination and consultation with the energy sector and other sectors as well as the management of energy information;
2. **Energy Security** - ensuring stable and adequate energy supplies to the country through diversifying Fiji's energy base and developing renewable energy resources and other alternative fuels and encouraging energy conservation and efficiency in energy production, conversion and use;
3. **Power Sector** - ensuring that the entire population has access to electricity through extension of the FEA grid network, stand-alone systems of the DOE and extensions from government stations by the PWD; and
4. **Renewable Energy** - increasing the use of affordable and appropriate renewable energy technologies.

The DOE is the agency tasked with the responsibility for implementing the NEP and ensuring that the policy objectives are achieved. [6]

3. Oil Dependency

Energy intensities in Fiji, measured by the ratio of primary energy requirement to GDP, have been exhibiting an interesting trend. During the 1990s, it seemed that the amount of energy necessary to produce one unit of GDP has been on a declining trend (Table 3). When considering petroleum in particular, it is obvious that the petroleum intensity has also been falling from 1993 to 2000, while during the same period, the electricity intensity has remained unchanged. This indicates that the Fiji economy has become less energy intensive over the 1990s decade. However, the fact that energy supply and demand have both been on the rise in the same period suggests that the usage of energy especially petroleum products was more efficient with less wastage. This is a reasonable conjecture given the fact that more energy efficient technologies have been introduced in the market since the 1990s and even cleaner and better fuels have also improved the mileage per litre.

Table 3
Fiji's Energy Intensity (Ratio to GDP)

Year	Total Energy Intensity	Petroleum Intensity	Electricity Intensity
1993	13.1	5.8	1.0
1994	14.9	7.4	1.0
1995	13.8	6.4	0.9
1996	14.4	7.2	0.9
1997	14.7	8.1	0.9
1998	12.5	7.7	0.9
1999	21.0	14.7	0.9
2000	11.5	5.3	0.1

Source: Energy Statistics Year Book, 1993 - 2000, Department of Energy

6 The DOE works very closely with the various line departments in government and organisations outside of government in pursuing the policy objectives.

While hydro and biomass are significant primary sources for energy in Fiji, petroleum products remains the single most important energy source because it is used both as a primary and final source of energy. With low rainfall experiences over recent years, petroleum is increasingly being used to produce electricity and is also consumed as a final energy product.

As such, without any indigenous source of fossil fuels, Fiji is a net importer of oil. In fact, Fiji does not have any refining capacity, hence only refined petroleum products are imported. The petroleum is primarily bought by the three international oil companies (Total, Mobil and BP) that are based in Fiji from refineries in either Australia or Singapore, but more recently from Singapore. The petroleum is brought to Fiji and stored at the various oil companies' depots for delivery around Fiji or to be re-exported to other South Pacific island nations that are serviced by the three oil companies.

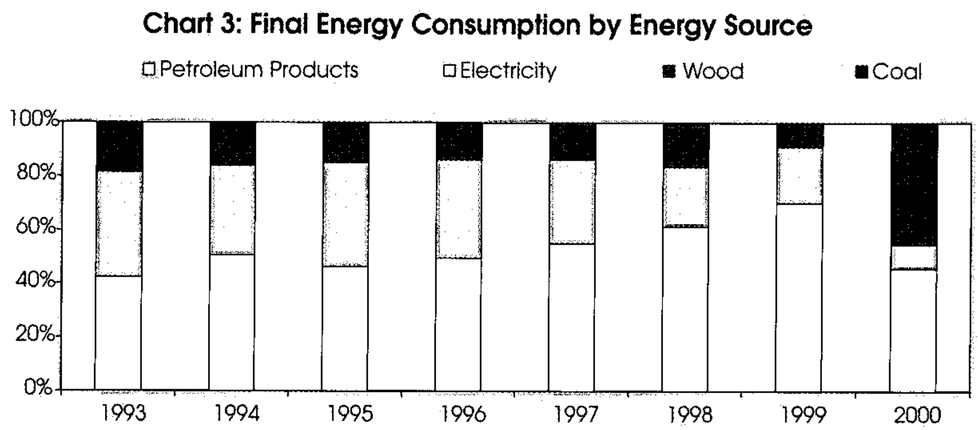
The domestic fuel market in Fiji is characterised by a high vertical integration, as the oil companies provide the entire infrastructure for product delivery to end-user customers in Fiji. The oil companies own the petrol stations, pump equipment and delivery vehicles. While there are no independent operators of petrol stations, the oil companies lease out their petrol stations to private operators at different rates of rental, depending on the annual turnover at each station. The private operators sell retail fuel from their rented petrol station at a fixed mark-up.

The oil companies also supply fuel to large industrial and commercial users. Amongst the industrial and commercial users in Fiji, the largest consumers of fuel are the transport, manufacturing, mining & quarrying and building & construction sectors. Aside from this, the FEA and the government are also large consumers of fuel for their diesel generators in the provision of electricity. All this makes fuel imports a major component of the country's total import bill. Furthermore, the pattern of energy demand in the 1990s and post 2000 reveals a growing demand for energy derived from imported petroleum. In fact, consumption of petroleum products is growing relatively faster than consumption of other energy sources such as electricity (hydro and thermal only), coal and wood (Table 4 and Chart 3).

Table 4
Final Energy Consumption by Energy Source (Terajoules)

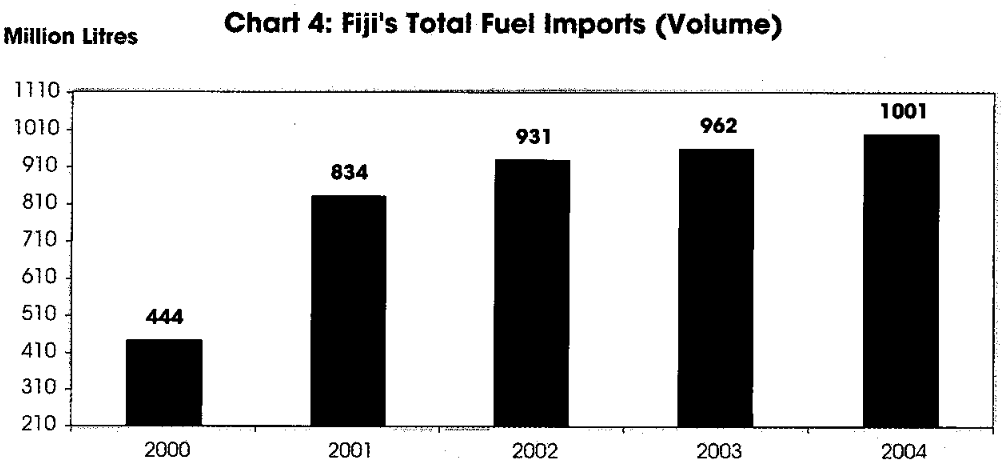
Year	Coal	Petroleum Products	Electricity				Wood	Total
			Diesel	Hydro	Baggase	Total		
1993	465.2	9,422.9	26.3	1,363.3	7,333.7	8,723.3	3,635.5	22,246.9
1994	398.0	12,793.4	26.6	0.0	8,406.1	8,432.7	3,669.8	25,293.9
1995	60.3	11,771.7	20.3	1,384.1	8,475.5	9,879.9	3,712.3	25,424.2
1996	34.9	13,540.0	25.2	1,314.2	8,648.3	9,987.9	3,732.0	27,294.6
1997	38.9	15,283.8	23.9	1,453.7	7,140.6	8,618.2	3,780.5	27,721.4
1998	71.1	14,639.8	25.2	1,504.5	3,739.3	5,269.0	3,827.7	23,807.6
1999	41.3	30,832.1	25.8	1,619.5	7,528.0	9,173.3	3,861.6	43,908.3
2000	0.6	10,666.5	17.9	1,491.8	7,247.6	7,247.6	3,908.7	23,333.1

Source: Energy Statistics Year Book, 1993 – 2000, Department of Energy



Source: Energy Statictics Year Book, 1993-2000, Department of Energy

While energy consumption data after 2000 is still unavailable, one can safely assume from recent data on fuel imports (in terms of value and volume) that petroleum is probably growing in terms of its share of the final energy consumption market. In fact, evidence from fuel import data from 2000 to 2004 suggests that the ratio of imported energy, namely petroleum products, have been taking an increasing share of the primary energy supply market (Chart 4). Total annual fuel imports increased by around 125 percent in terms of volume (litres).



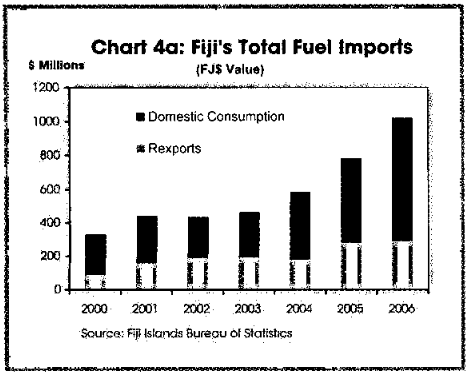
Source: Department of Energy

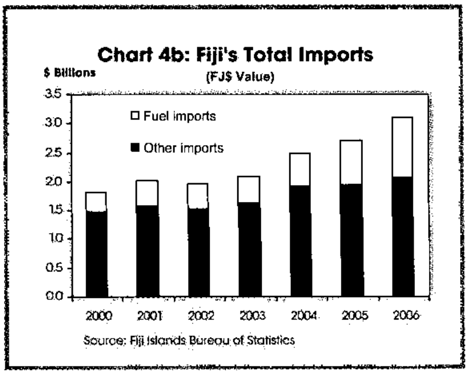
Fiji has no influence on world market prices, minimal room to influence retail prices through fiscal measures and no local substitutes for fuel, making the leading economic sectors heavily exposed to price volatility. As such, policy makers have recognised that Fiji's growing dependency on oil has to be addressed. Hence, there is a growing appreciation for the need to develop viable and affordable forms of renewable energy. There is some belief that renewable energies are in many cases the least cost energy service, especially when social and environmental costs are taken into account.

In support of this belief, the government of Fiji is committed to providing focussed support for the development, demonstration and applications of renewable energy (NEP 2006). However, these well-placed intentions of the government are faced with certain obstacles related to policy, regulation and financing. The pursuance of NEP objectives is expected to help towards bringing an integrated approach for raising Fiji's renewable energy sources. In fact, Fiji and other neighbouring island countries in the region are targeting to achieve 15 percent of the primary energy supply from renewable energy sources by 2010.

The lack of renewable energy alternatives and the associated high dependency on imported oil is accentuated during the current climate of high and volatile global oil prices. The oil price hikes that had begun in mid-2002, have had clear and direct effects on the Fiji economy.

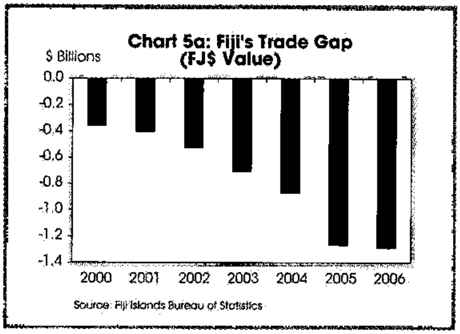
Firstly, a worsening of Fiji's **terms of trade** has become evident as the cost of oil in national income is on the rise. There is an increasing dependence on imported oil and there are no other alternatives for end-users.

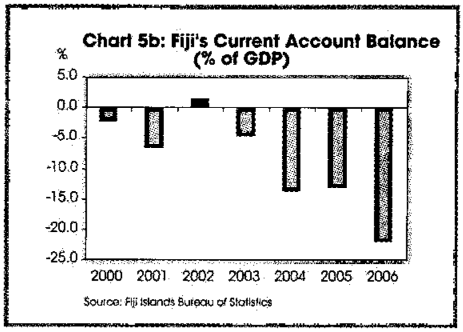




As a result, the total imports for the Fiji economy has burgeoned over the last four years as the total imports bill are increasingly being made up of fuel imports. By 2006, fuel imports made up around 33 percent of total imports, compared to about 22 percent in 2002.

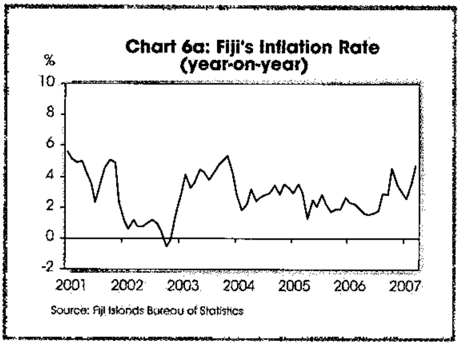
The growing import bill coupled with a poorly performing exports sector has led to a gradual widening of the trade balance as well. Fiji's trade gap grew from around $528 million in 2002 to an estimate of $1.3 billion in 2006. The 144 percent growth in the trade gap from 2002 to 2006 has, to some extent, contributed to a deterioration Fiji's balance of payments (BOP) (Chart 5b).

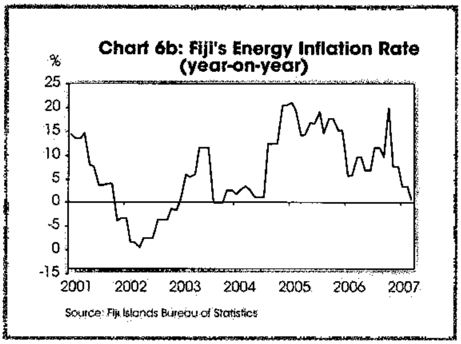




Aside from BOP concerns, the oil price shocks have also had an impact on inflationary pressures in the country. Increases in the international oil prices have had a direct impact on Fiji's inflation. Domestic energy prices (gasoline, diesoline, kerosene, cooking gas and electricity) have a weight of about 7.3 percent in the consumer price index (CPI). International oil price hikes and volatility have been transmitted into domestic inflation but on a lagged basis because the PIB reviews and changes the price of certain fuel products every two months.

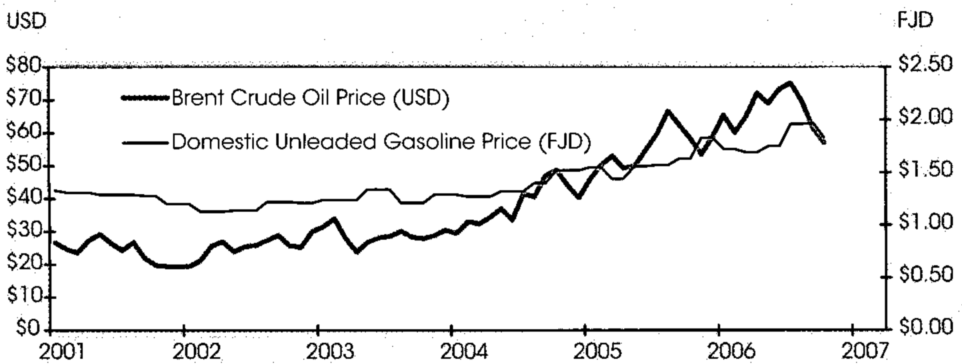
Nonetheless, inflation has remained quite low and stable over the last 5 years at an average of around 2.5 percent. This is partly due to the fact that the transmission of international fuel price movements into domestic fuel prices tends to be almost symmetrical for both increases and decreases global prices. The other main reason is that Fiji's fixed exchange rate regime also provides for much of the stability in Fiji's inflation.





Still, there is some reservation that the pinch of the international oil price shocks on inflation has yet to come in the form of second-round effects. Since the oil price hikes started in 2002, second-round effects of the increase in local energy costs have been virtually non-existent. The main reason for this has been due to controls on prices of services provided by certain large consumers of fuel, namely the transport industry and FEA. These industries have not been able to pass on the cost of the increase in domestic fuel onto their customers and hence the secondary effects have been stalled.

Chart 7: International Oil Price and Domestic Fuel Price Comparison



Source: Prices and Incomes Board and Bloomberg

4. Domestic Fuel Retail Price Mechanism

Like other small island economies, Fiji is a price taker in the global fuel market and faces an oligopolistic domestic price structure i.e., the presence of very few suppliers (Rao 2005). As such, a price control regime is in place whereby the PIB regulates the price of fuel to prevent possibility of the three oil companies exercising their market power to charge higher prices than they would be in a perfectly competitive market. The large number of firms and individuals that are heavily dependant on fuel provides a very strong basis for price fixing in Fiji.

At this point, it must be noted that there is a dichotomy in the fuel market in Fiji. One segment of the fuel market is unregulated. This segment includes all the large commercial, industrial, marine and international consumers of fuel such as government, FEA, FSC, EGM, Inter-Island Shipping, fishing companies and bus companies. Some of these industrial and commercial users benefit from government subsidies in the form of lower rates of fiscal duty. The other segment of the fuel market is the regulated segment where PIB price controls apply. The price controls are applicable to drum sales, wholesale rates ex-terminal, and retail petrol station prices.

The PIB reviews the price controlled segment of domestic fuel market every two months using a price fixing formula called the Petroleum Pricing Template (PPT). The PPT takes into consideration the various supplier costs before setting a new price. If the suppliers' costs have generally gone up, then the price of domestic fuel on the retail market will go up and if the supplies costs have generally reduced, then domestic fuel prices will be lowered. The factors that are considered when considering the suppliers costs are the free on board prices of fuel from Singapore, freight, insurance, the exchange rate, demurrage and losses, operating costs, fiscal duty, tax paid to government, distributional costs and a return on investment for the oil companies.

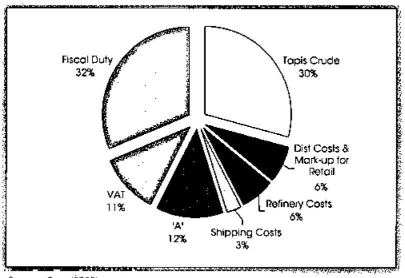
Rao attempted to broadly estimate the structure of fuel prices in Fiji. His data on fuel pricing was drawn from published sources and his own extrapolations. He carried out his estimations on the price of the two most widely used fuels in Fiji: unleaded petrol and diesoline. His analysis showed that almost 40 percent of the cost of unleaded petrol and slightly more than 45 percent of the cost of diesoline are determined in the global markets which are beyond Fiji's control. However, there is some control over the other portion of the costs by adjusting fuel taxes or by influencing the market power of the oil companies. In fact, based on Rao's estimates, the total tax collected from levies on fuel make up around 43 percent of the unleaded fuel retail price and 29 percent of the diesoline retail price. Since fuel in Fiji has no other viable substitutes, it is safe to assume that the taxes charged on fuel, both specific and ad-volarem, are passed directly onto consumers.

Table 5
Fuel Price Structure in Fiji
(main centres on the island of Viti Levu)

Costs per litre	Unleaded Fuel		Diesoline	
	($)	%	$	%
Tapis Crude	0.41	29.4	0.41	39.8
Refinery Costs	0.09	6.7	0.05	4.6
Shipping Costs	0.04	2.9	0.02	1.9
Fiscal Duty	0.44	31.4	0.18	17.5
'A'	0.174	12.4	0.186	18.1
Value Added Tax	0.156	11.1	0.114	11.1
Distribution Costs & Mark-up for Retail Outlets	0.09	3.5	0.07	6.8
Final price (as per Oct-04)	1.40	100	1.03	100

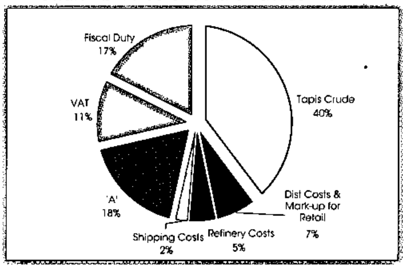
Source: Rao, G, Fuel Pricing in Fiji, USPEC Working Paper No. 2005/5.

Chart 7a: Price Structure - Unleaded Fuel



Source: Rao (2005)

Chart 7b: Price Structure - Diesoline



Source: Rao (2005)

Oil companies purchase refined petroleum products from Singapore and have them transported by bunkers to their main depots in Suva and Vuda. At this stage, the cost of fuel already includes its refinery costs and conveyance costs such as insurance and freight. On entering Fiji, a fiscal duty is charged at a rate of 44 cents per litre of unleaded petrol and 18 cents per litre of diesoline. Then the oil companies charge a mark-up rate that caters for their administrative and distribution costs as well as ensuring that a reasonable return on investment is made. At the retail end, value added tax (ad-valorem) of 12.5 percent is charged.

5. Policy Responses to Higher Oil Prices

The impact of the oil price shocks since mid 2002 has had some implications on the Fiji economy. These shocks and their ensuing effects have come at a time when Fiji has been faced with other critical challenges such as an unsustainable growth in consumer demand, slow investment, very poor export performance and growing government debt levels. These factors, together with the oil price shocks, have thus led to a widening trade balance and a deteriorating balance of payments position (BOP). While the oil price shocks are not the root and cause of the pressure on the BOP, the absence of the oil price shocks would have meant that the pressure would have been considerably less than what is currently being experienced, especially with imported fuel now making up one third of the total import bill for Fiji.

As such, both government and the Reserve Bank of Fiji (RBF) have been instituting various policy decisions over the last three years in order to address the pressure on the BOP. A clear distinction must be made at this stage. Policy actions by both government and the RBF were directed at addressing Fiji's BOP and not specifically towards addressing the impacts of the oil price hikes. It is understood that the oil price hikes did have a role in placing undue pressure on the BOP but it is also acknowledged that the BOP pressures also emanate from a long standing issue of poor exports performance and a more recent consumer demand driven growth.

Government in particular, has been developing an integrated and comprehensive National Exports Strategy, in order to address the narrow export base, thus raising Fiji's exports. There has also been a deliberate attempt by government at fiscal consolidation in order to reduce the national debt and secure long term sustainable growth. These policy actions however, will take some time before their effects are seen.

However, from a sector-specific viewpoint, the government is working towards a medium term target of reducing vulnerability on imported petroleum products. The DOE and FEA are committed to exploring possibilities of developing viable renewable energy alternatives that will ultimately reduce the dependency on oil imports in the medium term.

The Reserve Bank of Fiji (RBF) has also delivered a range of policy actions over the last 4 years. Since 2004, the RBF had been raising interest rates in order to rein in the strong growth in credit, which is believed to be supporting consumer demand and imports growth. In 2006, the RBF also raised the Statutory Reserve Deposit (SRD) ratio in order to tighten liquidity in the banking system and hence, improve the responsiveness of commercial bank interest rates to the money market interest rates. The results of these policy decisions are still being seen, but in a nutshell, interest rates have risen, and more recently, commercial bank credit has been slowing. The Bank has had to play a balancing act in raising the cost of borrowing to a sufficient level that will slow consumer borrowing but not a large enough extent so as to impede investment borrowing.

However, the ultimate impact of all these policy actions on easing the pressure on BOP remains to be seen. The RBF has also introduced various other policy measures in response to political developments in recent months. However, these further policies and their surrounding issues are outside the scope of this Paper and cannot be adequately covered here.

6. Concluding Remarks

Energy facilitates economic growth and prosperity and therefore, energy security is an important part of development. Small and vulnerable island economies like Fiji are inherently faced with high oil dependency. It is therefore critical that the issue of oil dependency is considered within the entire framework of economic development rather than merely an energy sector issue. Fiji has already seen how its increasing oil dependency since 2000 has negatively impacted its terms of trade, trade balance, BOP and to a lesser extent inflation, as oil price shocks came into play.

With the type of influence that energy has on macroeconomic variables, the National Energy Policy is quite critical in securing a sustainable future. Ultimately, a more effective solution to minimising the impact of oil price shocks is reducing the dependency on imported petroleum products in favour of indigenous renewable energy. This is because direct policy decisions of the central bank are merely for demand management purposes rather than influencing the country's dependency on oil.

References

1. Bakker, M.L., (2000), 1996 Fiji Census of Population and Housing, Fiji Islands Bureau of Statistics, *Parliamentary Paper* No. 51.
2. Currie, C., (1996), "Energy Efficiency and Energy Intensity", University of the South Pacific, *Journal of Pacific Studies*, Vol. 19, 1996.
3. Department of Energy, (2006), National Energy Policy, Ministry of Energy and Mineral Resources.
4. Department of Energy, (2003), Energy Statistics Year Book 1993-2000, Ministry of Energy and Mineral Resources.
5. Dr Rosillo-Calle, F, (2006), Synthesis Report for the Island Nations of Fiji, Kiribati, Samoa, Tonga, Tuvalu & Vanuatu, "Consultancy for: Biomass Resource Assessment, Utilisation and Management for Six Pacific Island Countries to the South Pacific Applied Geoscience Commission (SOPAC)", SOPAC Technical Report No. 370.
6. Fiji Electricity Authority, (2006), Project Information Document (PID) Appraisal Stage, Report No. AB2584.
7. Fiji Electricity Authority, (2006), Annual Report 2005.
8. Hamilton, J.D., (2005), "Oil and the Macroeconomy", University of California, *San Diego Department of Economics Working Paper* No.0508.
9. International Energy Agency, (2004), Analysis of the Impact of High Oil Prices on the Global Economy.
10. Ministry of Finance and National Planning, (2002), "Rebuilding Confidence for Stability and Growth for a Peaceful, Prosperous Fiji", Strategic Development Plan, 2003-2005.
11. Pacific Islands Forum Secretariat, (2006), "Import Management/Petroleum Advisory Services, Trade and Investment Programme".
12. Prices and Incomes Board, (2006), "A Review of Petroleum Pricing Instrument 1: The Bimonthly Restatement of Petroleum Prices", Public Consultation Document PCD 06-01.
13. Rao, B.B. and G. Rao, (2005), "Crude Oil And Gasoline Prices In Fiji: Is the Relationship Asymmetric?", University of the South Pacific, *Department of Economics Working Paper* No.2005/9.
14. Rao, G., (2005), "Fuel Pricing In Fiji", University of the South Pacific, *Department of Economics Working Paper* No.2005/5.
15. __________ (2004), "Pacific Islands Energy Policy", The Committee of Regional Organisations of the Pacific.

Chapter 4

OIL DEPENDENCY AND ENERGY POLICY IN INDONESIA

by Ferry Syarifuddin[1]
Bank Indonesia

1. Introduction

1.1. Background

Oil as the primary energy source is becoming one of the crucial issues since oil crises erupted in 1970s. Oil price has been fluctuating since then, influenced by a variety of factors, some of which are not governed by market fundamentals, such as geopolitics, natural disasters and refinery constraints. This condition has been worsened by rising concerns of energy supply availability in the near future as oil reserves are decreasing substantially. While consumers are concerned about security of supply, producers are also worried about the future of demand uncertainty and the underlying risk of making investment capital available without having a clear picture of the extent of the world's future energy needs. Oil producers are also concerned about the role of speculative buying in the market which has tended to push prices to levels not justified by supply and demand fundamentals. This has ultimately led consumers, supported by the government, to look at energy alternatives to decrease dependence on fossil fuels even as they continue to be the cheapest and most readily available energy resource, and will remain so for the foreseeable future.

All the above have raised concern about energy security. Energy security is viewed differently by different people, depending on where one stands. OPEC, which holds two-thirds of global proven oil reserves, insists that there is still sufficient oil to meet the world's needs in the years ahead. OECD countries will continue to account for a significant share of forecasted demand although almost 80 percent of future demand growth is predicted to come from the developing countries, mainly China and India.

Concern over security of supply stretches beyond the upstream sector to incorporate the entire oil supply chain, including refining. Besides being committed to ensure adequate crude oil supply, consumers must also be supplied with the refined products demanded. A definite correlation exists between crude oil and petroleum product prices to the extent that refinery bottlenecks have driven up crude oil prices. This recognition clearly demonstrates that the task of ensuring energy security is the responsibility of all countries (producers of crude and refined oils and consumers who are expected to use energy efficiently).

It is realised that crude oil will continue to play a central role in spurring world economic growth for the coming decades. This has raised concern over growing oil dependency in the future and in trying to find alternative energy sources instead of fossil fuels. Co-operation and dialogue among producers, consumers, investors, and governments, is the key to cheaper and sustainable energy availability. Nowadays, increasing interdependence of nations reinforces the issue of energy security co-ordination. The role of fossil fuels (oil based) in the global energy mix will continue to dominate discourses on energy and development in the future. Efforts to reduce oil dependency have to be taken seriously by all parties (led by the government) as fossil oil reserves are decreasing substantially. One good suggestion is to find and to develop alternative energy to reduce fossil fuel dependency.

1 Economist at Economic Research Bureau-Bank Indonesia.

The Indonesian government takes the concerns with regard to the need for security of energy supply seriously. It aims to contribute to petroleum price stability and moderation for the benefit of the domestic economy. Indonesia continues to discover new crude oil sources to increase oil production to meet rising domestic oil demand. The government is also accelerating upstream investments to meet expected future demand as well as making additional investments to ensure that the necessary increases in production capacity takes place. However, concern over supply security is something that is relevant for the entire supply chain. Oil market stability therefore also requires adequate investments in the downstream sector, something that has become increasingly apparent as a lack of effective refining capacity has put pressure on prices. Clearly, this is a sector that requires close attention in order to explore ways for better petroleum supply security.

Uncertainty concerning the scale of future required Indonesia oil and other energy production puts heavy risks in decisions to make appropriate investments. Oil and other energy investments requirements are very large and are subject to long lead-times and pay-back periods. Heavy over-investment or under-investment will have severe downsides for the industry, affecting future oil and other energy stability and security. The energy uncertainties over future energy demand growth stem from a number of factors, including economic, energy and environmental policies in consuming countries. This is why the Indonesian government is trying to set up a 'road-map' for energy demand and energy policy simultaneously, to reflect the need for security for energy demand and to demonstrate to the public that the government is serious in its commitment to support energy security.

1.2. Objectives

The biggest challenge for the government in the energy sector is to regain Indonesia's status as a net-oil exporter by increasing crude oil and refined oil production, by taking up a bigger share of non-fossil fuel as well as developing renewable energy. This can only be realised by spurring new oil exploitation and intensifying energy research and investment as well as creating comprehensive energy policies to support domestic energy conservation and efficiency. If these efforts are successfully implemented, Indonesia will be less dependent on oil and increasing international oil price will benefit the Indonesian economy through increased oil export proceeds.

This paper describes energy intensity in Indonesia, analyse oil dependency and energy policies proposed by the government to reduce oil dependency as well as to maintain sustained energy avalaibility. The paper describes recent Indonesian energy intensity especially oil and discusses the various oil/petroleum dependency measures in Indonesia. It assesses the current security of oil/petroleum supplies and the possibility of petroleum shortages in the near future. This study also discusses proposed energy policies being carried out by the government. The paper is divided into four sections. Section 1 reviews the development of the oil market and vulnerability in Indonesia. Section 2 discusses energy intensity development and oil dependency in Indonesia. Section 3 gives an account of proposed energy policies by the government to assure energy availibility in the present and future. Section 4 provides a summary and includes a recomendation for the government related energy policy.

Generally, the paper will on the whole, give a descriptive analysis on domestic energy intensity and oil dependency and describe the national energy policy proposed by the government to assure regular fuel supply with fair price throughout the country beside promoting energy efficiency. It will also examine government efforts in promoting renewable energy to substitute fossils energy.

2. Energy Intensity and Oil Dependency in Indonesia

2.1. Energy Intensity in Indonesia

Indonesia publishes the Indonesian energy balance sheets to demonstrate energy intensity which measure flows from origins (crude oil, coal, petroleum product, natural gas, etc) to uses of energy, e.g. production, export, import, stock, energy conversion etc. These data indicate that domestic energy (various sources of energy) use at the industry level (refineries, manufacturing plants, electricity plants, etc.) increased in the range of 50 - 200 percent over the 10-year period from 1991 to 2000. Meanwhile, the growth household use of various sources energy was relatively stable.

In 2000, the price of oil reached its highest level since the mid-1980s, excluding the price spike at the end of 1990. The recent price hike, if maintained for any significant length of time, is likely to accelerate the inclination towards energy conservation and the shift from oil to other sources of energy, especially in sectors other than transport. However, consumption of oil is likely to continue to grow in the medium term but at a slower rate than other energy sources, particularly for those which have a cost advantage. The longer the oil price hike lasts, the more this process will be accentuated. The price increase for petroleum has spilled over into the market for natural gas—the source of energy most closely competitive with petroleum. However, the spillover has not affected the market for coal, the other leading source of energy. Because of the incorporation of oil prices into formulas for the pricing of future deliveries of natural gas, the price increase for natural gas has lagged behind that of petroleum by about six months (according to Energy Information Agency – USA). The lag response of natural gas price, however, will not halt the demand of natural gas consumption in Indonesia in the future.

Over the last year, the price of crude oil has been increasing and has been followed by the increase in refined product prices. This oil price increase is worrying for most countries especially for oil importing countries and made worse by rapid growth in the population and domestic economic activities. In Table 1, we can see that refined oil product consumption increased steadily from 1991 – 2000.

Table 1
Consumption of Various Refined Oil Products in Indonesia

Thousand Kilo Litre

Kinds of Fuel	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Avgas	9.3	9.8	8.3	8.0	8.2	8.3	7.7	5.8	5.7	4.7
Avtur	1,124.10	1,293.60	1,481.80	1,620.00	1,744.30	2,014.70	2,093.40	1,270.90	1,119.30	1,348.70
Preminium	6,828.10	7,204.40	7,440.50	8,342.00	9,190.40	10,081.40	10,831.80	10,980.00	11,515.50	12,429.30
Kerosene	8,075.20	8,562.70	8,652.40	8,921.90	9,252.50	9,781.90	9,967.40	10,144.10	11,926.80	12,457.80
Solar	12,947.60	14,646.90	16,565.00	16,016.90	16,975.00	18,825.20	22,119.90	19,978.70	17,869.80	22,079.90
Diesel	1,724.80	1,805.00	1,835.30	1,776.70	1,601.20	1,380.60	1,415.80	1,271.90	1,309.40	1,472.20
Low grade solar	4,862.90	4,943.60	5,112.10	4,048.70	4,061.40	4,282.80	5,426.20	5,231.20	5,455.80	6,076.20
Amount	35,572.00	38,456.00	41,095.40	40,734.20	42,833.00	46,374.90	51,862.20	46,582.60	49,202.30	55,868.80

Source: Data and Information Minyak and Gas Bumi 2001, Ditjen Migas-DESDM

In order to reduce demand for refined oil products as well as to ease oil dependency, many countries have started research on the substitution of oil with alternative primary energy sources. Together with these, studies are underway to create more efficient technology to be implemented in industrial plants, transportation vehicles and households. The use of alternative energy (including renewable energy) is one of more achievable solution to move away from

Table 2a
The Growth in Use of Various Energy in Industrial Sector

Year	Energy Use (Thousand SBM)							
	Kerosene	Solar	Diesel	LPG	City Gas	Electric	Fuel Wood	Amount
1991	37.8%	18.0%	54.6%	45.0%	11.2%	14.7%	46.8%	24.4%
1992	36.6%	20.9%	46.4%	40.9%	13.8%	17.5%	42.0%	26.3%
1993	31.5%	24.7%	37.4%	34.1%	11.7%	20.5%	35.1%	26.5%
1994	10.8%	10.1%	12.1%	11.6%	16.7%	11.3%	11.2%	11.1%
1995	9.3%	7.9%	6.1%	9.5%	13.1%	9.5%	9.3%	9.1%
1996	9.6%	8.4%	7.5%	9.8%	12.5%	9.5%	9.6%	9.4%
1997	5.4%	5.4%	4.1%	5.8%	7.2%	5.7%	5.8%	5.6%
1998	-16.9%	-15.3%	-12.1%	-16.7%	-10.4%	-14.7%	-17.1%	-15.7%
1999	1.1%	1.5%	2.9%	1.8%	4.3%	1.6%	1.6%	1.5%
2000	5.6%	5.0%	4.4%	5.5%	4.4%	5.0%	5.5%	5.2%

Source: Energy Statistics, DESDM, Indonesia

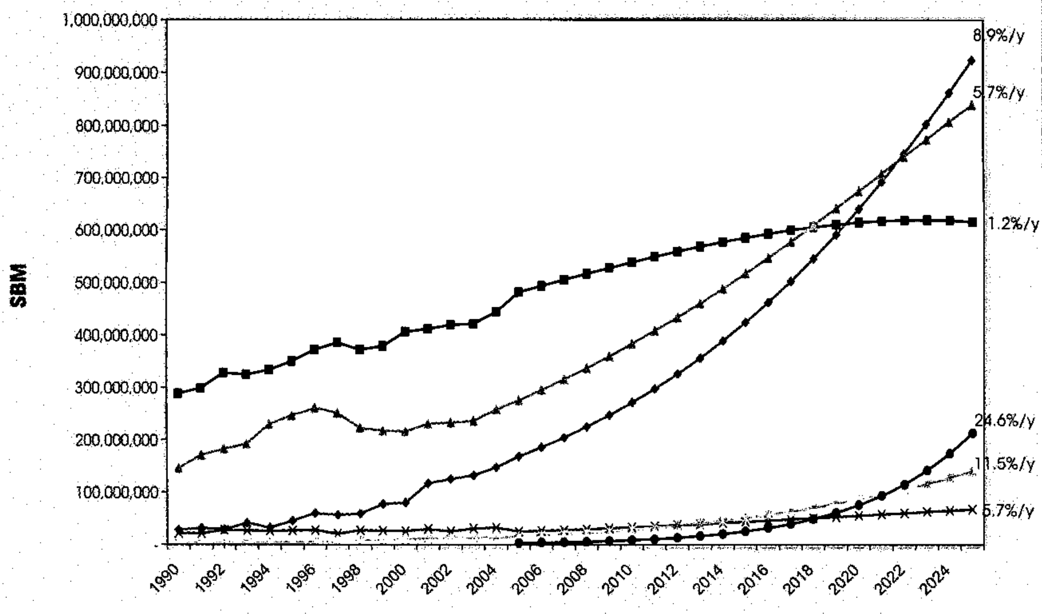
Table 2b
The Growth in Use of Various Energy in Households

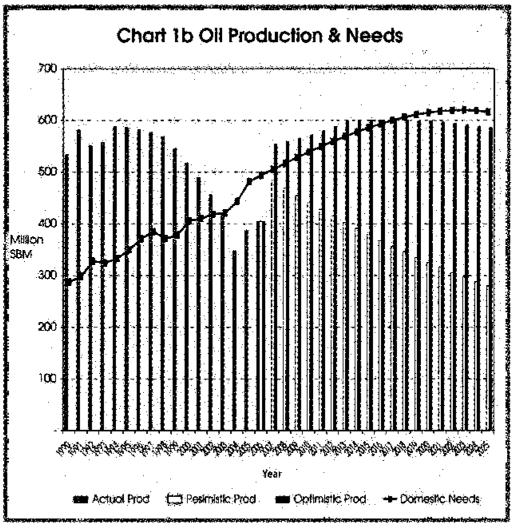
Year	Energy Use by sources (SBM)							
	Coal-Briket	Kerosene	LPG	City Gas	Electric	Charqoal	Fuel Wood	Amount
1990								
1991		1.4	1.4	1.4	1.4	1.4	1.4	1.4
1992		1.4	1.4	1.4	1.4	1.4	1.4	1.4
1993		1.4	1.4	1.4	1.4	1.4	1.4	1.4
1994	673.4	1.9	32.2	8.4	18.8	0.1	1.2	2.2
1995	87.7	1.9	25.4	8.0	16.5	(0.0)	1.0	2.1
1996	47.0	2.0	21.0	7.7	14.7	(0.1)	0.8	2.0
1997	54.0	6.7	9.1	12.7	16.4	(19.1)	3.0	3.9
1998	30.7	5.2	5.4	10.6	12.5	(23.5)	2.5	3.1
1999	19.0	3.7	2.0	8.4	9.2	(29.4)	1.8	2.2
2000	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

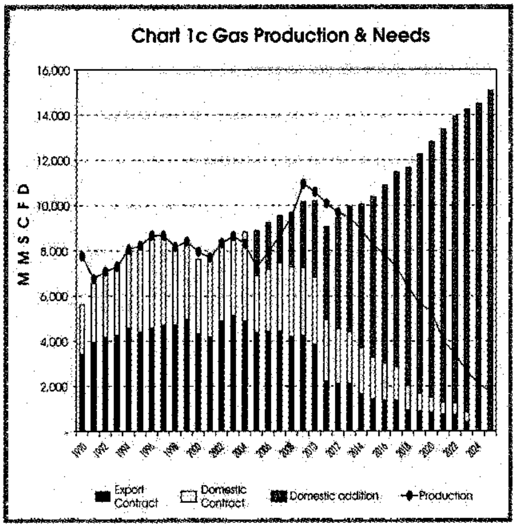
Source: Energy Statistics, DESDM, Indonesia oil dependency. The Indonesian government has been urging the people to use energy alternatives such as coal, LPG, bio-fuel, etc, to support energy conservation. Table 2a and 2b present the development of several energy uses by the industrial sector and households. The fastest growth of energy use is for LPG and city gas for the period 1991 - 2000.

Though oil is still expected to be the primary energy in the near future, there have been efforts to shift away from oil towards natural gas, a less expensive and less polluting source of energy. While the price of oil has been increasing, the price for natural gas has been relatively stable. With the support from the government in its energy policy, the use of oil is expected to decrease in the future while gas and coal will increase substantially with natural gas replacing petroleum as the leading source of energy in the future. This increase is largely in line with the growth in real GDP although it is expected that there will be some decline in the ratio of energy use to GDP in the future as a result of increased efficiency. In Indonesia, the growth in natural gas consumption has outpaced the growth in oil consumption and the share of natural gas in total energy use has doubled. As for other primary energy sources, coal will be used more intensively as Indonesia have abundant coal reserves. Meanwhile, hydropower and geothermal, are used mainly in electrical power plants in some parts in Indonesia (Chart 1a, 1b, 1c).

Chart 1a
Historical & Projection of Energy Use in Indonesia



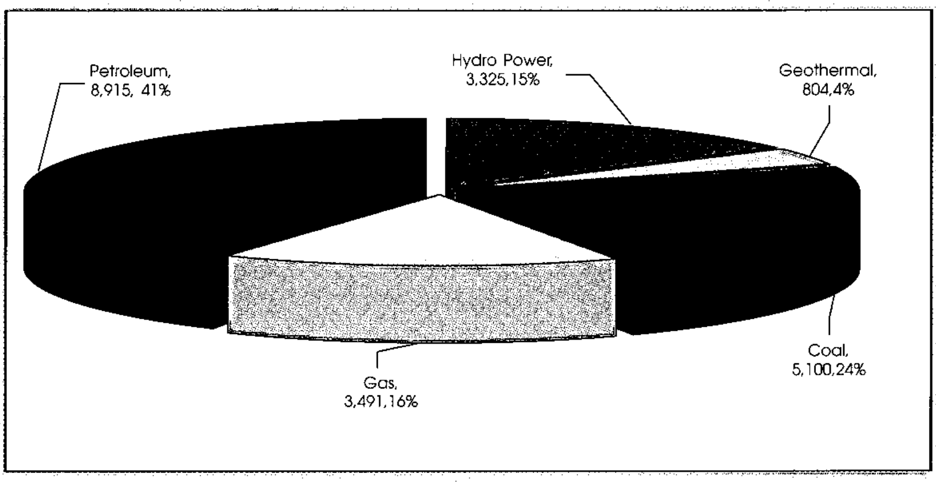




Source: National Energy Conservation, DESDM, 2006

Electricity is also an essential energy source generated through the use of primary sources. Petroleum and gas energy account for nearly 60 percent of Indonesia's electricity generation. The source of fueling electric plants in Indonesia is shown Chart 2 .

Chart 2
Fuel Sources for Electricity Generation in Indonesia (2005)



Source: National Energy Policy Blue Print, Indonesia, 2006

2.2. Renewable Energy (RE) Development in Indonesia

Indonesia's oil and gas reserves are currently the most important sources of energy despite reserves being rapidly depleted. One of Indonesia's alternative energy development strategies is to increase energy diversification by utilising renewable energy. The country is endowed with substantial resources of renewable energy, but until now has not been widely exploited. The contribution of renewable energy to the total energy mix is still quite modest at less than 1 %, if compared with the use of fossil energy.

2.2.1. Biomass

Indonesia has large potential of biomass energy, derived mainly from forestry, agriculture and estates. It is estimated that some proportion of total energy consumption especially in rural areas. come from biomass. Energy conversion technology is still being studied to use this energy for co-generation and bio-diesel technologies.

2.2.2. Wind Energy

The potential of wind energy is relatively small but in certain areas, particularly in some islands of Indonesia, this can be potentially developed. Wind power generation has been used for a variety of purposes, such as for rural electricity, water pumping and battery charging.

2.2.3. Solar Energy

The potential of solar energy in Indonesia is relatively good because it is a tropical country with plenty of sunshine. There are two technologies which can be developed or imported, namely solar thermal and solar photovoltaic. Solar thermal energy is generally used for heating water while solar photovoltaic is generally used in electric power plants, for water pumping, telecommunications, etc.

2.2.4. Hydropower

Hydro power resource is available abundantly in Indonesia and seems very promising because of the simple technology and easy installation in rural areas. It has long been in employing low-end mechanical technology.

2.2.5. Geothermal

Indonesia has an abundance of this energy source though it is not been surveyed intensively. Exploration is needed to exploit this energy source but the main obstacle faced is the very high costs involved to bring this energy source to end users.

2.3. Some Issues In Renewable Energy (RNE) Development In Indonesia

The financial aspects, pricing and private participation are recent crucial issues of renewable energy development in Indonesia.

2.3.1. Financial Aspects

Financing is an important factor in developing renewable energy (RE). The high pre-investment and investment costs in RE projects have resulted in low investor interests in RE. Efforts are needed to acquire funding with low interest rate and to facilitate entrepreneurs' access particularly small enterprises and cooperatives to credit or soft loans from financial institutions or banks. Incentives and financing schemes for RE should be encouraged and these are mainly in the hands of the central bank.

2.3.2. Pricing

The prices for renewable are not competitive compared to fossil energy price since the technology of RE development has not been mastered. Moreover, an energy price policy to encourage its development has not been implemented. In order to enable renewable energy to compete with the price of fossil energy, a policy concerning the energy price should be implemented. Another task is eliminating the energy price subsidy especially for fossils oils in a gradual and planned manner.

2.3.3. Private Participation

Because of the high cost to produce RE, not many parties (including private concerns) are interested. Commercialisation of RE is hindered by the high costs in comparison to fossil oil, lack of marketing to potential consumers, lack of awareness of the potential of RE technologies as investment opportunities, and poor linkages with the private sector. The potential for RE and thus private sector participation, can only be realized if the costs can be lowered.

2.3.4. Manufacturing Capability

The local manufacturing capability of certain renewable energy technologies is still being developed in Indonesia. Some micro hydro components such as turbine, governor, and electrical devices can be manufactured with local contents although some of them are still imported. Photovoltaic modules and solar thermal water heaters are also still imported. Biomass gasifiers are nevertheless being produced in Indonesia.

2.4. Measures of Oil Dependence and Vulnerability

2.4.1. Oil Production and Problems in Indonesia

Since 2004, Indonesian crude oil production has not been able to meet its production target of 1.05 million barrel per day because of problems related to domestic oil exploration and refinery plants. Domestic crude oil production has been decreasing while domestic consumption has continued to increase. In 2003, crude oil production reached 1,146 million barrels per day (MBD) while in 2004 and 2005, it reached only 1.096 MBD and 1,062 MBD respectively. Presently, the average domestic oil production is only 909.240 barrels per day, although crude oil production in July 2006 recovered to reach 1,028 MBD. Without any serious efforts to explore new fields and revamp existing oil plants and invest in new ones, the decreasing trend of domestic crude oil production may continue.

Several oil companies in Indonesia have not been able to meet the production target. These companies include PT Pertamina which produces only 81 percent of the target, Conoco (88 percent), Chevron Texaco Indonesia (80 percent), Pertamina Bumi Siak Pusako (78 percent), and Kondur Petroleum (68.69 percent). To meet the target, efforts are needed overcome obstacles with support from the government. These have included the opening of 11 new oil fields to add an additional 24.25 MBD.

While Indonesia has significant amounts of primary energy source reserves besides oil such as coal (for the next 147 years), natural gas (for the next 62 year) and geothermal energy, their extraction would incur high costs and has thus, not been fully exploited. Indonesia is still very much dependent on oil and reserves are decreasing because of this intensive usage. Indonesian oil reserves were 15,000 metric barrels (MB) in 1974 and in 2000, it has declined to 5,123 MB. Indeed, in 2004, proven oil reserves were only 4,301 MB or 9,000 MB with new potential fields (for the next 18 years). The decreasing oil reserves was caused by two main factors: (i) the declining volume of crude in the oil fields which have been in operation for a long time and (ii) limited new investments in oil plants to replace old oil plants and to explore new oil fields. This situation was made worse by increasing demand and is mainly the reason why Indonesia became a net-oil importer from 2004 as oil imports exceeded oil exports. Without new significant investments in new plants, Indonesia will continue to be a net-oil importer.

Table 3
Primary Energy Reserve in Indonesia in 2004

Energy Type	Predicted Reserve	Proven Reserve P1 + P2	Output (per year)	(Reserve/ Output)
Crude Oil	86.9 billion barrels	9 billion barrels	500 million barrels	18 years
Gas	384.7 TSCF	188 TSCF	3.0 TSCF	62 years
Coal	57 billion tonnes	19.3 billion tonnes	130 million tonnes	147 years

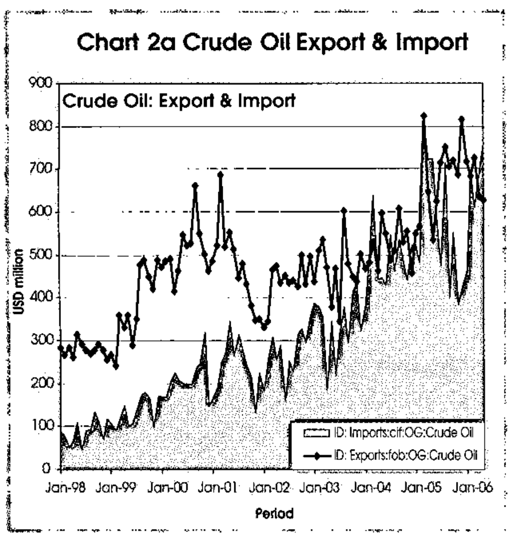
Source: National Energy Policy Blue Print 2006, Indonesia

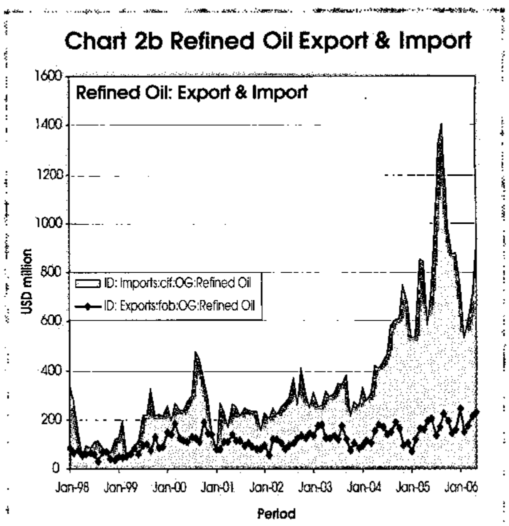
2.4.2. Oil Trade Balance

Domestic crude oil production is actually sufficient for current domestic needs if used more efficiently. While Indonesia needs to import crude oil, some portions of domestic crude oil production are exported as shown in the Charts 2a and 2b.

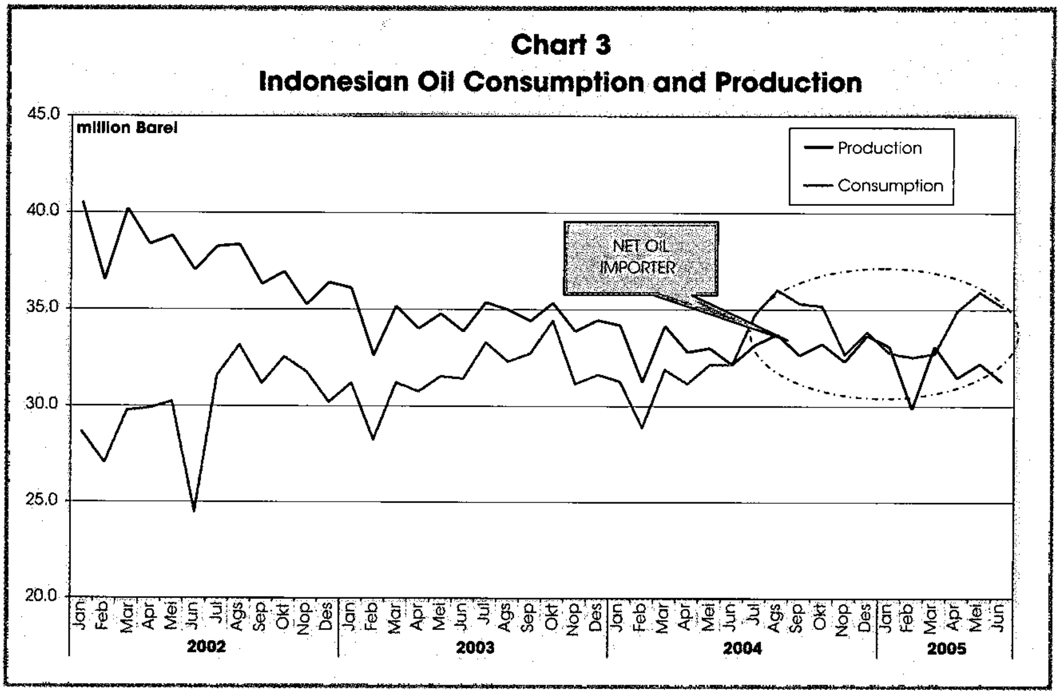
The domestic oil trade balance since 2004, has shown a deficit due to the fact that domestic petroleum consumption is growing faster than domestic oil production. Since 2000, it has been well known that crude oil needs have already reached 150 percent of crude oil exports. Meanwhile, oil imports have only been 30 percent of domestic oil production mostly in the form of solar, low-grade solar and kerosene.

Chart 3 indicates that Indonesia hs become a net-importer country from 2004, as its consumption of domestic oil products has exceeded the amount of domestic oil exports.





Source: National Energy Conservation, DESDM, Indonesia,2006



2.4.3. Oil Dependency in Indonesia

On source of vulnerability is the increased dependence not only on foreign oil, but on fewer energy options. For example, the main energy used for electricity plants currently is oil, reserves of which will only last for another 18 years. An over-reliance on any one fuel source leaves consumers vulnerable to price spikes and supply disruptions. While Indonesia has enough coal to last for another 147 years, it has not exploited this source. Thus it would be wise to shift the use of energy from oil to coal, especially for power plants. Research into clean coal technologies may increase the attractiveness of coal as a source for new energy generation.

Indonesia currently faces a deficit of about 300,000 barrels of oil per day to meet domestic needs. In the short term, increased production cannot be expected from old plants and fields. An additional 160,000 barrels per day can be expected from Cepu Block which will start operating in 2008. Meanwhile, the recent strike of oil workers in Venezuela, the war in Iraq, and violence in Nigeria have reduced world oil production, increased oil prices and raised concerns of sufficient oil supplies in the near future. Such concerns, accompanied by high natural gas prices have raised the issues of energy security, petroleum dependence and vulnerability in Indonesia.

2.5. Measures of Petroleum Dependence in Indonesia

There have been various studies looking at how a country is vulnerable to dependency on oil or to measure this dependency. Measures used in Indonesia (depending on the data availability) include those proposed by A.F Alhajji and James L. Williams[2] as described as follows:

2 Article was originally published in the Middle East Economic Survey (MEES 46:16, April 21, 2003)

2.5.1. Petroleum Imports as a Percentage of Total Petroleum Supply

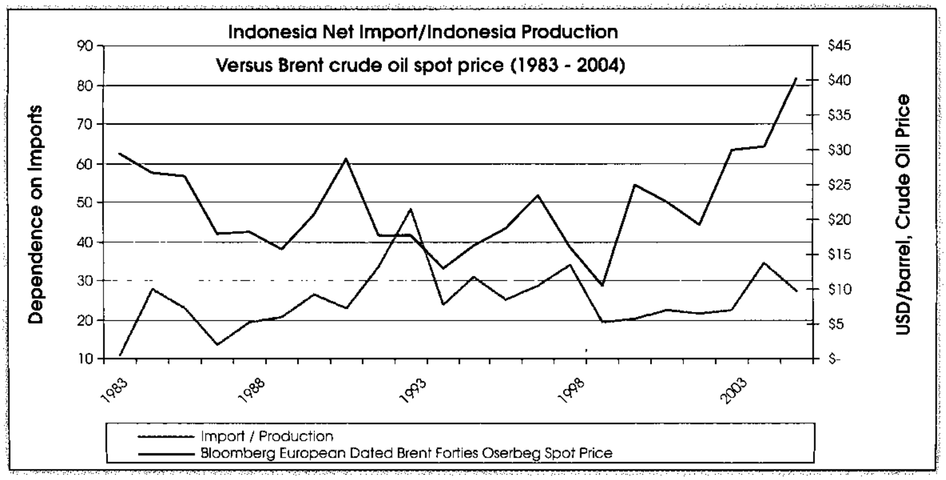
This measure is useful to indicate how much a country is dependent on oil supply from abroad. Looking at the historical data, Indonesia has been increasing its import of crude oil while import of refined products has been relatively stable in absolute values (mostly solar and low grade solar).

Table 4
Characteristics of Oils in Indonesia (000 Barrel Per Day)

	1997	1998	1999	2000	2001	2002	2003	2004
Crude Oil Production	1,330.4	1,315.4	1,355.5	1,272.5	1,214.2	1,125.4	1,139.6	1,099.4
Imports of Crude Oil	190.6	212.2	232.0	219.1	326.0	327.7	306.7	330.1
Exports of Crude Oil	967.0	898.8	973.8	811.3	795.5	792.3	588.3	556.2
Imports of Refined Product	301.3	180.6	189.9	217	216.2	225.4	323.8	275.6

The degree of import dependence as percentage of production is relatively stable despite showing a significant fluctuation and reached its peak of almost 50 percent in 1993. The high ratio is caused primarily by higher petroleum consumption after oil price showed a decreasing trend. Overall, it only fluctuated between the range of 20 percent – 40 percent. While petroleum consumption showed an increasing trend in absolute terms, domestic refined output also indicated the same trend for the period. The significant decline in Indonesian crude oil production since 2004 on the supply side, was met by the increasing crude oil imports to meet needs from the domestic refinery production sector. However, as a result of increased crude oil production and decline in demand for domestic refined products in 2005 as a result of higher petroleum price, dependence on imports is expected to fall from then on.

Chart 4
Net Petroleum Imports Relative to Total Petroleum Production

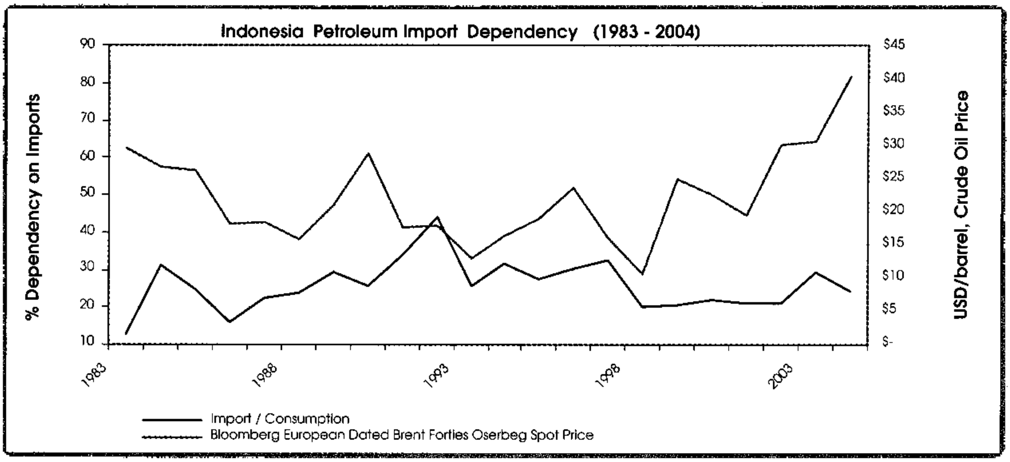


Source: OPEC

2.5.2. Petroleum Imports as a Percentage of Total Petroleum Consumption

The degree of import dependence as percentage of consumption is relatively stable. It has only fluctuated in the range of 20 percent – 40 percent. Even though petroleum consumption in absolute value showed an increasing trend, domestic refined product output also indicated the same trend for the period 1990 -2004. Declining Indonesian production on the supply side was met by the increasing crude oil imports as mentioned before. However, as a result of higher petroleum price and implementation of conservation strategies as well as energy diversification, dependence on imports is expected to fell from the year 2005 onwards.

Chart 5
Percentage of Net Petroleum Import Relative to Total Petroleum Consumption



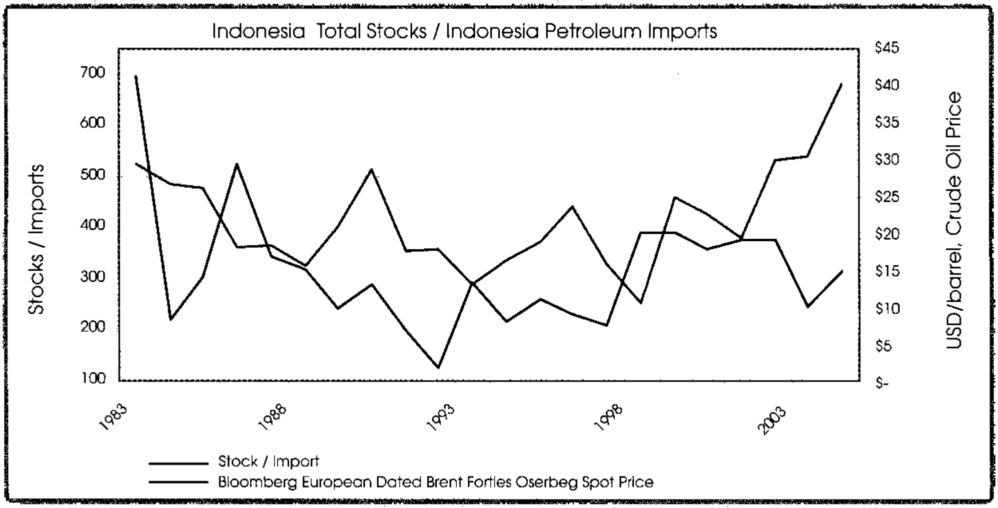
Source: Oil Statistics, OPEC

Indonesian dependence on foreign oil reached record highs in last five years leading to 2004. Major changes in Indonesia oil imports were related to changes in the domestic economy and oil production. While Indonesia has become a net-oil importing country since 2004, it nonetheless, has access to abundant primary energy sources other than oil such as coal, gas, hydro power, and renewable energy.

2.5.3. Total Stocks Coverage of Imports

This ratio measures the petroleum imports covered by total stocks, which include commercial and government-controlled stocks. The number of stock coverage of imports decreased significantly in 1993 as the price of oil price decreased. At that time, the usage of petroleum showed significant increases while domestic refined product output did not change. However, the ratio increased in the period 1998 - 2002 because of the slowdown in domestic economic growth as Indonesia faced economic crises.

Chart 6
Days of Total Stocks Coverage of Imports



Source: OPEC

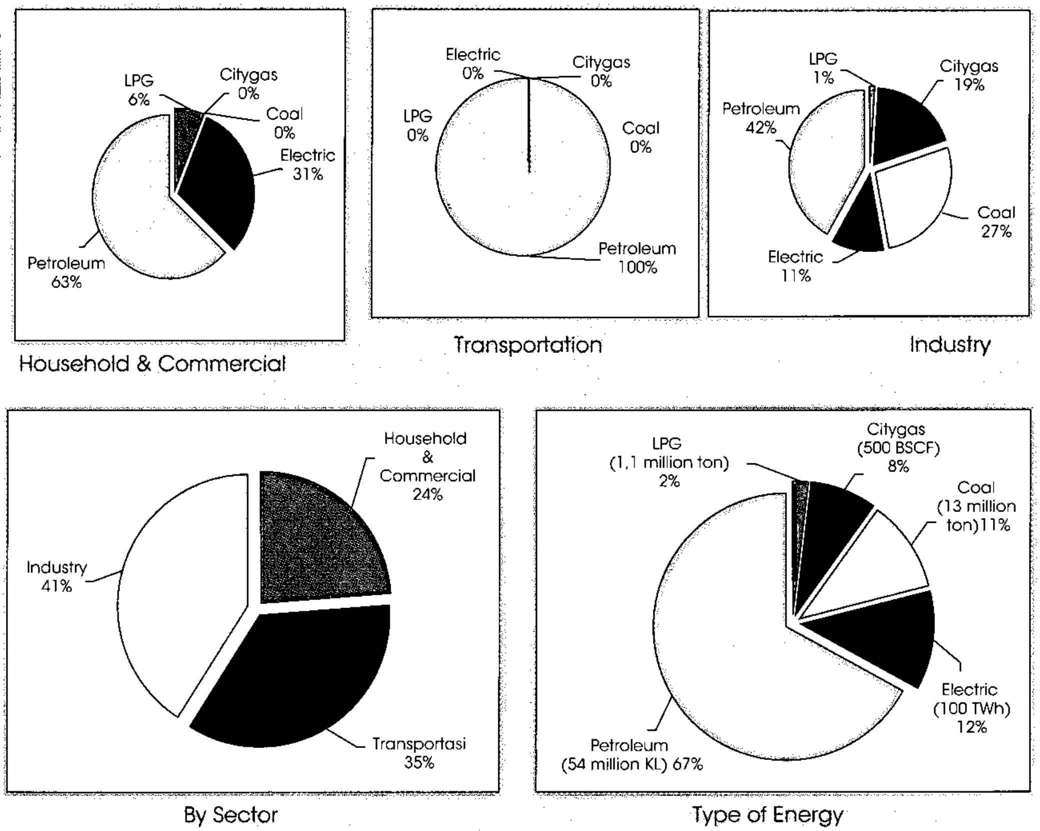
2.5.4. Percentage of Petroleum in Total Energy Consumption

This measures the share of petroleum in total energy consumption in a country. In Indonesia, the use of petroleum for fuelling energy is very intensive in all economic sectors. In 2005, the share of petroleum used in households and commercials reached 63 percent of total energy source used. In the transportation sector, the petroleum share reached almost 100 percent of total energy source used. Meanwhile, the share of petroleum used in the industrial sector reached 42% of total energy source used.

Petroleum share in the total energy consumption in Indonesia was relatively stable in the last decade, reaching over 50 percent compared with the current share of petroleum in the total energy consumption for OECD and Europe which is around 41%. The high share of petroleum use in Indonesia is due to the high switching costs of equipment should it want to use alternative energy sources. However, the sharp increase in oil prices since 2000 may have caused some fuel switching that has led to a slight decline in petroleum share. Looking at Chart 7, we see that refined oil products are still dominant for most economic sectors in Indonesia.

Although the government is still making substantial efforts to reduce their dependence on oil, this dependency will continue in the near future as technological change will cost too much.

Chart 7
Share of Various Energy Consumption in Indonesia, 2005



Source: National Energy Policy, Indonesia, 2006

From the measurements, there are indications for concerns in Indonesia regarding the extent to which petroleum influences energy security especially in terms of its inability to reduce oil dependency in recent years, the large share of petroleum in the energy consumption, and the increase in the petroleum share in the last few years.

3. Energy Policy in Indonesia

3.1. Indonesia's Energy Policy: Oil Subsidies Dilemma

Disruption of oil production, high prices of petroleum, and intensified refined oil production has all made Indonesia more reliant on oil and has been made worse by oil subsidies of the government. The government allocated subsidies of 138.6 trillion rupiah in 2005 as a result of higher crude oil prices. This situation has led to a call for a new energy policy in Indonesia, which will not only reduce oil subsidies, but also promote energy conservation as well as ensure the sufficiency of energy availability at fair prices. The oil subsidies have also been controversial as it only benefit those who own vehicles. Instead it may be wiser if the authorities allocated the subsidy of Rp138.6 trillion for poverty alleviation.

Some options for resolving the subsidy issue include fiscal policy, monetary policy, policy options on oil subsidies and structural adjustments. For fiscal policy, this would mean looking into getting surplus government revenue since crude oil has to be paid for in US Dollars. Alternatively, the government can either borrow from other countries, or it could instruct its own central bank to print more of its fiat money i.e. implement a loose monetary policy as a second option. However, printing more rupiahs has proven tricky as this could ignite inflation in the domestic economy and may affect the confidence of foreign investors as happened during the Asian Financial Crisis of 97/98.

With the third option, the government can review the policy of gasoline subsidies. This is not very popular politically as the last time the government reduced gasoline subsidies, it sparked wide spread demonstrations by the people in many parts of Indonesia.

The fourth option of making structural adjustments could include:

1. Removing all forms of subsidies for petroleum products immediately and channel the annual saving into other state redistributive programmes;
2. Introducing an excise tax on all grades of gasoline and diesel to discourage automobile usage (for environmental protection);
3. Increasing tariffs on all car imports and introduce non-tariff barriers e.g. hefty vehicle registration fees on all new vehicles;

3.2. Energy Policy in Indonesia

The mission of the Energy Policy of Indonesia is geared towards guaranteeing domestic energy supply, increasing added value of energy, managing energy in a ethical and sustainable way, preservation of the environment, providing energy equally through out the country, and developing local capability. To reach that mission, the government has taken various measures including energy intensification, energy diversification, and energy conservation. Furthermore, some strategic plans has been implemented as regulated in the Law no. 22/2001 on Oil and Gas, Law no. 20/2002 on Electricity, Law no. 27/2003, Law on Energy Utilisation, and Law on General Mining. The national energy policy is directed towards market mechanism, with consideration to the poor. The government is also implementing regional autonomy in the energy sector. Besides developing the energy infrastructure, the government is also promoting energy efficiency in all sectors and assisting energy supporting industries and empowering people in energy development. President Susilo Bambang Yudhoyono also issued a presidential instruction (Inpres) No 1/ 2006 on the Supply and Usage of Bio-fuel on February 7, 2006 in Jakarta. The President also signed Presidential Regulation no 5/ 2006 on National Energy Policy and Inpres No 2/2006 on the Supply and Usage of Liquefied Coal as Alternative Fuel. The last three policies will likely be used as the basis of stipulating a law on national energy, which will soon be discussed in National Parliament (DPR).

To sum up, the National Energy Policy will promote the following basic principles:

- The Policy is a long-term, comprehensive strategy.
- The Policy will advance new, environmentally friendly technologies to increase energy supplies and encourage cleaner, more efficient energy use.
- The Policy seeks to raise the living standards of people and thus public policies such as policies for energy, environmental, and economic policies must be fully integrated.

To meet these principles and thus achieve the goals, Indonesia must implement policies on conservation, modernise its energy infrastructure, increase energy supplies, accelerate the protection and improvement of the environment, and increase the nation's energy security.

The policies also stipulate a blue print for mixed energy target by 2025 to shift the national energy requirement composition to less than 20% for crude oil, over 30% for natural gas, over 33% for coal and over 5% each for bio-fuel and geothermal. For renewable energy, especially biomass, nuclear, hydro, solar, the target is to increase them to more than 5%, while liquefied coal is targeted for over 2%. The regulation also stipulates that the government could provide facilities and incentives for energy conservation and the development of alternative energy. Table 5 shows domestic energy needs projected for Indonesia to fuel domestic economic activity up to 2025.

Table 5
Indonesia Energy Needs Projection

		1990	1995	2000	2005	2010	2015	2020	2025
Hydro Power Elecric Plant	GWh	11.79	14.33	13.65	18.28	34.21	36.23	46.27	55.46
Biofuel	Thousand barrel/day	-	-	-	-	72.60	189.34	248.88	318.43
Coal	Million tonnes/year	5.81	9.21	22.34	32.28	30.27	87.48	116.76	179.17
Other RNE	Thousand barrel/day	-	-	-	0.03	0.57	5.57	89.36	176.28
Gas	MMSCFd	1,946.5	3,509.1	3,121.6	3,581.5	7,101.6	5,707.7	11,650.1	17,948.5
Crude Oil	Thousand barrel/day	814.9	1,007.61	1,236.26	1,082.56	1,102.23	1,295.52	1,340.00	1,390.24
Geothermal	GWh	1.19	2.28	4.99	14.65	36.79	77.28	136.56	178.23

Source: DESDM, Indonesia

The policy needs to be urgently implemented since oil prices continue to rise in the midst of factors not governed by market fundamentals such as geopolitics, natural disasters and refinery constraints. A primary goal of the energy policy is to expand supply from diverse sources such as domestic oil, gas, and coal. It also means the greater use of hydropower and non-hydro renewable sources. The national energy policy also seeks to lessen the impact of energy price volatility and supply uncertainty on the people. The policy is comprehensive in scope as it considers the environment and ensures sufficiency of supply.

Indonesia is facing serious energy challenges such as electricity shortages and dramatic increases in gasoline price, a strained supply system, and increasing oil imports. These challenges can only be addressed with implementation of sound policies. There are no easy, short-term solutions. In 2004, Indonesia used 509.7 thousand barrels of oil per day more than in 1991, while during the same period, domestic energy production decreased by 15 percent. While domestic production of coal, natural gas, nuclear energy, and renewable energy has increased somewhat in recent years, these have been largely offset by declines in domestic oil production. As a result, Indonesia has met almost all of its increased refined product energy demand over the past ten years with increased imports.

3.2.1. Policy for Promoting Energy Efficiency and Conservation

Conservation and energy efficiency are crucial components of a national energy plan. Energy efficiency is the ability to use less energy to produce the same amount of work or services. Conservation is simply using less energy. Improved energy efficiency and conservation reduces energy consumption and energy costs, while maintaining necessary services in homes, offices, factories, and automobiles. Greater energy efficiency will help Indonesia reduce energy imports, the likelihood of energy shortages, emissions, and volatility in energy prices. In recent years, Indonesia is trying to improve its energy efficiency by developing the use of energy efficient technologies.

3.2.2. Government Policies Related to Energy Efficiency

The government has formulated national energy conservation from 1979. Several activity and programme implementation guidelines have been also developed in order to support the energy conservation policy. These are all stated and specified in the document entitled National Energy Conservation Master Plan (NECMP).

(i) The National Energy Conservation Master Plan (NECMP)

- NECMP is the framework plan for the implementation of a national energy conservation programme that covers industry, transport, and household sectors;
- It outlines the strategies and activities to support the government's energy policy through general policy instruments, namely, information, incentives, regulation and pricing;
- It increases public awareness towards energy conservation and creates the appropriate climate that is conducive for energy conservation endeavours;
- NECMP as a framework plan for the implementation of a nation wide energy conservation programme has not been completely implemented, so the benefits that are expected through the implementation of NECMP are also not yet fully realised;
- NECMP is intended to be a continuous process of action, implementation and evaluation. The performance, results and impact of the NECMP should be continuously assessed to come up with the corrective actions. NECMP is now under review.

(ii) Government Actions in Promoting And Encouraging Energy Efficiency

- Presidential Decree No. 9/1982 indicates the interest of the government to conserve energy and serves to persuade government agencies to conserve energy;
- In 1991, another Presidential Decree was issued to garner public participation in energy conservation. The decree calls for issuance of other policies directly related to energy conservation such as investments, loans and other financing sources, and energy pricing.
- As of present, energy conservation programmes have not been fully realised as expected and programmes to be accomplished by the various ministries are not focused. As a result, energy efficiency and conservation are still practiced as a norm.

3.2.3. Recent Developments on Energy Efficiency Policy

There is increasing pressure towards more serious energy conservation programmes as strong economic growth and increasing population consistently demand large amounts of energy. Meanwhile, significant quantities of energy (oil, gas, coal) is also expected to generate foreign exchange. The General Policy on Energy recognises the above demand and is accommodating fundamental changes. Diversification of energy is a must and policy is geared towards preserving limited sources and switching to use abundant alternative national energy resources. The policy is also trying to formulate a fair price for the energy which reflects their economic value. Finally, strong government commitment is significant in promoting public participation in energy efficiency and conservation.

Nevertheless, there are some obstacles which can hinder the saving energy programme. These include i) an increase in product quality demanded by end users, usually leading to additional energy consumption to produce better products, for example; ii) an increase in the use of secondary (recycled) fibre in papermaking (particularly derived from grades of waste paper), requiring more energy for cleaning and screening to remove contaminants.

However there is no firm consensus about which technologies or techniques to use to realize savings. Interest in energy efficiency seems higher in the organisations which are characterised by relatively intensive energy consumption, export oriented manufacturing companies, profit oriented companies and those that have international management standards, owned partly or wholly by foreign investor.

(i) Energy Conservation Activities

Several activities have been and are being carried out by the government, non-governmental institutions as well as the private sector to promote energy conservation practices in their respective line of authorities, i.e., via campaigns, training, demonstration projects, energy audits, award programmes and standards. The activities that have been carried out so far are the following:

A. Identification study. To identify the potentials and barriers to conserve energy. The results show that 10 to 30% of total energy consumption can be saved through housekeeping, proper management, and retrofit.

B. Technical guidance and training. These activities were implemented mostly in the industrial sector to support the energy conservation programme. A number of instruction books have been published, and some trainers have been also trained.

C. Energy audit. Energy audits have been conducted in selected companies in order to analyse energy and material streams and to evaluate the efficiency of energy use and to estimate investments required in adapting energy efficiency and conservation measures.

D. Campaign and information dissemination. The purpose is to create public awareness on energy, role, and benefits of implementing energy saving programmes. Some of the activities include the distribution of posters, brochures, and multi-media campaign through radio, TV, and newspaper.

E. Demonstration project. Several Energy Efficiency & Conservation projects have been demonstrated in industries, hotels, and transport such as:

- Fuel efficiency in vehicle fleets. The benefits of simple cost effective management of measures have been demonstrated in bus and taxi companies which improved fuel performance of up to 12%. The measures include proper maintenance, awareness of driving style, and management commitment.

- Energy efficiency in hotels. Energy management and best practices in selected hotels indicated an energy saving of about 16 – 38 percent of total energy consumption.

- Energy efficiency in small and medium industry. The development and promotion of energy efficient equipments have been conducted in small and medium industries. Improvements in performance were noted in small boilers, kerosene stoves, etc.

(ii) Regulation

Presidential Decree No. 43, 1991 was issued to develop and implement energy conservation activities in all sectors. In 1993, the Ministry of Energy and Mineral Resources issued a decree to implement energy conservation in the energy and mining sectors and to train energy and mining managers.

A. Clean and Lean Transport Initiative (CALTI)

CALTI is a cooperation project between government institutions and transport associations and aims to increase public awareness on energy efficiency and environmental issues. This project is supported by the Clean Air Project (CAP) of Swiss contact and the Department for International Development of the United Kingdom. The CAP encourages the involvement of bus operators to allow regular emission inspections and maintenance to reduce fuel consumption and exhaust gas emission of bus fleets in Jakarta. Tune-ups and other measures could reduce fuel consumption of between 5% and 10% (see Table below).

B. Demand Side Management (DSM) and Labeling

DSM focuses on clipping the peak load which contributes primarily to household lighting, street lighting, and household electric appliances. The idea behind the programme is that the effective implementation of DSM and labeling cost less than building and operating new power plants to meet peaks in electricity demand.

Although the importance of DSM and labeling are noted by the government, current programmes have not yet been fully implemented due to financial constraints. The Directorate General of Electricity and Energy Utilization (DGEEU) is now planning/implementing the following three programmes:

- TERANG programme which aims to reduce electricity demand by installing compact fluorescent lamps (CFLs) in households;
- PJU programme which aims to reduce electricity demand by installing efficient lamps in street lighting;
- Socialisation programme, an awareness programme especially for DSM.

Furthermore, unless a comprehensive national energy policy is adopted, the Indonesian people will still lack adequate access to the electrical transmission grid, face insufficient domestic energy supply, and regional imbalance in supply sources. It is important to meet these challenges with a comprehensive energy plan that takes a long-term approach to meeting national energy needs.

3.3. Other Issues Related to the Policies

Other issues related to energy policies include the following:

- The Draft of the Mining & Energy Law is targeted for completion in 2006.

  The draft of the Mining & Energy Law (RUU Minerba) is targeted to be ratified into Law in 2006. The draft law will replace Law No. 11 year 1967 on Mining Issues which are considered obsolete.

- Challenges Confronting Electricity Supply. Indonesia's electricity supply has failed to keep pace with growing demand. This imbalance is projected to persist into the future. The adverse consequences have manifested themselves most severely in Jakarta, where supply shortages have led to high prices and even blackouts. In other regions, inadequate supply threatens the reliability and affordability of electric power.

  Large amounts of new generating capacity are slated for installation around the country. However, there is a geographic mismatch between where to generate energy and where it is needed. Indonesia's most pressing long-term electricity challenge is to build enough new generation and transmission capacities to meet projected growth in demand.

However, even with adequate generating capacity, Indonesia does not have the infrastructure to ensure reliable supply of electricity. Investments in new transmission capacities have failed to keep pace with growth in demand and with changes in the industry's structure.

- Indonesia to Reduce Rather Than Halt Gas Exports. In future, the production from the country's gas reserves will be prioritised for the local consumption with reference to Law No. 22/2001 on oil and gas. In the past, gas was prioritised for export with only a small portion allocated for local consumption. Moreover, Indonesia was also committed to the development of the "Trans ASEAN Gas Power Plant" in effort to meet gas demand in ASEAN. Therefore, the development of domestic gas infrastructure is crucial and important to meet the demand locally. Indonesia will reduce but not halt its exports of gas when long-term contracts expire in 2009 and 2010 in order to help lower costs for local firms. There will be more gas used for the needs of domestic industries but that does not mean that the supply of gas outside the country will be halted. The bulk of the gas would go to domestic industries in Indonesia, one of the world's largest gas exporters.

  Many of Indonesia's long-term liquefied natural gas (LNG) supply contracts with East Asian countries, such as Japan, China, Taiwan and Korea, will start expiring from 2010. Just over half of Indonesia's domestic natural gas output was exported in 2005. Related to the policy, Indonesia's state energy firm 'Pertamina' is expected to cancel a number of LNG export shipments due to dwindling reserves.

- Energy & Mineral Reserves Department and IEA signed the Letter of Intent (LOI) on Review on Energy Policy. The Department of Energy and Mineral Resources together with the International Energy Agency (IEA) have signed the LOI to review the national energy policy. IEA will provide recommendations to the government, as what has been done in Ukraine, China and other countries.

- Oil production has potential to be increased. While alternative energy will play a significant role in fossil energy substitution in the future, the government will continue its efforts to increase oil production provided that there are still potential hydrocarbon basins available and by enhancing oil production from existing oil fields.

- The government plans to place a number of mining areas as state reserves, which will be operated by state-owned mining enterprises to ensure domestic supply and conserve mining reserves for the future. These state reserve areas will not be exploited until domestic requirements are fulfilled. The state enterprise which is appointed to operate the area may cooperate with either local or foreign private companies. These reserves will prevent coal and mineral reserves from depleting in a short time. An area could be set as a state reserve area if there is an oversupply of national production and the area has no economical value during the time it was set as reserve area or the area is a forest conservation area. Production in these areas will be well controlled and regulated to meet national requirements and the exports will be targeted to cover the state foreign exchange. There will be more detailed government regulations to determine the reserve areas.

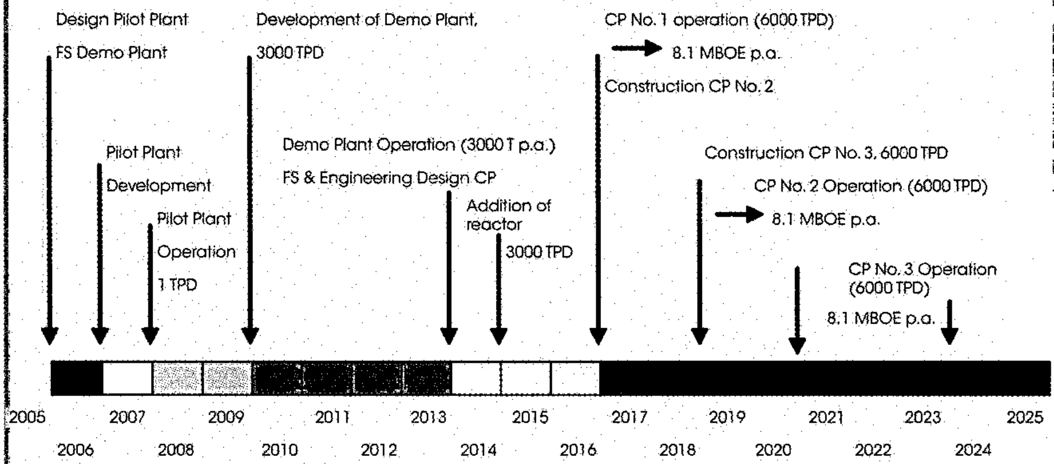
3.4. Roadmap of the Energy Infrastructure in Indonesia

The most recent solutions for energy conservation and diversification are the usage of more coal and renewable energy. Coal is found in abundance in Indonesia while renewable energy sources are essential for ensuing sustainable energy in the future. The government is therefore, setting up a roadmap to use these two energy sources more intensively as well as conducting research on other energy sources such as geothermal, biomass, hydro, and even nuclear for energy diversification.

3.4.1. Roadmap for Brown Coal Liquefaction (BCL)

Diagram 1

Road Map of Coal Infrastructure in Indonesia



Notes:

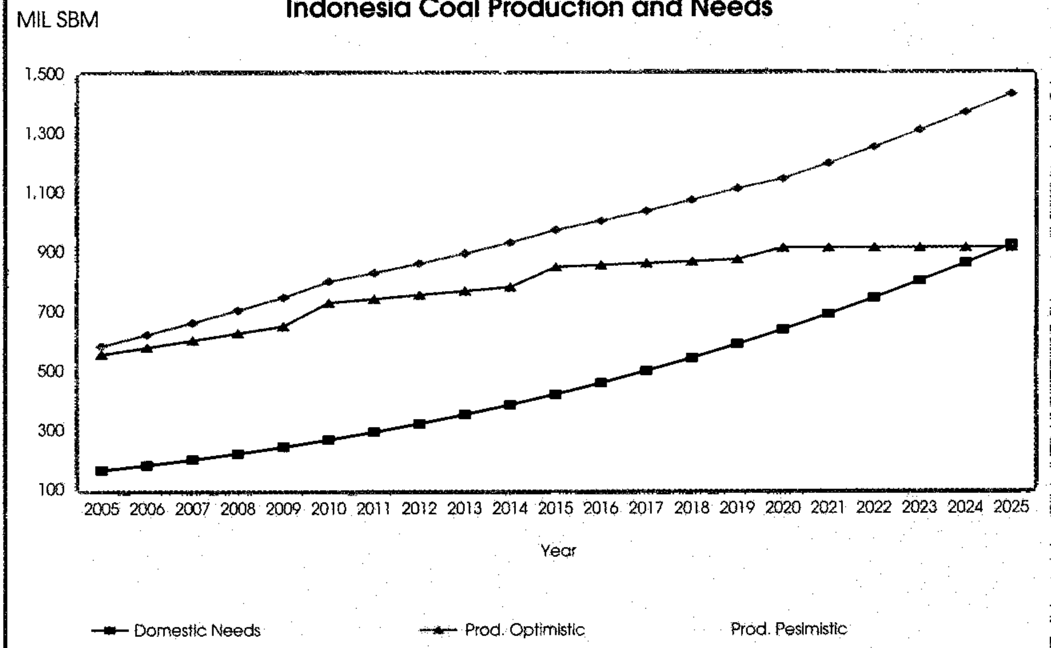
FS: Feasibility study

CP: Commercial Plant

Source: DESDM, Indonesia 2006

Coal is Indonesia's most abundant fuel source with reserves for about 147 years. About half of Indonesia's coal production is consumed domestically, with electricity generation accounting for about 24 percent of coal consumption.

Chart 8
Indonesia Coal Production and Needs



3.4.2. Roadmap of Renewable Infrastructure Development

Renewable energy technologies tap natural flows of energy such as water, wind, solar, geological, and biomass sources, to produce electricity, fuels, and heat. Non-hydropower renewable electricity generation is projected to grow at a faster rate than all other sources. It is also continuously renewable, can be very clean, domestically produced, and can generate income for farmers, landowners, and others. Although its production costs generally remain higher than other sources, renewable energy has not experienced the price volatility of other energy resources.

Non-hydropower renewable energy sources currently account for only about 4 percent of total energy consumption and 2 percent of total electricity generation. The sources of non-hydropower renewable electricity generation are biomass (the direct combustion of plant matter and organic residues such as municipal solid waste use), geothermal (use of naturally occurring steam and hot water), wind, and solar energy. Biomass and geothermal account for most of the generation of renewable electricity. Researches into using bio-fuel as an alternative energy are also in progress. Indonesia is expected to increasingly use this alternative energy source gradually (Diagram 2).

Diagram 2
Bio-fuel Use Projection

Year	2005-2010	2011-2015	2016-2025
Biodiesel	Using Biodiesel 2% of Solar Consumption 0.72 million kL	Using Biodiesel 3% of Solar Consumption 1.5 million kL	Using Biodiesel 5% of Solar Consumption 4.7 million kL
	National Biofuel Standard		
Gasohol	Using Gasohol 2% of Premium Consumption 0.43 million kL	Using Gasohol 3% of Premium Consumption 1.0 million kL	Using Gasohol 5% of Premium Consumption 2.8 million kL
Biofuel	Using Biofuel 1.1 million kL	Using Biofuel 2.2 million kL	Using Biofuel 7.5 million kL
Perpres No 5/2006	**National Energy Conservation**		
Biofuel	Using Biofuel 1.7 million kL	Using Biofuel 4.0 million kL	Using Biofuel 22.0 million kL

Source: National Energy Policy, Indonesia, 2006

3.5. Energy Policy Implication

3.5.1. Renewable Energy's Share on National Energy Mix to be Increased

Indonesia's oil and gas reserves are currently the most important sources of energy. Meanwhile, reserves of oil and gas are rapidly depleting. In this respect, the utilisation of renewable energy (RNE) should be developed. One of Indonesia's energy development strategies is to increase diversification by utilising renewable energy. Indonesia is endowed with substantial resources of renewable energy, but has not been widely exploited until now. Therefore, the contribution of renewable energy to the total energy mix is still quite modest, at less than 1%, if compared with the use of fossil energy.

In order to reduce fossil energy dependency, the government tries to look for energy alternatives to substitute fossil energy gradually. With the potential of diverse source of new and renewable energy in Indonesia and in line with the increasing oil price, the share of RNE on national energy mix is expected to increase from the current target set in the National Energy Management Blueprint (2006).

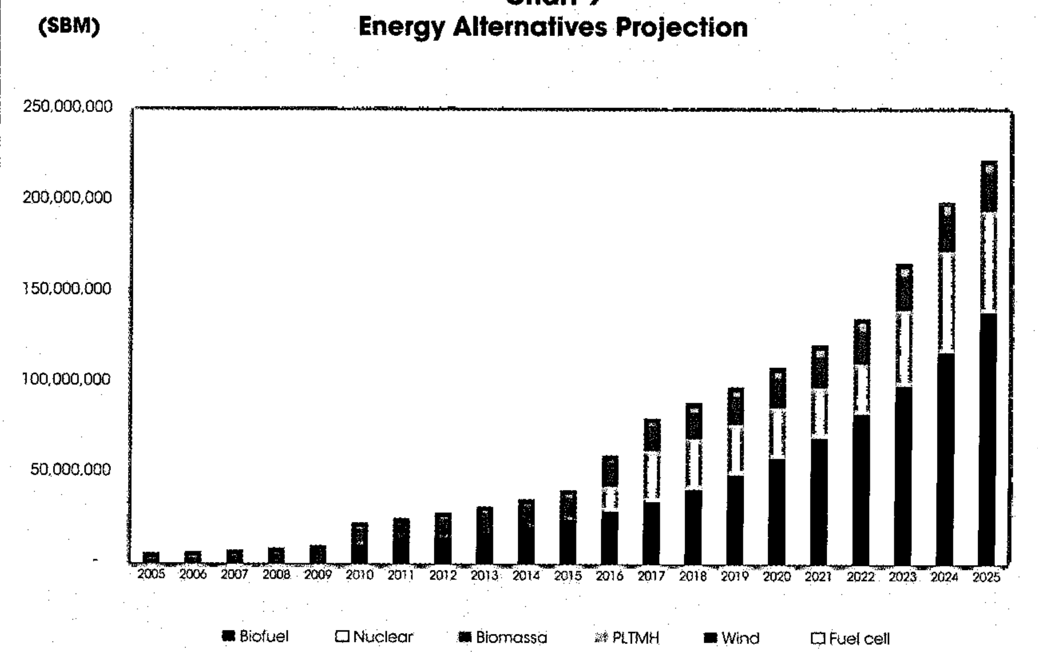
At present, the Center for Energy Information of the Ministry of Energy and Mineral Resources in cooperation with other institutions and universities are reviewing the target to see whether it can be further enhanced. In the National Energy Management Blueprint 2005, the share of RNE will be increased to around 10.6 % in 2025 from the current figure of about 5%. Some of the RNEs to be developed will be from geothermal (from 1.4% in 2004 to 3.8% in 2005) and other RNEs (bio-fuel, biomass and nuclear) from the current 0.2 % share to about 4.4 % in 2025. With the current high oil price, the target is likely to be increased further. To support this target, the government will provide the necessary investment climate for RNE development as well as continuing to rationalise energy price to meet its economics value on a gradual basis.

The world's top palm-oil producers, Malaysia and Indonesia, have decided to set aside nearly 40 percent of their crude palm oil output for bio-diesel production. Both countries agreed to commit to a targeted amount of six million tonnes of crude palm oil each annually as feedstock for the production of bio-fuels and bio-diesel. However, this decision could increase the prices of edible-oil.

The government policy on renewable energy is closely linked to economic development, particularly to improve living standards and people's welfare. In the long-term, renewable energy development is expected to be able to contribute significantly to sustainable national energy supply. The development of RNE makes specific reference to the National Energy Policy, Law No. 20/2002 on Electricity, Law No. 27/2003 on Geothermal, Ministerial Decree on Distributed Power Generation, and Ministerial Decree on Renewable Energy and Energy Conservation Policy. Recently, the government and the Parliament are tabling the Energy Law.

According to the National Energy Policy, the strategies of renewable energy development are (i) to implement non-large hydro renewable energy obligation to improve funding models such as small-scale enterprise credit, and to improve renewable energy equipment manufactured through license, joint venture and assembling.

Chart 9
Energy Alternatives Projection



(i) Law No 20/2002 on Electricity

Article 4 of the Electricity Law mandates that in order to ensure the availability of energy sources for electricity generation, the use of local energy sources shall be prioritised with the obligation to use renewable energy sources. To follow up this mandate, the Government of Indonesia is currently developing a Presidential Decree on Utilization of Indigenous Energy Resources for Power Generation.

(ii) Law no. 23/2003 on Geothermal

This regulation is to control the utilisation of geothermal energy for supporting sustainable development, increase governmental revenue and support the economic development of the country.

(iii) Ministerial Decree on Distributed Power Generation

This Decree mandates that electricity production from renewable energy should be purchased by the state utility company. The system is limited only to the utilisation of renewable energy resources with installed capacity up to 1 MW. The purchase price is 60 % of production cost, if it is connected to low voltage grid and 80 % of production cost, if it is connected to medium voltage grid. The selling of electricity is based on non-firm capacity.

(iv) Ministerial Decree on Renewable Energy and Energy Conservation Policy

This policy consolidates programmes on optimising utilisation of renewable energy, efficient utilisation of energy, and increasing public awareness and influencing behaviour on energy efficiency. The objectives of this policy are to ensure sustainable energy supply, whereas the role of renewable energy is increasing, achieving more efficient, varied, safe, reliable and environmentally friendly energy utilisation pattern.

3.5.2. Long Term Programmes of Renewable Energy Development

Long-term Programmes of Renewable Energy Development include the application of the energy players' mandatory mandate to utilise renewable energy (Non Fossil Fuel Obligation) and establishment of institutions for funding in order to finance development in renewable energy.

For Renewable Energy Development, the government has undertaken the following steps:

- To promote renewable energy in funding institutions such as banks and domestic guarantors;
- To promote public private partnerships for RE development and provide incentives;
- To continue with energy price subsidy elimination;
- To promote formulation of a national standard for RE equipment;
- To improve the quality of resources in handling RE;
- To develop clearing house for RE;
- To establish a partnership programme between research institutes and industries;
- To create networking on RE development at national and international level.

(I) Alternative for Fuel Oil Transportation

Alternative fuels also include traditional energy sources such as natural gas and liquid propane that are not traditionally used as transportation fuel. Ethanol is made by converting the carbohydrate portion of biomass into sugar, which is then converted into ethanol through a fermentation process. Ethanol is the most widely used bio-fuel, and its production has increased sharply since 1980, rising from 200 million gallons a year to 1.9 billion gallons. Today, many states are considering phasing out the use of MTBE (methyl tertiary butyl ether), an oxygenate additive for gasoline. If they do so, this will likely spur greater reliance on ethanol.

Changes in the composition of transportation fuels such as gasoline and diesel fuels, is one way to improve vehicle performance while reducing emissions and lowering oil consumption. Reformulated gasoline contains fuel additives such as ethanol to increase oxygen content, which reduces harmful emissions such as carbon monoxide. Low-sulfur gasoline reduces sulfur oxide emissions. New diesel fuels, some of which have lower sulfur contents are produced from clean-burning natural gas, can help vehicles with diesel engines achieve lower emissions.

In addition to advanced transportation fuels, alternative fuels are being developed, such as bio-diesel, electricity, ethanol, hydrogen, methanol, natural gas, and propane. These alternative fuels not only reduce dependence on petroleum transportation fuels but also reduce or entirely eliminate harmful emissions as well. With the exception of natural gas and propane, these fuels also have the potential of being generated from renewable resources, such as ethanol from corn. The government has promoted the development of alternative fuels for many years and this programme has helped to reduce reliance on oil-based fuels.

The evolutions toward more efficient, environmentally friendly transportation fuels has been mirrored by improvements in vehicle design, components, and materials. Alternative fuel vehicles, which can either switch between two fuels or run on a mixture of two fuels such as gasoline and ethanol, are being developed. Recent developments in both alternative fuel vehicles and petroleum-based vehicles, such as advances in engines, drive trains, and emission-control technologies, may double or triple the efficiency of current vehicles. Some of these new technologies include hybrid electric vehicles, which combine an engine with an electric motor, and fuel cells, which produce electricity by converting a fuel, generally hydrogen and oxygen, into water.

(ii) Construction of Pilot Plant for Mineral Processing

The Research and Development Center of Mineral and Coal Technology of the Department of Energy and Mineral Resources has come up with a pilot plant to integrate mineral process. The project is expected lower exports of Indonesia's raw materials. The Energy and Mineral Resources Minister, Purnomo Yusgiantoro, has formally started the project, which is located in Cipatat, Bandung, Indonesia. It marks the beginning of the Indonesian mineral sub- sector growth improvement and is expected to add value to raw materials. Many import products in the domestic market are not advanced products technologically as they be manufactured locally once the processes are perfected by Indonesian researchers. To launch the project, the Center has come up with a three phased blueprint. The first is to prepare the area, equipment and supporting facilities. The second is the physical construction and equipment installation to process kaolin, felspar, bentonite zeolite, iron sand and gold ore. The third is the development of technology for other minerals, which will be conducted in 2007-2008. Previously, the Center has already started a Coal Technology Center in Palimanan, Cirebon, West Java, Indonesia.

(iii) Crash Programme Regulations for Developing Electric Power Plants

President Susilo Bambang Yudhoyono has signed three presidential regulations to support the crash programme to develop electric power plants across the country which will provide a legal umbrella for PLN to speed up the development. However, there are various hurdles to overcome such as area acquisition, transmission and distribution. The power plant project development will consist of power plants with a total of 10,000 MW capacity provided by the private sectors and small scaled partnership programmes with a total capacity of 2,000 MW. The projects will require funding of around Rp. 200 trillion.

(iv) Coal for Fired Power Station and Export

Indonesia may raise electric production by at least 9% in 2007 as the country starts building a series of coal fired power stations. Indonesia's coal output will reach more than 180 million tons in 2007 from 165 million tons in 2006. Indonesia, which overtook Australia as the world's largest power station coal exporter in 2005, has more than doubled production in the last five years. PT Adaro Indonesia and PT KPC are increasing capacities to meet demand from Asian utilities which have boosted coal use even as oil prices have risen to record highs. Indonesia wants to add 20,000 MW generated by coal fired stations by 2010. This will increase demand by as much as 70 million tons. The majority of the country's coal mines are in Kalimantan and Sumatra.

In addition to the 10,000 MW, which the government has assigned PLN to build, the government wants another 10,000 MW to be provided by independent power producers by 2010. The producers will sell the electricity to PLN. Indonesia may export 125 million tons of coal in 2006 from 117.9 million tons in 2005 according to the Indonesian Coal Association. Its main export markets are Japan, South Korea and Taiwan, while China and India are emerging markets. PTBA may supply low rank coal to power plants in southern China and in India starting 2010. The company sells its better quality coal to Japan, Taiwan and Malaysia. PTBA will cooperate with the China Railway Corp. to construct a double track railway to transport 20 million tons of coal a year from its mine in Tanjung Enim to the port in Lampung. The company also plans to construct a railway and canal from Tanjung Enim to a port in nearby Bangka Island. The project, a joint venture with Citic Group, China's biggest state run investment company, will need 20 million tons of coal starting 2011. Total worldwide export of thermal coal by sea may rise 3% to 512 million tons in 2007. According to the London based shipbroker Clarkson Plc., Australia will ship 111.9 million tons of coal while South Africa, the third largest exporter, will sell 65.7 million tons. Coal sales within Indonesia are expected to rise about 13% to 40 million tons in 2006. Three new coal fired power plants in Java are expected to start operating in 2006.

4. Concluding Remarks

Indonesia's dependency on oil has been growing while its reserves are dwindling. The decreasing oil reserves are caused by two main factors. Firstly, is the decreasing volume of crude being exploited in the oil fields which have been in production for a long time and secondly, is the limited investments in new oil plants to replace old oil ones and exploration of new oil fields. This is worsened by increased demand arising from economic development and increasing population. Indonesia has therefore become a net-oil importer since 2004 as oil imports exceeded oil exports. Without significant investment in new oil plants, Indonesia will continue to be net-oil importer and become more dependent on oil imports.

Indonesia's oil and gas reserve are currently the most important source of energy despite reserves rapidly depleting. In this respect, the utilisation of renewable energy should be encouraged and developed. One of Indonesia's energy development strategies is to increase energy conservation, efficiency, and diversification by utilising renewable energy. The oil dependence measurements have raised concerns for Indonesia's energy security such as the inability to reduce its dependence on oil in recent years, the large share of petroleum in the energy consumption, and the increase in the petroleum share in the last few years.

In order to preserve national energy, the government has made efforts in its energy policy for the availibility and security of energy sufficiency for the present and the future. The mission of the Indonesia Energy Policy is to guarantee domestic energy supply, increase added value of energy, manage energy ethically and in a sustainable way. This includes preservation of the environment, provide energy equally throughout the country, and developing local capability.The policy includes government efforts to:

- review and make recommendations on using the nation's energy resources more efficiently.
- conduct a review of current funding and historic performance of energy efficiency research and development programmes in light of the recommendations of this report.
- promote greater energy efficiency.
- promote public education programmes relating to energy efficiency.
- improve the energy efficiency of appliances.
- take appropriate actions to conserve energy use at their facilities to the maximum extent consistent with the effective discharge of public responsibilities.
- direct all agencies to use technological advances to better protect the environment.
- consider economic incentives for environmentally sound offshore oil and gas development where warranted by specific circumstances - to explore opportunities for royalty reductions, consistent with ensuring a fair return to the public where warranted for enhanced oil and gas recovery; for reduction of risk associated with production in frontier areas or deep gas formations; and for development of small fields that would otherwise be uneconomic.
- to search for technology to meet the goals of increasing electricity generation while protecting the environment and to continue to develop advanced clean coal technology by:
  - Funding research in clean coal technologies.
  - Supporting a permanent extension of the existing research
  - Exploring regulatory approaches that will encourage advancements in environmental technology.

  Policies to support increasing share of use of Renewable and Alternative Energy include:
- Increasing renewable energy production such as biomass, wind, geothermal, and solar.
- Providing increased support for research and development of renewable energy resources.
- Conducting a review of current funding and historic performance of renewable energy and alternative energy research and development programmes in light of the recommendations of this report.
- Developing a new renewable energy partnership programme to help companies to buy renewable energy more easily, as well as receive recognition for the environmental benefits of their purchase, and help consumers by promoting consumer choice programmes that will increase their knowledge about the environmental benefits of purchasing renewable energy.
- Extending and expanding tax credits for electricity produced using wind and biomass.
- Funding research into alternative and renewable energy resources, including wind, solar, geothermal, and biomass.
- Focusing research and development efforts on integrating current programmes for fuel cells and distributed energy.

References

4 A.F. Alhajji and James L. Williams, (2203), "Measures of Petroleum Dependence and Vulnerability in OECD Countries", *Middle East Economic Survey*, April 21.

5 Energy Balance, Indonesia, Badan Pusat Statistik (BPS) – Indonesia, 1998 – 2002.

6 Energy Outlook, Various Issues, Energy Information Agency – USA

7 Kurtubi, (2006), "Oil Price Outlook and Energy Policy".

8 Ministry of Energy and Mineral Resources, RI, "The National Energy Policy", DESDM-RI.

9 National Energy Management, RI: Blueprint: 2005 – 2025, DESDM-RI, May 2006.

10 OPEC Bulletin 3-4/06, OPEC, 2006.

Glossary

Barrel (Oil): A unit of volume equal to 42 U.S. gallons.

Biomass: Organic non-fossil material of biological origin constituting a renewable energy source.

British Thermal Unit (Btu): The quantity of heat needed to raise the temperature of 1 pound of water by 1°F at or near 39.2°F.

Coal: A readily combustible black or brownish-black rock whose composition, including inherent moisture, consists of more than 50 percent by weight and more than 70 percent by volume of carbonaceous material. It is formed from plant remains that have been compacted, hardened, chemically altered, and metamorphosed by heat and pressure over geologic time.

Cogeneration: The production of electricity and another form of useful energy (such as heat or steam) used for industrial, commercial, heating, or cooling purposes.

Crude Oil: A mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Crude oil may also include:

- Small amounts of hydrocarbons that exist in the gaseous phase in natural underground reservoirs but are liquid at atmospheric pressure after being recovered from oil well (casing head) gas in lease separators and that subsequently are commingled with the crude stream without being separately measured.
- Small amounts of nonhydrocarbons produced with the oil, such as sulfur and other compounds

Crude Oil Stocks: Stocks of crude oil and lease condensate held at refineries, in pipelines, at pipeline terminals, and on leases.

Electric Power Plant: A station containing prime movers, electric generators, and auxiliary equipment for converting mechanical, chemical, and/or fission energy into electric energy.

Electricity Generation: The process of producing electric energy or transforming other forms of energy into electric energy. Also, the amount of electric energy produced or expressed in watt-hours (Wh).

Energy: The capacity for doing work as measured by the capability of doing work (potential energy), or the conversion of this capability to motion (kinetic energy). Energy has several forms, some of which are easily convertible and can be changed to another form useful for work. Most of the world's convertible energy comes from fossil fuels that are burned to produce heat that is then used as a transfer medium to mechanical or other means in order to accomplish tasks. Electrical energy is usually measured in kilowatt-hours, while heat energy is usually measured in British thermal units.

Energy Consumption: The use of energy as a source of heat or power or as an input in the manufacturing process.

Energy Source: A substance, such as oil, natural gas, or coal, that supplies heat or power. Electricity and renewable forms of energy, such as wood, waste, geothermal, wind, and solar, are considered to be energy sources.

Fossil Fuel: Any naturally occurring organic fuel formed in the Earth's crust, such as oil, coal, and natural gas.

Fuel Cell: is an electrochemical energy conversion device. A fuel cell converts the chemicals hydrogen and oxygen into water, and in the process it produces electricity. The other electrochemical device that we are all familiar with is the battery

Fuel Ethanol: An anhydrous, denatured aliphatic alcohol intended for motor gasoline blending.

Gas-Turbine Electric Power Plant: A plant in which the prime mover is a gas turbine. A gas turbine typically consists of an axial-flow air compressor and one or more combustion chambers where liquid or gaseous fuel is burned. The hot gases expand to drive the generator and then are used to run the compressor.

Geothermal Energy: Energy from the internal heat of the Earth, which may be residual heat, friction heat, or a result of radioactive decay. The heat is found in rocks and fluids at various depths and can be extracted by drilling or pumping.

Hydrocarbon: An organic chemical compound of hydrogen and carbon in the gaseous, liquid, or solid phase. The molecular structure of hydrocarbon compounds varies from the simplest (methane, a constituent of natural gas) to the very heavy and very complex.

Hydropower: The production of electricity from the kinetic energy of falling water.

Hydropower Plant: A plant in which the turbine generators are driven by falling water.

Jet Fuel: A refined petroleum product used in jet aircraft engines. It includes kerosene type jet fuel and naphtha-type jet fuel.

Methane: Hydrocarbon gas, which is the major component of natural gas.

Methanol: A light, volatile alcohol eligible for motor gasoline blending.

Methyl Tertiary Butyl Ether (MTBE): An ether, intended for motor gasoline blending.

Natural Gas: A gaseous mixture of hydrocarbon compounds, primarily methane, delivered via pipeline for consumption. It is used as a fuel for electricity generation, a variety of uses in buildings, and as raw material input and fuel for industrial processes. *Note*: This product, also referred to as *dry natural gas* or *consumer-grade natural gas*, is the product that remains after *wet natural gas* has been processed at lease facilities and/or natural gas processing plants. This processing removes nonhydrocarbon gases (e.g., water vapor, carbon dioxide, helium, hydrogen sulfide, and nitrogen) that would otherwise make the gas unmarketable and natural gas liquids.

Natural Gas, Dry: The marketable portion of natural gas production, which is obtained by subtracting extraction losses, including natural gas liquids removed at natural gas processing plants, from total production.

Natural Gas, Wet: A mixture of hydrocarbon compounds and small quantities of various nonhydrocarbons existing in the gaseous phase or in solution with crude oil in porous rock formations at reservoir conditions. The principal hydrocarbons normally contained in the mixture are methane, ethane, propane, butane, and pentanes. Typical nonhydrocarbon gases that may be present in reservoir natural gas are water vapor, carbon dioxide, helium, hydrogen sulfide, and nitrogen. Under reservoir conditions, natural gas and the liquefiable portions occur either in a single gaseous phase in the reservoir or in solution with oil and are not distinguishable at the time as separate substances.

Nuclear Electric Power: Electricity generated by an electric power plant whose turbines are driven by steam generated in a reactor by heat from the fissioning of nuclear fuel.
Photovoltaic Energy: Direct-current electricity generated from sunlight through solidstate semiconductor devices that have no moving parts.

Proved Reserves, Oil: The estimated quantities of all liquids defined as crude oil that geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions.

Proved Reserves, Natural Gas: The estimated quantities of natural gas that analysis of geological and engineering data demonstrates with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions.

Refinery (Oil): An installation that manufactures finished fuels from oil, unfinished oils, natural gas liquids, other hydrocarbons, and alcohol.

Renewable Energy: Energy obtained from sources that are essentially inexhaustible (unlike, for example, fossil fuels, of which there is a finite supply). Renewable sources of energy include conventional hydroelectric power, wood, waste, geothermal, wind, photovoltaic, and solar thermal energy.

Wind Energy: The kinetic energy of wind converted into mechanical energy by wind turbines (i.e., blades rotating from a hub) that drive generators to produce electricity.

Wood Energy: Wood and wood products used as fuel, including round wood (cord wood), limb wood, wood chips, bark, sawdust, forest residues, fire wood, charcoal, pulp waste, and spent pulping liquor.

Chapter 5

IMPACT AND POLICY RESPONSES TO VOLATILE OIL PRICES IN KOREA

by Kyuil Chung
The Bank of Korea

1. Developments of Energy Policy

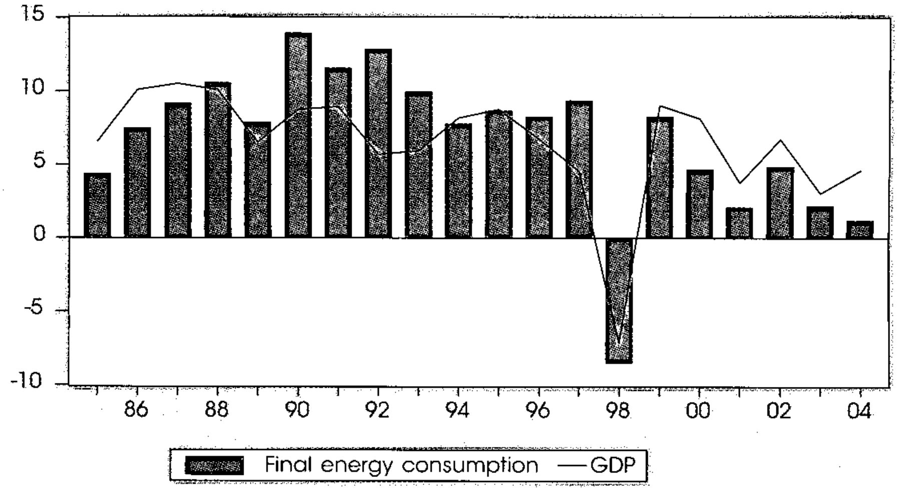
1.1 Energy Policy Objectives

The Korean economy recorded rapid economic growth from the 1970s to the 1990s. Reflecting this high economic growth, energy consumption in Korea also has increased sharply. As a result, Korea has become one of the world's 10 major energy consumers.

Figure 1 shows the annual growth rates of real GDP and final energy consumption. Both are moving together closely. The largest increase in final energy consumption took place between 1989 and 1997 when energy consumption grew faster than the economic growth. Since 1999, the growth rate of final energy consumption has been declining as the Korean economy shows relatively low economic growth.

Figure 1
GDP and Final Energy Consumption

(Annual growth rates, %)



Source: Energy Statistics Korea Energy Economics Institute

The Korean government has structured the energy sector to meet the rapidly growing demand for energy consumption generated by the high economic growth. Since the first oil crisis in 1973, the notion that "securing a safe supply of energy resources, thereby establishing a solid economic foundation to buffer changes in international energy prices"[1] has played a prominent role in Korea's energy policies. The three main policy objectives are:[2]

1) maintain a stable energy supply by increasing oil stocks and raising emergency preparedness, expanding the energy infrastructure in a timely manner, through LNG and nuclear; and promote energy co-operation with Northeast Asia;
2) strengthen market mechanisms by privatising public utilities;
3) establish environment-friendly energy systems by reforming the tax system, inducing the use of low-polluting energy, encouraging energy-efficient technologies and developing new and renewable energy sources.

1.2 Major Developments in Energy Policy[3]

The Korean Government played a strong role in managing the major energy companies, mainly through the total ownership of Korea Electricity Power Corporation and Korea Gas Corporation. It regulated the private refining industry by licensing production, by controlling refinery output, and by approving imports of crude oil and exports of petroleum products. It used pricing policies to provide a low-cost energy supply to fund the nation's industrial competitiveness.

However, the 1993 Economic Five-Year Plan called for economic reforms. It paved the way for further steps towards the government's withdrawal from the direct control of energy sector, and for facilitating a new regulatory framework, while ensuring the major long-term objectives of energy security and efficiency. Since then, the government's role in energy policy has clearly evolved in line with the 1993 plan. In response to the 1997 financial crisis in which GDP shrank by 8.6 % and total primary energy supply by 7.6%, the government accelerated the pace of the energy sector reforms that it had envisaged before the crisis. Since 2000, in addition to the structural reforms, the government has initiated a new move to promote energy efficiency.

Among many energy reforms, oil market liberalisation needs to be described with more details. The Korean Government has relaxed its controls over the petroleum industry since 1995, as shown below:

Distance Limits on the Operation of Service Stations

The regulation prohibiting the operation of service stations within a specified distance of each other was abolished in 1995.

Abolition of Government Price-setting for Petroleum Products

Under the Petroleum Price Fluctuating System which regulated the prices of petroleum products before 1997, the government determined prices for certain petroleum products on the basis of average costs calculated with cost data from domestic refineries. The products covered by this mechanism were reduced gradually. Jet and solvent prices were deregulated in 1983, followed by asphalt in 1988, premium gasoline and naphtha in 1989, and regular gasoline and kerosene in 1991. In January 1997, all petroleum-product price controls were lifted.

Prices for all petroleum products are now determined by the market, but they include a tariff on crude oil imports and imported petroleum products. A transportation tax or special

1 2000 Blueprint, Ministry of Commerce, Industry, and Energy, Republic of Korea.
2 Three objectives are from Energy Policies of IEA Countries, Republic of Korea 2002 Review, IEA
3 This part is mainly cited from Energy Policies of IEA Countries, Republic of Korea 2002 Review, IEA

excise tax is levied on the consumption of petroleum products. Surcharges are also imposed on imports and sales of petroleum products to finance the Energy Project Special Account.

Liberalisation of Export-import Business of Petroleum Products

Until 1997 all traders were required, under the Petroleum Business Act, to have a government permission to trade in petroleum products by a particular importer. The purpose of this requirement was to avoid over-dependence on Middle Eastern oil. This restriction was liberalised in 1997.

Opening the Retail Petroleum-Products Business to Foreigners

As of January 1997, the regulation on marketing petroleum products was liberalised. In May 1998, the retail business was opened to foreigners. Domestic and foreign firms could enter the oil refining business. Clearance procedures that had been mandatory for new construction and expansion projects of refining facilities were streamlined.

Deregulation in Retail Business

In early 1998, direct transactions became possible between oil refiners and service stations; previously, service stations had had to purchase products through traders.

1.3 Petroleum Product Pricing and Taxation

The prices of petroleum products differ considerably, as a result of their different tax rates. The basic price formula is like below:

Retail Price = (Crude oil price x average exchange rate) + (Usance cost (interest rate + profit and loss of foreign exchange)) + Tariff	Crude oil import
+ Production cost (refining + storage + transportation) + Tax	Production
+ Dealer's commission + Value Added Tax	Sales

The primary objectives of the Korean energy tax system were to raise revenues, to enable cross-subsidisation, and to stabilise prices. This led to price distortions. It also failed to provide any incentive for using energy efficiently, especially for industry.

Prices of crude oil, products, and LNG began to be deregulated in 1997 but are still subject to a number of taxes and levies. These include a tax collected for the Energy Project Special Account which is used to fund the expansion of the government's strategic oil stockpile and other projects (promoting LNG, energy conservation, phasing-out anthracite mines, developing energy R&D and renewable energy). This account is also fed from surcharges on petroleum imports and kerosene sales and LPG. LPG for cars is subsidised for the relative benefits that LPG has for the local environment (LPG-fuelled vehicles also get tax benefits). The LPG subsidy generated a rapid increase in the number of LPG-fuelled vehicles and LPG service stations. This LPG subsidy has been gradually being decreased according to the Energy Tax Reform indicated in Table 1. The price differential between kerosene and diesel fuel in favour of kerosene has resulted in kerosene's being illegally substituting for diesel. The reform is also correcting this.

Table 2 shows the energy tax system in Korea. Tax rates vary for each product. As indicated in the last row, tax accounts for 28 57% of retail prices for petroleum products. Tax share in the retail price for gasoline is the highest with 57%, followed by diesel 47%, LPG (car) 42%, and kerosene 28%.

Table 1
Price Differentials through Energy Tax Reform

	Transportation			Residential			Industrial	
	Gasoline (litre)	Diesel (litre)	LPG (litre)	Kerosene (litre)	Diesel (litre)	LNG (m^3)	Bunker-C (litre)	LNG (m^3)
Pre-reform	100	47	26	40	31	37	22	26
July 2001	100	52	32	43	31	37	22	26
July 2002	100	56	38	45	31	37	22	26
July 2003	100	61	43	48	31	37	22	26
July 2004	100	66	49	50	31	37	22	26
July 2005	100	70	54	53	31	37	23	26
July 2006	100	75	60	55	31	37	23	26

Source: Ministry of Commerce, Industry and Energy

Table 2
Energy Tax System in Korea (as of August, 2006)

(Won/litre)

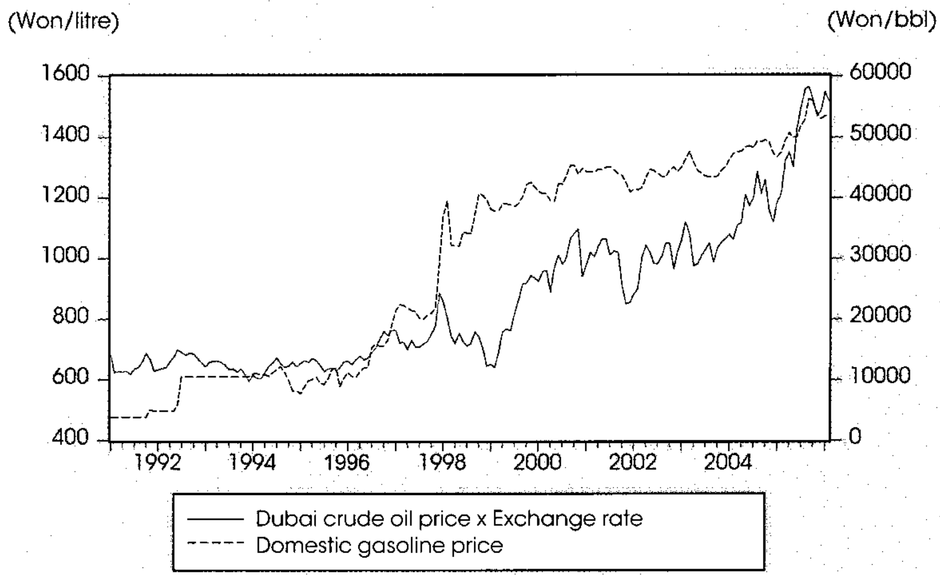
		Gasoline	Kerosene	Diesel	LPG (Car)
Import	Tariff (Ceiling rate)	5% (8%)	5% (8%)	5% (8%)	1.5% (5%)
	Surcharge	16	16	16	-
Sales	Special Excise	-	134.00	-	178.71
	Transportation	526.00	-	349.25	-
	Education	78.90	20.10	52.39	26.81
	Driving	139.39	-	92.55	-
	Surcharge	-	23.00	-	36.37
	Value Added Tax	140.7	87.6	118.2	67.4
	Total (Sales): A	884.99	264.70	612.39	309.29
	Retail Price: B	1,548.01	963.57	1,300.22	1,548.01
	Percentage of tax in retail price (A/B)	57.2%	27.5%	47.1%	41.7%

Source: Ministry of Commerce, Industry and Energy.

Figure 2 exhibits the comparison of crude oil import cost and domestic gasoline price. While crude oil import cost has shown very volatile movements, domestic gasoline price has shown relatively stable movement. This is because the tax rate on gasoline plays as a buffer which is moderating domestic gasoline prices: when crude oil prices jump (fall), the tax rate decreases (increases).

Figure 2

Crude Oil Import Cost and Domestic Gasoline Price



Source: IFS, IMF, Energy Statistics, Korea Energy Economics Institute

1.4. Energy Supply and Demand

1.4.1. Primary Energy Supply

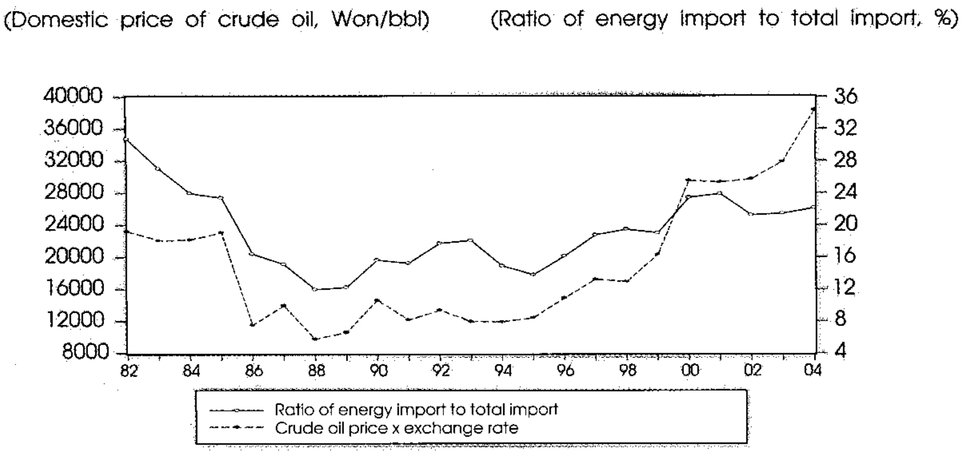
Since Korea has few natural resources, it imports most of its primary energy from overseas. The share of imported energy among total primary energy increased from 47.5% in 1970 to 96.7% in 2004. Main imported items are petroleum, coal, nuclear and LNG. Korean energy resources are limited to low-quality anthracite, hydro and, fire wood, which account for 3.3% of total primary energy in 2004 (Refer to Table 3). Due to this high dependence of imported energy, the share of energy import out of total import amounts to 22.1% in 2004. Figure 3 shows the movements of the ratio of energy import to total import. The ratio is basically affected by the crude oil import cost (crude oil price x exchange rate) which is the main item of energy import.

Table 3
Primary Energy Supply Structure (2004)

Supply	Amount (portion)
Domestic Production (thou. TOE)	**7,184 (3.3%)**
Anthracite (thou. M/T)	3,871
Hydro (Gwh)	5,861
Fire Wood & Other (thou. M/T)	3,977
Import (thou. TOE)	**213,054 (96.7%)**
Coal (thou. M/T)	78,245
Petroleum (thou. bbl)	752,329
Nuclear (Gwh)	130,715
LNG (thou. M/T)	21,809
Total (thou. TOE)	**220,238 (100%)**

Source: Energy Statistics, Korea Energy Economics Institute

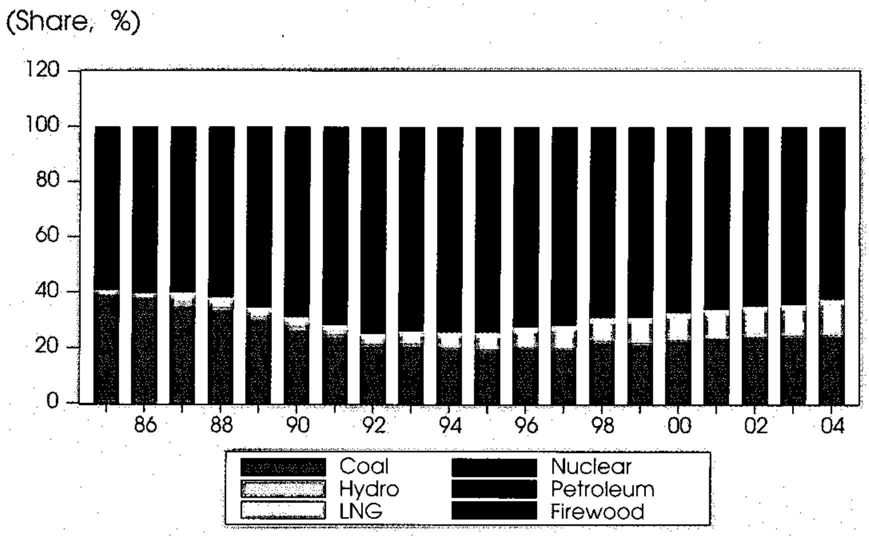
Figure 3
Ratio of Energy Import to Total Import



Source: Energy Statistics, Korea Energy Economics Institute

Figure 4 exhibits primary energy supply by types. Oil accounted for 46% (106 Mtoe) of Korea's total primary energy supply in 2004. Coal supply has increased continuously at an annual average rate of 6.9% for the past thirty years, and it accounted for 24% of total primary energy supply share in 2004. The use of coal has continuously decreased. Domestic anthracite, which was once consumed especially in the residential sector, is gradually being replaced by natural gas. The coal now consumed in Korea is imported and used to generate power. Nuclear power did not exist in Korea before 1977, but has increased sharply since 1982, at an annual average rate of 21.5%, and it took 15% of primary energy supply in 2004. Gas was introduced in 1986 in the form of LNG, and grew quickly, at 62.5% average growth rate per annum from 1986 to 1997. The share of LNG in primary energy supply was more than 13% in 2004.

Figure 4
Primary Energy Supply by Types



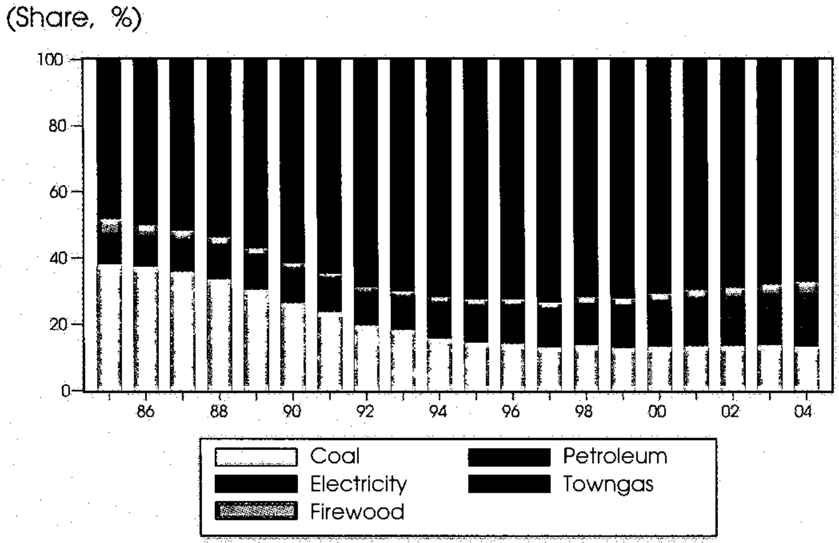
Source: Energy Statistics, Korea Energy Economics Institute

1.4.2. Final Energy Consumption

Final energy consumption increased up to 166 Mtoe in 2004 from 47 Mtoe in 1985. Korea is now the 10th largest energy-consuming country in the world.

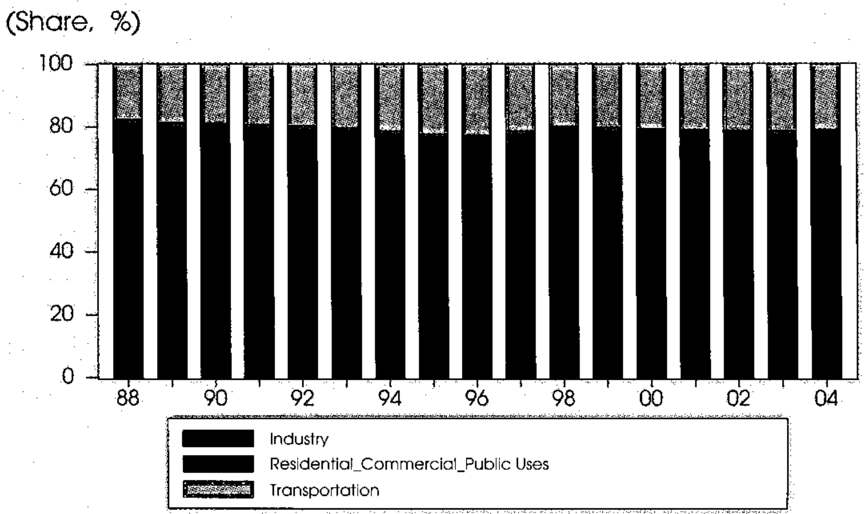
In 2004, oil retained the highest share of total final energy consumption, with 58% (refer to Figure 5). Power generation (electricity) represented 16%, coal 13%, and gas 10%. While the share of oil in the final energy consumption has been gradually decreasing, the use of electricity and town gas has increased continuously. Figure 6 demonstrates final energy consumption by sectors. Industry sector took the largest share of final energy consumption with 56% in 2004. Residential, commercial, and public uses accounted for 23%, and transportation 21%. As indicated by Figure 6, consumption by the industry and transportation sector has been continuously increasing.

Figure 5
Final Energy Consumption by Types



Source: Energy Statistics, Korea Energy Economics Institute

Figure 6
Final Energy Consumption by Sectors



Source: Energy Statistics, Korea Energy Economics Institute

1.5. Oil Supply and Demand

Korea has no domestic oil reserves and therefore imports all of its crude oil. In 2004, it imported 826 million bbl of crude oil, and 68% of which came from the Middle East. In 1980, Korea relied completely on the Middle Eastern oil. This high dependence on the Middle Eastern oil decreased to 55% in 1985. It, however, increased again to the current level (68%) during the 1990s. Diversifying the sources of supply remains an important policy objective.

Table 4 shows the supply and demand for oil in 2004. As for the oil supply, domestic production reached 886 million bbl (82%) and import amounted to 200 million bbl (18%). As for the oil demand, domestic consumption approximated 752 million bbl (72%), export 236 million bbl (22%), and international bunkering 58 million bbl (6%). Table 4 shows that the domestic oil refining capacity is more than what is needed to meet the demand due to the readily availability of refining facilities. Coupled with this is the declining growth rate of oil demand due to the increased preference for cleaner energy such as LNG.

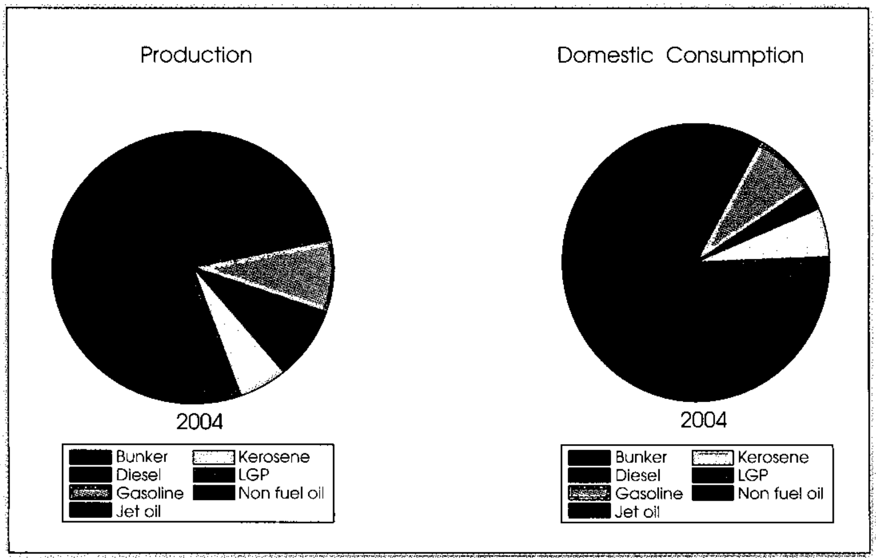
Table 4
Supply and Demand for Oil
(2004, thou. bbl)

Supply (share)		Demand (share)	
Production	886,413 (81.6%)	Domestic consumption	752,329 (71%)
		Int'l bunkers	58,387 (5.6%)
Import	199,994 (18.4%)	Export	235,506 (22.5%)
		Total	**1,046,222 (100%)**
Total	**1,086,407 (100%)**	**Stock changes**	**40,185**

Source: Energy Statistics, Korea Energy Economics Institute

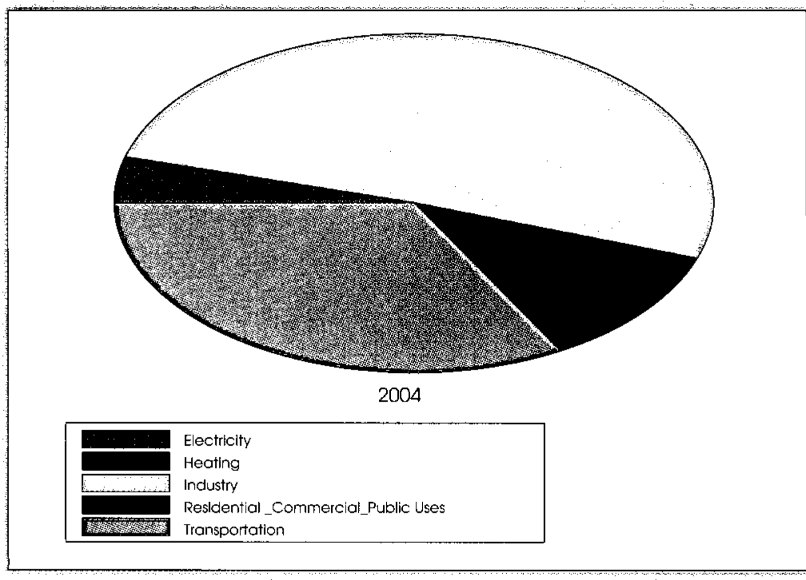
Figure 7 shows production and domestic consumption for petroleum products in 2004. Fuel oil such as gasoline, kerosene, diesel, bunker, and jet oil took 70% of production, followed by non-fuel (naphtha, solvent, and asphalt) with 26%, and LPG with 4%. On the domestic consumption side, fuel oil accounted for 49%, non-fuel oil 39%, and LPG 12%. Figure 8 represents domestic consumption of petroleum products by sectors. Petroleum products consumption by industry sector was 50%, transportation sector consumed another 30%, and the remaining part went to residential, commercial and public uses (12%) and power generating (4%).

Figure 7
Production and Domestic Consumption of Oil by Products



Source: Energy Statistics, Korea Energy Economics Institute

Figure 8
Domestic Consumption of Oil by Sectors



Source: Energy Statistics, Korea Energy Economics Institute

1.6. Evaluation

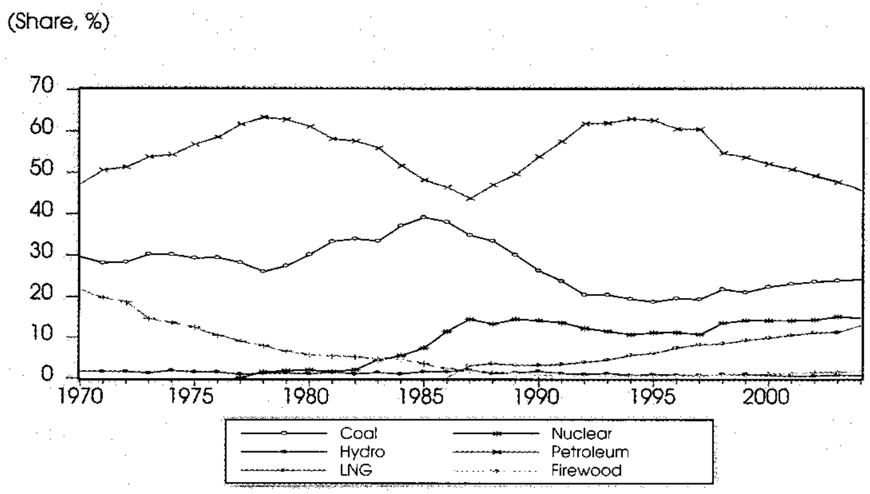
The Korean government has made efforts to diversify the sources of energy supply to improve the energy supply security since it imports 68% (2004) of its oil from the Middle East. The government has been also encouraging switching from oil to natural gas, so that Korea can reduce its dependence on oil and move towards a more environment-friendly fuel-mix. Figure 9 displays the trends of primary energy supply. Oil dependence[4] has been continuously declining since 1995 with the increasing use of nuclear energy and LNG. In 2004, oil dependence in Korea fell to 46% from 63% in 1995. On the other hand, the shares of nuclear and LNG rose to 15%, 13% in 2004 from 11%, 6% in 1995, respectively.

Judging from its declining trend of oil dependence, energy policy in Korea has worked successfully so far. This relatively low oil dependence makes the Korean economy less sensitive to volatile crude oil prices, and ensures the maintenance of sustainable economic growth.

However, there still remains a fundamental problem in Korea's energy supply structure. Figure 10 shows the comparison of oil dependence and imported energy dependence. Although oil dependence has fluctuated over the last 35 years depending on the economic situation, dependence on imported energy has been continuously increasing. As of 2004, Korea relied 97% of its primary energy supply on overseas resources. Though the prices of other primary energy sources such as coal, LNG, and uranium are not as volatile as oil prices, the high dependence on foreign energy resources is an on-going task for the Korean government to resolve.

Figure 9

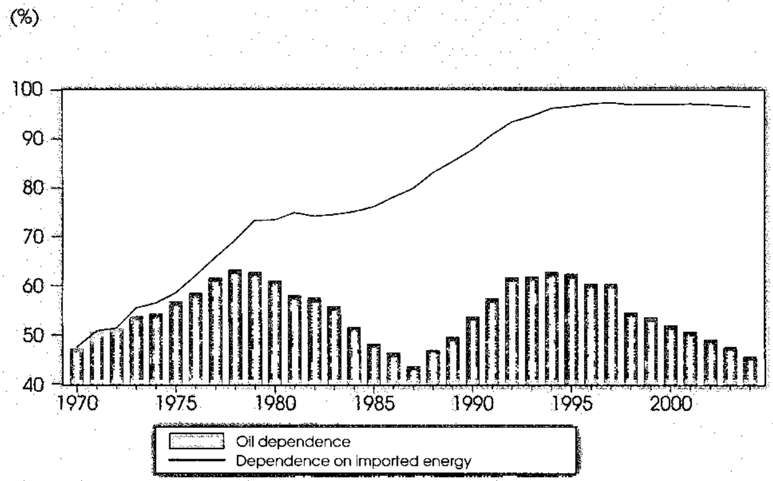
Trends of Primary Energy Supply



Source: Energy Statistics, Korea Energy Economics Institute

4 Calculated by using the formula: petroleum / total primary energy supply.

Figure 10
Oil Dependence and Imported Energy Dependence



Source: Energy Statistics, Korea Energy Economics Institute

2. Impact of Oil Price Shock and the Response of Monetary Policy

2.1. Description of the Data

The analysis of the impact of oil price shock to output and inflation is based on a five-variable VAR model, with industrial production, consumer price index, producer price index for coke and petroleum, monetary base, and call rate (one-day inter bank market rate).

The sample is monthly data from 1976. 8 - 2006. 7. All data are taken from the Bank of Korea Economic Statistics System (BOK ECOS) and are seasonally adjusted if necessary. All data are also transformed into annual growth rates except call rate. Therefore, oil price is defined as an annual growth rate of producer price index for coke and petroleum. Since the producer price index for coke and petroleum is used for oil price, the effect of exchange rate on oil price is already taken into account. Monetry base growth rate and call rate are chosen as variables showing monetary policy stances. Before 1998, Korea had adopted monetary targeting and M2 growth rate had been used as an intermediate target. Since 1999, it has changed its monetary regime to inflation targeting and call rate has been adopted as a new monetary policy operation target.

Due to the endogeneity of broad monetary aggregates such as M2 growth rates, the M2 growth rate in Korea and call rate do not show a negative relationship (refer to Figure 11). On the other hand, as illustrated in Figure 12, a monetary base growth rate in Korea and call rate exhibit a negative realtionship. Therefore, the monetary base growth rate is used to describe the monetary policy stance.

Figure 11

Call Rate and M2 Growth Rate

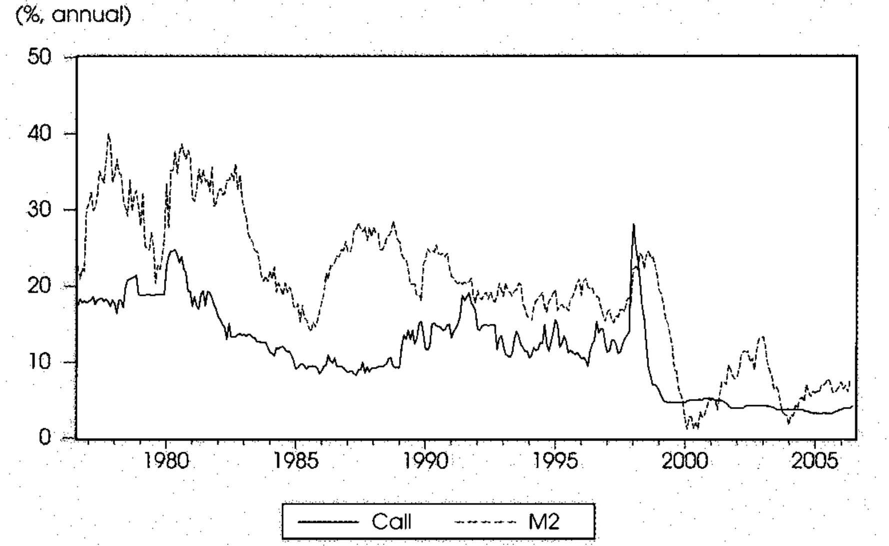
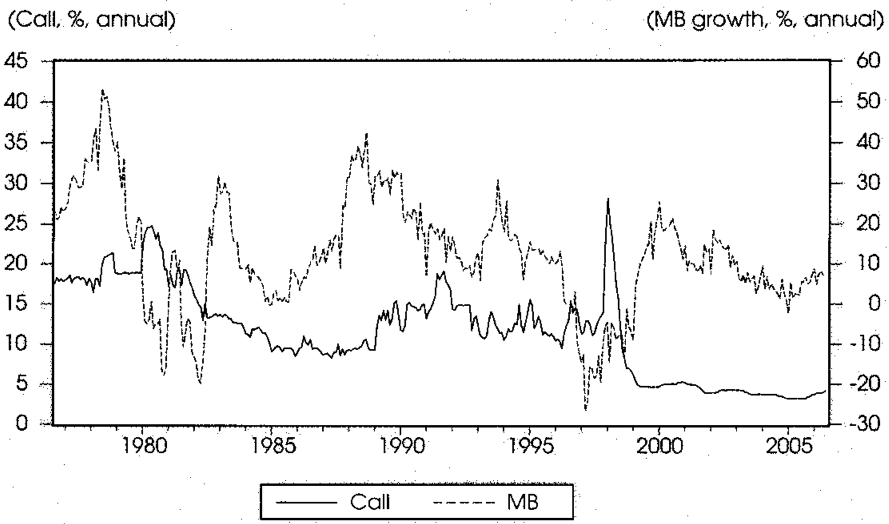


Figure 12

Call Rate and Monetary Base Growth Rate



2.2. Correlation Analysis

Before going into the VAR analysis, we can check the relationship between the oil price shock and IP growth rate and inflation using simple correlation analysis. Table 5 shows correlation coefficients classified by sample periods. The first column indicates the full sample case (1976.8-2006.5) in which the oil price shock and IP growth rate show a negative relationship with the coefficient of -0.375 and the oil price shock and inflation showing a positive relationship with the coefficient of 0.604. The second column represents the before 1997 financial crisis case (1976.8 - 1997.9). Compared to the full sample case, the negative relationship between the oil price shock and IP growth rate and the positive relationship between the oil price shock and inflation were much stronger. For example, the correlation coefficient between the oil price shock and IP growth rate was -0.42 and the coefficient between the oil price shock and inflation was 0.723. Based on these numbers, we can conclude that the oil price shock had had a very strong effect before the financial crisis occurred. On the other hand, after the financial crisis period (1998.10 – 2006.5), the relationship between the oil price shock and IP growth rate and inflation weakened dramatically. Specifically, the coefficient between the oil price shock and IP growth rate is close to zero, 0.033, and the coefficient between the oil price shock and inflation (0.398) is close to half of that before crisis one.

Figure 13 and 14 exhibit scatter plots of the oil price shock and IP growth rate and inflation by period. As confirmed in Table 5, the scatter plots before the crisis and the ones after the crisis show quite different features. Unlike the before crisis plots, we cannot find any meaningful relationships for after the crisis plots.

This simple correlation analysis implies that there was a structural change in the Korean economy around the 1997 financial crisis period and consequently the impact of the oil price shock has also changed.

Table 5
Correlation between Oil Price Shock and Economic Variables

	Full Sample (76.8-06.5)	Before (76.8-97.9)	After (98.10-06.5)
DOP, GIP[5]	-0.375	-0.420	0.033
DOP, INF[6]	0.604	0.723	0.398

5 DOP represents the growth rate of producer price index for coke and petroleum and GIP the growth rate of industrial production.

6 INF denotes CPI inflation.

Figure 13

Scatter Plot of Oil Price Shock and IP Growth

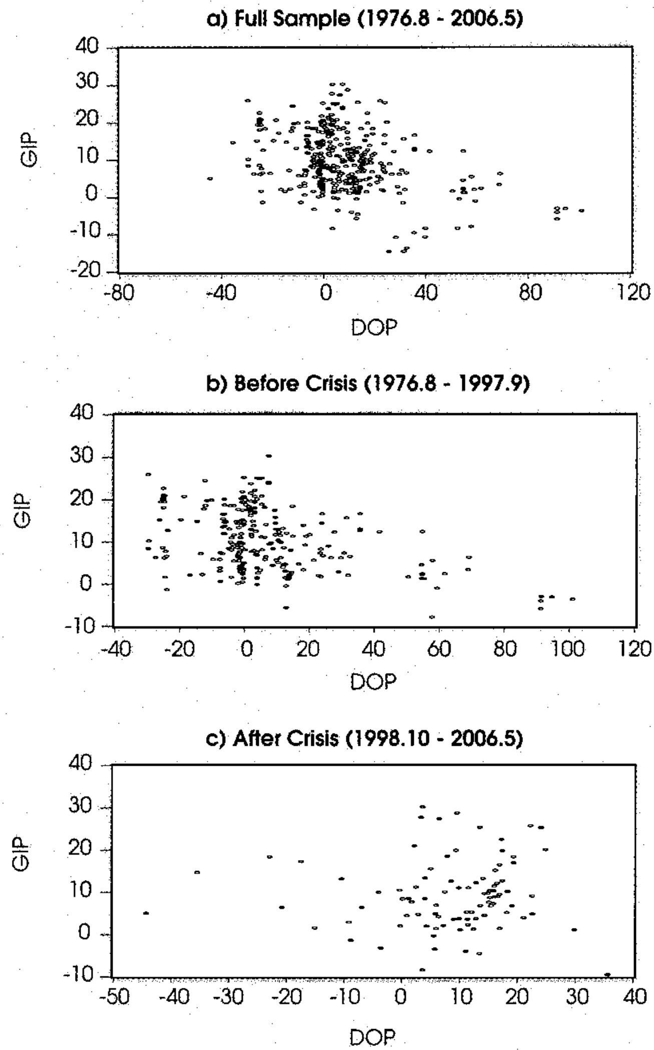
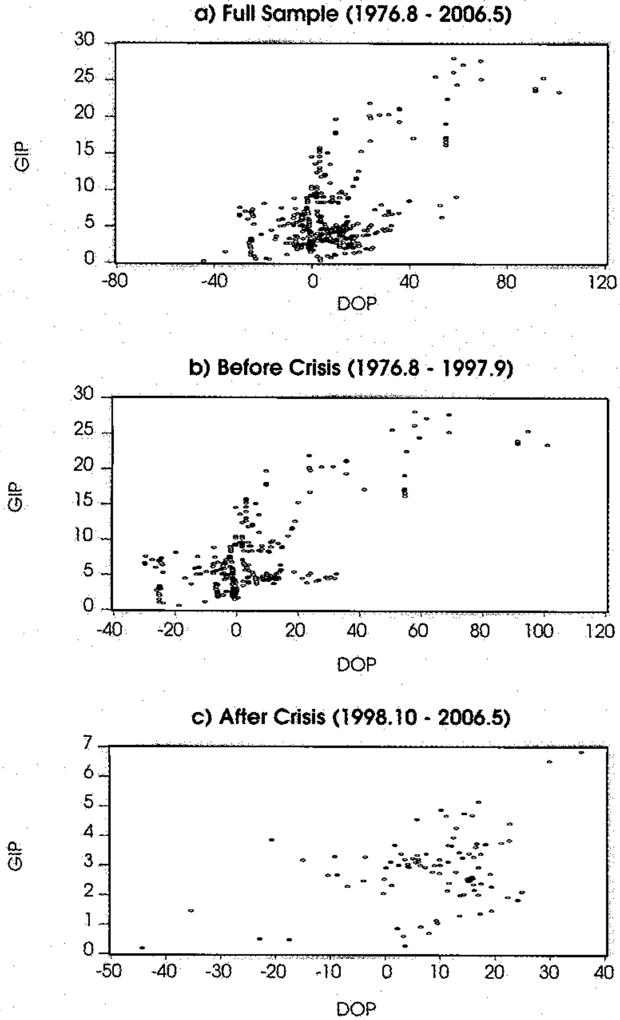


Figure 14

Scatter Plot of Oil Price Shock and Inflation



2.3. VAR Analysis

To investigate the effect of oil price shock on the economy, we need first to identify the oil price shock. Though there is plenty of literature on this topic, a recursive strategy is followed as proposed by Bernanke and Blinder (1992), Bernanke and Mihov (1998), and Christiano, Eichenbaum, and Evans (1996). Considering that it takes some time for oil price shocks to have an effect on the economy, and that monetary policy takes oil price shocks into account, it is quite reasonable to assume the Wold-Causal order of the variables is (GIP, INF, DOP, GMB, CALL). As mentioned earlier, GIP represents the growth rate of industrial production, INF CPI inflation, DOP the growth rate of producer price index for coke and petroleum. Additionally, GMB denotes the growth rate of monetary base, and CALL call rate. This ordering implies that oil price shock has a contemporaneous effect on monetary policy, but not on the industrial production or inflation. Three lag-lengths are selected according to the Schwarz Information Criterion (SIC). This implies that an oil price shock affects other economic variables with a one quarter time lag.

Figure 15 reports the impulse responses of the system to a shock to oil prices using full sample period (1976.8 - 2006.5). The upper-left panel shows the response of the IP growth rate (GIP) to a positive shock to the oil price (DOP). The increase of oil price results in a drop of the IP growth rate, which is consistent with our expectation. In reaction to a one percent oil price shock, the IP growth rate decreases up to -0.13% at around the 10th month. The upper-right panel shows the response of inflation. Inflation responds positively to the oil price shock and reaches the maximum point (+0.07%) at around the 8th month. The mid-left panel displays a 1% shock to the oil price. The mid-right panel shows the response of the monetary base growth rate. To resist inflation pressure caused by the oil price shock, the monetary base growth rate goes down to -0.2% at around the 10th month. Due to this tightened monetary policy, inflation goes down below the zero line from around the 32nd month. Reflecting the decline of monetary base growth rate, the call rate initially increases, but the response is not very significant because two standard deviation error bands contain the zero line.

Figure 16 shows the sub-sample period (before crisis: 1976.8 – 1997.9) results. Most of the impulse responses are very similar to the full sample ones. Here, however, the response of call rates is much stronger than the previous one. The call rate clearly increases by 0.06% at its maximum level in response to an oil price shock. This result leads us to conclude that monetary policy definitely counteracts the inflation pressure caused by the oil price shock before the 1997 financial crisis period.

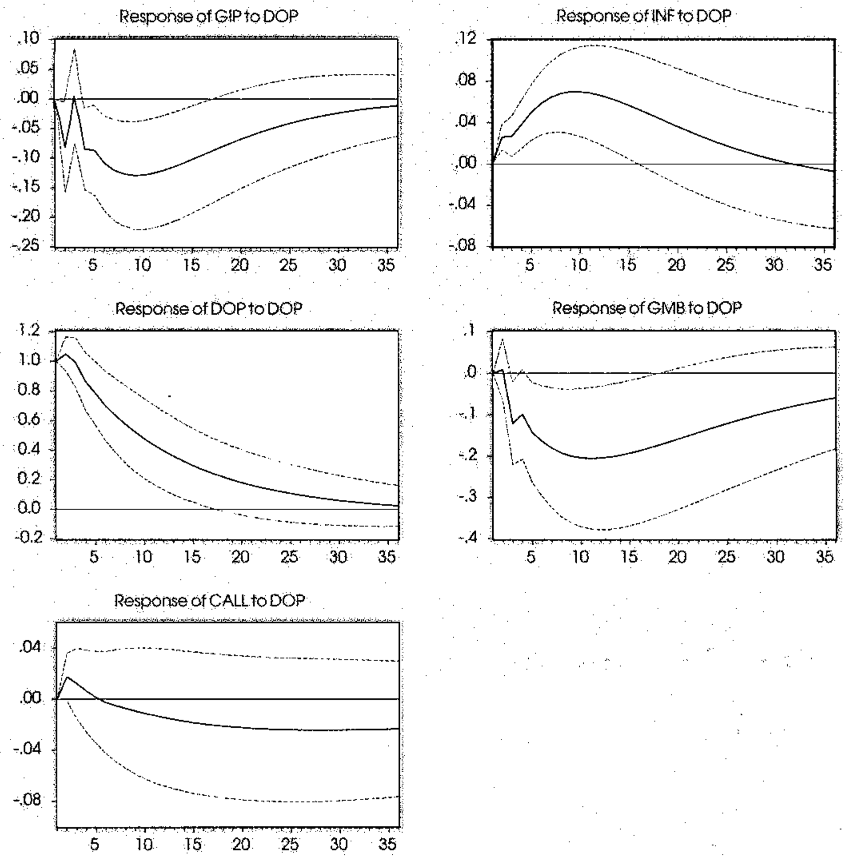
The most interesting results are shown in Figure 17 which is the result of after- the financial crisis period. As indicated in the upper-left panel, the response of IP growth rate is obscure. It moves around the zero line. On the other hand, inflation initially increases, but the response of inflation is statistically not significant. As inflation responds positively, monetary base growth rate is tightened after one month. The response of call rate is more obvious. It increases up to 0.013% at its maximum point which occurs at around the 5th month. Though the call rate shows a positive response to the oil price shock, the magnitude of the response is much smaller compared to the before crisis one (0.06% at its maximum). The results of the VAR analysis are broadly consistent with the correlation analysis. Based on the correlation and the VAR analyses, we can conclude that the effect of oil price shock on the economy has evolved in Korea as has the response of monetary policy.

Figure 15

The Impacts of Oil Price Shock

a) Full Sample (1976.8 - 2006.5)

Response to Nonfactorized One Unit Innovations ± 2 S.E.



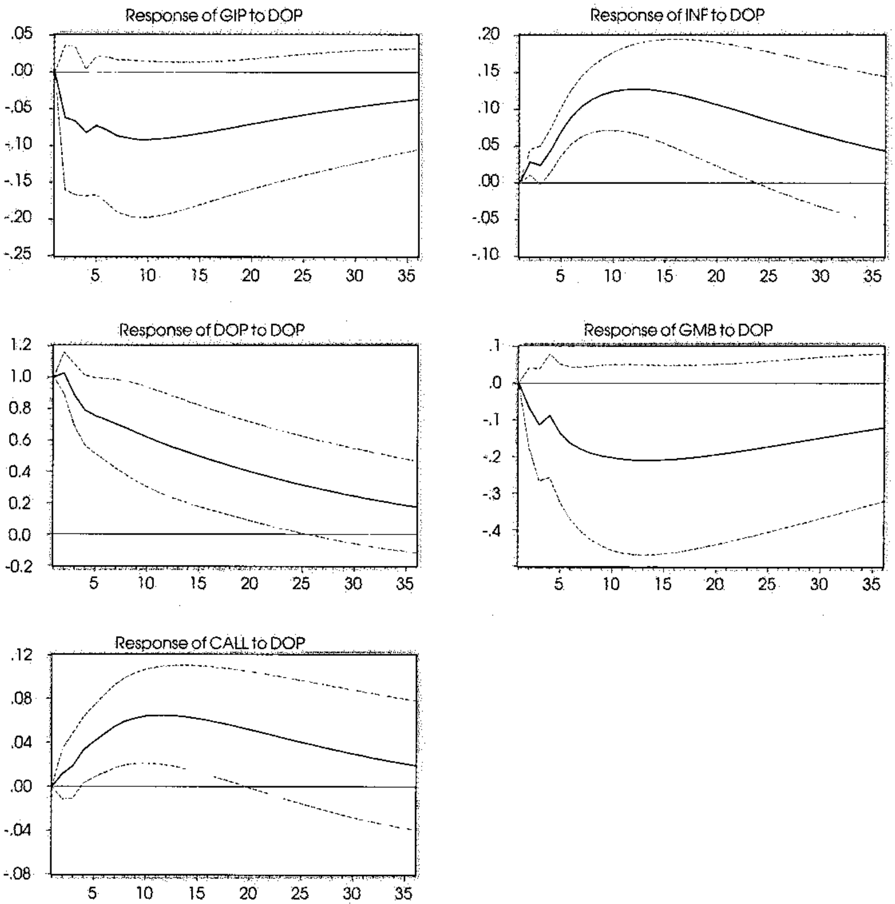
Note: a. The dotted lines represent two standard deviation error bands, the solid lines the responses of each variable.
b. The vertical units are %, the horizontal units months.

Figure 16

The Impacts of Oil Price Shock

b) Before Crisis (1976.8 - 1997.9)

Response to Nonfactorized One Unit Innovations ± 2 S.E.



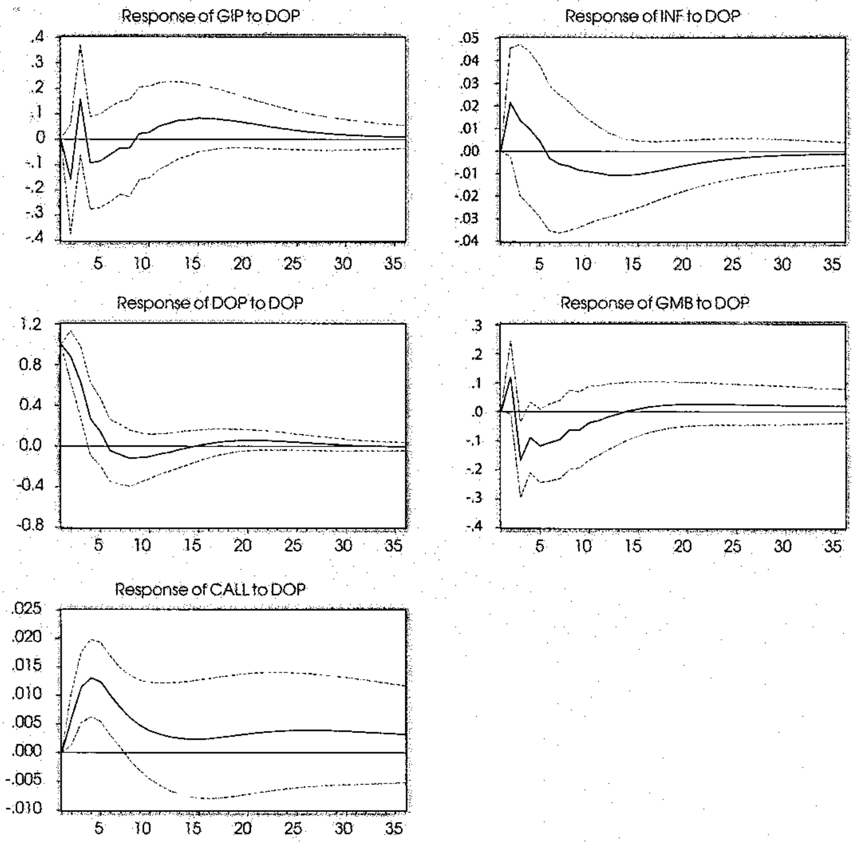
Note: a. The dotted lines represent two standard deviation error bands, the solid lines the responses of each variable.
b. The vertical units are %, the horizontal units months.

Figure 17

The Impacts of Oil Price Shock

c) After Crisis (1998.10 - 2006.5)

Response to Nonfactorized One Unit Innovations ± 2 S.E.



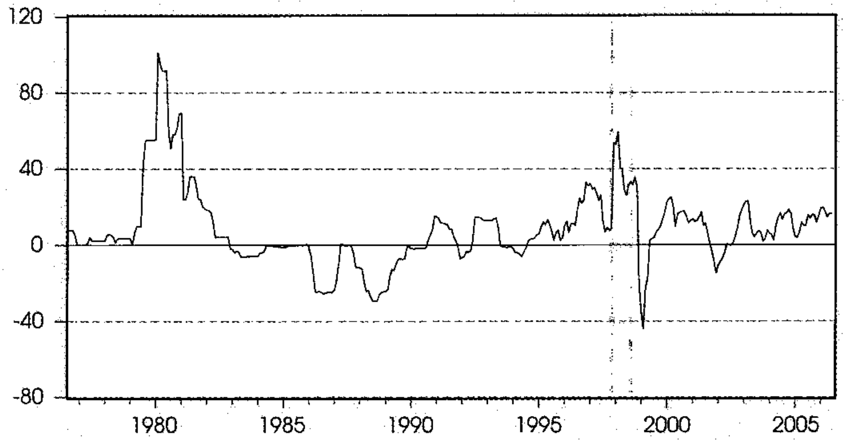
Note: a. The dotted lines represent two standard deviation error bands, the solid lines the responses of each variable.
b. The vertical units are %, the horizontal units months.

There may be various reasons for this reduced relationship between oil price shock and the responses of the economy. One of the possible explanations could be the lowered oil dependence in Korea after the financial crisis period (1998.10 - 2006.5) Figure 18 displays the oil price shock defined as an annual growth rate of producer price indexes for coke and petroleum since 1977. Oil price shocks have hit the Korean economy continuously during the last three decades. There were two big spikes in oil price shocks especially: one occurred during the second world oil crisis in 1979; the other during the Asian financial crisis in 1997. With the exception of the late 1980s to early 1990s, there were very stable or even negative oil price shocks, which reflected the global oil market trend. Figure 19 illustrates the dependence of oil in Korea. Oil dependence has been gradually decreased from 63% in

1995 to 46% in 2004. Interestingly, big oil price shocks and high oil dependence appeared around the same period before the financial crisis: oil dependence was above 60% in around 1980 and late 1990s. However, this pattern has not been repeated after the financial crisis. This break between oil price shocks and high oil dependence has played a certain role in lessening the impact of oil price shocks on the Korean economy.

Figure 18

Oil Price Shock



Note: The vertical units are %, the horizontal units years. Shaded area represents financial crisis period.

Figure 19

Oil Dependence

Note: The vertical units are %, the horizontal units years. Shaded area represents financial crisis period.

3. Conclusion

Over the last three decades, the Korean government has sought various policies to diversify its energy supply sources, to lower the oil dependence, and to improve energy efficiency. Based on the decreased oil dependence, the government's policies have worked successfully up to now. The high level of imported energy dependence, however, imposes another policy task for the government to accomplish.

During the same period, oil price shock has a negative effect on IP growth rate but a positive effect on inflation. Facing these economic difficulties, monetary policy represented as monetary base growth rate has been tightened to mitigate the inflation pressure. However, the response of the call rate is not so conclusive because of the mixed monetary policy regimes (from monetary targeting to inflation targeting) during the same period.

The above results are very different depending on the sample periods. Before the 1997 financial crisis (1976.8 – 1997.9), the effect of oil price shock on the economy was very significant and the monetary base growth rate decreased sharply to mitigate the inflation pressure. However, after the 1997 financial crisis (1998.10-2006.5), the effect of oil price shock on the economy is obscure. While the IP growth rate does not show any positive or negative response, inflation responds slightly positively although is statistically insignificant. Consequently, the call rate increases but its magnitude is quite small compared to the before crisis one.

There may be various reasons for the insignificant effect of oil price shocks after the financial crisis such as a structural change, globalisation, and the arrival of the world-wide low inflation era. Among many reasons, the lowered oil dependence in Korea may have played an important role in reducing the effect of oil price shocks. Exploring the relationship between oil dependence and the effect of oil price shock could be an interesting topic for further study.

References

1. Barsky, Roberts B., and Lutz Kilian, (2002), "Do We Really Know that Oil Caused the Great Stagflation? A Monetary Alternative", in Ben S. Bernanke and Ken Rogoff, eds., NBER Macroeconomics Annual 2001, MIT Press: Cambridge, MA, pp. 137-183.
2. ________ (2004), "Oil and the Macroeconomy Since the 1970s," *Journal of Economic Perspectives 18*, no. 4, pp. 115-134.
3. Bernanke, Ben S., Mark Gertler, and Mark Watson, (1997), "Systematic Monetary Policy and the Effects of Oil Price Shocks", *Brookings Papers on Economic Activity*, 1-1997, pp. 91-124.
4. Brown, Stephen P.A., and Mine K. Yücel, (1999), "Oil Prices and U.S. Aggregate Economic Activity: A Question of Neutrality", *Economic and Financial Review*, Federal Reserve Bank of Dallas, (Second Quarter), pp. 16-23.
5. Davis, Steven J., and John Haltiwanger, (2001), "Sectoral Job Creation and Destruction Responses to Oil Price Changes", *Journal of Monetary Economics*, 48, pp. 465-512.
6. Dotsey, Michael, and Max Reid, (1992), "Oil Shocks, Monetary Policy, and Economic Activity", *Economic Review of the Federal Reserve Bank of Richmond*, 78/4, pp. 14-27.
7. Energy Policies of IEA Countries, Republic of Korea 2002 Review, IEA.
8. Ferderer, J. Peter, (1996), "Oil Price Volatility and the Macroeconomy: A Solution to the Asymmetry Puzzle", *Journal of Macroeconomics*, 18, pp. 1-16.
9. Finn, Mary G., (2000), "Perfect Competition and the Effects of Energy Price Increases on Economic Activity", *Journal of Money, Credit, and Banking*, 32, pp. 400-416.
10. Hamilton, James D., and Ana Maria Herrera, (2004), "Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy", *Journal of Money, Credit, and Banking*, 36, pp. 265-286.
11. Hoover, Kevin D., and Stephen J. Perez, (1994), "Post Hoc Ergo Propter Once More: An Evaluation of 'Does Monetary Policy Matter?' in the Spirit of James Tobin", *Journal of Monetary Economics*, 34, pp. 89-99.
12. Leduc, Sylvain, and Keith Sill, (2004), "A Quantitative Analysis of Oil-Price Shocks, Systematic Monetary Policy, and Economic Downturns", *Journal of Monetary Economics*, 51, pp. 781-808.
13. Lee, Kiseok, and Shawn Ni, (2002), "On the Dynamic Effects of Oil Price Shocks: A Study Using Industry Level Data", *Journal of Monetary Economics*, 49, pp. 823-852.
14. 2000 Blueprint, Ministry of Commerce, Industry, and Energy, Republic of Korea

Chapter 6

THE ENERGY DYNAMICS IN MALAYSIA: ASSESSING THE IMPACT OF ENERGY POLICIES ON THE MALAYSIAN ECONOMY

by Mohamed Rizwan Habeeb Rahuman[1]
and Dr. Norhana Endut
Bank Negara Malaysia

Introduction

As a net energy exporter, while at the same time being a small and highly open economy, Malaysia represents a unique case study in determining the role of energy policies and the impact in oil prices on the macroeconomic indicators of the nation. This paper attempts to provide a broad survey of the Malaysian energy environment, its relevance to the economy from various perspectives, as well as an analysis of the impact of an oil price shock on the Malaysian economy.

In Section 1, the paper provides a broad discussion on petroleum macroeconomics in Malaysia. After a brief summary of Malaysia's real macroeconomic trends over the last 50 years, the paper proceeds to an overview of the evolution of the petroleum industry in Malaysia, anchored by the formulation of several policies related to energy. The role of the national oil company, PETRONAS, in the growth of the oil and gas industry is also assessed. Thereafter, Malaysia's energy macroeconomics is explored in great detail from various angles, including GDP, trade balance and domestic refining capacity. The domestic oil pricing mechanism for transportation fuel, namely the Automatic Price Mechanism (APM), is given a thorough analysis, especially in relation to the effect on Government expenditure and revenue. Finally, the paper examines the Malaysia's dependence on oil to generate energy to sustain the domestic economy.

Section 2 provides an econometric assessment of the impact of oil price shock on Malaysia and the resultant policy responses. After a short literature review on the impact of oil prices on economies, the paper then examines the macroeconomic impact and policy responses of oil price shock to Malaysia's economic growth and, most importantly, inflation. To quantify the effects of these impacts, a structural VAR was modelled and performed to determine the magnitude and lag of these impacts on the Malaysian economy, with the results examined and analysed.

1. Petroleum Macroeconomics in Malaysia

1.1 Malaysia's Macroeconomic Background

Malaysia is a small, highly open economy. When Malaysia gained its Independence in 1957, the economy was essentially driven by primary commodities, with substantial dependence on natural rubber and tin. Malaysia had comparative advantage in these commodities as it was the largest producer of both commodities in the world. In the early 1960s, to address the structural over-concentration of the economy, the government embarked on import substitution to promote resource-based industrial development associated with natural rubber and tin. Over the next few decades, other commodities, such as crude oil, natural gas, palm oil and timber, also contributed to the export earnings of the country.

---

1 Mr. Mohamed Rizwan Habeeb Rahuman and Dr. Norhana Endut are Acting Manager and Manager respectively at the Economics Department and Monetary Assessment and Strategy Department of Bank Negara Malaysia respectively. The views and opinions expressed in this paper are those of the authors and do not necessarily reflect the views of Bank Negara Malaysia

In the late 1960s, the inequitable distribution of wealth and identification of economic activity by race were threatening the social, political and economic stability of the fledgling multi-ethnic nation.This led the government to formulate the New Economic Policy (NEP) in 1970, aimed at poverty eradication and elimination of racial identification with economic function. Among the plans implemented included the modernisation of rural life through land openings, redistribution and development towards the poor for planting commodities such as palm oil and rubber, via the setting up of the Federal Land Development Authority (FELDA), as well as the rapid and balanced development of urban activities. In terms of alleviating poverty, among the programmes implemented by the government was instituting universal access to basic necessities by providing subsidised education (including tertiary level), as well as infrastructure to access basic human needs such as housing, health care, water and electricity.

In the early 1980s, the Malaysian economy experienced a slowdown in tandem with the global recession due to the second oil supply-shock amidst the Iran-Iraq war. As the recession was much longer than first anticipated, anti-cyclical programme taken in order to stimulate economic growth had instead led to structural imbalances in the economy, with deficits in both the current account and budget of the Federal Government.This was further exacerbated by the substantial collapse in the prices of natural rubber and tin in the mid-1980s, which caused the Government to undertake a major economic policy rethink on the heavy reliance on commodities in the economy.

The end-result was a re-emphasis of economic growth being led by the private sector, dubbed the Malaysia Incorporated Policy. This entailed the partial privatisation of many Government owned companies, as well as significant promotion of rapid industrialisation of the economy, thus reducing the dependence on commodities for export earnings. Subsequently, this had necessitated a widespread change in economic strategy. These include the liberalisation of foreign equity ownership in manufacturing activities in 1985, amendments to the Industrial Coordination Act 1975, and the creation of the Promotion of Investment Act 1986, which provided tax holidays to attract foreign direct investments (mainly manufacturers) to set up their operations in the country, creating new export avenues and increase jobs.These steps were needed to attract investments to promote sustainable economic growth and diversify the nation's economic base, while Government policy was re-oriented towards providing infrastructure and relevant support services to ensure a conducive business environment and enable the private industry to flourish.The positive effects of these structural changes did not take long to materialize, as the economy recovered in 1987.

Most importantly, by 1989, private sector contribution to economic growth had, for the first time, surpassed that of the public sector. The late 1980s was a landmark period in the evolution of the Malaysian economy as the fast-growing manufacturing sector replaced the agriculture sector as the main contributor to growth. The Malaysian economic growth was achieved mainly through export-oriented industrialisation with a favourable foreign direct investment (FDI) environment, structural reforms of the economy and a resilient labour market. During the decade preceding the Asian financial crisis in 1997, Malaysia recorded one of the highest real average gross national product (GNP) per capita growth rates in the world at 8 per cent a year.This phenomenal growth rate was achieved in an environment of price and labour market stability, with the inflation rate at 2.7 per cent while the unemployment rate was at 2.8 per cent in 1996. Naturally, this has caused Malaysians to experience a rapid increase in the standard of living, with significantly reduced poverty incidences, reduction in the urban-rural income gap and a relatively equitable distribution of income across all racial groups.

However, the Asian financial crisis interrupted the momentum.The crisis started in mid-1997 due to massive speculation on East Asian currencies, including the Malaysian ringgit. Nevertheless, with the implementation of appropriate and necessary policy measures, coupled with the strong underlying fundamentals of the economy (such as low inflation and stable labour market), the Malaysian economy recovered strongly, from a decline of 7.4 per cent in 1998 to a growth rate of 6.1 per cent in 1999 and 8.9 per cent in 2000. In addition, the external trade balance has consistently shown a surplus since October 1998.

During this period, the government adopted a stimulative fiscal policy stance, accompanied by an accommodative monetary policy. On 1 September 1998, selective capital control measures were put in place. As a small and highly open and trade-dependent economy (with its total external trade close to 200% of its GDP in 2005), a stable exchange rate is a major policy target, and the exchange rate volatility that preceded 1 September 1998 was decidedly unhealthy for the economy. As such, the Malaysian ringgit was pegged at RM3.80 to the US dollar in order to stabilise the exchange rate. The Government also undertook measures to strengthen the financial sector to substantially reduce systemic risks and ensure efficient financial intermediation by the banking system, which was extremely important for economic recovery. Measures were introduced to restructure and consolidate the financial sector, strengthen and recapitalise banking institutions, improve the efficiency of the intermediation process and facilitating corporate debt restructuring.

Despite the electronic down-cycle in 2001 and the subsequent adverse external shocks (such as the 11 September 2001 terrorist attacks in the US, the US invasion of Iraq in March 2003, and the persistent rise in commodity prices, especially oil, since 2003), the Malaysian economy, as measured in Gross Domestic Product (GDP), still posted an average annual growth of 5.5 per cent during the period from 2000-2005, with the trade surplus rising to 20.1% of GDP by 2005.

Table 1: Selected Macroeconomic Statistics in Malaysia

	1988	1992	1996	1998	2000	2002	2004	2005
Gross Domestic Product (% yoy)								
Nominal (RM million)	92,370	150,682	253,732	283,243	343,215	362,012	450,152	495,239
Real (Rm million)	89,143	126,408	183,292	182,237	210,557	220,422	249,314	262,175
Growth (Real GDP, % yoy)	9.9	8.9	10.0	-7.4	8.9	4.4	7.2	5.2
Exports (Goods, F.O.B.)								
Level (RM million)	55,260	103,657	197,026	286,563	373,270	357,430	480,740	533,788
Growth (% yoy)	22.2	8.3	6.5	29.7	16.1	6.9	20.8	11.0
% of GDP	59.8	68.8	77.7	101.2	108.8	98.7	106.8	107.8
Imports (Goods F.O.B.)								
Level (RM million)	43,923	101,440	197,280	228,124	311,459	303,090	400,077	434,010
Growth (% yoy)	35.6	-1.6	1.5	3.3	25.3	8.2	26.4	8.5
% of GDP	46.9	67.3	77.8	80.5	90.7	83.7	88.9	87.6
Trade Balance								
Level (RM million)	11,967	2,216	-254	58,439	61,811	54,340	80,663	99,778
% of GDP	13.0	1.5	-0.1	20.6	18.0	15.0	17.9	20.1
Inflation (% yoy)	3.4	4.8	3.5	5.3	1.5	1.8	1.4	3.0
Unemployment Rate (% of labour force)	7.2	3.7	2.9	2.5	3.1	3.5	3.5	3.5

Source: Department of Statistics Malaysia, Economic Planning Unit

1.2. Evolution of the Petroleum Industry in Malaysia

The first commercial exploitation of oil in Malaysia was undertaken by the Shell Oil Company in 1910 within the shore of the city of Miri, in the state of Sarawak, situated on the island of Borneo. The oil well, nicknamed 'The Grand Old Lady', symbolized the start of not just the petroleum industry in Malaysia, but also the era of the oil concession system. This system entails the international oil company (IOC) to provide a royalty payment on every barrel of oil produced, at a fixed percentage, to the sovereign state. Usually the percentage accrued to the state is substantially low (5%- 15% of total value of oil produced), while the rest of the oil revenue is accrued to the IOC. (Hashim, 2004)

The next major discoveries in Malaysia were made in 1962, offshore Sarawak and the nearby state of Sabah, by the two largest IOCs in the world, Shell and Exxon. Subsequently, Exxon and Conoco were also awarded concessions offshore Terengganu, a state in Peninsular Malaysia in 1968. The fields offshore Sabah and Sarawak eventually produced 88,900 barrels per day (bpd) by 1974. One of the main attractions by the IOCs to oil exploration in Malaysia was the fact that Malaysia's crude oil were of the 'light, sweet' variety, with extremely low levels of sulphur. This is a highly prized characteristic, as it can be easily refined using simple and relatively cost-efficient refining methods compared to the 'heavy, sour' crude oils. As such, the 'light, sweet' crude typically commands a substantial premium over the 'sour' crudes.

Following the 1973 Arab-Israeli conflict (better known as the 'Yom Kippur' war), on October 1973, Arab oil-producing states used oil as a political weapon, and embarked on an oil embargo, refusing to supply oil to countries that were deemed friendly to the state of Israel, particularly the United States of America, the largest oil consumer in the world. Crude oil prices effectively quadrupled, from USD2.60 per barrel (p/b) at the beginning of 1973 to USD11.65 p/b at the end of the year. However, the after effects of the embargo were felt worldwide, as oil is inherently a fungible commodity. The global economy suffered spiralling inflation, deteriorating balance of payments and serious imbalances in the fiscal positions of many countries. (BNM, 1973)

Malaysia was not immune to this problem. Even though Malaysia's oil exports rose by 20.7% to RM269.2 million in 1973 and 199.4% to RM677.9 million in 1974, the inflation rate in the country rose to 10.5% and 17.4% in those two years. In addition, due to the ongoing oil concession system, the Malaysian government was actually earning very little of the oil revenue (about RM70 million, or just a tenth of the total oil revenue in those two years), thus failing to help address the nation's deteriorating fiscal position. (BNM, 1973 & 1974)

As a country endowed with hydrocarbon resources, Malaysia was swept up by the wave of petroleum nationalism permeating among many oil producing countries during the 1970s, such as Saudi Arabia, Iran, Iraq, Venezuela and Indonesia. The Malaysian Government, led by the then Prime Minister, the late Tun Abdul Razak Hussein, was determined to ensure that the energy resources of Malaysia must be owned and exploited by Malaysians, and benefit the people of Malaysia, not the IOCs. In addition, the Government had learnt a painful lesson from the 1973-1974 oil shock that the economy of the country cannot be held hostage by issues of limited oil supplies; energy independence must be made a major priority of the country. (Hashim, 2004)

However, unlike the major oil producing nations at the time which resorted to forced nationalisation of oil companies operating in their countries, Malaysia embarked on a different strategy. The Government envisaged the creation of a totally new, nascent national oil company (NOC), wholly owned by the Government, competing alongside the IOCs. The energy resources of the country must be returned back to the country through the NOC, but only through negotiations with the IOCs. The ultimate aim was to terminate the concession system, which the Government had perceived to be exploitative and highly biased in favour of the IOCs. (Hashim, 2004)

However, this major initiative did not start well. The first attempt to create a NOC was made in February 1974, with the setting up of HIKMA (Malay language acronym for Hydrocarbon Malaysia), a government agency controlled by the Ministry of Primary Industries (MPI). HIKMA was made responsible to negotiate the return of the nation's energy assets to the country with the IOCs. However, a series of mistakes were made by officers of HIKMA (who were government servants seconded from MPI and whose area of expertise was actually rubber and tin, the two largest commodities produced in Malaysia at the time), such as the failure to collect sales revenue of an oil-laden tanker, had destroyed the credibility of the HIKMA negotiators in the eyes of the IOCs. This had subsequently led to the demise of HIKMA. (Hashim, 2004)

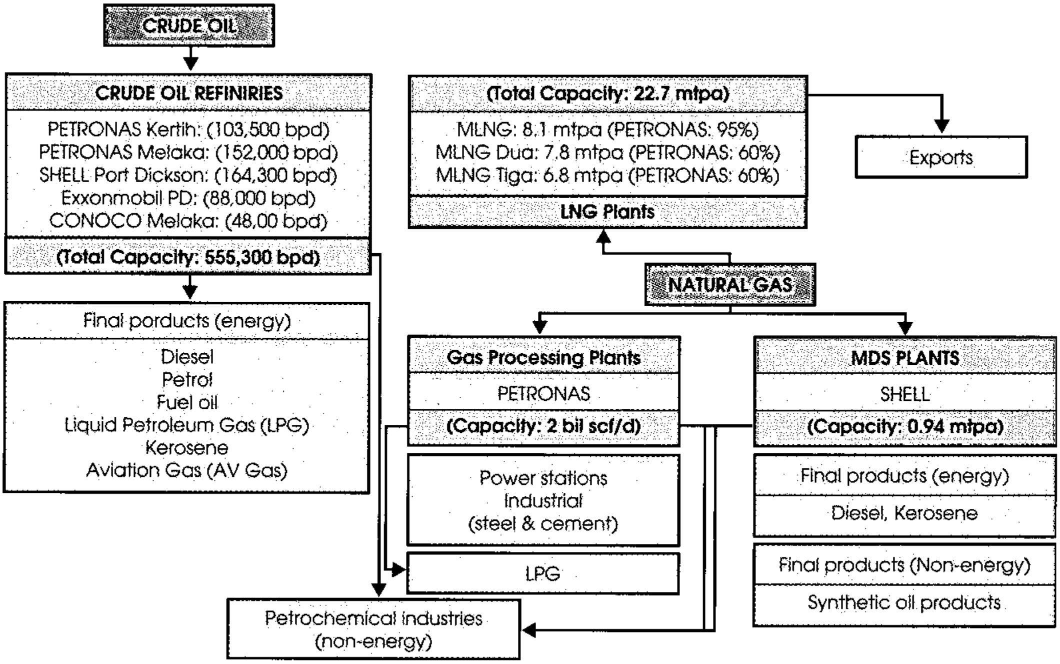
Undeterred by this setback, the Prime Minister realised that Malaysia's NOC must be created as a profit-making entity, and run as a professional corporate body, not as a government agency. On 17 August 1974, the government announced the creation of another NOC, Petroliam Nasional Berhad (translation: National Petroleum Corporation), or PETRONAS, a limited liability company incorporated under the Companies Act 1965, with the Malaysian Government as its' sole shareholder, and with a paid-up capital of RM10 million. Subsequent to its creation, the Government enacted an important legislation crucial to the energy industry in Malaysia, called the Petroleum Development Act 1974.

The Petroleum Development Act (PDA), 1974

- *The Malaysian Parliament passed the PDA on 1 October 1974. The PDA entails the following:*
- *PETRONAS is vested with the entire ownership of petroleum resources onshore and offshore Malaysia*
- *PETRONAS is vested with the exclusive rights, powers, liberties and privileges of exploring and developing petroleum resources*
- *In return for the petroleum ownership and rights, PETRONAS will pay royalty both to the Federal and state government*
- *Places responsibility for managing PETORNAS's petroleum development under the portfolio of the Prime Minister, under the National Petroleum Advisory Council (NPAC)*
- *PETRONAS is given the right to carry out processing and refining of petroleum and the manufacturing of petrochemicals*

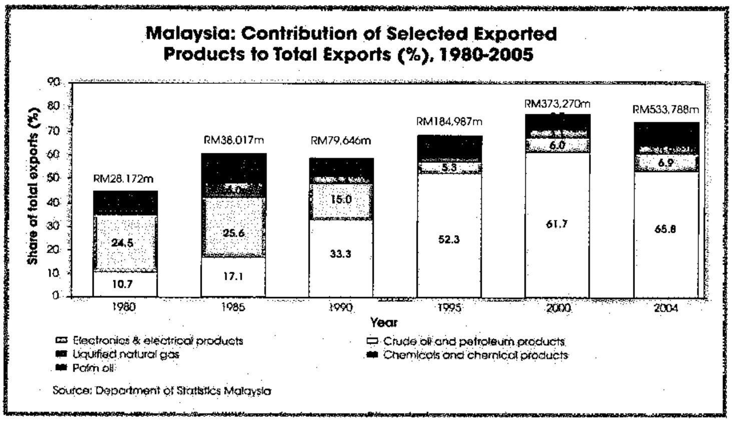
Following the creation of PETRONAS, negotiations were made with the IOCs to revert from an oil concession system to that of a Production Sharing Contract, or PSC. In the end, despite numerous objections from the IOCs, they concluded that Malaysia, as a sovereign nation endowed with hydrocarbon assets, wants to exploit these assets by itself and to realise the revenue on a fair and equitable basis. Furthermore, the IOCs are welcomed to this venture, but as equal business partners, not as masters. As such, all the IOCs operating in Malaysia agreed to rescind their oil concessions signed in the 1960s and, in its place, accepted PSCs with PETRONAS. The first PSC signed was with Shell in September 1976, followed by Exxon in December 1976. (Hashim, 2004)

Downstream Industry



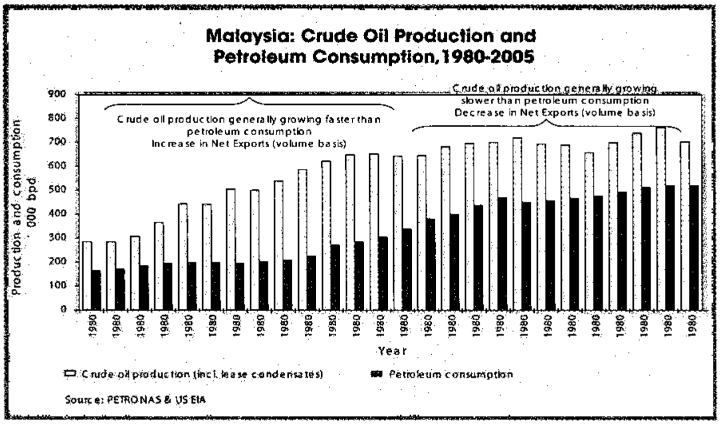
Source: PETRONAS

In line with the change in the share in GDP by the respective economic sectors, exports have also seen a structural transformation. Exports of energy commodities, which include crude oil, petroleum products and liquefied natural gas (LNG), have contributed significantly less to total exports in 2005, compared to 1980. In 1980, they contributed about a quarter of total exports, but by 2005, that figure had shrunk to 12.3%. Meanwhile, exports of E&E products rose dramatically, with its share rising strongly from 10.7% in 1980 to 65.8% in 2005.

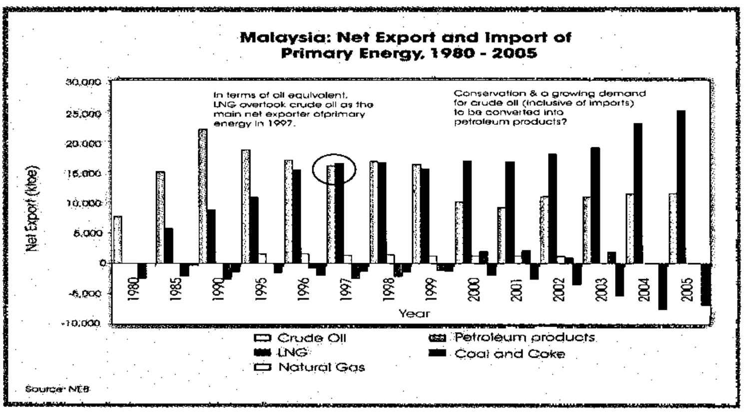


Malaysia's crude oil production, including condensates (which is similar to crude oil, but is initially found in a gaseous state before condensing to liquid when it is produced), have risen over the years, due to the discoveries of major fields offshore Terengganu (including the substantially large Tapis field discovered in 1976), Sabah and Sarawak in the 1970s and early 1980s. From a marginal output of just 93,940 bpd in 1975, the year after PETRONAS was established, the rise in crude oil production was exceptional, hitting 275,717 bpd in 1980, 446,738 bpd in 1985, and 659.932 bpd in 1994. During the period of 1980-1994, crude oil production rose at a faster rate compared to domestic consumption (194,250 bpd in 1985, 378,250 bpd in 1994), thus Malaysia's net oil exports (in bpd) were generally on the uptrend.

However, due to the strict implementation of the National Depletion Policy (NDP) by the Government, as well as the rise in domestic consumption in line with the economic growth (especially the significant rise in passenger car sales during the 1990s and 2000-2004), meant that oil were produced at a responsible level without overly depleting the existing oil reserves. As such, crude oil production grew at a slower pace for the next 6 years, while domestic consumption were rising at a faster pace (465,175 bpd in 1998, 519,000 bpd in 2004). After a temporary rise in output in 2004 of 762,318 bpd, production has since dropped back to 703,514 bpd in 2005.



However, if calculated in terms of export value, net exports of oil (defined as crude oil exports plus petroleum product exports minus crude oil and petroleum product imports), while declining in 1990s (1990: RM8.1 billion; 1994: RM4.3 billion), have started to increase again since the turn of the 21st century. While higher oil prices seen since 2003 is to partially account for the rise, another reason is the exponential increase in the exports of petroleum products (1990: RM1.3 billion, 2000: RM8.13 billion, 2005: RM16.7 billion). This has been extremely helpful in mitigating the exponential rise in imports of both crude oil and petroleum products (1990: RM3.8 billion, 2000: RM14.0 billion, 2005: RM32.5 billion). Even so, the substantial rise in LNG exports over the last 15 years has ensured that Malaysia would remain as a net energy exporting nation for the foreseeable future.



Why has Malaysia's exports of petroleum products been rising in recent years? More importantly, why does Malaysia need to import oil, when it clearly has enough oil to satisfy domestic demand?

The answer is due to a combination of these factors:

- the unique properties of Malaysia's crude oil;
- the history of oil refineries in Malaysia and Singapore; and
- the evolution of PETRONAS as a downstream oil producer

Malaysia produces crude oil and condensates that are defined as 'light, sweet', thus commands a higher premium over the heavier crude oils which has higher sulphur and thus requires a more complex, and expensive refinery technique to produce petroleum products such as petrol, diesel and jet fuel.

Malaysian Crude Grades

Malaysia produced 5 high quality of crude namely Tapis, Labuan, Miri, Bintulu and Dulang.

Crude oil	Density	Sulphur content	Classification
Tapis	45.4	0.08%	Very light & sweet
Dulang	37.2	0.07%	Light & sweet
Bintulu	33.6	0.06%	Light & sweet
Labuan	33.0	0.07%	Light & sweet
Miri	31.8	0.08%	Light & sweet

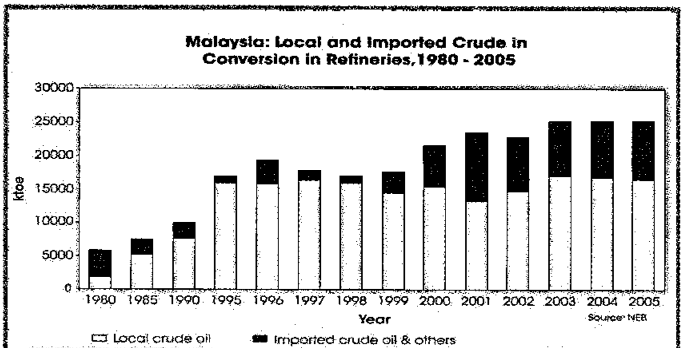
Source: PETRONAS

To capitalise on the price premium, Malaysia had decided to export a majority of its crude oil, and import heavy, sour crudes, mainly from the Middle East, as inputs for refineries in Malaysia to fulfil its domestic oil consumption needs, mainly for producing transportation fuels such as petrol and diesel. This was the practice until the mid-1980s, after which the rise in Malaysia's crude oil production from the mid-1980s through the mid-1990s had influenced Malaysian refineries to increase their plant's efficiency so as to be able to refine light, sweet crude oil (note: plants that are set up exclusively to refine heavier crude would not be able to maximise the refining of lighter crude). In addition, the price premium of lighter crude during the period was narrow at about USD1 – USD1.50 per barrel, thus negating the reason to import heavier crude.

However, since 2001, in line with developments in the global oil markets, with demand for lighter crude outstripping supply, the price premium had increased by a considerable margin of between USD8 - USD 12 per barrel, thus once again creating the favourable environment necessary to export more of Malaysia's lighter crude and increase the import of heavier crude for domestic refining.

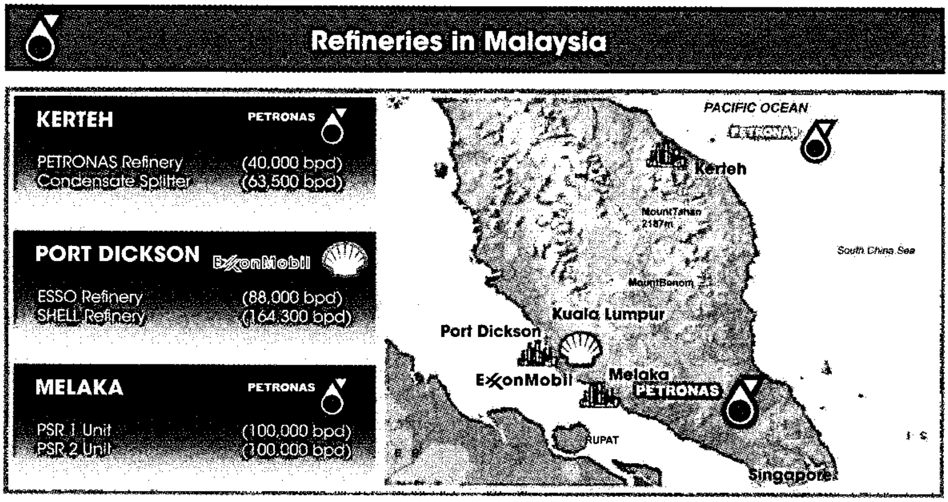
Malaysian Crude vs Other World Grades

Country	Crude Oil	API	Sulphur	Oil classification	Prices in April 05
Malaysia	Tapis Blend	45.4	0.08%	Very light & sweet	US$73.57
Algeria	Saharan Blend	44.0	0.07%	Very light & sweet	US$72.95
US	WTI	39.0	0.30%	Light & sweet	US$70.16
UK	Brent	38.5	0.40%	Light & sweet	US$70.54
Saudi	Arab Light	33.4	1.77%	Light & sour	US$67.90
Kuwait	Kuwait Export	31.0	2.52%	Medium & sour	US$65.40



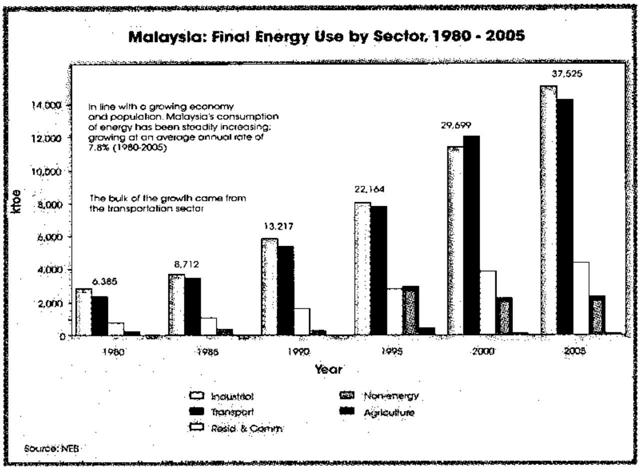
Share of total crude input (%)	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2004	2005
Local crude	31.6	69.6	77.5	94.3	81.9	91.4	93.1	82.7	71.2	56.4	64.9	67.5
Imported crude and others	68.4	30.4	22.5	5.7	18.1	8.6	6.9	17.3	28.8	43.6	35.1	32.5

Another factor is the unique history of Malaysia's refineries. Prior to 1985, the only refineries that existed in Malaysia were controlled by IOCs, which is Exxon and Shell, with a combined capacity of 243,000 bpd. While this was more than sufficient to cater for domestic consumption during the period, the fact that production of petrol and diesel for the local transportation sector relies heavily on IOCs, did not sit well with the Government at the time. This was made apparent during the second oil shock of 1979-1980, when the IOC refineries in Malaysia deliberately reduced the supply of petroleum products to force the government to increase the domestic retail price of petrol and diesel. (Hashim, 2004) Although the problem was solved organically with the decline in crude prices at the beginning of 1982, the Government learnt a valuable lesson and instructed PETRONAS to build its own refineries. This was accomplished with the building of a refinery in Kertih, Terengganu in 1985, with a capacity of 103,500 bpd, near the offshore oil fields. (Hashim, 2004) Another refinery was built in the state of Malacca in 1994, with another refinery (built in joint venture with an IOC, ConocoPhillips) added in 1999. The total capacity of these two plants is 200,000 bpd.

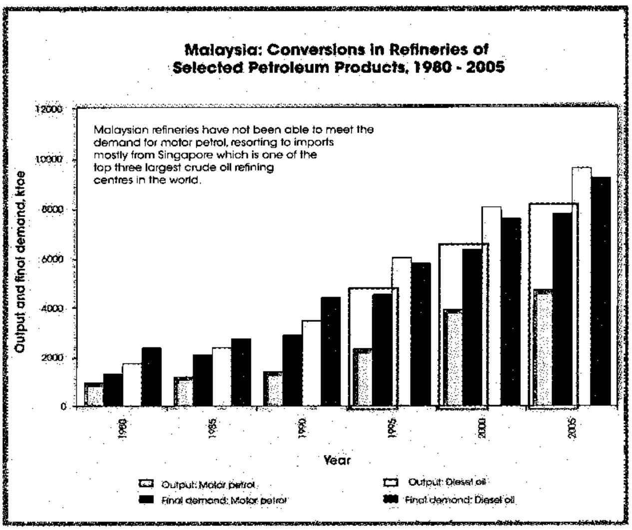


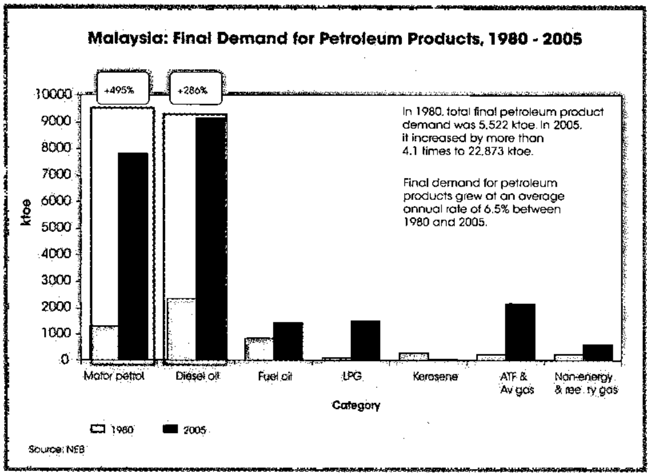
Source: PETRONAS

However, most of the output of the Malacca and Kertih refineries was mainly export-oriented fuels, such as jet fuel, naptha and low sulphur waxy residue. Meanwhile, domestic oil consumption rose exponentially in 1990s, as well as the period between 2000 and 2005 (averaging 7.8% between 1980 and 2005), due to a burgeoning passenger car market, in line with the robust growth of the Malaysian economy. The local refineries were unable to cope with the rise in demand for transportation fuels, particularly petrol and diesel.



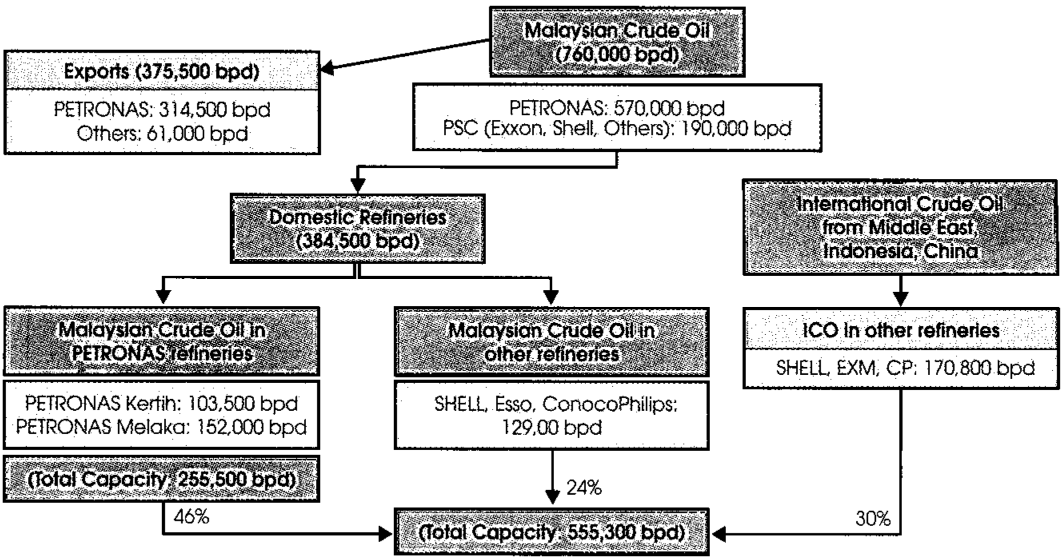
As a result, the shortfall in supply was made up with higher imports of petrol and diesel from nearby Singapore. Due to its historic legacy inherited from the colonial era, Singapore has been the main petroleum hub in Asia, with a refinery capacity of over 1.7 million bpd, using mainly heavy, sour crude imported from the Middle East and producing mostly transportation fuels. Malaysia had always imported such fuels from Singapore, which was the main reason for the use of the so-called Singapore posting prices to determine the domestic retail price of petroleum products in Malaysia. Demand for petroleum products quadrupled between 1980 and 2005, with the bulk of the growth emanating from petrol (rising by 495%) and diesel (rising by 286%).





The following diagram helps explain why it is necessary for Malaysia to import crude oil, despite being an oil producer:

Why Malaysia is importing crude oil? An example...



Source: PETRONAS

Table 2: Selected Oil and Gas Statistics in Malaysia

	1985	1990	1992	1994	1996	1998	2000	2002	2004	2005
Real GDP, Mining & Quarrying (% yoy)										
Growth (% yoy)	-1.9	0.1	4.6	6.0	2.9	0.4	0.3	4.3	3.9	0.8
Share to overall GDP (%)	10.4	9.4	8.6	7.3	7.7	7.9	7.3	7.2	7.0	6.7
Crude oil production (incl. condensates)										
Level (barrels per day)	466,378	622,468	659,017	659,932	715,689	725,035	680,762	698,462	762,318	703,514
Growth (% yoy)	-0.1	5.7	1.9	1.9	1.8	1.6	-1.2	4.9	3.6	-8.0
Natural gas production										
Level (million standard cubic feet per day)	1,237	1,866	1,756	2,362	3,402	3,722	4,367	4,676	5,196	5,797
Growth (% yoy)	147.2	3.2	11.2	12.6	21.1	-5.2	10.8	3.0	4.0	11.3
Crude oil exports (Goods, F.O.B.)										
Level (RM million)	8,697	10,639	9,147	6,546	7,212	7,510	14,241	11,600	21,318	28,508
Growth (% yoy)	-0.5	34.8	-10.3	-18.1	7.6	6.2	53.0	4.3	36.1	33.8
% of total exports	22.9	13.4	8.8	4.3	3.7	2.6	3.8	3.2	4.4	5.3
Petroleum products exports (Goods, F.O.B.)										
Level (RM million)	1,041	1,285	1,448	2,139	3,281	3,129	8,131	7,620	13,421	16,729
Growth (% yoy)	12.8	28.0	26.0	28.2	4.9	-7.2	80.2	-9.4	42.2	24.7
% of total exports	2.8	1.6	1.4	1.4	1.7	1.1	2.2	2.1	2.8	3.1
LNG exports										
Level (RM million)	2,300	2,635	2,540	2,550	4,746	5,981	11,423	9,888	17,079	20,790
Growth (% yoy)	29.6	27.6	-22.5	-3.9	49.7	-7.8	79.9	-11.1	27.9	21.7
% of total exports	6.0	3.3	-2.5	1.7	2.4	2.1	3.1	2.8	3.6	3.9
Oil imports (crude and petroleum products)										
Level (in current RM million)	n.a.	3,830.8	3,969.2	3,811.5	4,904.1	6,381.8	14,016.0	13,186.1	23,049.8	32,455.4
Growth (% yoy)	n.a.	2.5	-0.7	-4.5	16.3	7.3	109.3	-3.6	42.5	40.8
% of total exports	n.a.	4.8	3.9	2.4	2.5	2.8	4.5	4.4	5.8	7.5
Net oil exports (RM million)	n.a.	8,093.3	6,625.5	4,873.1	5,588.9	4,256.6	8,355.6	6,033.7	11,689.4	12,781.8
Net energy exports (RM million)	n.a.	10,728.1	9,165.9	7,423.2	10,334.9	10,237.9	19,778.1	15,922.1	28,768.2	33,572.0
Domestics oil consumption (bpd)	194,250	266,250	302,145	378,250	435,250	465,175	485,000	493,250	519,000	517,000

Source: Department of Statistics Malaysia, Bank Negara Malaysia, PETRONAS, Economic Planning Unit Malaysia, Malaysia External Trade Development Corporation (MATRADE) & US Energy information Administration (EIA)

1.3. Domestic Oil Retail Price Mechanism in Malaysia

Since 1 March 1983, the retail price of petrol, diesel and liquefied petroleum gas (LPG) has been determined by the Government through a pricing system called 'Automatic Pricing Mechanism' or APM. (For the purpose of this paper, the discussion will be restricted to petrol and diesel) The APM was jointly developed by the Government and the petroleum industry in Malaysia. Presently, the APM falls under the purview of the Ministry of Domestic Trade and Consumer Affairs. (DTCA).

The objective of the APM was to ensure price stability for both retailer and consumer of petroleum products, allow a systematic adjustment to accommodate any changes in the product cost of petrol, diesel and LPG, as well as operating expenses. The implementation of APM also benefits oil refineries and retailers as it provides a mechanism to better predict retail prices, thus assists them in planning future business plans and investment activities, such as expanding refining capacity and building new plants to suit demand.

The APM governs all retail prices of petrol, diesel and LPG; in other words, prices of these petroleum products cannot be higher or lower than the level set by the APM for the respective anchor locations. There are three anchor locations:

- Kuala Lumpur, representing states in Peninsular Malaysia;
- Kota Kinabalu, representing the state of Sabah; and
- Kuching, representing the state of Sarawak.

The APM is subject to monthly, annual & occasional review by the Government, and any revision to the elements of the APM in determining prices of the petroleum products is at the sole discretion of the Government.

The APM formula in determining the domestic retail price of petroleum products is:

> Product Cost + Operating Expenses + Company Margin + Dealer's Margin +
> Sales Tax-Subsidy Paid by Government = **Retail Price of Petrol, Diesel and LPG**

Before June 2005, **Product Cost** referred to the price of the finished product quoted by the six large oil refineries in Singapore (Shell (2 refineries), Exxon, ConocoPhillips, Caltex and Singapore Petroleum Corporation (SPC)), better known as the 'Singapore Posting (SP) Price'. However, the Government had since decided that using SP is inefficient, as the basis for determining the price is unknown, and is at the sole discretion of the oil refinery companies, thus suggesting a pricing bias in favour of these refinery companies.

Since June 2005, in line with the pricing method used in many Asia Pacific countries, such as Australia, the Phillipines, India and Thailand, the Government decided to use **Mean of Platts Singapore (MOPS)** as the basis for Product Cost. Platts is a company that specialises in providing unbiased, daily market price quotes of many petroleum products, including petrol, diesel and LPG. Platts's division in Singapore, based on its fair assessment of the market, publishes both the highest and lowest price of a product in a given day. MOPS would take the simple average of these two prices to determine the price of a petroleum product in a given day.

Prior to July 2003, the lag time of the product cost quoted in the APM was 2 month (as an example, the product price quoted in March 2006 was based on January 2006 prices). In July 2003, the lag time was reduced to 1 month, and most recently, since February 2006, the product cost has been quoted using current (or 'spot') month quotes. Since most of the products are imported from Singapore, the USD currency is used in the transaction. As such, the exchange rate used in determining the product cost in Malaysian ringgit (MYR) is a 3-month average of the USD/MYR exchange rate.

Operating Expenses refer to the costs incurred by the refinery in transporting the petroleum product from the plant to the service station ("petrol station"). Currently, the operating expenses have been fixed by DTCA at 9.54 sen per litre for both petrol and diesel. The costs that can be included in calculating the operating expenses are:

- Freight and Distribution costs
  - Transport costs (Lorry tanker and Ship)
  - Insurance costs
  - Product gained or lost in transit (during storage and delivery)
  - Distribution costs to service station

- Marketing costs
  - Administration costs
  - Sales costs
  - Financing costs
  - Depreciation costs

  (Costs that are disallowed are advertising, all forms of incentives and sales promotions, credit card costs (including merchant fees or transaction charges), entertainment expenses and bad debts expensed)

The **Company Margin** refers to the profit margin earned by the oil distribution company (purchases product from the refinery and sells it to the public through its service stations). The margins are fixed by DTCA. Between 1983 and 1994, the company margin of petrol and diesel per litre was set at 3.3 sen (Malaysian cent) and 1.3 sen respectively. Since 1994, the margin per litre was set at 4.45 sen for petrol and 1.75 sen for diesel. In February 2006, the margin has been revised higher to 5 sen for petrol and 2.25 sen for diesel.

The **Dealer Margin** refers to the profit margin earned by the operator of the service station. The margins are also fixed by DTCA, and the changes over the years can be seen in the Table below:

	Petrol (per litre)	Diesel (per litre)
Dealer Margin	• 4.72 sen (from 1983)	• 2.24 sen (from 1983)
	• 5.18 sen (from 1988)	• 2.27 sen (from 1988)
	• 6.18 sen (from 1994)	• 2.97 sen (from 1994)
	• 8.00 sen (from 2002)	• 3.50 sen (from 2002)
	• 9.50 sen (from 2006)	• 4.50 sen (from 2006)

Source: Domestic Trade and Consumer Affairs Ministry, Malaysia

Sales Tax refers to the tax imposed on the sale of petrol and diesel in Malaysia. The rate is 58.62 per litre for petrol, and 19.64 sen per litre for diesel. However, due to the persistent rise in crude oil prices since 2001, the Government has decided to exempt the collection of these sales taxes to keep the retail price at a manageable level.

The social responsibility undertaken by the Government in fixing the retail price at a low level had also meant that the Government had to pay **subsidies** to the distribution companies to compensate for the reduced sales collection, which is lower than the expenses incurred.

An example of the APM price mechanism in setting the price of petrol and diesel can be seen here, for the month of May 2006:

Example of APM Price Formulation (May 2006)

(Figures in sen per litre)	Petrol	Diesel
Product Cost (Singapore MOPS)	198.00	190.17
Operating Cost	9.54	9.54
Company Margin	5.00	2.25
Dealer's Margin	9.50	4.50
Sales Tax	58.62	19.64
Cost Build-Up	280.66	226.10
Sales Tax Exemption	(58.62)	(19.64)
Direct Subsidy Paid by Gov't	(30.04)	(48.46)
Selling Price/Pump Price	192.00	158.00

Source: Domestic Trade and Consumer Affairs Ministry, Malaysia

Due to the rise in crude oil prices, especially over the last five years, and the unsustainable deterioration on the Government's fiscal position due to the element of price distortion, the Government had no choice but to increase the retail price of petrol and diesel for transportation purposes (note: diesel sold to industrial and power generation users are not subject to the APM mechanism and these sectors must pay the full, unsubsidised price). The rise has been quite dramatic, with petrol prices allowed to rise by 60% between 2000 and 2006, while diesel price were revised higher by an exponential figure of 163% during the same period. However, the government is aware of the hardship on certain low-income groups, such as fishermen, and has allowed for petrol and diesel for fishermen to be sold at a nominal sum of 1 Malaysian ringgit per litre. Public transportation vehicles are also allowed to receive a 15 sen discount on the purchases of diesel through the use of fleet cards issued by DTCA to ensure only the deserving can benefit from the discount.

Evolution of Domestic Retail Petroleum Prices in Malaysia

Petrol price increases (RM)		
Date	Increase	Price per litre
Oct 2000	**0.10**	**1.20**
Oct 2001	0.10	1.30
May 2002	0.02	1.32
Nov 2002	0.01	1.33
Mar 2003	0.02	1.35
May 2004	0.02	1.37
Nov 2004	0.05	1.42
May 2005	0.10	1.52
Jul 2005	0.10	1.62
Feb 2006	**0.30**	**1.92**

+60% increase between 2000-2006

Diesel price increases (RM)		
Date	Increase	Price per litre
Oct 2000	**0.05**	**0.60**
Oct 2001	0.10	0.70
May 2002	0.02	0.72
Nov 2002	0.02	0.74
Mar 2003	0.02	0.76
May 2004	0.02	0.78
Nov 2004	0.05	0.83
Mar 2005	0.05	0.88
May 2005	0.20	1.08
Jul 2005	0.20	1.28
Feb 2006	**0.30**	**1.58**

+163% increase between 2000-2006

Source: Domestic Trade and Consumer Affairs Ministry, Malaysia

The direct subsidies paid by the Government, as well as the lost sales tax revenue due to the exemption on collection on the domestic sale of petroleum products has been quite costly to the Government, both on the fiscal expenditure and revenue. By 2005, the Government had to pay RM7.4 billion in direct subsidies to the oil distribution companies, which represents 5.8% of the total Malaysian Federal Government expenditure (2001: 1.5%). In the same year, the Government had to forego RM7.9 billion in lost sales tax revenue that were not collected, which constitute 7.4% of the total revenue earned by the Federal Government in 2005.

The Subsidies and Lost Tax Revenue on Petroleum Products has been Costly to the Government

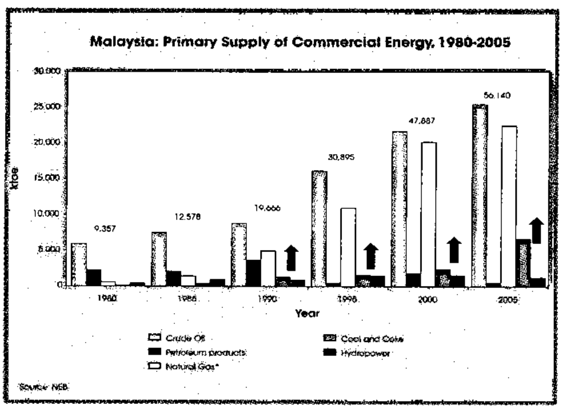
RM billion	2001	2002	2003	2004	2005
Direct Subsidy Paid by Government	2.40	0.92	1.82	4.79	7.41
Revenue Lost from Sales Tax Exemption	5.08	3.31	4.76	7.15	7.85
Total	7.48	4.23	6.58	11.94	15.26
% of Direct Subsidy to Gross Federal GOvernment Expenditure	1.5%	0.9%	1.6%	4.0%	5.8%
% of Revenue Lost to Gross Federal Government Revenue	6.5%	4.4%	5.1%	7.2%	7.4%

Source: Economic Planning Unit and Ministry of Finance, Malaysia

As such, the Government has made a policy decision, in the Ninth Malaysia Plan (9MP) (2006-2010) to commit to a move to a "market-based energy price mechanisms". This entailed a gradual removal of direct and indirect government subsidies in transportation fuel, fuel for electricity generation and other products during the course of the 9MP. Another policy decision, under the National Biofuel Policy 2005, related to the efforts to reduce the importation of diesel by blending in 5% of Processed Palm Oil to petroleum diesel for sale to the domestic transportation (branded as Envo-Diesel) by 2007. This measure is expected to reduce the imports of diesel by about 5%.

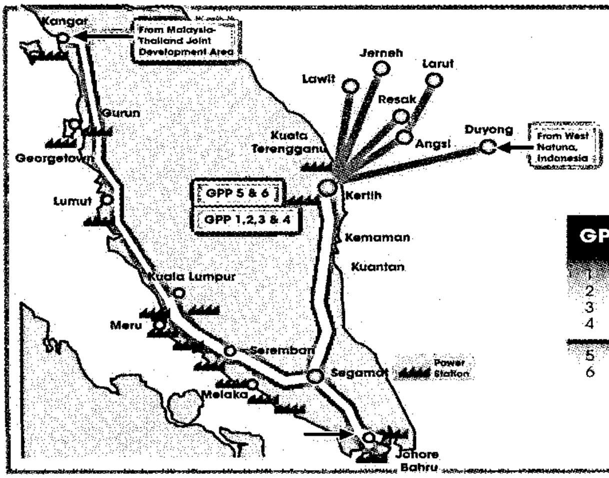
1.4. Oil Dependency and Energy Diversity in Malaysia

The discovery of natural gas offshore the state of Terengganu in 1979, as the world was in the throes of the second oil price shock was the catalyst for the 'Four (renamed 'Five') Fuel Diversification Policy for domestic energy supply, reducing the overdependence of a single source, chiefly oil, for energy generation, especially electricity. In the 1970s and early 1980s, an overwhelming majority of electricity generation was accomplished using crude oil. As such, Malaysia's dependence on crude oil was extremely high, at 88% of all energy supplied in 1980. The Government was aware that this was unsustainable; a fuel diversification strategy was vital in sustaining the economic growth of the country without being heavily dependent on one source of energy.



Subsequent to the discovery of natural gas in Malaysia in 1979, PETRONAS set up the first Gas Processing Plant (GPP) in Terengganu in 1984, initially for electricity generation. Since then, 5 other GPPs have been set up, in Terengganu and the nearby state of Pahang, with a total capacity of 2,000 million cubic feet per day (which is in line with the maximum production limit set under the National Depletion Policy). To distribute the gas from the GPP to the power plants, industrial and commercial users, PETRONAS built a gas pipeline that traversed the length and breadth of Peninsular Malaysia. The pipeline is known as the Peninsular Gas Utilisation (PGU) pipeline. As a result, currently close to 70% of the gas processed at the GPPs and sent through the PGU is to generate electricity, while a further 24% is supplied to industrial and consumer users. The remaining 7% is exported to Singapore for use in its own power generation plants.

A Gas Transmission Infrastructure Supports The Power Sector And Fuels Industrial Development



Gas Utilisation	
Power	69 %
Non-Power	24 %
Pipeline export	7 %

Total Consumption : 1,849 mmscfd

GPP	CAPACITY (mmscfd)	GAS-IN
1	250	1984
2	250	1992
3	250	1992
4	250	1994
5	500	1998
6	500	1999

The growth in natural gas supply as a share to total energy supplied in Malaysia has been phenomenal. From a minimal share of 7.4% in 1980, the share has grown exponentially to about 40% by 2005. This contrasts sharply with the supply of oil, whose share shrank from 88% in 1980 to 50% by 2005, with the overwhelming major portion of the oil used to produce transportation fuels (petrol, diesel and others) and a negligible amount for generating electricity (mostly in remote areas in the states of Sabah and Sarawak).

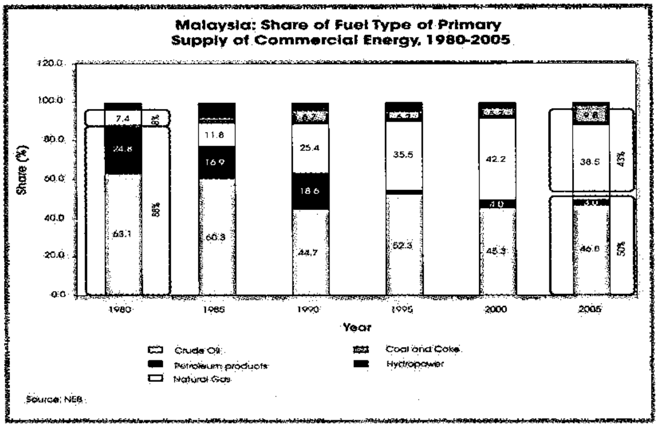
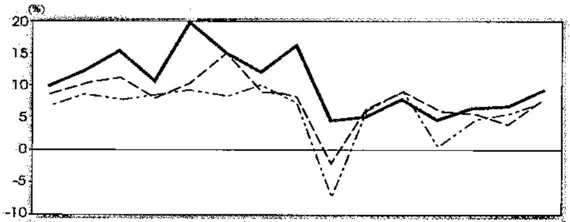


Figure 1: Annual Growth Rates of GDP, Final Energy Demand and Electricity Demand



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
GDP	6.8	8.6	7.8	8.3	9.2	8.3	10	7.5	-7.5	6.1	8.9	0.3	4.4	5.6	7.5
Final Energy Demand	8.7	10.2	11.2	7.9	10.4	14.9	9	8.3	-2.3	6.5	9.0	6.1	5.6	3.9	7.9
Electricity Demand	9.7	12.2	15.2	10.5	19.7	15.1	11.9	16.1	4.4	5.1	7.8	4.5	6.3	6.6	9.1

Source : i) Department of Statistics Malaysia
ii) National Energy Balance 2003, Ministry of Energy, Water and Communications

The growth in electricity generation has closely followed that of the growth in Malaysia's economy. The demand for electricity grew at such a rapid pace that the nation's electricity utility, Tenaga Nasional Berhad (TNB) (translation: 'National Power Company'), solely responsible for electricity power generation, transmission and distribution in Malaysia, was having trouble keeping up with the rise in demand. This had culminated in two incidences of major electricity power failures across Peninsular Malaysia in 1994 and 1996, which disrupted economic activity. To remedy this situation, the Government decided to issue licences to generate electricity to privately-owned power producers (known collectively as independent power producers or IPPs) to generate electricity and then sell it to TNB, which retains the exclusive right to transmit and distribute electricity to consumers.

Figure 2: The Major IPPs in Peninsular Malaysia

IPP	Location	Capacity (MW)	Period	Expiry	Fuel type	Est PPA price (sen/kWh)
1st Generations						
YTL Power Generation	Paka, Terengganu	808	21 years	Sept 2015	Gas	15.5
YTL Power Generation	Pasir Gudang, Johor	404	21 years	Sept 2015	Gas	15.5
Segari Energy Ventures	Lumut, Perak	1,303	21 years	July 2017	Gas	15.3
Genting Sanyen Power	Kuala Langat, Selangor	762	21 years	April 2016	Gas	14.6
Powertek	Teluk Gong, Melaka	440	21 years	Sept 2016	Gas	na
PD Power	Tanjung Gemuk, Port Dickson	440	21 years	Sept 2016	Gas	na
2nd Generations						
Pahlawan Power	Tanjung Keling, Melaka	330	21 years	Aug 2020	Gas	12.0
Panglima Power	Alor Gajah, Melaka	720	21 years	Feb 2023	Gas	11.7
GB3 Sdn Bhd	Lumut, Perak	640	21 years	Jan 2024	Gas	12.1
Teknologi Tenaga Perlis Consortium	Perlis	650	21 years	Mar 2024	Gas	13.0
Prai Power Sdn Bhd	Prai, Penang	350	21 years	Jun 2024	Gas	12.4
Kapar Energy Ventures	Kapar, Selangor	2,420	25 years	July 2030	Multi-fuel	10.6
3rd Generations						
Tanjung Bin Sdn Bhd	Tanjung Bin, Johor	2,100	25 years	Aug 2031	Gas	na
Jimah power	Port Dickson, Negeri Sembilan	1,400	25 years	Jan 2034	Gas	na

Source: Economic Planning unit, Malaysia

With the setting up of the IPPs, the demand for natural gas rose at a strong pace, as an overwhelming number of IPPs (the exception being two plants that will only be commissioned in 2007) use natural gas as fuel to generate electricity. The reason for this reliance on natural gas is two-fold.

First, the existence of the GPPs and the PGU ensures a reliable and secure supply of natural gas to power plants operated by both the IPPs, as well as TNB. Second, and arguably the most important factor, is that since 1997, the Government has set the price of natural gas that are sold to both the IPPs and TNB at a fixed rate of RM6.40 (USD1.73) per million British Thermal Unit (BTU). In line with the rise in crude oil, the international market price of natural gas has, since 2003, risen dramatically to RM24 (USD6.50) per million BTU. Thus, by charging below market rates for supplying natural gas to the power producers, PETRONAS has effectively been subsiding gas for electricity generation over the last nine years. This had created price distortion, particularly in setting the electricity tariff. The electricity tariff rate in Malaysia was revised higher for the first time in 9 years in May 2006. The amount of subsidies is not insubstantial, at RM11.5 billion in FY 2006, which represents a strong increase of 85.5% compared to RM6.2 billion in FY2006, due to the higher market price. As a result, PETRONAS had to forego about 8% of its revenue for FY2006 of RM166.9 billion. This would have affected the Federal Government fiscal position indirectly, as PETRONAS would have *contributed* about 8% less on the payments to the Federal Government for FY 2006. Since the fixed price system was implemented in 1997, a total of RM37.1 billion was subsidised by PETRONAS for the power generation sector.

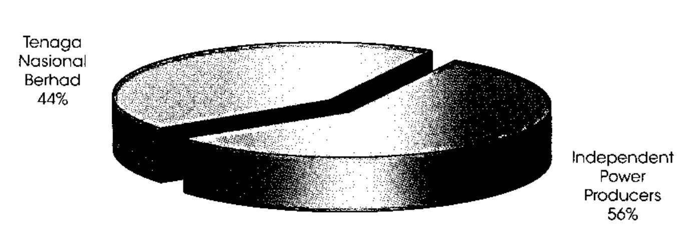
GAS SUBSIDY

93% increase due to higher volume and price

In RM billion

	FY2006	**+/-**	**FY2005**	**Cumulative subsidy since 1997**
POWER SECTOR	**11.5**	**85.5%**	**6.2**	**37.1**
TNB	5.0	117.4%	2.3	16.2
Independent Power Producers (IPPs)	6.5	66.7%	3.9	20.9
NON POWER SECTOR - INCLUDING NGV	**2.8**	**133.3%**	**1.2**	**5.7**
TOTAL GAS SUBSIDY	**14.3**	**93.2%**	**7.4**	**42.8**

IPPs take up a higher proportion of gas subsidy



Source: PETRONAS

1.5. Conclusion

In the period of 32 years since PETRONAS was established, Malaysia had formulated energy policies designed to facilitate the economic growth of the country. As a result of this strategy, Malaysia has managed to:

- assert its sovereignty over its hydrocarbon assets through the PSC system;

- create a national oil company that is today among the largest corporations in the world, and earns revenue and foreign exchange for the country, helping in the economic growth of the country;
- leverage on its energy independence to diversify its manufacturing sector to higher value adding activities, such as petrochemicals, gas processing and refineries; and
- diversify its sources of energy to reduce the dependence on oil, particularly for electricity generation.

Nevertheless, some structural problems remain, particularly related to energy price distortion by the use of fixed price mechanism, on both petroleum products sold to consumers, as well as the price of natural gas for power generation purposes. The problem was exacerbated by the persistent rise in crude oil and natural gas prices since 2003. However, to alleviate the situation, the Government has publicly made a commitment to allow the pricing of energy-related products to be determined by the market, by reducing the subsidies at a gradual pace.

2. The Impact and Policy Responses of Oil Price Shocks in Malaysia

2.1 Introduction

2.1.1. Snapshots of Oil Price Shocks Literature

The empirical literature on the macroeconomic impact of oil price shock can be categorised into two broad themes. The first theme centres on the response of the aggregate economy to a sudden and permanent price shock. The other theme consists of studies on attribution issues i.e. to what extent was recession caused by the oil price shocks, government policies or other events. This class of the literature marked the significant shift to the supply-side economics also known as real business cycle models[2].

However, the placement of oil price shocks in the framework of the real business cycle models raised several issues. First, historical record includes two negative price shocks: the 1960 oil price drop and the collapse of world oil prices in 1986. Although empirical evidence suggest a contractionary impact on output of a positive oil price shock, in neither of the above case did nations' economies experience a boom after the negative price shock. This raised the issue of possible asymmetry in the macroeconomic response to oil price shocks. Was asymmetric response to be expected theoretically, or did the asymmetric response simply reveal that the impacts of the positive oil price shocks of the 1970s were substantially overstated, having been confused with other events? (Jones and Leiby, 1996) Second, closer association with the business cycle literature brought to oil-macroeconomic research a well-developed body of thought on business cycle transmission mechanisms. Thus, subsequent literature on macroeconomics of oil shocks has addressed the issues of magnitude of effect and causality of the oil price shocks.

While studies in both areas aforementioned are abundant for the more developed countries, there are less so for the emerging markets and developing countries. This part of the paper attempts to explore the above research questions in the context of an emerging market economy. In this study, an empirical analysis on Malaysia is conducted to document the impact of oil price shocks on the economy and the policy responses of the Malaysian authority. This part of the study is divided into two main sections. The first section is set out to examine the impact of the recent increase in oil prices on the Malaysian economy, with

2 Study by Hamilton (1983) on the role of oil price shocks in the United States business cycles has had considerable influence on this area of research.

greater focus on the period 2004 onwards as global oil prices escalated during this period; and discuss succinctly the policy responses to these episodes. The second section of the paper investigates the dynamic relationship between real activities, prices, government revenue and an oil price shock over the period 1991:Q1 to 2006:Q1, providing an empirical evidence how situation in Malaysia may differs from the standard theory.

2.2. Macroeconomics Impact and Policy Responses

According to Hunt et al (2001), an oil price increase can influence macroeconomic behaviour through several channels. Some of these channels seem particularly relevant in the first few years following the shock.

- The first channel is the transfer of income from oil-importing countries to oil-exporting countries. This is expected to reduce global demand as demand in the oil-importing countries is likely to decline more than it will rise in the oil-exporting countries[3]. The reduction in global demand can, in turn, have important consequences for open economies, such as Malaysia, whose economies are dependent on external demand.
- The other channel is the cost of production channel. The increase in the cost of inputs to production can reduce the amount of non-oil (potential) output that can be profitably supplied in the short-run, given the existing capital stock and assuming that wages are relatively inflexible in the short-run. The magnitude of the impact on the economy is dependent on the extent of the reliance on oil as a source of energy for the domestic economy. It is also dependent on the conduct of national policies in insulating the domestic prices from the changes in world oil prices. In such case, oil subsidy could be used to stabilise domestic oil prices, thus, minimising the impact of increases in world oil prices on the domestic economy.
- Another channel of transmission is the resistance of workers and producers towards declines in their real wages and profit margins, thus, imparting an upward pressure on unit labour costs and the prices of finished goods and services. To the extent that workers and producers resist the fall in real wages and profit margins, there will be evidence of second round effects of oil price increases.
- Next the transmission can come from the impact of higher energy prices on headline price indexes (e.g. consumer price levels) and the potential for pass-through into core inflation which may induce central bank to tighten monetary policy.

Finally, to the extent that policy reactions seems inconsistent with announced policy objectives, the credibility of the monetary authorities may be eroded, and this poses consequences on inflation expectations and the inflation process.

2.2.1. Oil Price and Economic Growth

The impact of higher oil prices on Malaysia has been manageable given its position as a net oil exporter. For Malaysia, petroleum revenue as a percentage of GDP, using petroleum income tax and royalty as a proxy of measurement, doubled from 2.3% in 2000 to 4.5% in 2006[4] (please refer to Charts 2.1 and 2.2). Given Malaysia's position as a small and open economy, the domestic economy would be affected mainly by any deterioration in global economic conditions. Nonetheless, the world economy has thus far remained resilient despite higher energy prices. Malaysian exports to its trading partners continued to record strong growth as the economic activities of the trading partners remained robust despite the global oil price increases (please refer to Chart 2.3).

3 Studies have shown that the propensity to spend in the oil-exporting countries is significantly smaller in the short-run than in the oil-importing countries.
4 Petroleum income tax for the year 2006 is an estimate. Petroleum income tax and petroleum royalty made up about 50% of the total petroleum revenue for the government. The others include petroleum dividends, export duty, sales tax and import duty.

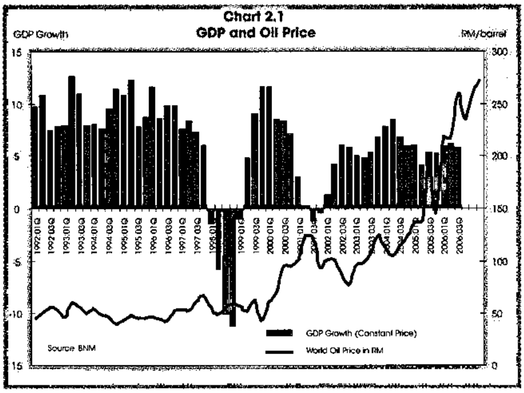


Chart 2.1
GDP and Oil Price

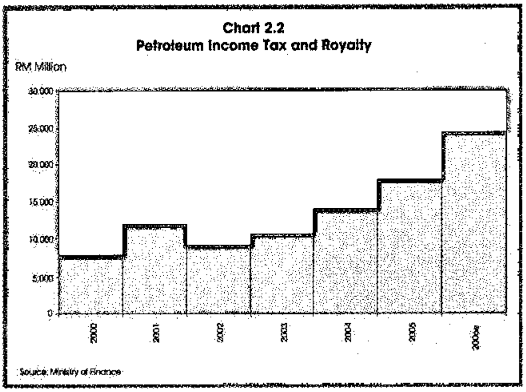


Chart 2.2
Petroleum Income Tax and Royalty

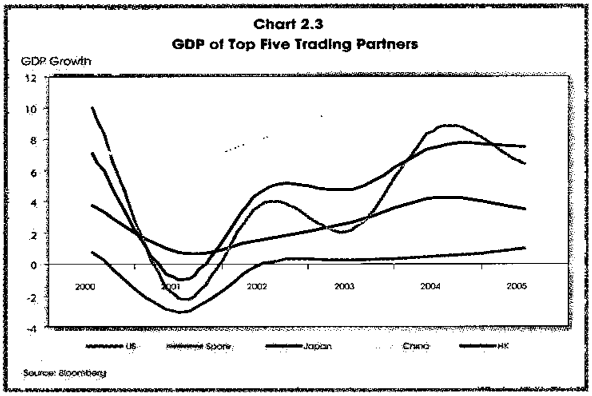


Chart 2.3
GDP of Top Five Trading Partners

2.2.2. Oil Price and Inflation

From historical point of view, based on an estimation using the Error Correction Model (ECM) for the period of 1991:Q1 to 2006:Q1, the pass-through of world oil prices, on immediate impact, into the CPI (Consumer Price Index) in Malaysia is relatively low.The pass-through is also slower, as it takes about seven quarters for the pass-through to complete. The long-run relationship between inflation and oil price is negative possibly driven by the data prior to the year 2004. During this time, a simple plot (please refer to Chart 2.4) of the CPI and oil price indicates a negative relationship as inflation moderated and remain on a downtrend in Malaysia after the Asian crisis (with an exception of the spike in 1998[5]).The average annual inflation for the years 2000-2003 was low at about 1.5%[6].

In fact, given the negative relationship, it can be deduced that prior to 2004, the pass-through from global oil price to domestic inflation is non-existence. As expected, the pass-through into PPI (Producer Price Index) is higher relative to the pass-through to CPI reflecting the importance of prices of imports in the producers' basket.

Table 2.1: Elasticity of Oil Price Pass-through into CPI & PPI

	Short-run Pass-through	Long-run Pass-through
CPI	**0.209**	**-0.455**
PPI	**0.514**	**1.071**

5 Inflation accelerated during this time due to the depreciation in the domestic currency.
6 Malaysia has been experiencing periods of low and stable inflation most notably since the Asian Financial Crisis in 1997.

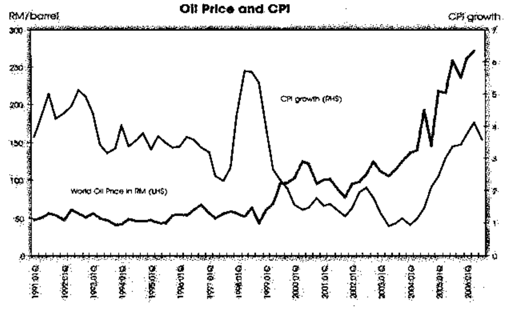
The slower and relatively small pass-through for the last fifteen years is possibly due, to some extent, to the oil subsidy and price controls that was imposed on retail fuel prices, gas prices and power rates, which has been insulating domestic inflation from oil price-inflation. However, the escalation on the global price of crude oil in 2004 and 2005[7] and the resulting higher subsidy expenditure has exerted an increasing burden on the government's operating expenditure, and at the same time, raised concerns over the misallocation of resources and costs of enforcement. Thus, the government removed partially the oil subsidy thereby allowing the greater oil price pass-through in 2005 and 2006. Table 2.2 displays the results from the ECM for the sub-sample 2003:Q1 to 2006:Q1 which show significantly higher pass-through from oil price to the CPI. In line with this development, annual inflation, as measured by the annual growth in the CPI, increased from 1.4% in 2004 to 3% in 2005.

Table 2.2: Elasticity of Oil Price Pass-through into CPI & PPI

	Short-run Pass-through	Long-run Pass-through
CPI	**0.455**	**1.484**
PPI	**0.583**	**1.856**

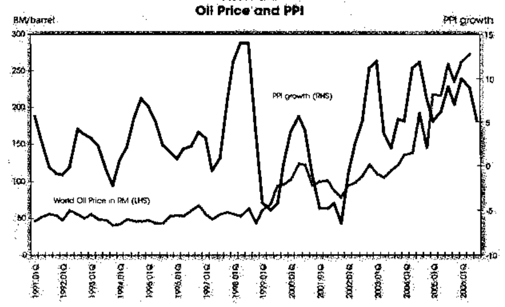
Charts 2.4 and 2.5 depict the movements of world oil price[8] in terms of domestic currency against domestic price indicators, the CPI and PPI. An eyeball analysis of the plots suggests that only the more recent episodes of oil price increases, namely beginning 2005 onwards, started to have an impact on the rate of inflation as measured by the CPI. Thus, the analysis on inflation and oil price increases in Malaysia will focus on this period henceforth. In the case of PPI, the pass-through seems to have been felt much earlier, at the end of 2002.

Chart 2.4
Oil Price and CPI



Source: Bloomberg and Department of Statistics, Malaysia

Chart 2.5
Oil Price and PPI



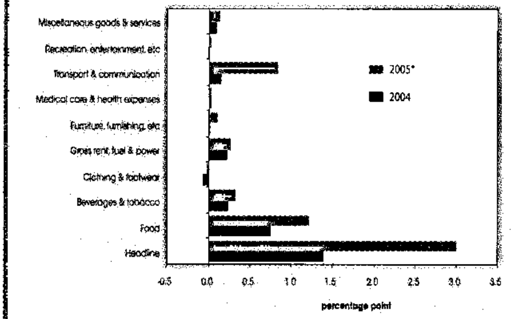
Source: Bloomberg and Department of Statistics, Malaysia

There are two ways in which oil price passes through into domestic inflation. One, it is reflected directly, with a short time lag, in fuel prices, where it represents a dominant cost factor. Two, oil price passes through much more slowly, with a longer time lag, into prices of other products where oil does not represent a key raw material or where it goes through several stages of processing. In this case, the impact of oil price changes on the prices of related products is difficult to quantify and monitor, as it is modified significantly by numerous other factors, for example, competition on the markets for the products, the capacity of the industry to absorb the cost, the varying forms of price controls or administrations on the products and etc. However, the broad components of CPI, for instance, the transport and communication; and food components, do provide some indication of the pass-through

7 For example, the West Texas futures prices increased by more than 30% at end-2004 and 2005 and by more than 5% by end-2006.
8 Price of US Brent per barrel in quarterly average.

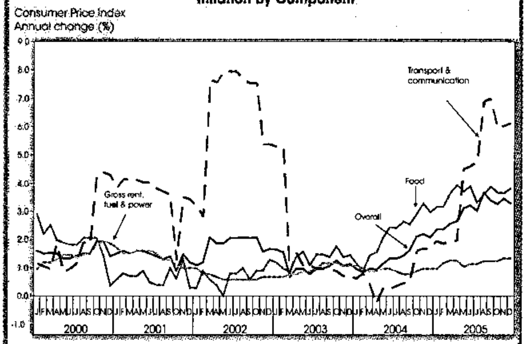
into the prices of these other products as these components are known to be sensitive to the fluctuations in the prices of energy and non-energy commodities. Chart 2.6 showed that although all categories in the CPI registered higher increase in 2005, the most significant increase in prices during the year was seen in the transport and communication and food categories. In fact, these two categories have shown an uptrend since 2004 (please refer to Chart 2.7).

Chart 2.6
Contribution to Inflation



*/ For comparison purposes, 2005 inflation refers to the previous base period (2000=100)
Source: BNM Annual Report 2005

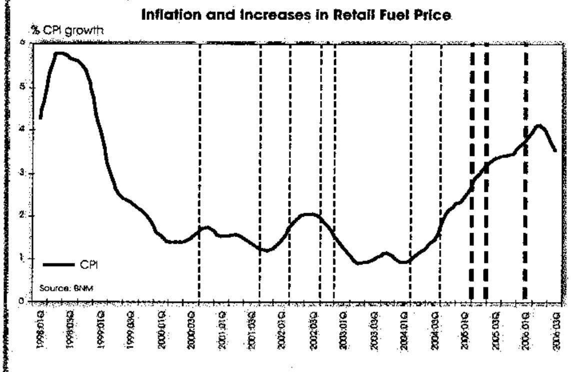
Chart 2.7
Inflation by Component



Source: Bloomberg and Department of Statistics, Malaysia

Chart 2.8 shows the growth in the CPI and the ten increases in retail petrol price in Malaysia (represented by the dotted lines), as a result of the removal of subsidy, since 2000[9]. To illustrate the contribution of these increases towards the domestic inflation, the increases in 2005 is analysed. There were two increases in the prices of retail petrol and diesel and petrol products in 2005 (May and August) that led petrol prices to increase from RM1.42 to RM1.62 per litre, a total of about 14% increase in prices. These increases contributed approximately to 0.39 percentage points to the inflation rate for the year[10]. In February 2006, another removal of the subsidy led to an increase of 18% in retail petrol price to RM1.92 per litre. Consequently, inflation rate increased to 4.8% in March and 4.6% in April 2006 as the higher fuel price transmitted into larger transportation cost[11].

Chart 2.8
Inflation and Increases in Retail Fuel Price



9 Please refer to Section 1 of the paper for detail information regarding fuel prices increases in Malaysia.

10 This analysis excludes the increase in the price of diesel in March 2005. Including the latter, the contribution to the inflation rate for the year is slightly higher at 0.4 percentage points (compared to 0.39 percentage points excluding the increase).

11 The increase was also in part the result of a higher weight being assigned to the transport category in the revised CPI basket (effective from January 2006, the Department of Statistics has revised the CPI base reference period).

Although there were concerns that the increase in domestic oil prices in 2005 and 2006 would cascade down into the prices of other goods, the subsequent outturn for inflation was moderate. For instance, despite the increase in inflation in March and April of 2006, the average inflation for the second-half of 2006 is lower at 3.3% (July-Nov., 2006). This could be attributable to several factors, including the increase in labour productivity[12] and the intensification of competition amongst producers and from imports might have contained the secondary effects from higher oil prices. In addition, capacity expansion amongst businesses might also play a role in increasing supply and mitigating possible demand pressures. Moreover, active surveillance and enforcement efforts undertaken by the relevant government agencies also appear to have been successful in ensuring that prices of controlled essential goods and services are transparent and not raised opportunistically.

More importantly, Bank Negara Malaysia (BNM) and the government undertook several measures to manage inflation expectations during the recent higher oil prices episodes. Among others, BNM communicated and provided inflation forecasts for the year 2006 to inform the public of the Bank's view of the inflation development throughout the year. In essence the Bank communicated that the increase in inflation in the first half of 2006 was temporary and that it would moderate in the second half of the year. This message was repeatedly communicated during the year, especially during the press releases for the quarterly GDP as well as in the Monetary Policy Statements. In addition, the government also issued an announcement that there would be no further adjustment of retail petroleum product in 2006. The clear communication also seems to have paid off as inflation expectations in Malaysia remained well-anchored throughout the year reflected by the lack of evidence of second round effect or demand induced inflation.

2.3. The Dynamic Relationships of Oil Price and the Economy

Many empirical researches have generated evolving impressions about the magnitude of oil-price effects on aggregate economic activity and about the extent to which activity responds symmetrically to oil-price increases and oil-price declines. However, the consensus was that for an oil-importing country, an exogenous increase in the price of oil has the following expected effects on the economy: output falls, prices rise and monetary policy tightens presumably in response to the inflationary pressures form the oil shock[13]. In the case of an oil-exporting country, the impact of a positive oil price shock on real activities is rather indeterminate. Output may possibly rise as increase in oil revenue may spur investment and consumption. However, the oil price impact on prices and the ensuing monetary tightening may possibly mitigate this expansionary impact on output. In addition, to the extent that global demand may fall with higher oil price, output of oil-exporting country may decline due to the contraction in the export sector. Thus, the impact of an oil price shock on the economy for an oil-exporting country remains an empirical question.

In order to examine the dynamic impact of the price of oil on domestic economic variables, a complete micro-founded model is probably most appropriate. However, for such a model, while it has the benefit of being tightly structured, often it does not have the ability to test many maintained hypothesis. The latter arises because specifying a model often involves imposing many quite arbitrary restrictions. Such a warning seems especially imminent in the present context, when the channels of influence of the price of oil may be many and varied. In such a case, analysing the innovation is more informative than estimating a standard macro model. In this exercise, a generalised and more structured vector autoregressive model (VAR) is utilised to estimate the model. It is imperative that such well identified model is used rather than the standard VAR (Cholesky-based decomposition) because this model allows one to test the questions at hand more accurately.

12 Productivity, as measured by real sales per employee in the manufacturing sector, increased by 10.6% in 2005 and 0.3% for Jan-Oct. 2006.

13 These impacts may also hold true for an open, oil-exporting country as global demand may decline as a result of oil price increases.

The generalised VAR model is as follows:

Assume the economy is described by a structural form equation

$$G(L)\, y_t = e_t \qquad (1)$$

where $G(L)$ is a matrix polynomial is the lag operator L, y_t is an n x 1 data vector, and e_t is an n x 1 structural disturbance vector. e_t is serially uncorrelated and $var(e_t) = \Lambda$. Λ is a diagonal matrix where diagonal elements are the variances of structural disturbances, so structural disturbances are assumed to be mutually uncorrelated.

We can estimate a reduced form equation;

$$Y_t = B(L)y_t + u_t \qquad (2)$$

where $B(L)$ is a matrix polynomial in the lag operator L and $var(u_t) = \Sigma$.

There are several ways of recovering the parameters in the structural form equations from the estimated parameters in the reduced form equation. Some methods give restrictions on only contemporaneous structural parameters. A popular and convenient method is orthogonalise reduced form disturbances by Cholesky decomposition. However, in such models, only the recursive structure, that is, the Wold-causal chain is assumed. Blanchard and Watson (1986), Bernanke (1986) and Sims (1986) suggested generalised methods in which non-recursive structures are allowed. While still giving restrictions on only contemporaneous structural parameters, more reasonable economic structures can be postulated.

Let G_O be the coefficient matrix (non-singular) on L_O in $G(L)$ that is the contemporaneous coefficient matrix in the structural form and let $G_O(L)$ be the coefficient matrix in $G(L)$ without contemporaneous coefficient G_O. That is,

$$G(L) = G_O + G_O(L) \qquad (3)$$

Then the parameters in the structural form equation and those in the reduced form equation are related by

$$B(L) = -G_O^{-1}G_O(L) \qquad (4)$$

In addition, the structural disturbances and the reduced form residuals are related by

$$et = G_O\, u_t \qquad (5)$$

which implies

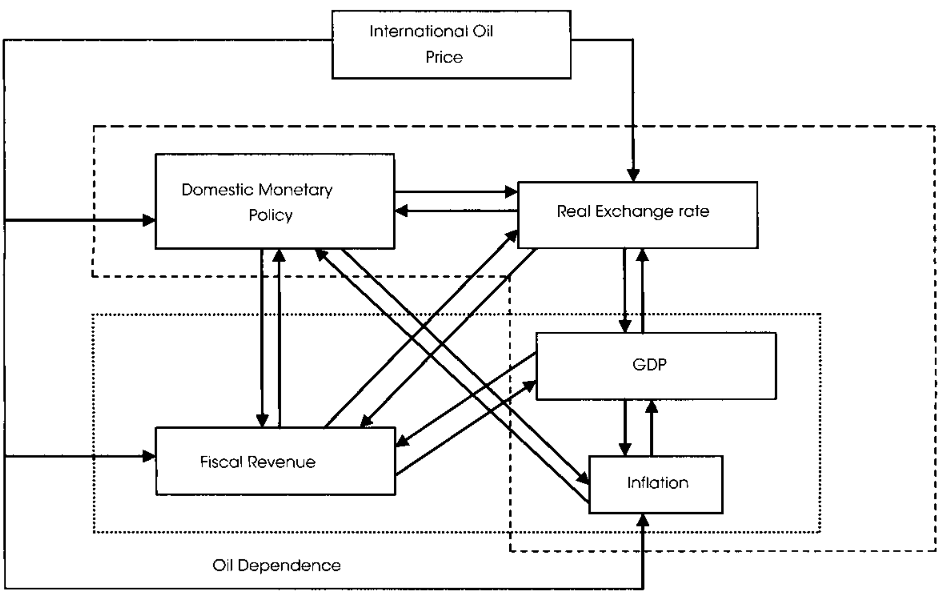
$$\Sigma = G_O^{-1}\, \Lambda\, G_O^{-1'} \qquad (6)$$

Maximum likelihood estimates of Λ and G_O can be obtained only through sample estimates of Σ. The right hand side of equation 6 has n x (n+1) free parameters to be estimated. Since Σ contains n x (n+1)/2 parameters, at least n x (n+1)/2 restrictions is needed. By normalising n diagonal elements of G_O to 1's at least n x (n-1)/2 restrictions on G_O is needed to achieve identification.

In the standard VAR modeling with a Cholesky decomposition, G_O is assumed to be triangular. The generalised method has an advantage over this recursive method in modeling realistic economic structures as it allows feedback and block diagonal structures. For example, in the recursive model, the variables included in the monetary reaction functions are assumed not to be affected by monetary policy shocks contemporaneously, and vice versa. In contrast, in the generalised method, it is possible to construct a structure allowing for the current mutual effects between monetary policy shocks and a variable such as exchange rate which is expected not only to affect monetary policy contemporaneously but also to be affected by monetary policy contemporaneously[14]. More importantly, in this case, the generalised method allows the variable oil price to affect some of the variables contemporaneously and some other variables through lags while at the same time blocking the impact of all the other variables from affecting the oil price. The latter is crucial for this study, as it must be assumed that the domestic economy is not large enough to affect the global oil price.

The decision on the choice of how many, and which, variables to include in the model is inevitably somewhat arguable, reflecting practical considerations such as degrees of freedom as much as economic considerations. The model in this study contains six variables. The variables are described briefly as follows (OIL, I, ER, GOV, P, Y); where OIL is the international price of crude oil, I is the interest rate (overnight interbank rate), ER is the exchange rate (real effective exchange rate), GOV is federal government revenue, P is inflation (CPI) and Y is real economic growth (real GDP). Chart 2.9 below illustrates the possible inter-linkages between these variables[15].

Chart 2.9
Transmission for a Small and Open Economy



14 This is especially true for models using quarterly data.

15 The following describes succinctly the structural assumption imposed on the model: The interest rate equation is assumed to be a reaction function of the monetary authority, which sets the interest rate after observing the current value of oil price and exchange rate but not the current value of all the other variables. As for the oil equation, none of the other variables are allowed to have an impact on oil price equation, neither contemporaneously nor through lags. This stand on the view that a single country is not large enough for changes in its variables to affect the global commodity price, as depicted in Chart 2.9. In the equation for exchange rate, monetary policy and oil price movement are allowed to have contemporaneous impact on the exchange rate. For the other structures, i.e. the government, price and income equations, the general assumptions is that fiscal policies, inflation and real activities respond to the other variables only with a lag.

The following are the results for Malaysia for the period 1991:Q1 to 2006:Q1: All data, with the exception of interest rate and exchange rate, are in logarithm form and the structural VAR is estimated using one lag based on both the Akaike Information Criterion and Schwarz Criterion.

Chart 2.10
Impulse Response of Output to Oil Price Shock

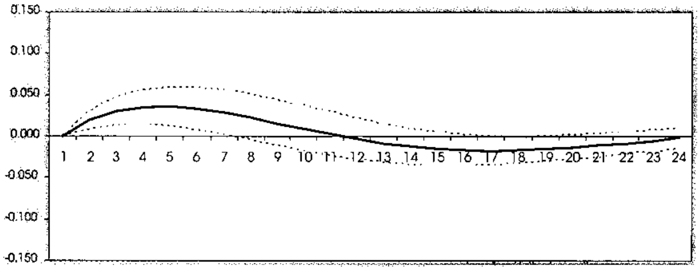


Chart 2.11
Impulse Response of Inflation to Oil Price Shock

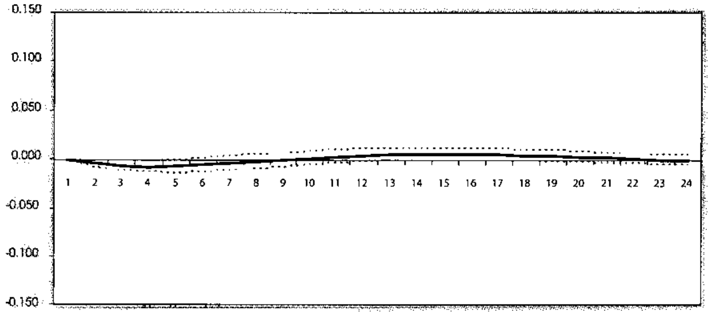
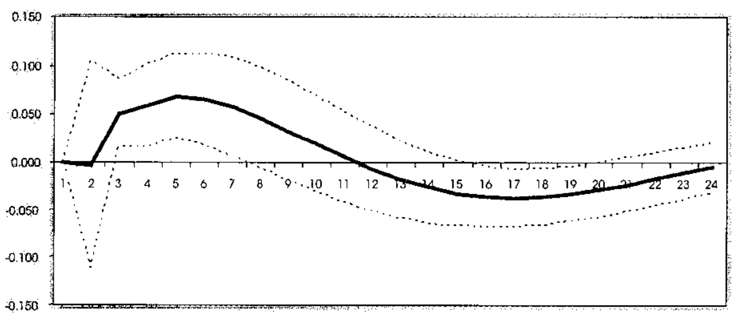


Chart 2.12
Impulse Response of Government Revenue to Oil Price Shock

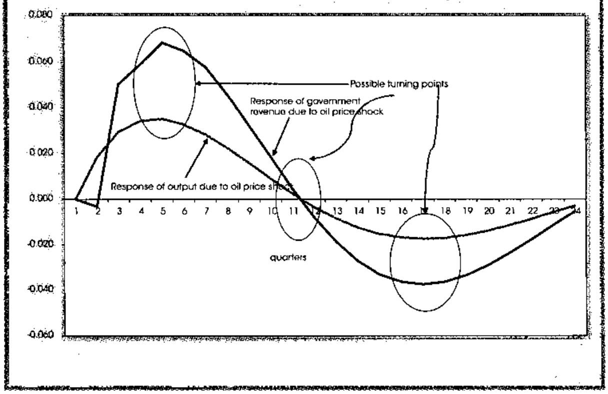


Charts 2.10, 2.11 and 2.12 depict the impulse response of output, inflation and the Federal government revenue to a one unit innovation in the world oil price (shock of the size of 1%). These charts are consistently scaled in order to provide a clearer comparison on the

impact of an oil price shock to these variables. In the case of Malaysia, a positive oil price shock (i.e. an increase in global oil price) has favourable influence on both output and fiscal revenue for at least up to 12 quarters. In contrast to the impact on these two variables, the oil price shock, however, does not seem to have a significant impact on the dynamics of the Malaysian inflation during this period. Inflation remain relatively unchanged, as shown by the standard error bands or confidence intervals which are not significantly different from zero for at least up to the first 10 quarters given the positive innovation in oil price.

Federal government revenue increases quite significantly after a lag of 2 quarters following a shock. This is probably attributable to the increase in petroleum revenue as Malaysia is the net exporter of oil. Government revenue reaches its peak after the fifth quarter, consistent with the fact that, in Malaysia, petroleum tax is paid based on the previous year's income. Further, the positive impact on government revenue starts to decay after one and half years probably due to the increasing burden of petroleum subsidy that started to kicks in. Output increases possibly as a result of higher investment and consumption from increasing oil revenue in the country. However, the positive impact on output turns around after 12 quarters possibly due to the diminishing impact of increasing oil revenue to the economy. Chart 2.13 depicts a clearer relationship between the two as the turning points between the two coincide significantly. In addition, given that inflation starts to pick up, albeit of a smaller magnitude after the 11th quarter (the standard error bands are significantly different than zero), this indicates possible transmission of the higher oil price into the domestic economy which may negate the initial expansionary impact.

Chart 2.13
Turning Points - Impulse Response Functions of Government Revenue and Output



2.3.1. Variance Decomposition

An analysis of the variance decomposition is utilised to determine, in terms of historical perspective, how much of the cyclical fluctuations in government revenue, prices and output are due to the oil price shock.

Table 2.3
Percentage of Variation in the Variables due to an Oil Price Shock

Horizon	Government Revenue	Inflation	Output
4 quarters	9.67	2.42	5.79
8 quarters	9.58	2.47	7.75
12 quarters	8.37	1.99	7.61
16 quarters	6.57	1.78	7.58
20 quarters	5.83	1.40	6.55
24 quarters	5.18	1.17	6.37

Table 2.3 summarises the changes that can be explained by an oil price innovation for these variables. At the 4 and 8 quarters horizon, almost 10 percent of the changes in government revenue are due to changes in the oil price. Within the 8 to 16 quarters horizon, only about 8 percent of the changes in output can be attributed to an oil price shock. In the case of inflation, oil price changes can only explained an even modest portion of the variation in inflation.

The structural VAR results above document the impact of an oil price shock on a country which is a net-exporter of oil. A positive oil price shock brings about an expansionary impact on output mostly via the positive impact on government revenue. However, oil price shock explains only a small proportion of the total variation in output. The variance decomposition result from this study provided evidence that the variation in output that can be explained by the innovation in the oil price is small and that the bulk of the variation in output are explained by its own innovation. Apart from its own innovation, the variation in output can also be explained by other shocks, such as technology shock, fiscal policy shock and monetary policy shock.

Table 2.4 examines how much have these shocks affects output. Since technology shock is not specified in the model, it is assumed that the impact of this shock is nestled within the impact of the innovation of output itself. Variation of output due to innovation from the exchange rate and price is not reported here hence, the numbers in each row will not add up to a hundred percent. Monetary and fiscal policy shocks are represented by the innovations in the policy rate and government revenue respectively. From Table 2.4, it is evident that disturbances in the oil price have not been the major source of variation in output in Malaysia, and its impact on output pales in comparison to other shocks in the economy.

Table 2.4
Percentage of Variation in Output due to the following Shocks

Horizon	Output Shock	Oil Price Shock	Monetary Policy Shock	Fiscal Policy Shock
4 quarters	66.69	5.79	4.99	1.94
8 quarters	38.72	7.75	15.57	2.07
12 quarters	31.69	7.61	20.40	1.74
16 quarters	30.07	7.58	20.16	1.82
20 quarters	28.93	6.55	19.53	2.03
24 quarters	29.06	6.37	19.52	2.06

2.4. Conclusion

Section 2 of the paper attempts to do two things. First, assess the macroeconomic implications of the recent increases in oil price focusing primarily on the period 2004 onwards. Second, examine the dynamic impact of an oil price shock on the economy using the generalised and structural VAR method. From the first analysis, it can be concluded that, thus far, the recent oil price increase has not led to an unfavourable outcome to the Malaysian economy. Malaysia continues to record robust growth in output in the recent years while inflation remains at manageable level. From the second study, the results indicate that a positive oil price shock has an expansionary impact on government revenue and output and relatively insignificant effect on inflation. Nonetheless, oil price disturbance only explains a small percentage of the total variation in the Malaysian output.

References

1. Bank Negara Malaysia (BNM), (1973, 1974, 1975, 1980, 1981, 2000, 2001, 2002, 2003, 2004, 2005),' BNM Annual Report', Bank Negara Malaysia, Kuala Lumpur.
2. Bank Negara Malaysia (BNM), (various), 'Monthly Statistical Bulletin', Bank Negara Malaysia, Kuala Lumpur.
3. Bank Negara Malaysia (BNM), (1999), 'The Central Bank and the Financial System in Malaysia: A Decade of Change', Bank Negara Malaysia, Kuala Lumpur.
4. Bernanke, B. S., Gertler, M, and Watson, M., (1997), "Systematic Monetary Policy and the Effects of Oil Price Shocks," *Brooking Papers on Economic Activity*, 1: 1997, pp. 911-42
5. Christiano, L.J., Eichenbaum, M. and Evans, C., (1999), "Monetary Policy Shocks: What Have We Learned And To What End?" in J.B.Taylor and M. Woodford eds. Handbook of Macroeconomics, Vol.1 Elsevier Science: Amsterdam pp.65-148.
6. Clarida, R., Gali, J. and Gertler, M., (1999), "The Science of Monetary Policy: A New Keynesian Perspective" *Journal of Economic Literature*, 37, pp.1661-1707.
7. Department of Statistics, (2005), 'Petroleum Statistics in Malaysia', Department of Statistics, Kuala Lumpur.
8. Department of Statistics, (2005), 'National Product and Expenditure Accounts 1987-2005', Department of Statistics, Kuala Lumpur.
9. Economic Planning Unit (EPU), (2005), 'Oil Price and Subsidies: An Explanation', Economic Planning Unit, Kuala Lumpur. (available at www.epu.jpm.my)
10. Economic Planning Unit, (2006), 'Explanation on Oil Price Subsidies and Other Social Obligations', Economic Planning Unit, Kuala Lumpur (available at www.epu.jpm.my)
11. Eichenbaum, M and Evans, C., (Nov. 1995), "Some Empirical Evidence on the Effects of Shocks to Monetary Policy on Exchange Rate", *The Quarterly Journal of Economics*, Vol. 110, Issue 4, pp.975-1009.
12. Energy Information Administration (EIA), US, (2006), "Energy Data: Malaysia", (available at www.eia.doe.gov).
13. Hamilton, J. D., (1999), "What is an Oil Shock?", *Working Paper*, UCSD
14. Hamilton, James D., (1996), "This is What Happened to the Oil Price - Macro economy Relationship," *Journal of Monetary Economics*, 38: 215-220.
15. Hamilton, James D., (1983), "Oil and the Macro economy Since World War II," *Journal of Political Economy*, 91, pp. 228-48.
16. Hashim, Ismail.. (2004), 'The Young Turks of PETRONAS', Berita Publishing, Kuala Lumpur.
17. Hunt, B., Isard, P., Laxton, D., (2001), "The Macroeconomic Effects of Higher Oil Prices," *IMF Working Paper*, WP/01/14 pp. 1-46.
18. Krichene, N., (2006), "World Crude Oil Markets: Monetary Policy and the Recent Oil Shock," *IMF Working Paper*, WP/06/62 pp. 1-25.
19. Kim, S., (1999), "Do Monetary Policy Shocks Matter in the G-7 Countries? Using Common Identifying Assumptions About Monetary Policy Across Countries" *Journal of International Economics*, No. 48, p. 387-412.
20. Leduc, S., and Sill, K., (2001), "A Quantitative Analysis of Oil Price Shocks, Systematic Monetary Policy, and Economic Downturns," *Working Paper*, No.01-9, Federal Reserve of Philadelphia.

21. Malaysia Energy Centre, (2004, 2005, 2006), 'National Energy Balance (NEB) 2003, 2004, 2005', Malaysia Energy Centre (Pusat Tenaga Malaysia), Kuala Lumpur.

22. Ministry of Domestic Trade and Consumer Affairs, Malaysia, (2005), ' Petroleum Products Sales in Malaysia' (available at www.kpdnhep.gov.my).

23. Ministry of Energy, Communications and Multimedia, Malaysia, (2005), ' Energy Policies in Malaysia' (available at www.ktkm.gov.my).

24. Ministry of Finance, Malaysia, (2005), 'Economic Report 2005/2006', Ministry of Finance, Kuala Lumpur.

25. Mork, K.A., (1989), "Oil and the Macroeconomy when Prices Go Up and Down: An Extension of Hamilton's Results," *Journal of Political Economy*, Vol.97, pp. 740-4.

26. Mussa, M. et al., (2000), "The Impact of Higher Oil Prices and the Global Economy," *IMF Working Paper*, WP/00/ pp. 1-46.

27. PETRONAS (2003, 2004, 2005, 2006), 'Media Release, Financial Statement and Results Announcement', Petroliam Nasional Berhad, Kuala Lumpur (available at www.petronas.com.my).

28. Prime Minister's Department, Malaysia, (2006), 'The 9th Malaysia Plan - 2006-2010', Prime Minister's Department, Kuala Lumpur,

29. Rasche, R. and Tatom, J.A., (1981), "Energy Price Shocks, Aggregate Supply, and Monetary Policy: The Theory and International Evidence," In Brunner and Meltzer, eds., Supply Shocks, Incentives, and National Wealth, Carnegie-Rochester Conference Series on Public Policy, Vol.14 Amsterdam: North-Holland.

Appendix 1

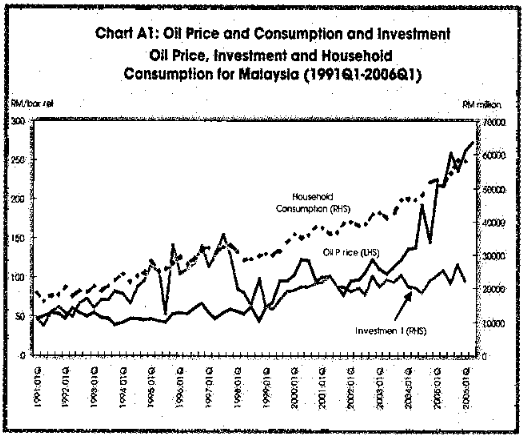


Chart A1: Oil Price and Consumption and Investment
Oil Price, Investment and Household Consumption for Malaysia (1991Q1-2006Q1)

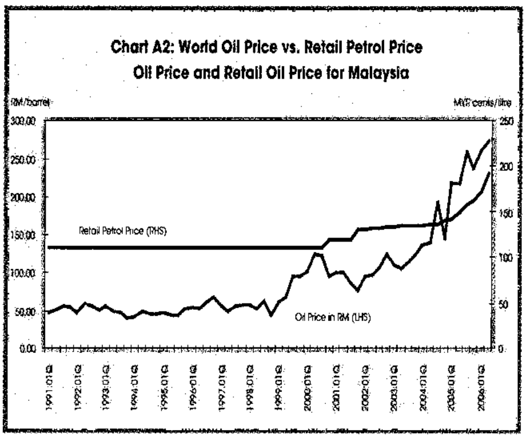


Chart A2: World Oil Price vs. Retail Petrol Price
Oil Price and Retail Oil Price for Malaysia

Chapter 7

COUNTRY PAPER OF MONGOLIA

by A. Chingunjav[1]
The Bank of Mongolia

1. Background

Mongolia is one of the coldest countries in the world. The capital city of Ulaanbaatar (UB) and other major cities use coal-fired combined heat and power (CHP) plants to provide heat to urban residents and supply electricity to about half the country's population. Maintaining adequate thermal and electric energy supplies is essential for the country's economic development and the well being of the population.

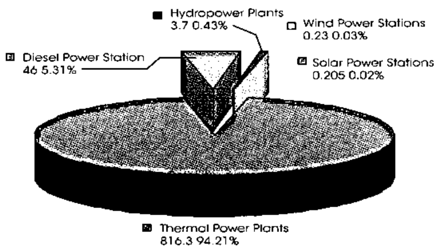
District heating is provided from 15th September to 15th May each year for residential users and to 1st May for government buildings. Steam and hot water is provided all year round.

2. Thermal Power, Energy Supply System

The actual power demand in Mongolia is comparably low due to the small population in a huge country and the rather low level of industrialisation. Power generating capacity is accordingly low also.

The Mongolian thermal power generation capacity is provided by seven coal fired combined heat and power (CHP) generation plants, numerous diesel power stations (some 600 diesel units with capacities ranging from 60 to 1000 kW) in some aimag centers and soum centers, which are not connected to the grids, and in some other locations spread all over the country and by imports from the Russian Federation. Coal is the only domestic fuel, whereas diesel as well as heavy fuel oil has to be imported.

Figure 1: Energy Production by Sources Structure of Energy Sources, MBo



Mongolia's electricity supply system essentially consists of three separate, independent grids: the CES, the EES and the WES, comprising six thermal power plants with heat extraction and seven distribution systems.

1 A. Chingunjav is Economist at the International Department of The Bank of Mongolia.

The CES supplies power and heat to the capital city of Ulaanbaatar and to thirteen nearby provinces (aimags), including the industrial towns of Darkhan and Erdenet, representing 81% of all of Mongolia's electricity supply. The CES is based on five coal fired generating plant and is connected to the Russian Electricity System. The other two grids are quite small. The WES operates on imports of electricity from Russia. The EES is centred in Choibolsan.

The CES with the poor peaking capability of the essentially base-load plants is unable to meet the daily system demand and the problem is aggravated by coal supply and spare part problems. Outages reduce the actual power delivery by about 14-18 %. In spite of recent improvements, the CES still uses 22% of the gross generation for its own use during the winter which is considered high. A serious aspect of the system is its age.

In addition, there are five isolated aimag centers not connected to the three grid systems: Murun, Uliastay, Altay, Bayankhongor and Dalanzadgad, each with a power plant supplying small local networks.

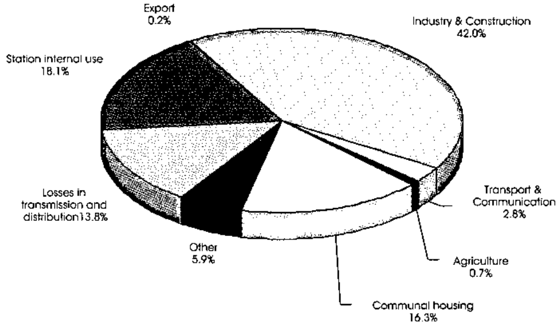
Of the total of 310 soum centers, some 185 are currently connected to the grid systems or to one of the 2 isolated aimag centers. Because of the low population density, the grid systems have to be very large to reach at the majority of the population. Long distances and low loads, however, create problems in the transmission systems. Losses in the transmission and distribution systems are high; technical losses were about 12% in distribution and about 2% in transmission.

As a result of upgrades and rehabilitation of the combined grid power systems, energy imports have been falling (see Table 1) and system reliability especially in the major grids, has improved significantly.

Table 1: Balance Sheet of Electricity mln.kWt.h

Year	2000	2001	2002	2003	2004
Resources- Total	**3127.0**	**3213.0**	**3279.0**	**3309.0**	**3474.3**
Gross generation	2946.0	3017.0	3111.7	3137.7	3303.4
Import	181.0	196.0	167.3	171.3	170.8
Distribution	3127.0	3213.0	3279.0	3309.0	3474.3
Consumption	1910.0	1948.0	2031.7	2194.6	2357.0
Of which:					
Industry & Construction	1182.0	1204.0	1260.1	1361.1	1458.8
Transport & Communication	79.0	87.0	84.7	91.5	98.5
Agriculture	21.0	17.0	22.0	23.8	25.6
Communal housing	463.0	476.0	487.1	526.1	567.6
Other	165.0	164.0	177.8	192.1	206.5
Losses in transmission and distribution	576.0	603.0	582.8	489.2	480.4
Station internal use	616.0	644.0	649.0	618.4	628.8
Export	25.0	18.0	15.5	6.7	8.2
Electricity produced per capita, kW.h	1307.0	1235.0	1265.4	1260.3	1311.6

Figure 2: Electricity Consumption by Sectors



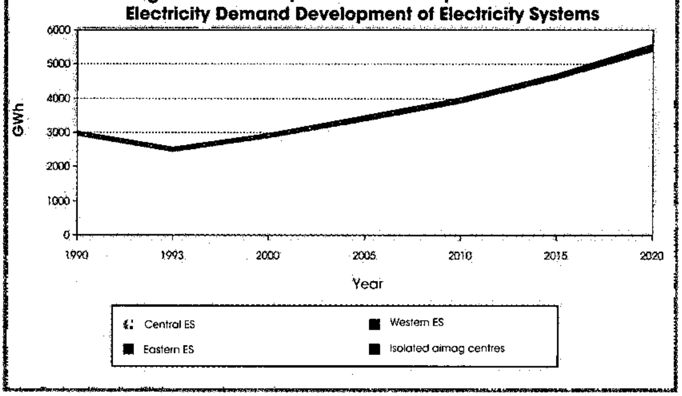
2.1. Demand Forecasts for Electricity Consumption

According to the Master Plan of the Government, demand for electricity is scheduled to increase at an annual average growth rate of 2.9 percent between 2005 and 2020 (see Table 2). This growth rate assumes that there will be improved efficiencies in the operating power and heat systems as well as energy savings resulting from conservation and energy efficiencies on the demand side.

Table 2: Electricity Load Forecasts, 2005-2020 (Gwh)

Systems	2005	2010	2015	2020
Central CES	**3450.5**	**3868.2**	**4559.0**	**5400.9**
UB EDO	1034.0	1238.1	1532.3	1937.6
Outside UB	1646.3	1856.5	2114.9	2383.1
Station Use	670.1	773.6	911.8	1080.2
Peak Load (MW)	565	691.7	820.0	977.2
Average rates of change (from. prev. year), %	2.6	3.0	3.5	3.6
Western ES	**41.2**	**45.8**	**51.7**	**58.8**
Peak Load (MW)	11.7	13.1	14.7	16.7
Av.r.of ch (fr.prev.year), %	2.2	2.2	2.4	2.5
Eastern ES	**65.6**	**73.0**	**82.3**	**93.1**
Peak Load (MW)	12.3	13.7	15.4	17.4
Av.r.of ch (fr.prev.year), %	2.2	2.2	2.4	2.5
Isolated aimag centres (Altai, Uliastai, Dalanzadgad)	26.6	29.6	33.4	37.8
Peak Load (MW)	5	5.6	6.4	7.2
Av.r.of ch (fr.prev.year), %	2.2	2.2	2.4	2.5
Total	**3483.8**	**4016.6**	**4726.4**	**5590.6**

Figure 3: Electricity Demand Development Until 2020



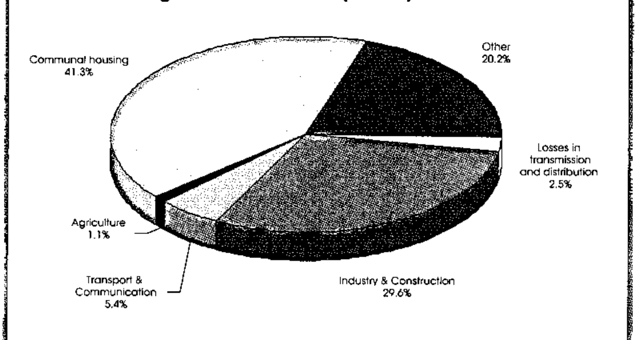
3. Heat

Because of the cold winters, heating is especially important in Mongolia - it is necessary for survival and the heat demand is extraordinarily high. Mongolia has the highest density of district heating and the long and cold winters make heat supply systems indispensable for the well being of the people.

In terms of heat supply sources for central or district systems, Mongolia has combined heat and power (CHP) thermal power plants in Ulaanbaatar, Darkhan, Erdenet, and Choibalsan. Most of the boilers are Russian, model BZUI-100, HP-18. In addition, there are some boilers of medium capacity produced in China. In the smaller urban areas, many of the plants are boiler only heating (BOH) and are model KE 25/14, KVTS 20/150. As the totals indicate, while capacity can meet demand in the near term, there will have to be some expansion.

The condition of the heat supply line system is not optimal. Transmission losses in the system due to leakage, radiation and other causes in Ulaanbaatar amounted to 15% of peak capacity, while losses in industrial heat delivery are considerably higher.

Figure 4: Heat Consumption by Sectors



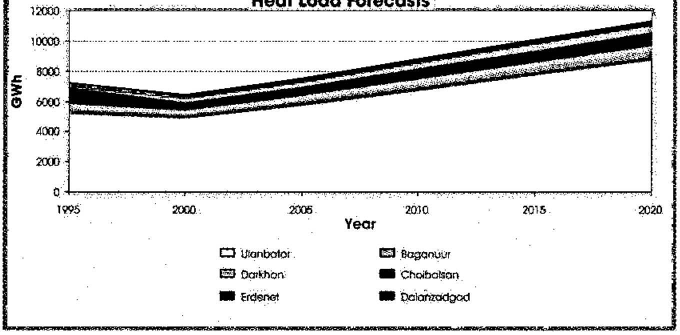
3.1. Demand Forecast for Heat Consumption

Heat loads are forecast to increase at the same rate of power demand in the district systems. According to the Master Plan, the average annual growth rate will be 2.9 percent for the period 2001-2020. This means that demand will basically double as shown by the figures in Table 3.

Table 3: Heat Load Forecasts, 2005-2020 (Gwh)

Centres with CHP, HP	2005	2010	2015	2020
				UB
Residential Heating (Water)	1741	2160	2686	3347
Business+Public Heating (Water)	3075	3395	3749	3940
Industrial Processes (Steam)	142	284	284	284
Losses (15% of Net)	744	976	1008	1136
Gross Distributed Heat	5702	6716	7727	8707
Average Change rate fr.prev.column, %	3.3	3.3	2.8	2.4
Peak load (per hour), MW	1468	1774	2030	2275
Darkhan				
Heat Demand	665	775	856	950
Peak Load, MW	230	268	295	328
Erdenet				
Heat Demand	641	747	825	916
Peak load, MW	166	194	214	238
Baganuur				
Heat Demand	296	345	381	423
Peak load, MW	75	87	97	107
Cholbalsan				
Heat Demand	199	232	256	284
Peak load, MW	65	76	84	93
Dalanzadgad				
Heat Demand	33	38	42	47
Peak load, MW	11	12	14	15

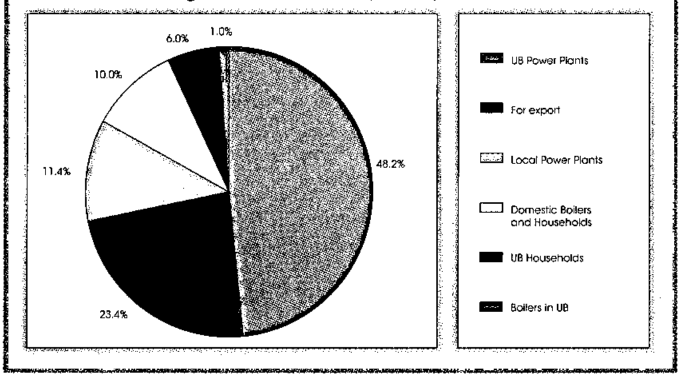
Figure 5: Heat Demand Development Until 2020
Heat Load Forecasts



4. Coal Sector

Coal is the only domestic fuel for energy production. As mentioned above, coal plants supply 94.2 percent of the energy produced in the country. The major suppliers of coal to the power industry are the Baganuur, Shivee Ovoo and Sharyn Gol mines with annual mine capacities of 4 million, 500 thousand and 1 million tons, respectively. Current production from all Mongolian mines amounts to approximately 5 million tons each year, of which power generation uses about 3.75 million tons.

Figure 6: Coal Consumption by Sectors



Recognising the importance of coal for the domestic energy sector and taking into the consideration the huge coal resources in the country, the Ministry of Fuel & Energy of Mongolia has initiated and prepared the **National Program** named **"Coal"**. The main aim of this programme is to develop Mongolia's coal sector till 2030 by increasing the production capacities of existing plants, to introduce into the production processes, ecologically friendly techniques, technology and equipment, to explore new and potential coal deposits, set up infrastructural facilities, to solve coal quality problems and complete utilisation of coal reserves, to produce liquefied and gas fuel from the coal for local consumers, and to create the national capabilities and environment for high-quality coal products export to Asia-Pacific region.

The "Coal" national programnme would undertake the following strategic tasks:

- Introduce up-to-date equipment into the coal producing sector to support the reliable coal supply for domestic users.

- Set up coal handling facilities at the biggest coal producers to improve the coal quality, both for domestic and foreign customers. Increase the export-oriented production.
- Establish coal-gasifying and gas-fired small plants to supply the rural areas with electricity.
- Intensively develop briquette production that will reduce the air pollution in the urban areas.
- Stage by stage installation and development of small, middle and large scale coal-chemical systems.
- Install the coal-based fuel producing plants with "Hydro Carbon", "SASOL", "Mobil Synthesis" and "Hydrogenesis" technologies to produce liquefied gas, petroleum and diesel to supply the domestic markets.
- Develop the coke-chemical industrial complex at the Tavan Tolgoi coal deposit (481.5 million tons of coking coal and 140.5 million tons of thermal coal).

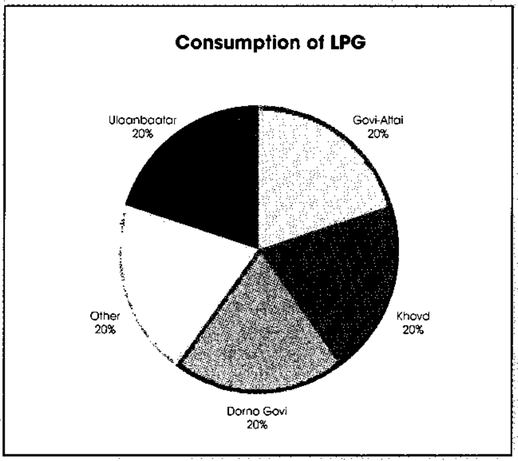
Expected results of the programme are:

- Coal processing facilities and chemical plants will be established in Mongolia allowing the increase of coal export by 2012 to 4Mt, by 2020 to 10Mt and by 2030 to 20Mt per annum.
- A chemical-technological structure equipped with data processing, coal gasifying and hydrogenising equipment.
- Small scale coal gasifying power plants will be installed in 27 soums (provincial units) by 2012 allowing replacement of diesel fuel with low-cost coal gas.
- Large scale coal gasifying power plant will be commenced by 2015.
- At least 2 coal briquetting plants will be installed by 2007 to reduce the air pollution of UB city.
- The coal carbonated filter producing plant will be started by 2010 for water treatment processes.
- The middle scale coal liquefying plant will be installed by 2012 that will be supplying 50% of domestic demand, and by 2020 the plant will be supplying most of demand allowing the reduction in oil products.
- Coke-chemical complex will be installed at the Tavan Tolgoi deposit which will produce some 10Mt of coke and more than 100 kinds of chemical products to supply both domestic and international markets.
- Fulfill the obligations by international contracts on reducing the greenhouse effect and toxic components exhausted to the atmosphere due to coal-fired plants.

5. Liquefied Petroleum Gas (LPG) in Mongolia

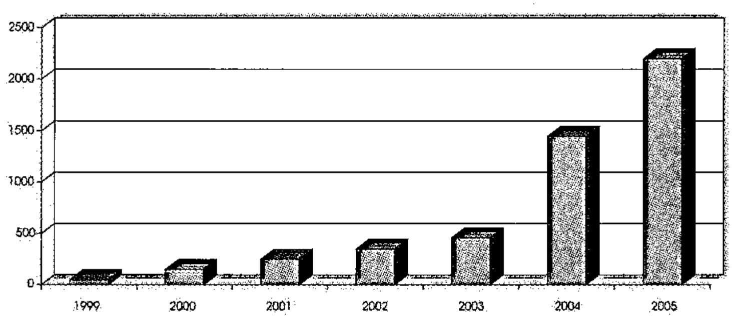
Recently, LPG is being widely used in Mongolia in sectors such as metallurgy, road maintenance, tourism, construction, medicine, illumination, restaurants, and cafes and at homes. Use of LPG in vehicles reduces air pollution, a major problem in Ulaanbaatar (UB) city. Thus, replacements of petroleum engines to LPG combustible engines are an essential solution to environmental problems. Work to install LPG combustible engines has commenced. The number of LPG users reached 15,000 in the country and over 7,000 are in UB.

Figure 7: Consumption of LPG



LPG is being imported from Russia and China. It is hauled by truck-tanks and in containers. In the rural areas, LPG is used for household needs. In 2000, imported LPG was 150 tones, which had increased in 2005 to 2,200 tones. The number of permanent LPG users amounted to 10,000. Figure 8 shows the LPG sales indices in Mongolia by years.

Figure 8: LPG Sales in Mongolia, tonn



Recently, 15 companies and entities were given licenses to import, produce and sell LPG. The "UNIGAS" LLC, one of the license holders, has installed a LPG recharging facility equipped with JLPA-1 standard LPG storage container and built 3 LPG car-refueling stations. Today, PG compatible accessories have been added to the engines of about 430 taxis.

As it mentioned before, 3 LPG car-refueling stations are in operation in UB. In the near future, the total number of gasoline and LPG combined engine cars is expected to reach 1,000.

There are already 7 LPG recharging facilities in UB, making a total of 10 throughout the country, and more than 20 LPG storage facilities in Mongolia. The total capacity of containers has reached 800 cubic meters. The total amount of imported LPG in 2005 was 2,200 t, up 4 points in comparison with the previous year's import.

The Action programme of the Government for 2005-2008 supports LPG use in households, vehicles and cars and also to build LPG feed lines into houses and apartments for household use. In 2000, the Government approved **"The LPG program"**, to increase LPG use as an environment friendly fuel.The use of LPG in cars and households will dramatically reduce air pollution in cities and settlements.The growth in the LPG sector would also reduce unemployment, supporting sustainable economic and social development.

Taxation policy, approved and legalised by the Parliament and Government on April 2004 to create favourable conditions for LPG importers, would encourage the increased consumption of LPG at lower prices.As the investments in the LPG sector increases, the final product price is expected to decline.

In 2003, the Government included the LPG sector in the list of "Most Important Sectors" and undertook measures such as tax abatement for LPG producers and customs duty exemption on LPG producing equipment.

The "LPG Program" is key to the Government's policy on the sector up to 2010. The following results are expected from the implementation of the programme:

1) Traditional energy sources such as the coal, timber and oil products emit toxic elements and carbon oxide into the atmosphere causing air pollution and greenhouse effect. Substituting them with LPG will greatly reduce toxic emissions and air pollution.
2) Creation of the LPG supportive legal environment will attract more domestic and foreign investors into the sector.
3) Expanding the LPG storage capacity will encourage more reliable supply to LPG end-users.
4) LPG supply to the remote rural (especially Gobi areas) areas with lack fuel sources will greatly improve the living conditions of inhabitants.
5) The programme implementation will create LPG servicing units and facilities, increasing consumption and establishing a LPG service network across the country.
6) Household use of LPG will generate a new power source, as well as improve the livelihood of the population.
7) Use of low cost LPG in transportation will reduce air pollution and save on high-cost fuel consumption which will improve economic conditions.
8) LPG use by small and medium scale producers and public services will greatly improve their sustainable development.
9) Developing the LPG sector will create a new jobs, reducing unemployment.

6. Hydropower Sector

According to the figures of the energy authorities, hydropower supplies 0.43 percent of the energy produced in the country. With an estimated 3,800 rivers and streams and a total length of 6,500 kilometers, Mongolia has significant hydropower potential. There are currently 5 small hydro plants operating (and installed capacity):

Khar-horin	528 kW
Chigjiin	200 kW
Bogdiin	2.0 MW
Mankhan	150 kW
Guulin	480 kW

The small hydro plants are run-of-river designs that provide electricity to neighbouring rural areas except during the winter. Consideration is being given to further develop small hydro plants in order to reduce diesel imports.

A number of larger hydro projects have been identified and are shown in Table 3. Because of the demand loads of the Central Energy System, serious consideration is being given to developing the Orkhon project. It would provide peaking capacity (which is atypical of hydro projects) for the CES and eliminate the need for Russian electricity imports. The Orkhon project would require a 20 kilometer transmission line to the 220 kV Erdenet-Ulaanbaatar line.

The Durgun HPP will be connected to the western energy systems of Mongolia, The Taishir HPP will supply electric energy to 2 provinces which have no connection to any energy systems of Mongolia.

One of the key issues confronting Mongolia as it considers developing its hydro resources is the cost of power. As Table 4 indicates, there is considerable range in power costs for the various proposed hydro schemes.

Table 4: Potential Hydropower Projects

Project Name	Installed Capacity (MW)	Production/year (GWh)	Capital Cost ($ millions)	Energy Cost (US ¢/h Wh)
Central ES				
Orkhon	100	219	160	4.60
Eglin	220	484	211	5.72
Burin	161	760	464	6.11
Shuren	205	957	747	7.81
Artsat	118	553	302	5.46
Western ES				
Durgun (ongoing)	12	36	25	6.94
Erdenburen	69	347	128	3.72
Buyan Nuur	58	281	405	14.41
Taishir (ongoing)	8	37	39	8.78
Maikhan Tolgoi	12	36	Not available	Not available
Other Regions				
Delger/Chargait	23	114	84	7.37
Khatgal	3	15	6	4.00
Zeergent 1	7	33	43	13.03
Zeergent 2	5	23	64	27.83

7. Solar Energy

Known as the "land of eternal blue skies", Mongolia has substantial solar potential. Approximately 71 percent of the total land area receives solar energy at a rate of 5.5-6.0 kWh/m2 per day, and 2900-3000 sunshine hours per year. An additional 18 percent of the country receives solar energy at the rate of 4.5-5.5 kWh/m2 per day, and 2600-2900 sunshine hours per year. Solar energy could be a suitable source for electricity for lighting and possibly cooking in rural areas.

The Government has programmes and plans in place to exploit solar energy. Currently, there are an estimated 4000-5000 photovoltaic units operating in the country, most of which are used to provide lighting and power for appliances in scattered rural areas.

More aggressive programmes are currently being developed and pursued, including the 100,000 Solar Gers Programme. Mechanisms to accelerate participation in this programme are being considered. One of the key issues is that while costs of the smaller household units vary from only S300-S500, many households would still require a loan for this amount. Small photovoltaic systems, though still rather expensive for the average Mongolian, are frequently used by herdsmen as power supply source for lighting, electronic appliances and communication equipment in their gers. However, the major users of photovoltaic power are Mongolia's telecommunication systems. Specific costs (local market price) of such small power generation systems are between US$6.50 and US$10.00 for each watt peak on the average, though it varies depending on output, related components, battery storage capacity, etc. It has been shown that these systems cost the least. In Mongolia, there are several medium sized photovoltaic power generating systems, set up as demonstration projects by various donors, operating in public facilities like schools and hospitals in soum centers. They further provide power for communication purposes in these soum centers and in remote areas.

8. Wind Energy

The Mongolian Altai ranges, the Tagna and Khan-Khentii mountain ranges, the mountainous areas of Khuvsgul are considered areas with low wind energy resources. The intensity of wind power here is less than 100 W/m2, the duration of 3.5 m/s wind speed per year is less than 3000 hours. This area comprises 32.3 % of the country.

The Steppe zone, Ikh Nuuruud and Post Altai Gobi areas, on the other hand, have sufficient wind energy resources. The wind power equals 100-150 W/m2 with 3000-4000 hours of wind per year. These areas encompass 28 % of the total territory.

The Gobi Desert area, Dornot and Sukhbaatar provinces belong to the areas with high wind energy resources, which comprise 39.7 % of the national territory. These areas have the highest rate of wind power with over 150-200 W/m2 and wind duration of 4000-4500 hours per year. Therefore, there are opportunities to harness this power source, especially for the rural population.

The potential of wind power generation is quite substantial in Mongolia and has so far been generated only with small wind turbines systems of 50 and 100 W capacities. However, there are many of these wind turbines in use currently in the rural areas. It is estimated that more than 4000 wind power systems have been installed, mainly by herdsmen. Nomads are practically self sufficient in terms of power requirements by using small wind turbines. The recent study by Nippon Koei Co. Ltd. of Japan, Master Plan Study for Rural Power Supply by Renewable Energy in Mongolia shows that most of the wind turbines are used in the southern Gobi region.

A wind potential survey has been conducted in Mongolia sponsored by USAID and TACIS in order to produce a reliable wind map. This map was issued at the end of the year 2000 by the National Renewable Energy Laboratory (NREL), US Department of Energy and will help target the areas where wind power can be harnessed. The survey reveals that in almost 40% of the country, mainly in the south-eastern part, conditions are good for wind power generation, where wind speeds are between 5.6 and 6.4 m/s. More than 10% of the total land area are considered as "windy land" and estimated to have good-to-excellent wind potential for utility scale applications, with wind speeds between 6.4 and 7.1 m/s.

9. Geothermal Energy

A geophysical study has identified 42 small hot springs in Hangai, Hentii, Huvsgol, Altai Mountains, Dornod-Dahgangiin Steppe, and the Orhon-Selenge region. The average underground heat flow at the hot springs of the Khangai Mountains is about 52 ± 6 MW/m2, in the Khuvsgul Lake region 80 ± 10 MW/m2, in the Mongol Altai Mountain region 54 ± 24 MW/m2 and in the Dornot Mongolia Steppe 44 ± 6 MW/m2. Although the local population makes some use of the hot springs, there has not been any plans to harness the geothermal power.

10. Oil Energy

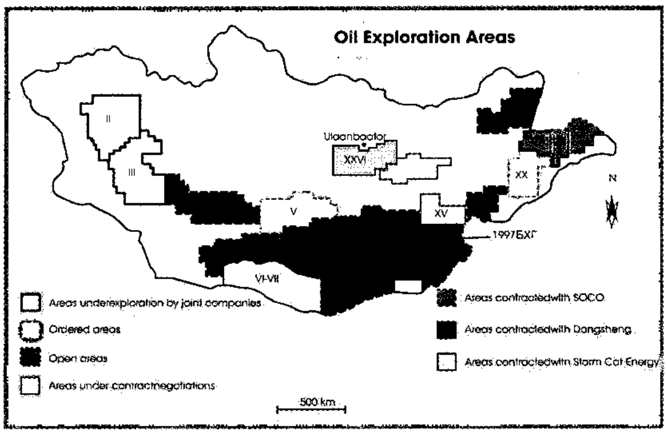
Mongolia at the moment has no refinery capacity. Domestic oil demand is completely met by imports mainly from Russia with a small portion from Kazakhstan and China.

State policies on the Oil Sector are presented in the "Oil Law of Mongolia" and "Policy on the Oil Sector till 2010" as approved by the Government in 2002 and other releases relevant to the Government's activities.

10.1. Oil Exploration and Mining

Twenty-five exploration areas which have the potential for oil and coal-methane gas deposits were identified in the Mongolian-US-UK joint investigation at the beginning of the 1990's. Since then, from 1993, SOCO International LLC, an American company, has undertaken oil exploration and mining activities in areas XIX, XXI and XXII of the Tamsag Basin and Dornod. The Dongsheng Qingon Petroleum Group of China has undertaken oil exploration and mining at areas XIII and XIV of Dornogobi. In 2004, a contract was signed with Canadian Storm Cat Energy to share production in 4 areas.

Figure 9: Oil Exploration Areas in Mongolia

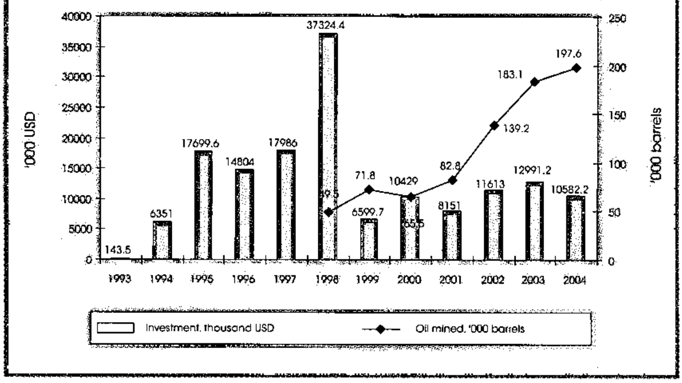


SOCO Tamsag Mongolia LLC, USA, is the first foreign company who signed a product sharing contract in 1993, having performed explorations in the country. The total amount invested is some US$100.0 million. During the period 1998-2004, the company mined 789.7 thousand barrels (105.3 thousand tonnes) of oil and exported 739.6 thousand barrels (98.6 thousand tonnes).

The Dongsheng Oil Mongolia has acquired all rights to perform exploration activities from the Australian Rock Oil Company in March 2003. During 1994-2004, the contractors undertook geological and geochemical explorations in areas totalling 5,194.2 square km. The total amount invested is some US$ 68.9 million. The Dongsheng Company had mined 65.3 thousand barrels and exported 53.4 thousand barrels in 2004.

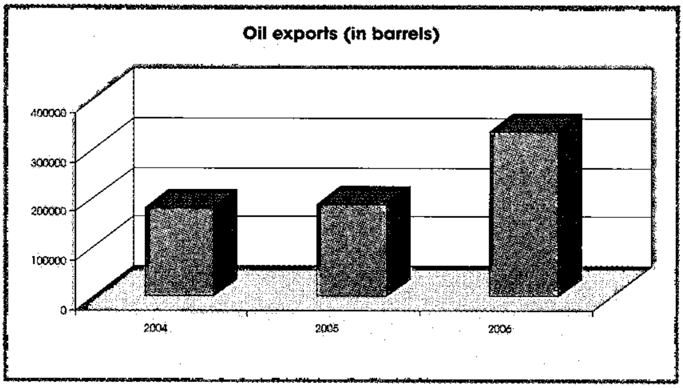
In 1995, Canadian Sproul International estimated the oil reserves of the Zuunbayan and Tsagaan Els deposits to be 149.8 million barrels. Furthermore, the Russian Tatneft Company explored 45,400 square km at the Dornogobi Basin and reported the reserves of 298.0 million tonnes or 2.1 billion barrels.

Figure 10: Oil Investment and Mined Oil



The total amount of investments in the oil sector in the period of 1993 to 2004 was US$ 167.2 million, of which US$ 98.1 million were from SOCO, US$ 68.3 million from Dongsheng and US$ 0.82 million from Storm Cat Energy. Crude oil explored in the South of the country is exported to China.

Figure 11: Crude Oil Exports 2004-2006



10.2. Consumption of Oil Products

In spite of rising international oil market prices, oil consumption of the country has increased in recent years except for 2005.This is the result of the increase in import of cars and other vehicles, growth of the freight and passenger turnover in connection with economic growth and as well as the growing number of diesel heating systems.The Tables below show the growth in the number of vehicles by type and turnover of freight and passenger.

Table 5: Car and Vehicle Import, 2002-2005

Vehicles by type	2002	2003	2004	2005
Passenger	63224	68458	79691	87792
Trucks	24610	22975	25430	27435
Buses	10841	9834	10645	11067
Tanks	1709	1320	1376	1267
Vehicles for special purposes	3421	3188	3276	3623
Total	103805	105775	120418	131184
Annual change		2%	14%	9%

Table 6: Carried Freight, 2002-2005

Carried freight (in thousand tones)	2002	2003	2004	2005
Railway	11637	12284.7	14031.8	15586.3
Road	1888.7	5335.9	7561.9	9617.4
Air	2.4	2.2	2.3	2
Water transportation	1.8	0	0	0.5
Total	13529.9	17622.8	21596	25206.2
Annual change		30%	23%	17%

Table 7: Carried Passengers, 2002-2005

Carried Passengers (mln. Passengers)	2002	2003	2004	2005
Railway	4	3.9	4.3	4.2
Road	101.4	163.7	186.6	188.2
Air	0.3	0.3	0.3	0.3
Total	105.7	167.9	194.2	192.7
Annual change		59%	16%	-1%

In 2006, Mongolia consumed 649.3 thousand tones of oil products refelcting an increase by 15.6 percent in comparison to the previous year (Figure 12). According to preliminary estimations, this number will rise to 670.0 thousand tones in 2010. Table 8 shows oil product consumption by years.

Figure 12: Oil Imports, 2000-2006

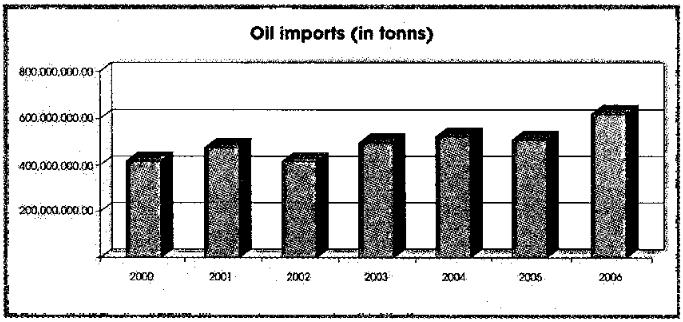


Table 8: Oil Imports, 2000-2006

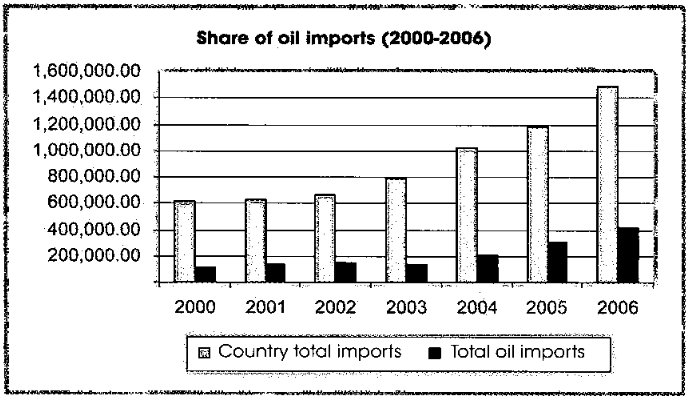
Year	Annual import (in kg)	Annual change
2000	445,322,560.00	100.00
2001	493,720,550.00	110.87
2002	453,622,700.00	101.86
2003	513,551,078.50	115.32
2004	574,847,671.90	129.09
2005	561,921,925.00	126.18
2006	649,248,245.10	145.79

11. Indexes of Oil Dependence

11.1. Share of Oil Imports in the Total Country Import

Due to the growing oil consumption in connection with economic growth and rising market prices, the share of the oil imports in total country imports has grown in recent years. Oil imports in 2006 made up 28.5% of total country imports, increasing by 3.5 % as compared to the previous year.

Figure 13: Share of Oil Imports in Total Country Imports



11.2. Oil Intensity of the Economy

Economic growth in recent years has led to the increase of oil intensity as shown in the Table below.

Table 9: Oil Intensity Index of the Economy

Year	GDP (at current prices, in billon tugriks)	GDP (thousand USD)	Oil imports (thousand USD)	Oil Intensity
2002	1240786.8	1117514.52	110017.6	9.84%
2003	1461169.2	1274425.45	142551.3	11.19%
2004	1910880.9	1612297.17	215343.6	13.36%
2005	2266505	1880590.26	302135.9	16.07%
2006	3172445.6	2689305.2	422563.3	15.71%

11.3. Import Price Index

Mongolia imports 100 percent of the oil products consumed in the economy and these imports make up about ¼ of total country imports. Therefore, the rise in international oil prices have a direct negative effect on the country's terms of trade.

Due to the rise in international oil market prices by 21 percent during 2006, the country's import price index increased 1.6 fold in comparison to the base year - 2000 and by 17.6 percent of that of the previous year.

Figure 14: Import, Export Price Indexes, 2000-2006

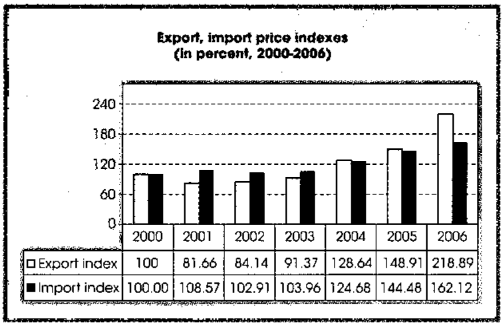
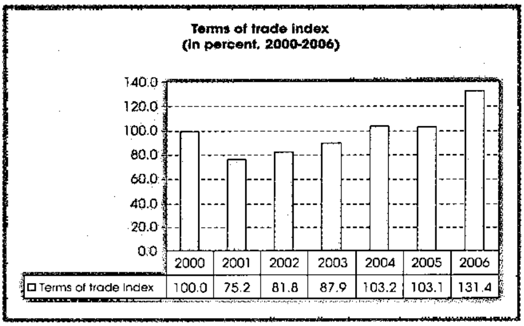


Figure 15: Terms of Trade, 2000-2006



12. Conclusion

Coal is the main primary energy source in Mongolia accounting for 94.2% of total energy production of the country. Diesel power stations in some province centres which are not connected to the grids and other locations spread all over the country, produce 5.31% of domestic energy.

The share of oil imports have been growing since 2000 in spite of the skyrocketing international oil prices due to increasing domestic demand based on the growth of the whole economy and the transportation sector.

Recognising the state and importance of the development of the energy sector to achieve the planned annual growth of 6 percent, the Mongolian government approved a number of important policy documents and action plans in the energy sector aimed at the expansion of the share of renewable and hydro power stations in domestic energy production.

Successful implementation of approved National Plans in the various segments of the energy sector, government activities to support production of petroleum products from slate and coal for which Mongolia has in abundance, the increase in oil exploration and creation of capacities for oil refining, expansion of the number of the hydro power stations throughout the country, will all contribute to the improvement of country in terms of trade, import indexes and as well as to the moderation of the country's dependence on oil.

Chapter 8

THE IMPACT OF OIL PRICE SHOCKS IN THE NEPALESE ECONOMY

by Dila Ram Subedi[1]
Nepal Rastra Bank

1. Introduction

1.1. Nepal at a Glance

Nepal is a landlocked and predominantly mountainous country sandwiched between India on three sides (East, West and South) and China to the North. The country spans a total area of 1.47,181 square km, with tropical plains in the south and the Himalayas in the North within a mean width of 193 km. This tremendous variation in altitude within a relatively short distance is what gives the country its varied ecological zones and the range of biological and cultural habitats it enjoys.

Nepal is endowed with a rich natural and cultural diversity. The mountains, hills and the Terai are three distinct ecological regions running from the north to the south respectively and from three parallel belts spanning the length of the country. The mountainous region consists of a large number of magnificent snow covered mountains including Mount Everest (8848 m). The hill region, on the other hand, comprises of several attractive peaks and fertile valleys including the densely populated Kathmandu and Pokhara valleys. The Terai region in the south is fertile and dense forest occupies in the region.

For administrative purposes, Nepal is divided into 5 development regions, 14 zones and 75 districts. Similarly, 58 municipalities and 3913 village development committees are formed for decentralisation of authority

1.2. Macroeconomic Situation

The first Five Year Plan was started for the period of 1956-1961. The plan was the first initiation for macroeconomic policy formulation process. For this purpose, the specific targets and strategic had been fixed. To date, 10 five year plans have been implemented in the country. The current Tenth Five Year Plan (2002-07) has been targeted to reduce poverty, the single objective of the plan and identified that 31% of the total population lies below the poverty line. To achieve the target, the plan has set various economic, social, cultural, administrative strategies.

The economic policy of Nepal which links various international agencies, includes programmes for liberalisation of trade and industrial policies and rationalisation of the foreign exchange regime such as fully liberalising the current account (reflected in the acceptance on May 30, 1994 of Article VIII of the Article of Association of the International Monetary Fund) and gradually initialing steps to liberalise the capital account. To concretise the process of liberalisation, Nepal has taken membership of various regional and multilateral organisations. The country is also the founding member of the Asian Clearing Union (ACU) started in 1974, and the South Asian Association for Regional Co-operation (SAARC) in 1985. Nepal has also signed an agreement on the South Asia Free Trade Area (SAFTA) and the Bay of Bengal Initiative for Multilateral Technical and Economic Co-operation (BIMSTEC) in 2004. Further, the country also became a member of World Trade Organisation (WTO).

1 Mr. Dila Ram Subedi is Assistant Director of the Research Department of Nepal Rastra Bank.

Nepal Rastra Bank (NRB), the central bank of Nepal was established in 1956 under the NRB Act, 1955, which discharge the NRB with central banking responsibilities including guiding the development of the embryonic domestic financial sector. Since inception, there has been a significant growth of the domestic financial sector. The number of financial institutions has gone up from a single financial institution to presently 198. The structure of the Nepalese economy has also undergone a significant change. Today, Nepal is more integrated with the global economy as had been mentioned earlier as evidenced by higher levels of trade as percentage of Gross Domestic Product (GDP) and increasing membership in international trading organisations, such as Nepal's membership in the WTO in 2004. As a reflection of the change, the new NRB Act was implemented in 2001. The Act provided operational autonomy and independence to the Bank for addressing these new challenges.

Nepal faced an armed conflict from 1956 to 2006 but an arms laying down is currently in progress. The whole nation is therefore, now concentrated on building the constitutional assembly before July 2007. For this, a United Nations Special Team is working on managing the weapons of both combatants and the national army.

2. Energy Policies and its Impact on Oil Dependence

The energy sector is a relatively new sector in Nepal. Until the Fifth Plan Period (1975-80), Nepalese planners did not realise the necessity of treating energy as a separate sector. The importance of the sector was felt only in the Sixth Plan Period (1980-85), which included energy planning and policies along with water resources policies.

The Sixth Plan estimated per capita energy consumption at 196 Kg. of oil equivalent of which 37% is being met by fuel wood and remaining by coal petroleum products and electricity. The major problems pointed out by the sixth plan were that fuel wood destroyed the forests and high prices of petroleum products. Thus, it was felt that Nepal could harness hydro power since it is rich in water resources.

The periodic Five Year Plans reflect policies, programmes and targets of the government. The Tenth Plan (2002 - 2007) has specifically identified targets in renewable energy technology, such as installation of additional 200,000 biogas plants, 10 MW of electricity through small hydropower etc. Energy efficiency has not been mentioned in the Tenth Plan for Industry, Commerce and Supply. However, the industrial energy management programme, environment sector support programme, standard enhancement programme, and monitoring of electricity consumption have been given priority. The 10th Plan under "Labour and Transport System" has a long term commitment to develop a sustainable, reliable, low-cost, safe, comfortable, pollution free and self-reliant transport system that contributes to the overall economic, social, cultural, and tourism development. For the transportation sector, the 9th Plan set a 20-year target for electric vehicle promotion, particularly trolleys and electric trains.

The current Tenth Five Year Plan (2002-2007) has set the objective of improving the supply and distributions of essential commodities. The two strategies are to strengthen the food supplies in remote areas of the country and the other is to promote market based petroleum prices. For this, the management of the Nepal Oil Corporation (NOC) will be improved and leakage will be reduced. Private sector involvement in NOC activities has been initiated since 2004 and also the rationalisation of petroleum product prices from 2003. The plan expects to make the price of petroleum products more competitive and reduce the loss of NOC. The storage capacity of petroleum products will also be increased and the prices of petroleum products will become market based.

The periodic development plans as well as the Perspective Energy Plan (PEP) for Nepal have mostly addressed renewable energy technologies (RETs) and highlighted the strategies to be adopted for the development of clean energy resources for the betterment of the rural mass. However, most of the policies have yet to be realised as plan documents need to be fully verified, developed and implemented to achieve the goals of overall rural development. As long as the subsidy for fossil fuel (kerosene) and the ignorance of the cost of environmental impacts persist, there is little hope of renewable energy sources finding a niche in the market economy or of achieving energy efficiency. The 10th Plan has also clearly stated the policy options available, such as improving efficiency in energy production and use, shifting the fuel mix and reducing the rate of deforestation and increasing forestation to reduce CO_2 emissions.

In order to develop and explore petroleum products in the country, Nepal has enacted the Nepal Petroleum Act 1983 which permits the Department of Mines and Geology to enter into agreements with international oil companies for petroleum exploration and production. Till now however, there has been little development in the exploration and production of petroleum products and the country is still completely dependent on the foreign markets for oil.

2.1. Issues of Energy Planning and Policies

The issue involved in energy planning and policies may be seen from the following characteristics of the Nepalese energy sector:

- Nepal depends on India and other countries for petroleum fuels
- Hydro-power is regarded as Nepal's major potential source of energy with potential power estimated at above 83290 MW.
- Low level of per capita energy consumption..
- Non-sustainability due to excessive dependence on forest resources.
- Inefficient energy resources.
- Access to electricity by the population is below 20%.
- Heavily reliance on external assistance for hydro resources development
- Rapid deforestation as a fuel wood is still a dominant source of energy.
- No coal deposits has been identified in Nepal.
- Potential of wind energy is yet to be determined.
- Bio-gas has become an important alternative energy source, with ample potential to develop a large number of biogas plants.

2.2. Major Sources of Energy

Forest, agriculture residue and hydropower are the major sources of energy in Nepal. Excessive dependence on the forests is not desirable as it may lead to several environmental problems and decrease in the output. The present trends and patterns of energy consumption need to be changed if the national development process is to be made sustainable in the long run.

Table 1
Historical Trend of Energy Consumption by Fuel Type (in '000 GJ)

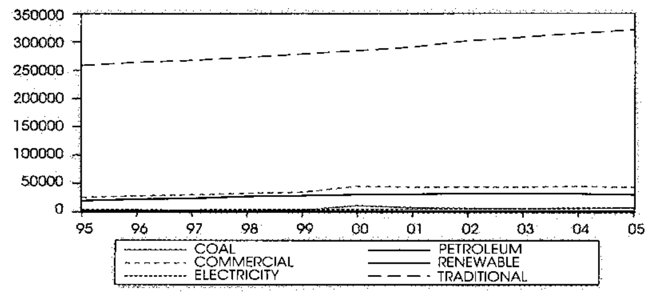
Fuel type	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Traditional	**258,212**	**263,634**	**267,138**	**272,893**	**278,748**	**284,735**	**290,859**	**302,085**	**308,606**	**315,269**	**322,105**
Fuel wood	230,651	235,495	237,555	242,687	247,884	253,199	258,636	269,158	274,960	280,888	286,960
Agricultural residue	10,354	10,571	11,645	11,893	12,166	12,446	12,732	13,026	13,327	13,635	13,964
Animal dung	17,207	17,568	17,937	18,314	18,698	19,091	19,492	19,901	20,319	20,746	21,181
Commercial	**24,784**	**27,759**	**29,440**	**32,741**	**34,851**	**44,956**	**43,344**	**43,852**	**43,271**	**44,863**	**43,195**
Petroleum	**19,119**	**21,615**	**23,623**	**26,619**	**28,180**	**30,224**	**31,286**	**32,305**	**32,116**	**31,596**	**30,063**
LPG	643	916	1,075	1,131	1,232	1,508	1,975	2,401	2,761	3,257	3,821
Motor Spirit	1,172	1,380	1,497	1,572	1,674	1,862	1,984	2,119	259	2,276	2,534
Air Turbine Fuel	1,357	1,469	1,731	1,860	2,009	2,056	2,283	1,716	1,911	2,316	2,417
Kerosene	6,559	7,568	8,841	10,226	10,696	12,006	11,472	14,018	12,641	11,271	8,659
Hight Speed Diesel	8,597	9,501	9,783	11,402	11,978	11,780	12,367	10,857	11,378	11,369	11,911
Light Diesel Oil	149	174	78	38	21	156	134	94	24	23	3
Fuel Oil	406	341	320	54	189	428	588	578	554	421	-28
Others	236	266	299	337	380	428	482	522	588	663	747
Coal	**2,839**	**3,085**	**2,540**	**2,579**	**2,893**	**10,504**	**7,446**	**6,481**	**5,721**	**7,292**	**6,459**
Electricity	**2,826**	**3,059**	**3,278**	**3,542**	**3,778**	**4,227**	**4,612**	**5,066**	**5,434**	**5,974**	**6,673**
Renewable	**319**	**435**	**561**	**705**	**856**	**1,015**	**1,217**	**1,432**	**1,665**	**1,779**	**1,955**
Biogas	298	412	536	678	826	981	1,179	1,392	1,620	1,731	1,903
Micro Hydro	21	23	25	27	30	34	38	40	44	47	50
Solar	0	0	0	0	0	0	0	0	1	1	2
Others	0	0	0	0	0	0	0	0	0	0	0
Total	**283,315**	**291,828**	**297,139**	**306,339**	**314,455**	**330,706**	**335,420**	**347,369**	**353,542**	**361,911**	**367,255**

Source: Water and Energy Commision Secretariat (WECS), Nepal

Table 1 shows historical trend of energy consumption by fuel type for the year 1995 to 2005. It can be seen that there is a shift in the energy consumption pattern from traditional to the commercial and renewable sources, albeit at a slow pace. The share of commercial source has increased from about 9% in 1995 to about 12% in 2005. Similarly there is a growing trend in the renewable sources. Within the commercial source, electricity is on the higher side in substituting other fuels. The following graph depicts the trend of fuel consumption, showing that Nepalese fuel pattern is highly dominated by the traditional fuel.

Chart 1

Trend of Fuel Consumption ('000 GJ)



The overall energy consumption in Nepal is largely dominated by the use of traditional non-commercial forms of energy, i.e. fuel wood, agricultural residues and animal waste. However, this share is in a decreasing trend. The share of traditional forms of energy to energy consumption is about 87% in 2005 as compared to 91%% in 1995.The remaining 12% of energy is from commercial (petroleum fuels, coal and electricity) and renewable (1%) sources.

Table 2 : Energy ConsumptionTrend (2005)

Fuel type	Consumption	%age
Traditional	322105	87
Commercial	43195	12
Renewable	1955	1
Total	367255	100

Source: WECS, Nepal

Figure 1

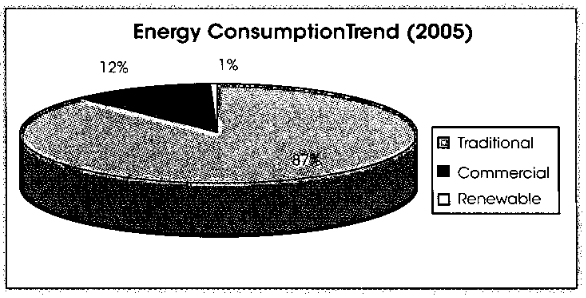


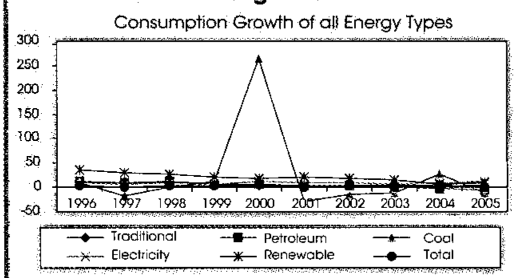
Table 3 shows the ten year annual trend of energy consumption within the country.There is variation in coal consumption and petroleum products while renewable consumption have a decreasing trend and electricity and traditional sources show a consistent trend in consumption. In 2000, coal increased by 263.1% whereas the growth of this commodity declined by 29.1% in 2001. Petroleum products have decreasing trend, the consumption of which increased by 13.1% in 1996 and after 10 years in 2005, a negative growth was registered at 4.9%. Renewable sources have little share in national consumption, which also has a decreasing trend.

Table 3: Yearly Change of Energy Consumption

Year	Traditional	Petroleum	Coal	Electricity	Renewable	Total
1996	2.1	13.1	8.7	8.2	36.4	3.0
1997	1.3	9.3	-17.7	7.2	29.0	1.8
1998	2.2	12.7	1.5	8.1	25.7	3.1
1999	2.1	5.9	12.2	6.7	21.4	2.6
2000	2.1	7.3	263.1	11.9	18.6	5.2
2001	2.2	3.5	-29.1	9.1	19.9	1.4
2002	3.9	3.3	-13.0	9.8	17.7	3.6
2003	2.2	-0.6	-11.7	7.3	16.3	1.8
2004	2.2	-1.6	27.5	9.9	6.8	2.4
2005	2.2	-4.9	-11.4	11.7	9.9	1.5

Source: WECS, Nepal

Figure 2



2.3. Energy Export / Import Composition

To meet national demand, Nepal imports petroleum products and coal. Coal is imported only from India while petroleum products are purchased from the international market and transported and exchanged with India.

Table 4: Energy Import/Export Composition
(in '000 GJ)

Year	Import**	Export***	Total Energy
1995/96	25,731	313	291,828
1996/97	27,288	361	297,139
1997/98	31,335	243	306,339
1998/99	33,179	231	314,455
1999/00	43,219	342	330,706
2000/01	40,112	454	335,420
2001/02	39,575	482	347,369
2002/03	38,124	692	353,542
2003/04	39,398	505	361,911
2004/05	36,941	399	367,255
2005/06*	41,795	480	379,518

*: Provisional **: Petroleum Products, Coal & Electricity
***: Electricity
Source: WECS, Nepal

Figure 3

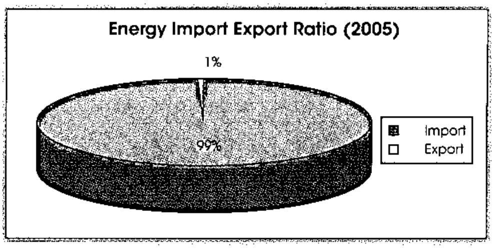


Table 4 shows that there is a huge import-export gap of the energy sector. Basically, Nepal imports petroleum products and coal from abroad and exports electricity to India. In 2005/06, Nepal imported 41795 thousands GJ of energy and exported 480 thousands GJ electric energy to India.

Table 5 shows the import pattern of petroleum products in Nepal.The import of petroleum products increased by 14%, 15%, 9%, 15%, 5% and 9% from 1995 to 2000 respectively. From 2001 to 2005, the import trend of these products registered a declining trend by -1%, 1%, -2%, -4% and -8%, respectively. In 2006, there was a 2% rise in similar commodity imports.

Table 5
Historical Trend of Imports of Petroleum Proiducts

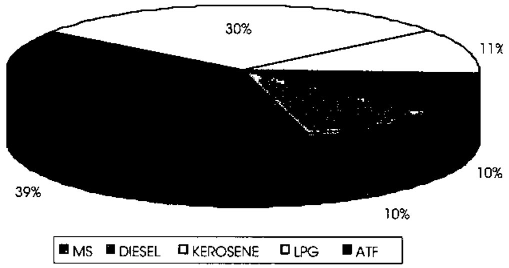
Year	MS (KL)	Diesel (KL)	Kerosene (KL)	LPG (MT)	ATF (KL)	Total Petroleum*	Increment
1994	31,476	195,473	162,324	9,760	30,436	419,709	-
1995	35,019	228,016	176,963	13,049	37,886	477,884	14
1996	41,736	254,323	213,830	18,600	40,776	550,665	15
1997	46,261	259,358	244,546	21,824	48,722	599,247	9
1998	47,507	302,063	287,595	22,961	51,700	688,865	15
1999	51,584	319,158	298,351	25,019	56,010	725,103	5
2000	55,570	327,427	350,196	30,627	59,123	792,316	9
2001	59,245	333,791	325,198	40,102	65,620	783,854	-1
2002	63,578	287,657	390,113	48,757	47,274	788,622	1
2003	68,482	301,672	351,696	56,079	53,546	775,396	-2
2004	67,965	302,644	313,127	66,142	64,394	748,130	-4
2005	76,097	308,076	233,310	77,594	68,340	685,823	-8
2006	78,463	310,535	233,310	89,045	76,887	699,195	2

* Except for LPG
Source: WECS, Nepal

The following Figure depicts the commodity share in total petroleum (2006). According to the Figure, diesel holds the highest (39%) share and petrol and ATF both register the same low share of 10%.

Figure 4

Commodity Share in Total Petroleum (2006)



2.4. Energy Consumption Pattern

The energy consuming sectors has been defined as per the economic sector of the country. They are the residential, commercial, transport, industrial and agricultural sectors. For the ease of energy accounting, others have been included as energy consuming entities which do not fall in the five sectors. This includes street lights, temples, mosques, churches, etc. The sectoral energy consumption pattern for the year 2004/05 has changed only marginally as compared to the previous years. Table 6 shows the different percentage share of energy consumption by various sectors in 2004/05. The figures show that the residential sector accounts for the major share of energy consumption (90.28%), followed by transport (3.78%), industry (3.47%) , commercial (1.45%), agricultural (0.84%) and others(0.18%).

Table 6
Percentage Share of Sectoral Energy Consumption

Year	Residential	Industrial	Commercial	Transport	Agriculture	Others	Total
1995	92.11	3.9	0.9	2.77	0.23	0.09	100
1996	91.68	4.03	0.97	2.99	0.24	0.09	100
1997	92.32	2.16	1.07	4.02	0.33	0.1	100
1998	91.91	2.26	0.95	4.42	0.36	0.1	100
1999	91.53	2.39	1.02	4.72	0.23	0.11	100
2000	89.25	4.75	1.12	3.87	0.9	0.11	100
2001	89.78	3.88	1.23	4.05	0.94	0.12	100
2002	90.58	3.61	1.42	3.46	0.8	0.13	100
2003	90.59	3.39	1.48	3.59	0.81	0.14	100
2004	90.17	3.79	1.47	3.62	0.8	0.15	100
2005	90.28	3.47	1.45	3.78	0.84	0.18	100

Source: WECS, Nepal

Energy use and economic welfare are closely intertwined. Historically, Nepal's rural population has been meeting their energy needs from traditional sources such as fuel wood and other biomass resources. The use of modern forms of energy such as electricity and fossil fuels are comparatively new and making them accessible in rural areas is still a great challenge. Moreover, it is evident that due to environmental concerns and the need to the improve quality of life, traditional means of biomass consumption are neither sustainable nor desirable. There is a strong positive correlation between per capita energy consumption and a country's development status.

The following individual graphs depict the trends of usage of petroleum products in the different sectors. There is the higher growth in the commercial sector followed by agricultural sector. The use of petroleum products in the industrial sector seems slower due to the unfavourable insurgency situation in the country at that time. Similarly, residential and transportation sectors use of petroleum products show slower trends in the observed years.

AGR =Agriculture, COM=Commercial, IND= Industrial, OTH= Other, RES = Residential, TRA = Transportation

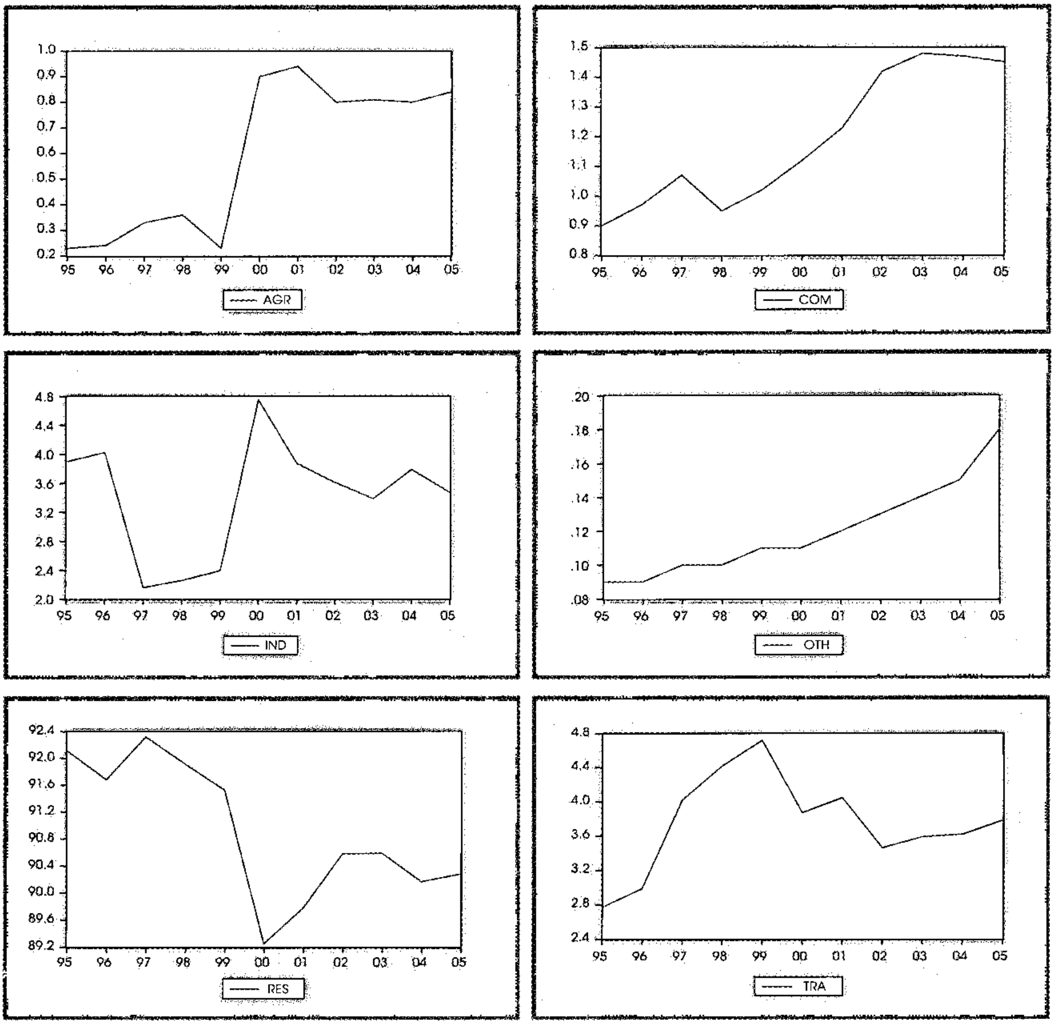


Table 7
Sector-wise Petroleum Consumption

Sector	2001/02	2002/03	2003/04	2004/05	2005/06	% change
	1	2	3	4	5	5/1
Residental	12,839	11,748	10,892	9,061	9,108	-29.1
Industrial	1,945	1,936	1,812	1,331	1,469	-24.5
Commercial	2,846	2,970	3,001	2,893	3,205	12.6
Transport	12,004	12,683	13,112	13,873	14,189	18.2
Agriculture	2,671	2,780	2,778	2,905	2,873	7.6

Source: WECS, Nepal

Table 7 indicates that the sector-wise petroleum consumption differs at different time periods. In FY 2001/02, petroleum products were mainly used for residential and transport sectors whereas, in FY 2005/06, the trend in the commercial, transport and agriculture sectors' energy consumption show a significant rise.

Box 1: World Petroleum Production, Demand & Supply

In 2003, USA, Britain and their allies launched an attack on Iraq. This conflict led to the cut down of global oil production resulting in the increase of the gap between production and supply of petroleum products. Since then, the global oil price tended to increase steadily upward to mark the unpredicted high US$ 75 per barrel in June 2006. However, the prices of oil products declined and it presently stands around US$ 58 per barrel. The volatility of the global oil prices have multiple effect in the world economy as well as Nepalese economy especially in driving up inflation and inflationary expectation.

Table 8: World Petroleum Production, Demand & Supply, 1995-2005 (Thousand Barrels per Day)

Year	Production	Demand	Supply	1	2	3
	1	2	3	% change	% change	% change
1995	26,004	69,984	70,314	-	-	-
1996	26,461	71,539	71,960	2	2	2
1997	27,710	73,293	74,185	5	2	3
1998	28,774	73,945	75,679	4	1	2
1999	27,579	75,596	74,879	-4	2	-1
2000	29,267	76,619	77,793	6	1	4
2001	28,344	77,406	77,717	-3	1	0
2002	26,352	78,082	76,957	-7	1	-1
2003	27,822	79,742	79,565	6	2	3
2004	29,924	82,453	83,005	8	3	4
2005	31,115	83,987	84,441	4	2	2

Source: Energy Information Administration, Official energy statistics for the US government.

Table 8 shows the aggregate production, demand and supply of the world petroleum based on the data from 1995 to 2005. In 1999, the production and supply of oil prices both declined by 7.0% and 1.0% respectively, whereas in 2001, the production declined by 3.0% and supply stood at par with the previous year. However, for remaining years, production increased at a higher level and supply followed at a lower rate. During the period, demand rose marginally in all the years but the production and supply showed a fluctuating trend. The fluctuation in the production market had affected the supply side, consequently pushing the market price to change periodically and the trend of fluctustion hit on the oil prices as demand was persistently increased.

2.5. Petroleum Product Pricing and Supply

The price of petroleum products is fixed by the government of Nepal (GoN). The Nepal Oil Corporation, a government undertaking, is the sole authority for the import and supply of oil products and it distributes the products to private petroleum dealers. The dealers then determine their retail prices for end users.

The major characteristics of the current agreement between NOC and IOC as follows:

1) The present IOC/NOC Agreement was signed on 28 March 2002 and the agreement is valid till end-March 2007.
2) The Agreement is for the import of crude oil by NOC and "high seas" sale of crude oil to IOC.
3) The previous Agreement was for the import of refined petroleum products (HSD, SKO) by NOC and handing over of the refined products to IOC.
4) Operating principles of the Agreement consists the exchange of equivalent values of crude oil and petroleum products between IOC/NOC.
5) The basis of pricing of petroleum products for NOC is the Refinery Transfer Price (RTP), which is the notional import parity landed cost.
6) Quantity of crude oil imported by NOC will be as per requirement.
7) Customs duty on crude oil and duty draw back on import of crude oil is accepted in the Agreement.
8) Supply of petroleum products from various IOC nominated locations/alternate supply points are also provisioned.
9) NOC is to furnish quarterly product /location requirements to IOC.
10) Quality specifications as per BIS standards and quantity measurements are as per standard operating procedures.
11) Supply of Blue Dyed SKO is provisioned.
12) IOC identifies and nominates the type of crude to be imported by NOC and IOC/NOC jointly prepares tentative programmes of crude import by NOC.
13) NOC to pay directly to Crude Oil Suppliers for import of crude oil.
14) Payment of crude oil imported by NOC and sold to IOC is based on IOC's Average monthly Official Selling Price (OSP) converted to Indian Rupees.
15) Modalities of crude oil imported by NOC and handing over to IOC are well defined. Crude import operations like cargo size, crude quality, transportation, demurrage, ocean loss, terms and conditions for FOB contracts, bill of lading, independent inspection/survey at load port(s) and transfer of documents of title to the goods are well defined.
16) Pricing of products to be supplied to NOC is based on Haldia port location and Refinery Transfer Price (RTP) Haldia is based on notional import parity cost plus IOC's marketing cost and margins plus railway transportation from Haldia to depot locations.
17) Normally excise duty/sales tax and other levies are not applicable to NOC but if central/state government levy any duties/taxes, such charges would be recoverable by IOC.

18) IOC's pricing of MS, HSD, SKO, LPG, ATF, FO, LDO at depots will be arrived at by adding marketing costs and margins plus price balancing factors and actual railway freight to RTP.

19) Pricing of special products like Bitumen, JBO, MTO, PBM, HEXANE will be as per the prevailing selling price of IOC.

20) IOC extended discount on marketing margin @ 20% of prevailing domestic margin, which was further extended to 50% on subsequent amendment of the supply agreement.

21) For payment of product supplies, NOC is to pay on the 15th of every month on the IOC's actual sale value of various products during the month preceding the previous month.

22) Various modalities/structures for payment by IOC to NOC for crude oil imports are defined.

If NOC had actually imported crude oil, NOC's purchase price may have been higher than IOC's purchase price, because of IOC's experience, expertise in the field, volume and scale of operations. The NOC would not be able to recover from IOC, the price paid to International suppliers because of OSP pricing clause in the agreement.

The Tenth Plan (2002-2007) has the programme to strengthen the management capacity of NOC as well as introduce measures for reducing leakages. The Plan also promotes private sector participation in the activities of NOC. It is expected that the effective implementation of these plans and policies would streamline continuous supplies of petroleum products and enable NOC to become financially viable.

Table 9
Prices of Petroleum Products in Nepal (in US$)

FY	Exchange Rate with USD/1NPR*	Petrol	% change	Diesel	% change	Kerosene	% change	LP Gas (Per Cind)	% change
1986	17.60	0.62		0.43		0.33			
1987	21.10	0.55	-11.49	0.36	-16.59	0.27	-16.59		
1988	21.80	0.59	7.95	0.34	-3.21	0.26	-3.21		
1989	23.50	0.55	-7.23	0.32	-7.23	0.24	-7.23		
1991	27.40	0.69	26.32	0.33	4.06	0.25	2.92		
1991	29.10	0.67	-3.36	0.31	-5.32	0.25	0.30		
1992	42.70	0.59	-12.63	0.23	25.52	0.19	-25.82		
1993	42.60	0.64	9.59	0.26	9.42	0.21	12.76		
1994	49.00	0.59	-7.76	0.24	-4.43	0.19	-9.44		
1995	49.11	0.59	-0.22	0.24	-0.22	0.17	-9.54		
1996	50.45	0.64	9.09	0.27	11.54	0.19	8.80	6.79	
1997	56.25	0.69	7.63	0.29	7.63	0.19	1.49	7.78	14.57
1998	56.75	0.69	-0.88	0.27	-6.89	0.19	-3.19	8.19	5.35
1999	67.60	0.59	-13.90	0.24	-13.34	0.16	-16.05	6.88	-16.05
2000	68.15	0.59	-0.81	0.34	42.59	0.19	22.81	6.82	-0.81
2001	70.40	0.66	12.94	0.39	14.34	0.31	61.34	7.81	14.50
2002	74.65	0.62	-7.04	0.35	-8.01	0.23	-26.01	7.37	-5.69
2003	78.00	0.68	9.85	0.39	10.51	0.29	27.23	8.46	14.85
2004	74.75	0.72	6.72	0.41	5.71	0.32	10.81	9.36	10.67
2005	74.14	0.80	11.28	0.51	22.94	0.42	31.07	10.86	15.95
2006	70.35	0.96	19.80	0.71	39.40	0.62	47.44	12.79	17.82

Source: Nepal Rastra Bank (Year end basis)

Table 9 presents the annual average retail prices of the different oil products in Nepal in US dollar terms. The Table further shows that the rate of price changes in petrol, diesel and kerosene is higher compared to that of LP Gas. In FY 2006, prices of petrol, diesel and kerosene increased by 19.80%, 39.40% and 47.44% respectively. However, the price of LPG increased only by 17.82% as the government still subsidises LPG and kerosene prices.

Box 2: Current Financial Situation of Nepal Oil Corporation

Nepal Oil Corporation, the only state owned importer and distributor of oil products in Nepal is facing financial crisis. Its monthly operating loss is Rs. 0.53 crores and the cumulative amount to be paid to IOC amounted to Rs. 1335.46 crores on January 2006.

Table 10: NOC's Monthly Profit/Loss Calculation as at January 2006

NOC's Profit/Loss Position (Prices are VAT)	Petrol	Aviation Fuel	Diesel	LP Gas	Kerosene
Estimated Import/Sales as per FY 063/064 Projection	7,700	6,700	24,000	8,000	20,000
Depot Landed Cost, N.Rs./KL or Cyld in case of LPG	54,063.55	49,952.12	43,713.90	924.81	48,184.65
Ex-Depot Selling Price, N.Rs./KL or Cyld for LPG	56,592.15	68,125.97	44,667.47	718.72	45,519.69
Profit/Loss Per Kl (or Per Mt. for LPG)	2,528.60	18,173.86	953.38	-206.09	-2,664.96
Profit/Loss Per Litre (or Per Cyld for LPG)	2.53	18.17	0.95	-206.09	-2.66
Monthly Profit/Loss, Rs.	19,470,239	121,764,834	22,885,891	-116,100,597	-53,299,160
Net Estimated Monthly Loss to NOC, Rs.					-5,278,792
Total Government Rev. (N.Rs/Lit of Cyld)	24.16	10.80	9.27	191.52	1.99
Monthly Govt. Revenue in Cores N.Rs.	18.60	2.89	22.24	10.79	3.98
* Total Monthly Govt. Revenue					58.51
Net Estimated Monthly Loss to NOC in Cores NRs.					-0.53

Source: Nepal Oil Corporation-Exchange rate: 1US$=71.38 Rs. (January 16, 2007)

*: *On the basis of November transaction of NOC.*

The table indicates that NOC dostributes LP Gas and Kerosene at a price below the cost whereas there is profit in petrol (Rs. 2.53), aviation fuel (Rs. 18.17) and diesel (Rs. 0.95) per liter. In aggregrate, there is Rs. 58.51 cores monthly revenues for the government by selling this products. The monthly loss recorded about 0.53 crores for NOC.

Table 11 and 12 show the cost components and expected retail prices of petrol diesel and kerosene. The government subsidised 26% of value added tax (VAT) in kerosene. The main aim of the subsidy is to ensure the welfare of the deprived and low income group. However, diesel plants were the main users of the subsidised oil and the targeted group did not derive the full benefits of the subsidies.

Table 11
Cost Breakdown of Major Petroleum Products
(as of 01.01.2007 IOC Price)

Cost Components	Petrol		Diesel		Kerosene	
	(Rs/KL)	(%)	(Rs/KL)	(%)	(Rs/KL)	(%)
Import Price (IOC Depot) as of 16.12.'06	**33,878.93**	**55.59**	**37,332.69**	**75.65**	**43,472.96**	**90.22**
Govt Duties (Custom, Road Tax, Spl Fee, VAT)	24,159.64	39.64	9,268.05	18.78	1,988.87	4.13
Transportation charge (RXL-KTM)	1,463.24	2.40	1,463.24	2.97	1,463.24	3.04
NOC's Overhead Expenses	347.15	0.57	347.15	0.70	347.15	0.72
Insurance (0.12%)	80.19	0.13	58.09	0.12	56.73	0.12
Technical Loss/Stock Loss	479.37	0.79	387.75	0.79	378.63	0.79
NOC's Interest Expenses	535.28	0.88	490.67	0.99	477.08	0.99
Total Landed Cost upto Kathmandu	60,943.80	100.00	49,347.64	100.00	48,184.65	100.00
NOC's Total Landed Cost (KTM)	**60,943.80**	**100.00**	**49,347.64**	**100.00**	**48,184.65**	**100.00**

Source: Nepal Oil Corporation

Table 12
Expected Retail Selling Price Calculation at Kathmandu
(when at par with cost*)

S.N.	Details of Cost Components	Petrol		Diesel		Kerosene
1	**NOC EX. DEPOT PRICE (VAT)**	**54,063.55**		**43,713.90**		**48,184.65**
2	VAT 13%		7,082.26		5,682.81	
3	SHRINKAGE (0.4%, 0.3% & 0.3%) PER KL	216.25		131.14		144.55
4	SUB TOTAL 6	54,279.80		43,845.04		48,329.20
5	TRANSPORTATION LOCAL, PER KL	139.71		139.71		139.71
6	SUB TOTAL 5	54,419.51		43,984.74		48,468.91
7	Insurance (0.15%)	81.63		65.98		72.70
8	DRUM DEPRECIATION, PER KL	0.00		0.00		163.22
9	SUB TOTAL 4	54,501.14		44,050.72		48,704.83
10	DEALERS' COMMISION (3%), PER KL	1,635.03		1,321.52		1,461.15
11	SUB TOTAL 5	56,136.17		45,372.24		50,165.98
12	WORKING LOSS 0.15%	84.20		68.06		75.25
13	EXPECTED SELLING PRICE PER KL	56,220.38		45,440.30		50,241.23
14	VAT 13%	7,308.65	7,308.65	5,907.24	5,907.24	
15	EXPECTED SELLING PRICE PER KL	63,529.03		51,347.54		50,241.23
16	**EXPECTED R.S.P. PER LTR.**	**65.53**		**51.35**		**50.24**

Source: Nepal Oil Corporation-Exchange rate: 1US$=71.38 Rs. (January 16, 2007)
**: On the basis of January transaction of NOC*

2.6. Measuring Oil Dependence in Nepal

The strikes of oil workers in Venezuela, the war with Iraq and the violence in Nigeria had reduced international oil production and increased oil prices globally. These have raised concerns of sufficiency of future supplies. Such concerns, accompanied with high natural gas prices have raised the need for new energy policies in the dependent countries including Nepal. The crisis has focused attention on issues of energy security, petroleum dependence and petroleum vulnerability, in various consuming countries, to the extent that the International Energy Agency (IEA) has made a presentation on issues such as response to disruption, the effectiveness OPEC production increases, the Saudi's utilisation of their excess capacity, the IEA's commitment to releasing oil from public oil stocks such as Strategic Petroleum Reserves (SPR) and the recent co-operation between IEA and OPEC to avert an energy crisis and lessen the impact of any petroleum shortages. These issues will be instrumental to any future discussions on energy security and energy policy in the oil consuming and producing countries.

Many non-OPEC countries view import dependency very differently from the way it is viewed in Nepal. Since Nepal imports all its refined oil products and has no exports, it becomes very vulnerable to rises in prices petroleum imports.

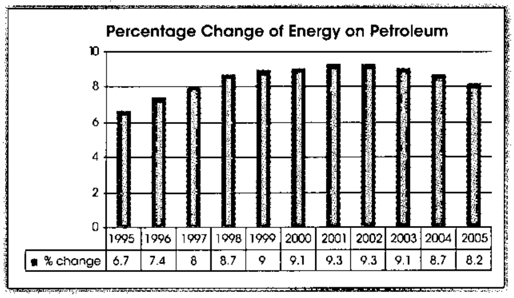
In terms of the energy consumption pattern, increases in consumption in the commercial, transport, agriculture and other sectors show that the consumption trend has diversified from residential uses. However, this latter sector's fuel consumption is still predominant suggesting that the consumption of petroleum has been stepped up in the transportation sector while residential expenditure is leveling up. The national demand for oil products which is totally imported from abroad has a negative impact on Nepal's national economy. Table 13 shows that the share of petroleum products on total energy is consistent during the eleven years.

Table 13
Share of Petroleum in Total Energy
(in '000 GJ)

Year	Petroleum	Total Energy	Energy on Petroleum
1995	19,119	283,315	6.7
1996	21,615	291,828	7.4
1997	23,623	297,139	8.0
1998	26,619	306,339	8.7
1999	28,180	314,455	9.0
2000	30,224	330,706	9.1
2001	31,286	335,420	9.3
2002	32,305	347,369	9.3
2003	32,116	353,542	9.7
2004	31,596	361,911	8.7
2005	30,063	367,255	8.2

Source: WECS, Nepal

Figure 5



To reduce its dependency on national consumption, Nepal has implemented various measures such as developing alternative energy sources such as biogas, micro hydro, solar, wind, improved cooking stoves, and briquette.

Imported petroleum products can be measured in two ways. Firstly, Nepal can develop alternative energy sources as the country is rich in water and forest resources, and the other measure is by efficient usage and minimising leakages. To implement these measures, effective energy policies should be formulated. The development of alternative energy resources such as biogas, hydropower, solar, wind, improved cooking stoves and briquettes, can play a pivotal role. Forests, agricultural residence and hydropower are the major sources of energy. The over dependence on the forest is not desirable as it leads to environmental problems and decrease in the farm output. The present trends and patterns of energy consumption need to be changed if the national development process is to be sustainable in the long run.

There are various measures for oil dependency and some of these include:

- Petroleum imports as a percentage of total petroleum consumption

- The number of days total petroleum stocks cover petroleum products
- The number of days total petroleum stock cover consumption
- The percentage of petroleum in total energy consumption

The degree of import dependence among non-OECD countries differs from country to country. The dependence can be measured by the following method:

Oil Dependence = Net imports of oil products / Net oil products supply * 100

The number represents the net inflow of foreign oil as a percentage of total oil consumption. By applying this method, Nepalese dependency is negative. Computing dependence this way implicitly assumes that differences between petroleum products are not significant in terms of overall dependence. There is a further implicit assumption that in the event of a disruption in imports, exports would not continue unabated.

The possibility of an energy crisis in the near future is greater than previous years. Data points to the fact that non- OECD dependency and vulnerability are increasing day by day. The global nature of financial and spot markets make shortage in one region felt throughout the world. However, petroleum prices may increase in some countries more than others for a short period of time. Theoretically, a country may suffer during the period needed to transfer oil from other markets to their particular country. Dependency and vulnerability is abated by energy diversification, and better co-operation between consuming and producing countries. Although any shortages in the world will lead to higher oil prices worldwide, countries that are more diversified will be less affected by petroleum shortages. In addition, imports diversification will lower the relative impact of supply disruption on most countries.

3. Oil Price Shocks in Nepalese Economy

The rise of world oil prices has worsened the trade balance, leading to a higher current account deficits, deteriorating the net foreign asset position. At the same time, higher oil prices tend to decrease private disposable income and corporate profitability, reduce domestic demand and depreciate the exchange rate. The speed and output costs of adjustment depends on factors such as the degree of trade openness, structural flexibility, and central bank credibility, as well as the expected persistence of shocks and the speed with which it is allowed to feed through into domestic fuel prices. These factors determine the extent to which rising oil prices raise inflationary pressures and consequent monetary tightening that could lead to a more pronounced slowing in growth.

4. Measuring the Impact

4.1. Methodology

A small underdeveloped economy like Nepal faces various difficulties in the face of an oil price hike. To reduce the oil dependency, Nepal has been adopting the policy to cut tax rate on kerosene and LP Gas. However, this policy has not benefited the main targets which are the poor in rural areas.

Revenue, policy interest rates, inflation, GDP, total oil supply, total government revenue from the oil products, exchange rate were initially used for running the Model. On the impact of oil prices, the results are quite significant for inflation and exchange rate. The Model does not include GDP due to unavailability of quarterly series. The Model uses exchange rates and oil prices (diesel price) as explanatory variables. The attempt to run the vector auto regressions (VARs) did not yield e significant results. Therefore, the results are not incorporated in this paper. A simple equation is used to show the relationship with a dependent variable (inflation) and two independent variables (exchange rate and petrol prices).

The structure of the OLS model is as follows,

$$Yi = b_1 + b_2X_1i + b_3X_2i \quad \text{..(1)}$$

Where, Y_i, is the dependent variables, X_1 and X_2 are the explanatory variables, i the ith observations in case where the data are time series. b_1 is the intercept term. It gives the mean or average effect on Y of all the variables excluded from the Model although its technical interpretation is the average value of Y when X_1 and X_2 are set equal to zero.

4.2. Data

From the data (Table 14) generated by using the OLS model, the equations is,

$$P = b_1 + b_2e + b_3doil \quad \text{..(2)}$$

Here,

p = inflation rate,

e = growth rate of exchange rate

doil = growth rate of diesel price

$$P = 5.50 + 0.76e + 4.63doil$$

t-statistics; (10.15) (2.1) (0.35)

R2 = 0.10 Durbin Watson = 0.48

Table 14
Data Series of Nepal

Year	Period	Inflation (1995/96=100)	Exchange Rate (Per one US$)	Diesel Prices*
1995	Q1	7.5	50.01	0.27
	Q2	7.1	50.38	0.27
	Q3	8.8	50.94	0.27
	Q4	9.2	55.19	0.27
1996	Q1	9.6	57.10	0.29
	Q2	9.9	55.74	0.29
	Q3	7.3	56.71	0.29
	Q4	5.7	57.03	0.29
1997	Q1	6.7	57.03	0.27
	Q2	6.8	57.03	0.27
	Q3	8.9	57.29	0.27
	Q4	10.9	59.67	0.27
1998	Q1	12.5	63.00	0.24
	Q2	13.6	64.21	0.24
	Q3	9.9	68.09	0.24
	Q4	9.6	67.90	0.24
1999	Q1	5.3	67.68	0.34
	Q2	3.4	67.99	0.34
	Q3	3.8	68.56	0.34
	Q4	1.1	68.73	0.34
2000	Q1	1.6	68.86	0.39
	Q2	2.9	69.34	0.39
	Q3	1.9	71.57	0.39
	Q4	3.4	73.73	0.39
2001	Q1	2.9	74.11	0.35
	Q2	2.7	74.55	0.35
	Q3	2.9	74.99	0.35
	Q4	3.0	76.40	0.35
2002	Q1	3.5	77.01	0.39
	Q2	2.7	77.98	0.39
	Q3	6.0	78.29	0.39
	Q4	6.8	78.30	0.39
2003	Q1	5.4	78.06	0.41
	Q2	5.2	77.36	0.41
	Q3	3.6	75.07	0.41
	Q4	1.7	74.09	0.41
2004	Q1	2.5	73.77	0.51
	Q2	3.5	72.69	0.51
	Q3	5.8	73.93	0.51
	Q4	6.4	73.75	0.51
2005	Q1	7.8	71.00	0.71
	Q2	8.1	70.76	0.71
	Q3	7.1	70.73	0.71
	Q4	8.8	72.98	0.71

** Annual Data are taken as the representative of each quarter*

Source: Nepal Rastra Bank

4.3. Empirical Results

According to the OLS model, the price level in Nepal is affected by both the changes in exchange rate and oil prices. The t-statistics shows that the impact of exchange rate is statistically significant. However, the change in diesel price is not found to be significant. The impact of oil prices may be explained by the exchange rate itself. Further, there are a host of factors affecting inflation. The Indian rupee is pegged to Nepalese rupees while the exchange rates of other currencies are simultaneously determined with Indian currency. Any appreciation and depreciation of Nepalese rupees with foreign currencies are based mainly on movement of the Indian exchange rate. Thus, the Indian exchange rate has an inflationary impact on the Nepalese economy. The weight of petroleum products on the Nepalese CPI is 9.7% (as calculated on the basis of base year 1995/96= 100). This may not represent the consumption pattern of oil products adequately as the share of petroleum products may be more than what is computed by the previous household budget survey (HBS). This is expected to be revised by the ongoing fourth HBS.

5. Conclusion

International oil prices are extremely volatile. Oil companies should be vigilant and require regular analysis of trends in the market. Due to inflexibility, inefficiency and poor managerial capability, the state owned oil corporation (NOC) is facing various obstacles in the Nepalese market. Privatisation has been suggested to smoothen the supply of petroleum products. Oil prices should also be adjusted automatically with international price levels.

The imported inflation brought about by increases in oil prices has multiple impacts in the economy. As inflation increases, the effects will be transmitted to higher transportation costs and restaurant meals. The higher oil prices also require larger amounts of foreign currencies to be paid to international markets and would result in the depreciation of the domestic currency. The depreciation of the domestic currency would subsequently lead to a higher trade deficit. As oil prices affect all segments of the economy, the level of national income, output and employment would decline as a result.

In Nepal, monetary responses to these shocks have had no effective reaction. Policy interest rates and depreciation of currency rates are indirect tools, the effects of which will have some time lags while the impact of oil shocks require some immediate solution to lessen the burden on the economy. In light of this, Nepal should implement policies on budgetary operations or the fiscal side. Private participation for importing and proper distribution of oil products would also be beneficial.

The future of oil prices remains uncertain. Supply as well as demand pressures appear to be as strong as ever. With the view towards energy security and efficiency, Nepal needs to reevaluate conceptions that the oil price hikes are only temporary. The financial costs of oil subsidies have escalated sharply and are now beginning to create fiscal strains. The belief that subsidies benefit the poor most may not always ring true and while subsidies may provide short-term relief from the pain of higher oil prices, they do so at high opportunity costs and at the risk of upsetting macroeconomic stability.

References

1. A Glimpse of Nepal's Macroeconomic Situation, Nepal Rastra Bank, Kathmandu, Nepal, 2006.
2. Agreement for Supply of P.O.L. Products between IOC and NOC, 2002.
3. C. William Skinner, (1995), "Measuring Dependence on Imported oil, Energy Information Administration\ Monthly Energy Review", August 1995.
4. Various Publications, Nepal Oil Corporation.
5. Energy Synopsis Report, WECS, Government of Nepal, June 2006.
6. Energy, Environment and Climate Change Issues; Nepal, a Study by the Asian Regional Research Programme in Energy, Environment and Climate (ARRPEEC), Swedish International Development Co-operation Agency, 1997.
7. Gujarati, Damodar N., Basic Econometrics, Fourth Edition, Reprint 2005.
8. Inflation Analysis and Price Situation, Special Issue on Petroleum Products' Price, Nepal Rastra Bank, Research Department, Price Division, Mid-August 2006.
9. Nakarmi ,Amrit, (2000), "Petroleum Pricing in Nepal; An Overview and Some Suggestions", Center for Energy Studies IOE, Pulchowk, Lalitpur, Nepal.
10. National Planning Commission, Perspective Energy Plan for Nepal, 1995.
11. News, Bureau of Labour Statistics, United States Department of Labour, Washington D.C. 20212, www.bls.gov/cpi
12. Oil Price History and Analysis, WTRS Economics, Energy Economics Newsletter, www.wrbg.com\prices.
13. Pandey, Ravindra Prasad, (2005), "Inflation'", Nepal Rastra Bank in 50 Years, Nepal Rastra Bank, Kathmandu, Nepal , July 2005.
14. Promotion of Renewable Energy, Energy Efficiency and Greenhouse Gas Abatement (PRESA), Country Draft Report, Nepal, March 2004.
15. Shrestha, Rita, (1997), "Energy Planning and Policies of Nepal", Dissertation for Master of Sciences (Urban Planning), Centre of Urban Planning and Environmental Management, The University of Hong Kong.
16. The Challenges of Higher Oil prices, Asian Development Outlook, ADB, 2005.

Annex 1:

Basic Energy Conversion & Energy Contents of Various Fuel Type

Basic Energy Coversion

Units	Kcal ('000)	GJ	TCE	TOE
Kilo Calori (Kcal)	1,0000	000041868	0.0001429	0.0000972
Giga Joule (GJ)	238.8459	1.0000000	0.0341208	0.0234622
Tons of Coal Equivalent (TCE)	7000.00	29.3076000	1.0000000	0.0687622
Tons of Oil Equivalant	10,290.00	42.6217000	1.4542880	1.0000000

Energy Contents of Various Fuel Type

Fuel Type	Units	Kcal ('000)	GJ	TCE	TOE	Other
Coal	tonne	6,000	25.12	0.86	0.58	
LPG	Kl		30.08			0.611
	tonne	11,760	49.24	1.68	1.14	1.637
MS	Kl	8,000	33.49	1,014	0.78	0.71
	tonne	11,290	47.27	1.61	1.1	1.41
ATF	Kl	8,640	36.17	1.23	0.84	0.78
	tonne	11,130	46.60	1.59	1.08	1.29
KRS	Kl	8,660	36.26	1.24	0.84	0.78
	tonne	11,130	46.06	1.59	1.08	1.29
HSD	Kl	9,060	37.93	1.29	0.88	0.83
	tonne	10,960	45.89	1.57	1.07	1.21
LDO	Kl	9,350	39.15	1.34	0.91	0.85
	tonne	10,960	45.89	1.57	1.07	1.17
FO	Kl	9,860	41.28	1.41	0.96	0.93
	tonne	10,560	44.21	1.51	1.03	1.07
Electricity	MWh	860	3.6	0.12	0.08	5.78

Source: WECS, Nepal

Annex 2

Sectoral Petroleum Consumption

(i) Residential Sector Petroleum Consumption

Petroleum	2001/02	2002/03	2003/04	2004/05	2005/06
Total	12,839	11,748	10,892	9,061	9,108
LPG	1,301	1,451	1,711	2,008	2,217
Motor Spirit	0	0	0	0	0
Air Turbine Fuel	0	0	0	0	0
Kerosene	11,537	10,297	9,181	7,053	6,891
High Speed Diesel	0	0	0	0	0
Light Diesel Oil	0	0	0	0	0
Fuel Oil	0	0	0	0	0
Others	0	0	0	0	0

Source: WECS, Nepal

(ii) Industrial Sector Petroleum Consumption

Petroleum	2001/02	2002/03	2003/04	2004/05	2005/06
Total	1,945	1,936	1,812	1,331	1,469
LPG	0	0	0	0	0
Motor Spirit	0	0	0	0	0
Air Turbine Fuel	0	0	0	0	0
Kerosene	662	603	538	413	404
High Speed Diesel	182	190	190	199	197
Light Diesel Oil	1	0	0	0	0
Fuel Oil	578	554	421	-28	27
Others	522	588	663	747	841

Source: WECS, Nepal

(iii) Commercial Sector Petroleum Consumption

Petroleum	2001/02	2002/03	2003/04	2004/05	2005/06
Total	2,846	2,971	3,001	2,893	3,205
LPG	1,028	1,229	1,449	1,700	2,040
Motor Spirit	0	0	0	0	0
Air Turbine Fuel	0	0	0	0	0
Kerosene	1,818	1,741	1,552	1,192	1,165
High Speed Diesel	0	0	0	0	0
Light Diesel Oil	0	0	0	0	0
Fuel Oil	0	0	0	0	0
Others	0	0	0	0	0

Source: WECS, Nepal

(iv) Transport Sector Petroleum Consumption

Petroleum	2001/02	2002/03	2003/04	2004/05	2005/06
Total	12,004	12,683	13,112	13,873	14,189
LPG	72	81	96	113	128
Motor Spirit	2,119	2,259	2,276	2,534	2,628
Air Turbine Fuel	1,716	1,911	2,316	2,417	2,721
Kerosene	0	0	0	0	0
High Speed Diesel	8,028	8,414	8,407	8,807	8,710
Light Diesel Oil	69	18	17	3	3
Fuel Oil	0	0	0	0	0
Others	0	0	0	0	0

Source: WECS, Nepal

(v) Agriculture Sector Petroleum Consumption

Petroleum	2001/02	2002/03	2003/04	2004/05	2005/06
Total	2,671	2,780	2,778	2,905	2,873
LPG	0	0	0	0	0
Motor Spirit	0	0	0	0	0
Air Turbine Fuel	0	0	0	0	0
Kerosene	0	0	0	0	0
High Speed Diesel	2,647	2,774	2,772	2,904	2,872
Light Diesel Oil	24	6	6	1	1
Fuel Oil	0	0	0	0	0
Others	0	0	0	0	0

Source: WECS, Nepal

Chapter 9

OIL DEPENDENCE, IMPACT OF OIL PRICE VOLATILITY AND POLICY RESPONSE IN PAPUA NEW GUINEA

by Dr. Gae Kauzi[1]
Bank of Papua New Guinea

1. Introduction

Energy consumption is an input to the development process (e.g., various forms of fuel used in industries) as well as an output/benefit (a family driving a car or having electricity connected to their house in a village) of economic development.

Papua New Guinea has vast energy resources including oil, gas, hydroelectricity and renewable energy. As much as 30 per cent of PNG's export revenue came from the oil (petroleum) and gas sub-sector between 1993 and 2001. The country's current known oil reserves stand at nearly 500 million barrels and about 40 trillion cubic feet of gas. But the country has always been a producer of crude oil and gas solely for export until 2004. All refined petroleum products for use in industries and daily conveniences in the economy have always been imported until then. A new era dawned on PNG when the new Napa Napa oil refinery was completed and in June 2004 the first shipment of crude oil from Kutubu to be refined at the refinery was made. The first sale of domestically refined product occurred in August 2004. The first export of refined petroleum products also occurred in the same quarter. The refinery is producing marine diesel, diesel, gas oil, naptha and jet A1 fuel from the primary distillation unit and gasoline from the reformer unit (for conversion of naptha to gasoline).

2. Development of National Energy Policy

The National Energy Policy in Papua New Guinea has generally been fragmented and remained so since independence. Perhaps this reflected the fact that there have been more than one agency involved in different aspects of energy provision in PNG and the country had always imported petroleum products for its energy consumption needs. Each agent had a different perspective to the provision of energy. For instance, the then state-owned Electricity Commission (now corporatised to PNG Power) is responsible for supplying fuel-powered electricity, mainly in urban centres, the Consumer Affairs Council (now the Independent Consumer and Competition Commission) is responsible for pricing regulation, the relatively new Petroleum and Energy Department is responsible for the Government's interest in the development of projects in the energy area and so on and so forth. These various responsibilities are governed by various respective legislations. There was perhaps complacency on the part of authorities to pay attention to policies relating to alternate energy sources and import replacement.

First, the exploration, discovery and exploitation of energy sources such as crude oil, gas and hydropower in addition to the traditional electricity from transformation fuel and second, the fast pace of market based development, the need to develop a more coherent national energy policy has become apparent. As the then Deputy Prime Minister and the current Minister for Petroleum and Energy, Sir Moi Avei said in his foreword to the Draft National Energy Policy:

"The way in which we produce, supply and consume energy is of vital importance to sustainable development in all facets, as energy has deep relationships with each of its three dimensions – the economy, the social welfare and the environment.

1 Dr. Gae Kauzi is Research Project Coordinator of the Research and Analysis Unit of the Bank of Papua New Guinea.

These relationships are developing in a rather fast and complex manner due to increase globalisation, growing market liberalisation and new technologies, as well as by growing concerns about the climate which we live in and about energy supply security which is vital for vibrant economy and depends on adequate and reliable energy supply due to our demand situation. The diversification of supply sources from the traditional sources of high priced imported oil products (even with our own petroleum products development and yet to be fully developed natural gas resources,) is a positive sign of dependence on the country's own natural resources.

In order for energy to be an integral part of sustainable development, new policies are needed to be developed and such policies must be cohesively balanced among the three dimensions of sustainable development. Energy should be seen as the engine room of any nation and must be placed high in the echelons of government priority." (Draft National Energy Policy, 2005, p4)

In 2005, a project team was tasked to examine the different past polices and come up with a National Energy Policy that will bring every aspect of energy planning and delivery for the nation in a coordinated manner and help the government to deliver on its aims and objectives on national development. Under the auspices of the Department of Petroleum and Energy, particularly the Division of Energy, the team was tasked to produce two policy documents - the Rural Electrification Policy and the National Energy Policy and their accompanying plans; the Rural Electrification Plan and the PNG Energy Plan based on which projects can be initiated and implemented.

The National Energy Policy gives authority for the right of Rural Electrification Policy to be considered for further development of rural area for power development. The National Energy Policy addresses the macro energy issues of the energy sector of the PNG economy whilst the Rural Electrification Policy addresses a specific or micro area of energy, and that is, the provision of electricity in the rural areas. The latter is a subset of the former. One of the objectives of the National Energy Policy is "to contribute to the economic and social development of rural PNG through the provision of cost effective and reliable electricity supplies." Rural electrification projects both here and in other developing economies have shown that with the delivery of electricity to rural communities, there have been some remarkable improvements in the social and economic indicators in these communities. (Rural Electrification Policy, 2005, p18).

The goal for policy and planning in energy development is:

"Open and consultative cross-sectoral policy development and integrated planning to achieve sustainable supply and use of energy".

The policies, as sourced from the PNG Draft National Energy Policy 2005, to work towards this goal are:

1. Ensure energy sector policy and planning addresses the availability and efficient use of affordable, and appropriate sources of energy, taking into account a balance of social, cultural, technological, institutional, environmental, economic, and global market issues.
2. Promote sustainable energy options for electricity generation, transportation, water supply, health care, education, telecommunication, tourism, food supply, and income generation particularly to the rural population that is without access to electricity.
3. Promote the development of appropriate regulatory guidelines to meet the needs of suppliers and consumers.

4. Assess and promote indigenous resource potential and technical capacity for all aspects of energy sector planning and development.
5. Promote efficient use of energy in all sectors of the economy.
6. Promote the involvement of all stakeholders, including non-government organisations, local communities especially youth and women in policy development and integrated planning.
7. All energy service companies and large mining, agricultural and retail companies are mandated to provide energy data in terms of fuel used, energy generated to the National Energy Office or National Statistical Office for the sector to plan efficiently for the country.
8. Promote the development of national energy policy and related policies and PNG Energy Plans and Electricity Plans that address the reduction of fossil fuel imports and greenhouse gas emissions and strive to meet national renewable energy targets.
9. To convene, as required, an inter Departmental consultative committee (the National Energy Advisory Committee) to discuss and provide advice and recommendations to the Energy Division of DPE on major energy sector issues and initiatives, and to ensure effective co ordination of the PNG Energy Plan is approved across departments and ministries.

The goal of rural electrification is:

Increase the provision and accessibility of electricity by 15% of the rural population by the year 2025 through an integrated planning approach.

The policies, as stated in the Draft PNG Rural Electrification Policy 2005, to work towards this goal are:

1. Promote increased use of cost-effective and environmentally friendly reliable electricity supplies to rural areas through both grid-connected electrification programs and stand-alone renewable-based power systems.
2. Promote a level playing field approach for the application of renewable technologies and conventional energy sources where feasible in rural areas.
3. Promote a joint approach by all stakeholders for the development and supply of electricity.
4. Mobilise external financing and other resources to develop renewable rural electricity initiatives.
5. Maximise net benefit to meet existing economic and social development needs.
6. Ensure that CDM renewable energy projects approved by NCDMA be collaboratively developed and administered for the recipient community.

3. The Energy Sector

The energy sector in PNG comprises all activities revolving around the exploration and development of energy resources and their transportation and retail, to the generation, transmission and distribution of electricity (electrical energy), including the production of energy products. Thus, the sector includes sub-sectors such as petroleum, gas, hydroelectricity, mini-hydroelectricity, thermal electricity (from diesel, gas and biomass generation), wind and solar power generation, as well as mineral extraction. (Draft National Energy Policy, 2005, p18.)

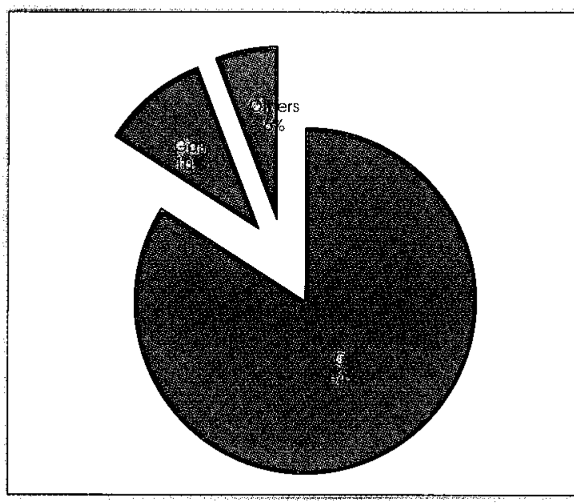
3.1. Supply/Production of Energy in PNG

Papua New Guinea has enormous alternative energy resources, which are grossly under-developed. For example, of hydroelectricity potential of some 15,000 megawatts, only one per cent (1%) has been developed[2]. PNG has abundant potential of biomass.

Of the total domestically produced primary energy supply in 2002, crude oil and petroleum products accounted for 84 percent, natural gas 10 percent, the balance consisted of 6 percent including hydro and other fuels. Around 85 percent of the total domestic energy production is exported. Most of gas produced was used for electricity generation for the Porgera Gold Mine while all of the hydro and other fuels were for the generation of domestic electricity.

Figure 1
PNG Primary Energy Supply by Fuels (2002)

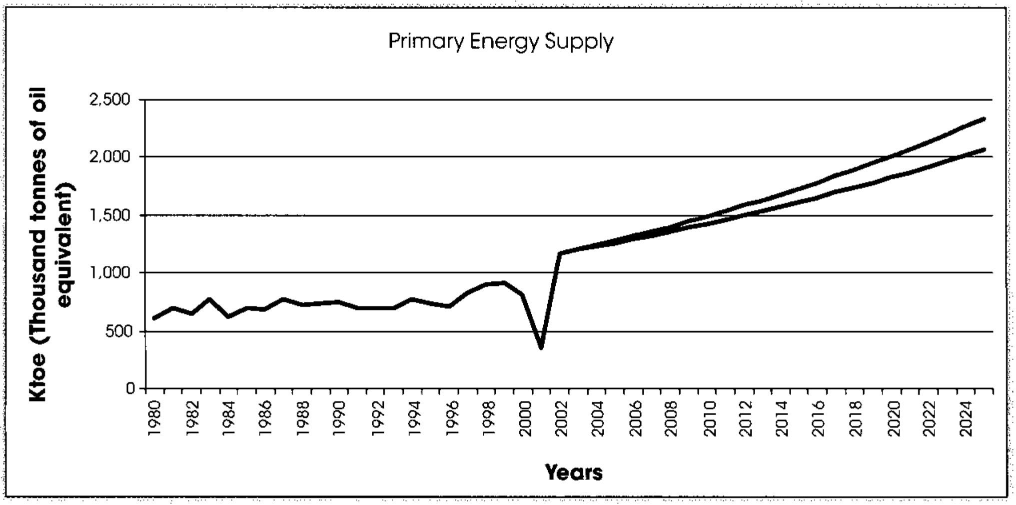
PNG Primary Energy Supply by Fuels (2002)



(Taken from the Draft National Energy Policy Document, Original Source: EDMC, IEEJ, Japan)

2 Source: Final Concept Note for Non-Lending Technical Assistance: PNG Rural Electrification Policy and Strategy Development, March 2003.

Figure 2
PNG Primary Energy Supply Trend (1980 to 2025)



Source: Taken from the Draft National Energy Policy, Original Source - Actual Data APEC & DPE; Forecast - DPE

	1980	1985	1990	1995	2000	2005	2010	2015	2020	2025
Primary Energy Supply (BAU at 3.05% GDP)	604	700	752	731	806	1,280	1,488	1,729	2,009	2,335
Primary Energy Supply (@ 2.5% GDP)	604	700	752	731	806	1,260	1,426	1,613	1,825	2,065

Figure 3
Petroleum Products Supply Trend (1980 - 2025)

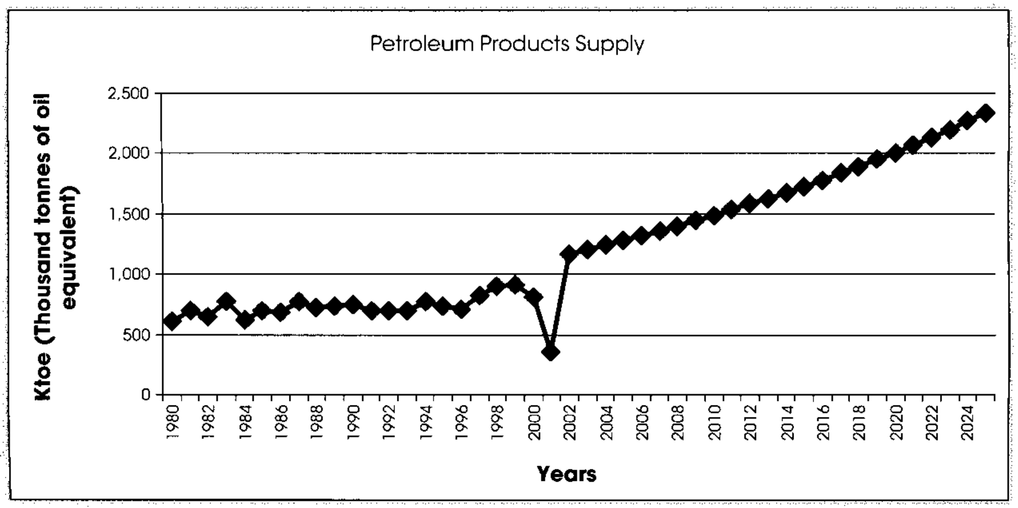
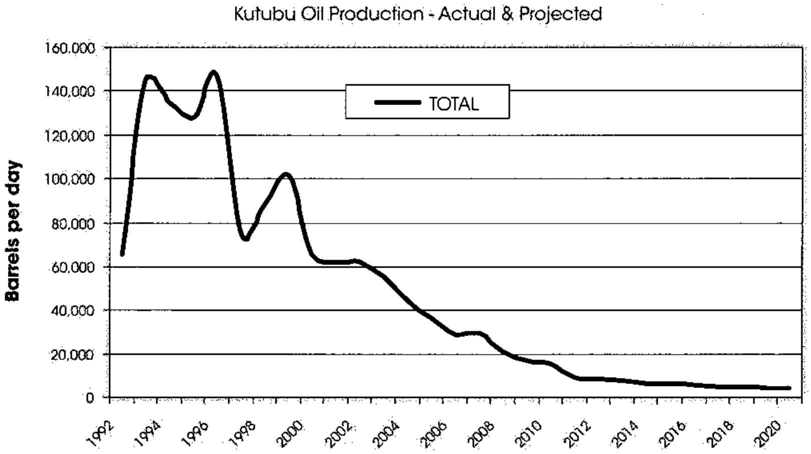


Figure 4
Indigenous Oil Production Trend in PNG: Actual 1992-2000 and Projection 2002 to 2020

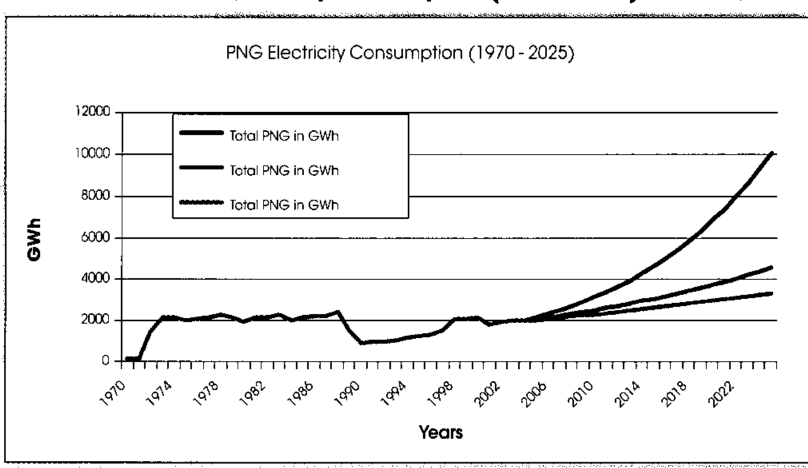


Taken from the Draft National Energy Policy, Original Source: DPE (Petroleum Division) Report 2000

3.2. Demand for Energy in PNG

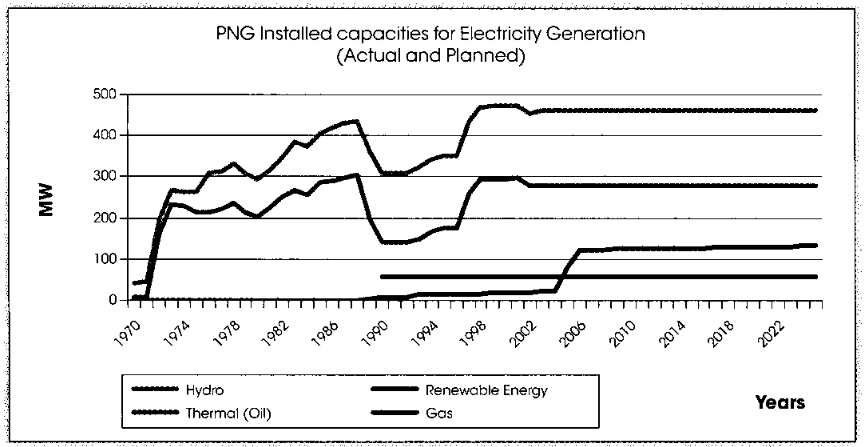
3.2.1. Electricity/Power Sector

Figure 5
PNG Electricity Consumption (1970 - 2025)



Taken from the Draft National Energy Policy Document, Original Source: APEC & DPE; Forecast - DPE

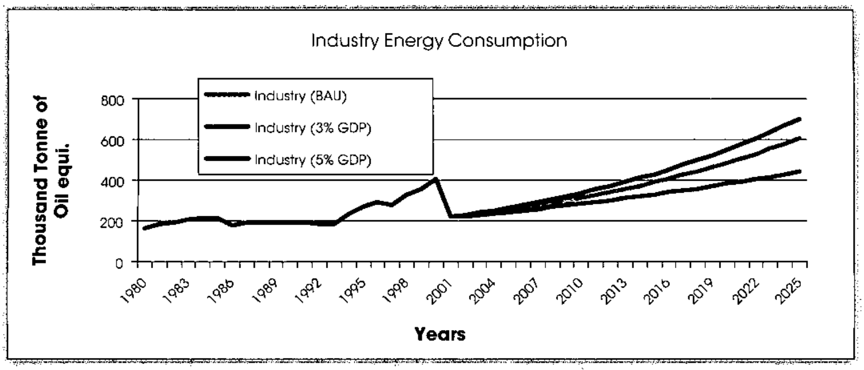
Figure 6
PNG Installed Capacities for Electricity Generation



Taken from the Draft National Energy Policy Document, Original Source: APEC & DPE; Forecast - DPE

3.2.2. Industry Demand

Figure 7
Industry Energy Consumption



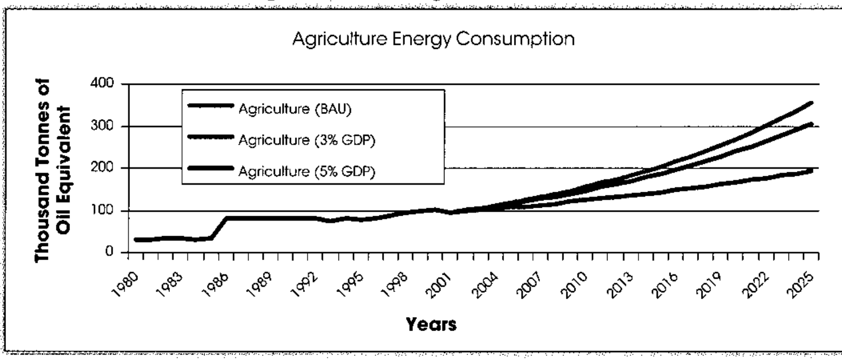
Taken from the Draft National Energy Policy Document, Original Source: APEC & DPE; Forecast - DPE

Table Form

	1980	1985	1990	1995	2000	2005	2010	2015	2020	2025
Industry (BAU)	161	214	190	271	404	252.24	314.03	390.97	486.75	606
Industry (3% GDP)	161	214	190	271	404	245.36	284.44	329.74	382.26	443.15
Industry (5% GDP)	161	214	190	271	404	264.98	338.19	431.63	550.88	703.07

3.2.3. Agriculture Demand for Energy (Agriculture Sector is Treated Separately from Industry)

Figure 8
Agriculture Energy Consumption



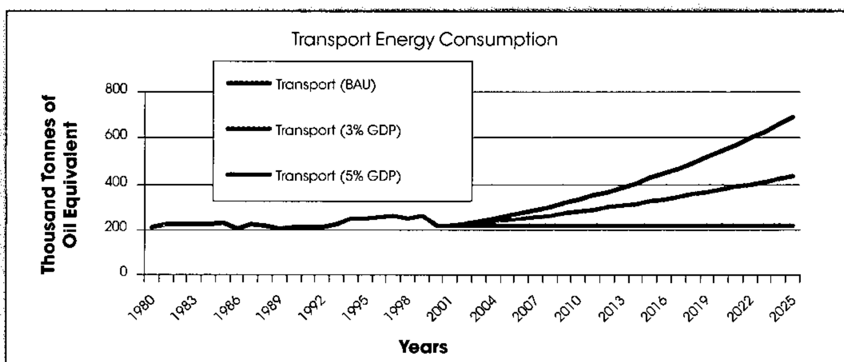
Taken from the Draft National Energy Policy Document. Original Source: APEC & DPE; Forecast - DPE

Table Form

	1980	1985	1990	1995	2000	2005	2010	2015	2020	2025
Agriclture (BAU)	30	33	81	77	103	110.73	119.03	127.96	137.55	147.87
Agriclture (3% GDP)	30	33	81	77	103	106.09	109.27	112.55	115.93	119.41
Agriclture (5% GDP)	30	33	81	77	103	108.15	113.56	119.24	125.2	131.46

3.2.4. Transportation Sector Demand for Energy

Figure 9
Transport Energy Consumption



Taken from the Draft National Energy Policy Document, Original Source: APEC & DPE; Forecast - DPE

4. Oil Dependency

Papua New Guinea is the second-largest country in the Oceania or the South Pacific region in terms of population and third in terms of land area.[3] It is endowed with a rich natural resource base that includes major gold and copper deposits, large oil and natural gas reserves, and extensive forests and maritime fisheries. Despite these abundant resources, the economy still struggles to achieve sustained economic growth. Real GDP growth has mostly been low to moderate since independence in 1975. Only in the 1990s, particularly in the first half of the decade, did the economy experience high growth of real GDP. This was due to the mineral boom with new mines and the first crude oil production coming into being.

Following the instability of the late 1990s, the PNG economy is now going into its 5th year of macroeconomic stability and economic recovery, supported by sound economic policies and high export commodity prices. "Continued high export commodity prices have significantly strengthened the external position since 2004, which has led to a sharp increase in net foreign assets, while disciplined macroeconomic policies and low interest rates have spurred business confidence, which has led to the increase in private sector credits and net domestic assets since 2005." (IMF's selected issue paper "Liquidity and Inflation in PNG" for IMF Article IV Consultation in 2007).

Energy consumption has increased steadily over the years. Demand for petroleum products increased as total energy demand increased. All the demand for petroleum products were met through imports. It has been the single major form of energy. In 1993, production and export of crude oil commenced, following the successful exploration and subsequent negotiations between the foreign investor, the government and the landowners for the Kutubu oil project in the highlands region to take place. As the output, crude oil, was all exported, the economy's dependence on imported refined oil product continued. However, as a share of total energy consumption, demand for petroleum products declined slowly as the other forms of energy consumption, hydro for electricity and gas increased their share.

This scenario changed in 2004 when a new era dawned on Papua New Guinea, with the first oil refinery- the Napa Napa oil refinery- outside of Port Moresby began producing refined oil products from crude oil. Some of the refined products are exported while some go towards meeting the demand in the domestic market. Consequently, the overall oil dependency of the economy declined markedly to around 50 percent.

Table 1
Oil Dependency in Papua New Guinea

Year	Total Energy Consumption 1/	Petroleum Products Consumption 2/		Total Petroleum	Petroleum Import		Oil Dependency
	Thou. TOE	Thou. TOE	%	Thou. TOE	Thou. Bbl	%	%
1980	456	410	89.9	600	NA	100	95.0
1985	562	477	84.9	650	NA	100	92.4
1990	547	448	81.9	655	NA	100	91.0
1995	724	579	80.0	670	NA	100	90.0
2000	949	745	78.5	780	NA	100	89.3
2005	1139	889	78.1	1250	NA	40	59.0

Notes
1/ An estimation is assumed for hydro and gas energy, which is added onto the consumption of petroleum products.
2/ The total consumption of petroleum products is obtained by the summation of industries' consumption of oil products.

Sources: Department of Petroleum and Energy's Draft National Energy Policy 2005 & PNG Power Data on forms of energy/electricity generation 2006.

3 The exact scope of Oceania is defined variously, with interpretations including Australia, New Zealand, New Guinea, and various islands of the Malay Archipelago.

5. Price Determination Mechanism of Fuel Products

The project agreement signed in 1997 by the Government and InterOil Ltd for the latter to build and operate an oil refinery in PNG has embedded in it, a provision for the pricing of fuel products from the refinery. The fuel products are to be sold to domestic distributors at Import Parity Price (IPP). This means that the products would be treated as if they were imported. The IPP is the cif price (in kina) of importing equivalent products from Singapore. It is calculated monthly based on the previous month's Singapore prices.

Upon becoming operational in mid 2004, the refinery has since supplied all of PNG's requirements for petrol, diesel and kerosene. The Independent Consumer and Competition Commission (ICCC) regulates and monitors the prices of the fuel products ex-Napa Napa to ensure they are consistent with the IPP. This comes under the Petroleum Pricing Review Final Report issued in August 2004. Under the Report, the calculation of the retail prices for fuel product is based on a framework that is effective until 2009. An indicative retail price is announced on the 8th of each month and is arrived at by adding freight charges, taxes and the retailers profit margin to the IPP. Prices may differ across provinces/centres due to differences in freight costs.

IPP + Excise Duty + Freight Charge + Retailer's Margin + General Sales Tax (10%)

= Retail Price of Petrol, Diesel and Kerosene

There is no government subsidy for prices of petroleum products.

6. Impact of and Policy Responses to Volatile Oil Prices

To look at the impact of the recent/current world oil price increases and the response of macroeconomic policy, in particular monetary policy, it is necessary to look at the key economic fundamentals at the different time periods.

Historically, the first oil crisis of 1974/75 and the second oil crisis of 1980-82 resulted in a deteriorated terms of trade for the Papua New Guinea economy and a rise in inflation. The rise in oil prices caused inflation to increase in PNG's major trading partner economies such as Australia. This in turn led to increased imported inflation given PNG's great dependence on imports, yielding inflation rates of 14.3 percent in 1973 and 19.7 percent in 1974. Similarly, in 1980 to 1982, inflation rate averaged 8.1 percent.

On both occasions, the international prices of the major agricultural and mineral export commodities declined. That led to deteriorated balance of payments positions for the economy.

By contrast, the oil price increase of the 2000s is accompanied by high agricultural and mineral commodity prices, induced by China and India's economic growth. Thus, the terms of trade has not deteriorated. The relatively high export commodity prices led to increased exports, a healthy balance of payments position for the PNG economy and an increase in international reserves to a record level of US$699 million in the fourth quarter of 2004 and by the end of 2006, it was over US$1.0 billion The high international reserves combined with a relatively weak US dollar and prudent fiscal management led to a relatively stable kina exchange rate. The kina appreciated against the US dollar from the record low of 25 US cents in 2002 to 30 US cents in the fourth quarter of 2003 and stabilised between 30 and 32 cents in

2004 and the end of 2005 and reached 33 US cents by the end of 2006. Against the Australian dollar, the kina has varied between 40 and 45 cents. Relative to the first nine years of the floating exchange rate regime, this represents a short but significant period of a sustained stable kina in the 11 years of the regime. Exchange rate movement is a major determinant of inflation in the PNG economy, as shown by internal Bank of Papua New Guinea research. The feed through of changes in a trade-weighted exchange rate to inflation is 0.5 percent for every percent depreciation of the Kina over four quarters (Sampson, Nindim, Marambini and Yabom, 2006). Given this, the relatively stable Kina has helped PNG to achieve low inflation, as measured by the consumer price index (CPI), of 2 to 5 percent in the 2004 to 2006 period, the lowest since the floating of the Kina in 1994.

Moreover, despite the worldwide oil price increases, inflation rates in PNG's major trading partners have been low. In particular, Australia's inflation has been at around 2 percent, driven by the strong Australian dollar and strong economic growth. This translated into low imported inflation for PNG unlike in the first two oil price crises. If there were high inflation in PNG's major trading partner economies, there could have been higher inflation in PNG under the stable Kina, given the experience of high inflation in the first two periods of oil crisis under the fixed exchange rate system when imported inflation increased.

We do not imply by the above that the current international oil price rises does not impact on PNG. Indeed, the prices of fuel products have risen by some 20 percent or more between 2003 and 2006. The impact on the overall inflation is, however, to a lesser extent than during the first two oil crises. One technical or operational factor for the lesser impact could be that fuel products account for a very low weight (1.51 percent) in the CPI basket of goods. However, the influence of increased fuel prices on other goods and services would be sufficient for the second round effect, as they have high weights in the CPI and fuel is an input for their supply.

The ultimate impact of increased oil prices on the PNG economy, as in many economies, is on inflation and production. The formulation of monetary policy does not account directly for the first round of increased oil prices. It caters for oil price changes indirectly through the forecasts of inflation which has embedded in it oil price changes. It reacts to the second or subsequent rounds of increased inflation, as measured by the CPI. With low inflation in 2003 to 2006, the Bank of Papua New Guinea eased its monetary policy in the second half of 2003 and has maintained that stance through to 2006. During the same period, real gross domestic product (GDP) grew by around 2 to 4 percent, induced by the high export commodity prices, including oil prices, and the stable macroeconomic conditions, following the dismal GDP performance in the late 1990s to 2002.

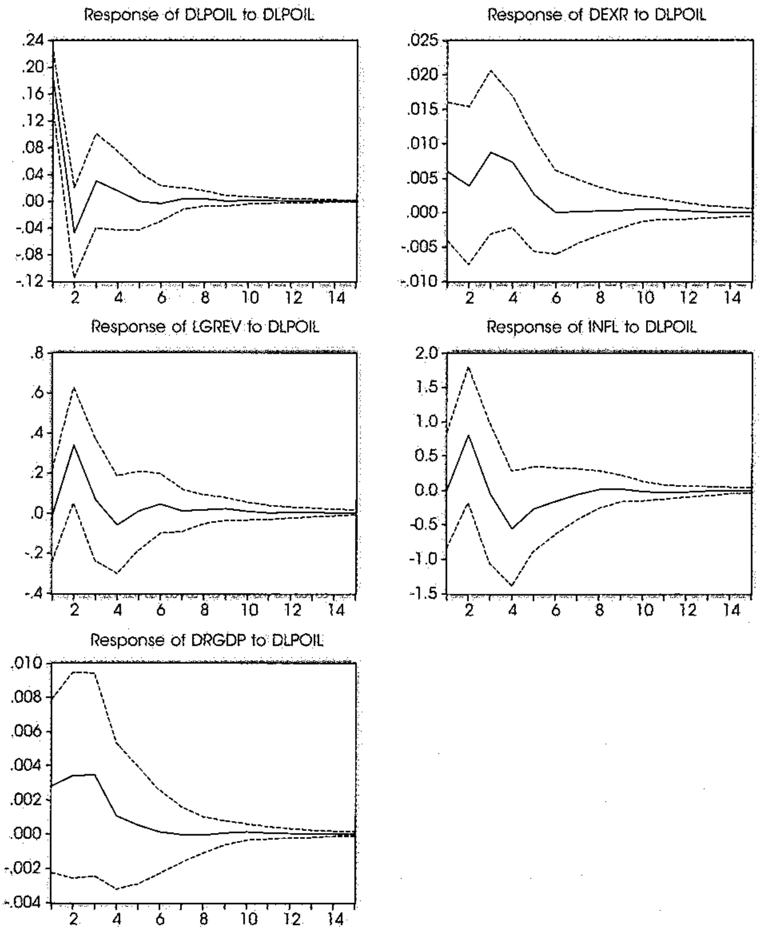
7. Structural VAR Model Results

This section presents indicative results of the structural VAR analysis, when the VAR method is applied on the PNG economy data for the period 1996.1 to 2005.4.

The Figure 10 below reports the impulse responses of the economy to a shock in oil prices. In response to a 2.0 percent increase in oil price, the domestic currency (Kina) appreciates by around 0.5 percent before stabilising by the 6th quarter (top right panel). The exchange rate appreciates because in the PNSG economy, a rise in oil price means more foreign exchange earnings from the export of oil, which exerts an upward pressure on the exchange rate. Government revenue increases by about 3 percent in the 2nd quarter (middle left panel) and declines by the 4th quarter. It stabilises by the 12th quarter. The increase in Government revenue comes from increased mineral tax that results from increased exports of oil, itself being the response to the oil price increase. Inflation increases by 0.5 percent by the 2nd quarter (middle right panel) and fluctuates between 0.5 and -0.5 percent over 6 quarters before stabilising in the 8th quarter. Real GDP grows marginally by 0.25 percent then fades away by the 10th quarter. The growth in real GDP is consistent with the growth in export earnings (supply response) although the exchange rates appreciated.

Figure 10
Structural (Restricted) VAR Model Results

Response to Cholesky One S.D. Innovations ± 2 S.E.



8. Conclusion

The results of the VAR model together with the qualitative analysis has to be understood with a caution that not all factors for the performance of the economy with respect to the oil price increase can be explained in that context only. Our explanation is only within the context of the macroeconomics of the economy and what the model can explain.

The structural VAR model results are consistent with the qualitative analysis provided earlier. The increase in international oil price did not lead to a decline in activity as might be expected because the higher price actually induced a growth in export of oil, which together with increased production and export of other commodities, also because of higher prices, led to an increase in real GDP. This is contrary to the popular belief that increased oil prices would induce a decline in demand and therefore a decline in activity. The increase in foreign exchange inflows, supported by prudent fiscal management, caused the Kina to appreciate instead of depreciating as one might expect from increased prices of PNG tradable goods. The relative stability in the exchange rate and low imported inflation helped PNG attain low inflation outcomes.

All these are in contrast to the experiences of the first two oil crises, where PNG experienced a deteriorated terms of trade, low growth in exports, high inflation because of high imported inflation and subdued economic activity.

The stability in the exchange rate, low inflation and good fiscal management made it easy for the Central Bank. From the second half of 2003, it eased monetary policy and has maintained that stance throughout most of the 2003 to 2006 period. This is in contrast to the expectation that during the period oil price rise, a central bank would normally adopt a tight monetary policy stance in fear of inflationary pressures. The factors underlying this stance are explained above. The stance and conduct of monetary policy has also assisted the macro environment. The maintenance of an easy (officially called 'neutral') stance has led to a low interest rate environment, which has encouraged growth in credit. The real GDP growth in 2005 and 2006 especially can partially be attributed to that.

References

1. Government of PNG, (2005), National Energy Policy, Department of Petroleum and Energy, Port Moresby.
2. Government of PNG, (2005), Rural Electrification Policy, Department of Petroleum and Energy, Port Moresby.
3. Government of PNG, (2005), Policy Handbook, Department of Petroleum and Energy, Port Moresby.
4. Bank of Papua New Guinea, Quarterly Economic Bulletin, Various Issues, Port Moresby.
5. Various Consultations with PNG Power, Independent Consumer and Competition Commission and Interoil Products Ltd.
6. Papers from the two SEACEN Workshops on the Project.
7. Sampson T, Nindim W., Marambini J & Yabom J, (2006), "Exchange Rate Pass-Through in Papua New Guinea", *Bank of PNG Working Paper*, 2006/02, Port Moresby.

Chapter 10

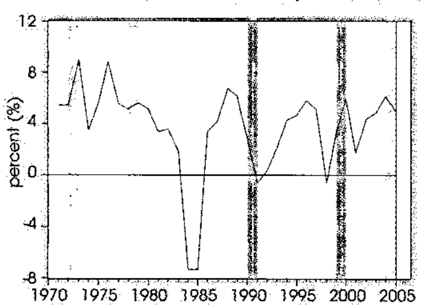
POLICY CONSIDERATIONS IN THE LIGHT OF OIL PRICE VOLATILITY

by Jade Eric T. Redoblado [1]
Bangko Sentral ng Pilipinas

1. Introduction

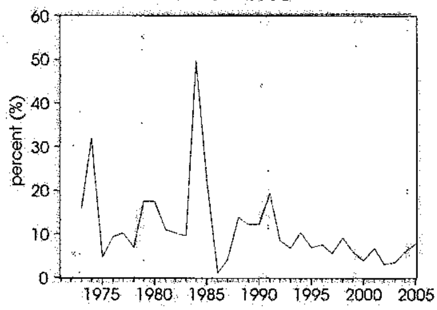
Prices of Dubai crude oil has almost quadrupled from $18.18 per barrel in January 2002 to $69.17 per barrel by July 2006. The higher oil price has not had the same impact as in previous oil shocks. In the same period, the average growth of quarterly Gross Domestic Product (GDP) has been 5.2 percent. Although inflation has inched up during the same period, its rise has been tempered over the past few months and it is nowhere near the levels reached during previous oil shocks. Altogether, the magnitude and the cause of recent oil price volatility are different from previous episodes. In real terms, the rise in crude oil prices was less than in previous episodes of oil price volatility. Growth in demand from fast-growing economies has caused the rise in demand unlike previous oil shocks wherein armed conflict precipitated the skyrocketing of oil prices. Furthermore, the Philippine economy is better placed to absorb the current oil price shock with its vastly improved economic infrastructure and better power generation mix. Significantly, inflationary pressures are less this time. Lastly, the monetary policy framework adopted by the Bangko Sentral ng Pilipinas has allowed the economy to better handle inflationary pressures.

Figure 1a. Year-on-Year Percentage Growth of Real Gross Domestic Product, 1970 - 2005



Note: Shaded regions are oil price shock episodes.

Figure 1b. 2000-Based Headline Inflation, 1970 - 2005



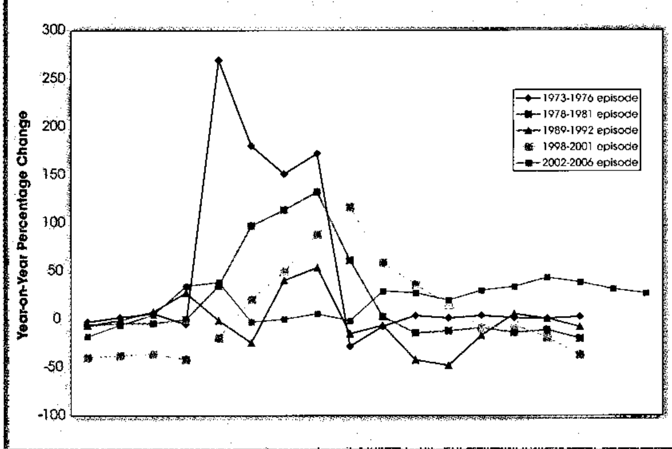
Note: Shaded regions are oil price shock episodes.

2. Size and Nature of the Shock

Based on comparison of real Dubai crude oil prices from previous oil shock episodes, the current rise in oil prices is much smaller in magnitude. Furthermore, the rise in oil prices was more gradual compared to the sudden skyrocketing experienced in previous episodes especially during the 1970s. The reason for this is that growth in demand from fast-growing economies like India and China have driven the rise in oil prices and not supply shocks borne out of armed conflicts which are more disruptive of economic activity and which characterised the oil shocks of the 1970s and early 1990s (Walton, David (2006)).

1 Mr. Jade Eric T. Redoblado is Bank Officer IV at the Center for Monetary and Financial Policy of Bangko Sentral ng Pilipinas.

Figure 2. Episodes of Rising Oil Prices, 1973-2006



The impact of an oil price shock depends on the economy's ability to absorb or mitigate the shock, the monetary policy framework and the monetary policy response. Walton, David (2006).

3. State of the Economy

The Philippines is better placed to absorb the impact of oil price volatility compared to previous episodes. In contrast to the 1973 oil shock, the Philippines have the energy infrastructure in place to adequately deal with oil shocks. When the first oil shock hit the country in 1973, the domestic economy was completely dominated by local affiliates of multinational oil companies which in turn were dependent on their mother companies for crude oil supply. Difficulty in procuring supplies was experienced by these local affiliates such that the country resorted to government-to-government based procurement contracts which were deemed more reliable vis-à-vis the very fluid and volatile commercial oil market. The situation became the basis for the creation of the Philippine National Oil Company which was tasked with the provision and maintenance of an adequate and stable supply of oil and refined petroleum products for domestic use and to promote and engage in oil exploration activities. The sale of an equity position in its subsidiary Petron to the Saudi Aramco Group in 1994 also helped to ensure an adequate supply of crude oil for the local market. The country also was able to broaden its supply base with the establishment of cooperation agreements with oil producing neighbours in ASEAN particularly Indonesia and Malaysia.

The role of imported oil in Philippine energy consumption has declined significantly from the time of the first oil shock in 1973. At that time, imported oil accounted for 92 percent of total primary energy consumption. By 2005, that had been effectively reduced to 37 percent. This is best seen in how the country has reduced its use of imported oil in power generation and even for transportation. The Philippines serves as a showcase of how to successfully wean power generation from imported crude oil. As late as 1990, oil-based power plants accounted for 47.2 percent of the power generating mix. By 2005, their contribution to power generation had been reduced to 10.9 percent. Even in transportation, great strides have been made since the 1970s. Currently, almost all rail passengers are transported on electric-powered trains which can obtain power from non-oil sources. The recent rise in gasoline prices has encouraged a shift by taxi operators to LPG or CNG powered cabs. More are being retooled as part of a programme by the Department of Energy. Furthermore, legislation on the use of alternative fuels is in the works.

Renewable energy initiatives have also been supported by the Department of Energy. With only 20 MW of generating capacity installed, Ilocos Norte's wind energy potential of 2,000 – 3,000 MW remains largely undeveloped while the rest of the country's 74,000 MW wind electricity potential has not even been begun to be tapped. (Elliot D., M. Schwartz et al (2001)).

Figure 3. Indigenous versus Imported Fuels in Primary Energy Consumption, 1973-2005

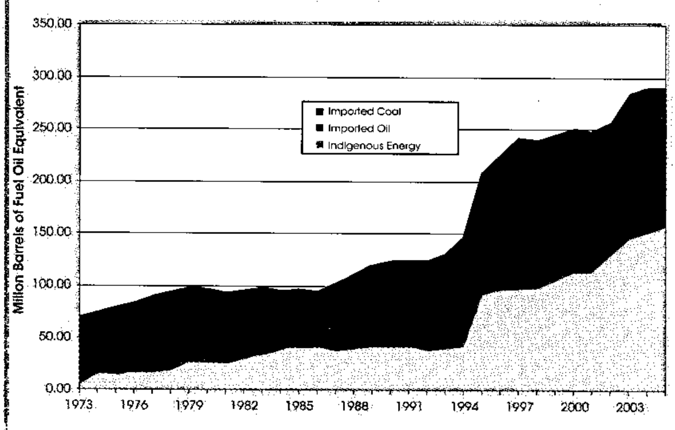
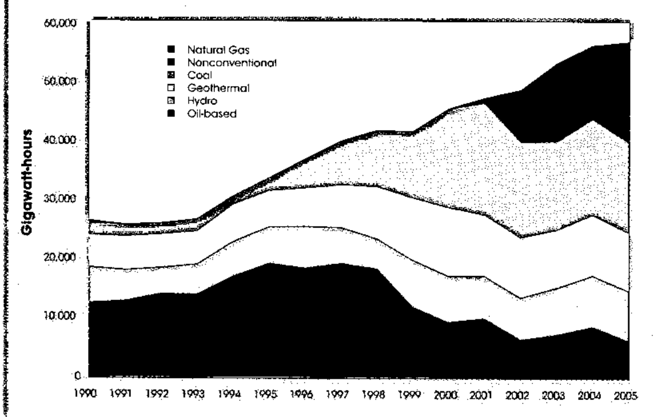


Figure 4. Power Generation by Source in Gigawatt-hours, 1990-2005



With respect to monetary management, significant and deep-seated reforms have been put in place. Among the significant reforms enmeshed in the establishment of the Bangko Sentral ng Pilipinas in 1993 was the prohibition on involvement in quasi-fiscal functions and development banking which included extending forward cover to oil companies. The losses due to these activities of the old Central Bank of the Philippines hobbled its operations and limited its flexibility to conduct monetary policy. The creation of the Bangko Sentral ng Pilipinas provided a fresh opportunity to redefine the focus of central banking and reestablish flexibility in the conduct of monetary policy.

Despite the reforms undertaken, nagging questions on the vulnerability of the Philippine economy to oil shocks remain. How much does oil price volatility affect output and inflation? Given recent literature on negative effects of monetary policy intervention, how much impact does monetary policy have on output and inflation?

4. Econometric Estimation

To provide some answers to these questions, a set of vector autoregressive models are estimated over the period 1981-2006. Given the large role of remittances in the Philippine economy, the log change of real Gross National Product is used to represent output while the log change of its implicit price index is used to represent inflation. The rate of unemployment is also included to account for social welfare. Variables used to represent oil shocks are the log change in the Dubai crude price (benchmark price for imported crude) and normalised oil price changes. Normalised oil price changes are computed as the level of the Dubai crude price divided by the standard deviation as generated from the time-varying conditional variance of a generalised autoregressive conditional heteroskedastic model. The use of normalised oil price changes allows the incorporation of information from the volatility of crude oil prices. Proxies for monetary policy include the 91-day Treasury Bill rate, the level of the overnight reverse repurchase rate, the change in the overnight reverse repurchase rate and standardised change in the level of the overnight reverse repurchase rate. To derive usable information from asymmetric change in oil prices, several price change indicators were used. The oil price increase indicator was calculated as the log change in the level of the Dubai crude oil price when the log change was higher in the current quarter than in the previous quarter and zero, otherwise. An analogous procedure was used to calculate for an oil price decrease indicator. Similar procedures were adopted to compute for normalised oil price increase and normalised oil price decrease indicators. Unit root tests were done to ascertain the properties of the variables.

Unrestricted vector autoregressive estimates were generated. Where applicable, vector error correction models were estimated. To compare the impact of the oil shock and monetary policy variables, eight-quarter forecast error variance decomposition analyses were also done with output and inflation as the dependent variables. Since variance decomposition output is dependent on the ordering of the variables, several combinations were used and the average percentage contributions of the oil shock and monetary variables are presented.

In almost all cases, the oil shock variable has greater predictive power on the behaviour of output as compared to the monetary policy variable. As a predictor of output, the log change in the level of the Dubai crude oil price accounts for a greater proportion of the behaviour of the output than any of the monetary policy variables. Similar observations can be made for the normalised oil price changes. Between the two, normalised oil price changes holds greater predictive capability than the log change in the Dubai crude oil price. This can be noted across the various pairings with monetary policy indicators. The additional information it derives from oil price volatility makes it a better predictor of changes in output. For the monetary policy indicators, the results depend on the pairing of oil shock indicator and monetary policy variables. Using the log change in the level of the Dubai crude oil price, it appears that the 91-day Treasury Bill rate has better predictive power than the overnight reverse repurchase rate. However, when oil price volatility is accounted through the normalised oil price change variable, the overnight reverse repurchase rate becomes a better predictor of changes in output. Notwithstanding these results, it can be observed that the functional forms of the overnight reverse repurchase rate that account for shifts in policy preferences (first difference of overnight reverse repurchase rate and standardised first difference of overnight reverse repurchase rate) are a better predictor of the behaviour of output regardless of the oil shock indicator used. In summary, the best predictors of the behaviour of output are the variables that incorporate information on oil price volatility and the variables that hold greater information on shifts in policy preferences.

Table 1: Distribution of Forecast Error Variance in Percentages		
Dependent Variable = Log Change in Real GNP		
VAR 1	Log Change in Dubai Oil Price	6.16
	91-day Treasury Bill Rate	2.69
VAR 2	Log Change in Dubai Oil Price	5.72
	O/N Reverse Repo Rate	2.24
VAR 3	Log Change in Dubai Oil Price	8.66
	First Difference of O/N Reverse Repo Rate	3.29
VAR 4	Log Change in Dubai Oil Price	8.66
	Standardised First Difference of O/N Reverse Repo Rate	3.29
VAR 5	Normalised Oil Price Changes	16.13
	91-day Treasury Bill Rate	2.31
VAR 6	Normalised Oil Price Changes	9.29
	O/N Reverse Repo Rate	2.38
VAR 7	Normalised Oil Price Changes	9.79
	First Difference of O/N Reverse Repo Rate	3.38
VAR 8	Normalised Oil Price Changes	9.79
	Standardised First Difference of O/N Reverse Repo Rate	3.38
VAR 9	Oil Price Increases	4.61
	Oil Price Decreases	4.69
	91-day Treasury Bill Rate	2.65
VAR 10	Oil Price Increases	1.79
	Oil Price Decreases	4.17
	O/N Reverse Repo Rate	1.92
VAR 11	Oil Price Increases	2.85
	Oil Price Decreases	6.49
	First Difference of O/N Reverse Repo Rate	2.89
VAR 12	Oil Price Increases	2.85
	Oil Price Decreases	6.49
	Standardised First Difference of O/N Reverse Repo Rate	2.89
VAR 13	Normalised Oil Price Increases	6.50
	Normalised Oil Price Decreases	12.79
	91-day Treasury Bill Rate	4.28
VAR 14	Normalised Oil Price Increases	3.72
	Normalised Oil Price Decreases	6.98
	O/N Reverse Repo Rate	1.82
VAR 15	Normalised Oil Price Increases	5.35
	Normalised Oil Price Decreases	6.48
	First Difference of O/N Reverse Repo Rate	2.96
VAR 16	Normalised Oil Price Increases	5.35
	Normalised Oil Price Decreases	6.48
	Standardised First Difference of O/N Reverse Repo Rate	2.96

To derive information on asymmetric effects of oil price shocks on output, the oil shock variables were segregated into their respective increases and decreases by using a dummy. The results are in contrast to the literature. Though they may be negligible in magnitude, they show that the behaviour of output reacts more to decreases in oil prices/oil price volatility compared to increases in oil prices/oil price volatility. The lessening dependence on imported crude oil during the study period may have allowed the economy to increase production by making a greater portion of potential output more usable whenever an oil price decrease or a decrease in oil price volatility comes along. On the other hand, after eight quarters, it is also possible that oil price increases may have had their effects already mitigated by policy response while oil price decreases may continue to benefit the economy. In summary, oil shock variables that incorporate oil price volatility and monetary policy indicators that take greater account of changes in policy preferences continue to have greater predictive power over simple first differences or levels.

Similar variance decomposition tables were generated for predicting inflation. The output indicates that the predictive power is premised on particular pairings of oil shock and monetary policy variables. When paired with the 91-day Treasury Bill rate, normalised oil price changes are better predictors of GNP-based inflation whereas when paired with the levels or changes in the overnight reverse repurchase rate, the log change in the Dubai crude oil price proves to be the better predictor of GNP-based inflation as compared to normalised oil price changes. Paired with the 91-day Treasury Bill rate, the sum of its predictive power with the log change in the Dubai crude oil price (4.97%) is far less than that of the sum of its predictive power with normalised oil prices changes (25.40%), the highest for all possible combinations. This can be interpreted to mean that when there exist some common shares caused by both oil and monetary shocks, the normalised oil price changes absorbs more predictive power than the log change in the Dubai crude oil price for GNP-based inflation. The opposite case holds when the two oil shock indicators are paired with the overnight reverse repurchase rate. The log change in the Dubai crude oil price and the overnight reverse repurchase rate account for 10.65% of the forecasted behaviour of GNP-based inflation as against 8.92% from normalised oil price changes and the overnight reverse repurchase rate.

With respect to potential asymmetric effects, the result on output is replicated on GNP-based inflation. Oil price decreases continue to have a greater effect on inflation versus oil price increases. This may simply indicate that policy response may have already wended its way into the system to limit the effects of oil price increases. Also, pairings matter. When the 91-day Treasury Bill rate is used as a proxy for monetary policy, its predictive power is higher when paired with oil price increases and decreases (4.63%) than when it is combined with normalised oil price increases and decreases (3.84%). On the other hand, when the overnight reverse repurchase rate is used to as a monetary policy indicator, its pairing with oil price increases (2.96%) contributes more to forecasting the behaviour of GNP-based inflation than when it is paired with normalised oil price increases and decreases (1.48%). When normalised monetary policy indicators are used, the percentage accounted by the combination with oil price increases and decreases (20.62%) are greater than when it is combined with normalised oil price increases and decreases (18.62%).

Table 2: Distribution of Forecast Error Variance in Percentages		
Dependent Variable = Implicit Price Index of GNP		
VAR 1	Log Change in Dubai Oil Price	1.08
	91-day Treasury Bill Rate	3.89
VAR 2	Log Change In Dubai Oil Price	8.63
	O/N Reverse Repo Rate	2.03
VAR 3	Log Change in Dubai Oil Price	10.99
	First Difference of O/N Reverse Repo Rate	4.54
VAR 4	Log Change in Dubai Oil Price	10.99
	Standardised First Difference of O/N Reverse Repo Rate	4.54
VAR 5	Normalised Oil Price Changes	23.46
	91-day Treasury Bill Rate	1.94
VAR 6	Normalised Oil Price Changes	7.83
	O/N Reverse Repo Rate	1.09
VAR 7	Normalised Oil Price Changes	9.56
	First Difference of O/N Reverse Repo Rate	6.02
VAR 8	Normalised Oil Price Changes	9.56
	Standardised First Difference of O/N Reverse Repo Rate	6.02
VAR 9	Oil Price Increases	1.49
	Oil Price Decreases	1.69
	91-day Treasury Bill Rate	4.63
VAR 10	Oil Price Increases	2.44
	Oil Price Decreases	10.49
	O/N Reverse Repo Rate	2.96
VAR 11	Oil Price Increases	4.42
	Oil Price Decreases	12.85
	First Difference of O/N Reverse Repo Rate	3.35
VAR 12	Oil Price Increases	4.42
	Oil Price Decreases	12.85
	Standardised First Difference of O/N Reverse Repo Rate	3.35
VAR 13	Normalised Oil Price Increases	5.04
	Normalised Oil Price Decreases	6.18
	91-day Treasury Bill Rate	3.84
VAR 14	Normalised Oil Price Increases	2.51
	Normalised Oil Price Decreases	8.34
	O/N Reverse Repo Rate	1.48
VAR 15	Normalised Oil Price Increases	5.60
	Normalised Oil Price Decreases	7.47
	First Difference of O/N Reverse Repo Rate	5.55
VAR 16	Normalised Oil Price Increases	5.60
	Normalised Oil Price Decreases	7.47
	Standardised First Difference of O/N Reverse Repo Rate	5.55

To shed light on the possible negative effects of both monetary policy shocks and oil shocks, impulse responses were generated from a structural VAR model. The results show that though much smaller in magnitude, monetary policy shocks have a more persistent effect on both output and GNP-based inflation.

Figure 5a. Effect on the Log Change in Real GNP from Oil and Monetary Policy Shocks Response to Cholesky One S.D. Innovations

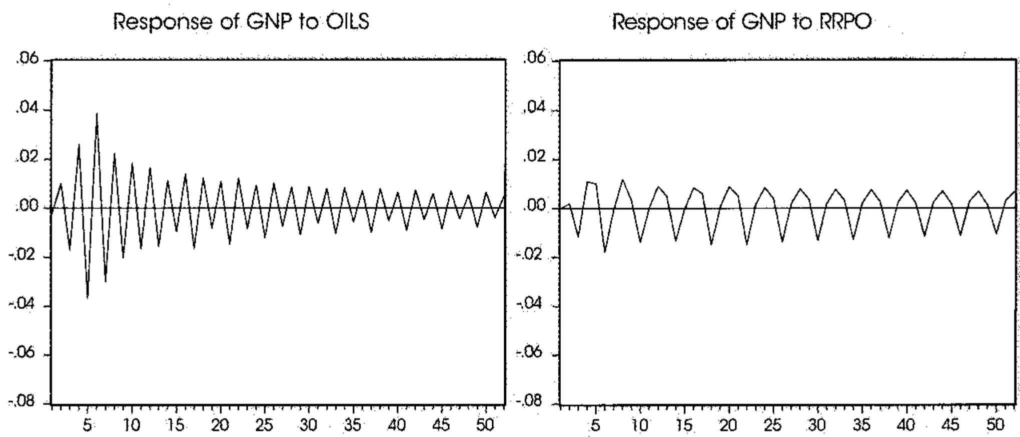
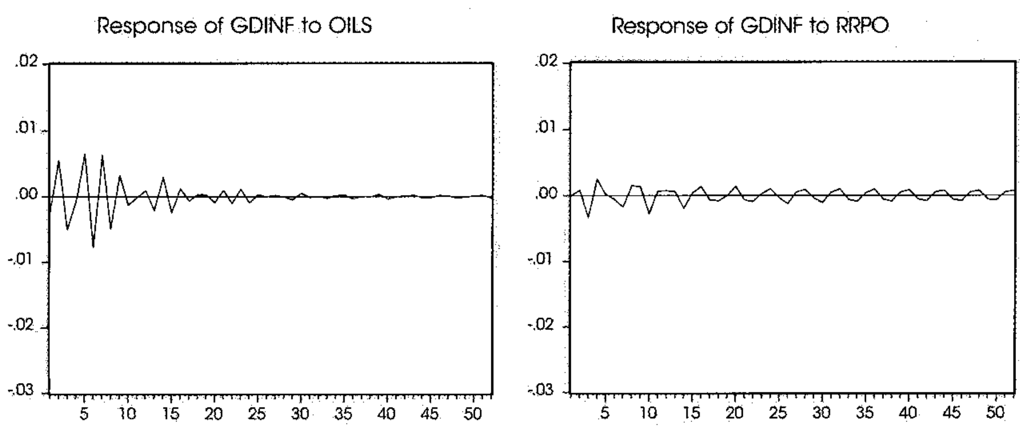


Figure 5b. Effect on GNP-Based Inflation from Oil and Monetary Policy Shocks Response to Cholesky One S.D. Innovations



Volatility on growth of output induced by an oil shock tends to start dissipating in around eight quarters while that from a monetary policy shock, though smaller in magnitude, takes much longer to go away. Also, price volatility from an oil shock appears to be completely dissipated in six years while that from a monetary policy shock persists longer.

5. Monetary Framework

With energy policy in place, the role of monetary authorities needs greater definition. Central banks have had almost universal success in bringing down inflation over the past two decades (Rogoff, Kenneth (2006)). The near-total focus on price stability by central banks has led them to help mitigate the harmful effects of oil shocks. On average, the lower inflation was less volatile and unless dislodged by strong exogenous shocks, would have made costs and prices easier to predict promoting further price stability. The same period also saw the rise of the inflation targeting as a serious monetary framework for the conduct of monetary policy.

Pre-announced inflation targets have compelled central bankers to fully account for the inflationary effects of oil price movements in monetary policy (Walton, David (2006)).This kind of transparency has limited the persistence of inflation. In this way, greater transparency in monetary policy would then contribute to greater policy credibility and anchors market expectations about inflation. With greater policy credibility, inflation expectations remain anchored even in the event of oil price volatility.

The nature of inflation targeting as a forward-looking monetary framework has also helped. Being based on inflation forecasts, careful and vigilant monitoring of price movements became the norm and any potential threat to price stability is detected early on and usually dealt with before they become serious.This limits the ability of exogenous shocks like oil price volatility from propagating their impact across the economy.

6. Scope for Monetary Policy

In an environment of higher oil prices, central bankers try to maintain a very delicate balance in their conduct of monetary policy. To combat the inflationary effects of higher oil prices, monetary policy is set such that it is tight enough to prevent inflationary pressures from oil price movements from getting entrenched or embedded in the system. At the same time, it is maintained loose enough lest output and demand be choked off. Given this, it is with greater policy vigilance and sustained credibility by the central bank that inflation expectations are prevented from taking off.

References

1. Eliot D., M. Schwartz, R. George, S. Haymes, D. Heimiller and G. Scott, (2001), Wind Energy Resource Atlas of the Philippines, Report Prepared for the National Renewable Energy Laboratory of the US Department of Energy, Golden, Colorado.

2. Rogoff, Kenneth, (2006), "The Myth of Central Banks and Inflation", Article in the 29 August 2006 Issue of The Financial Times, http://www.ft.com/cms/s/ff05c5b6-3783-11db-bc01-0000779e2340.html.

3. Walton, David, (2006), "Has Oil Lost the Capacity to Shock?", Speech Given to the University of Warwick Graduates' Association Senior Directors' Forum on 23 February 2006, http://www.bankofengland.co.uk/publications/speeches/2006/speech268.pdf.

Chapter 11

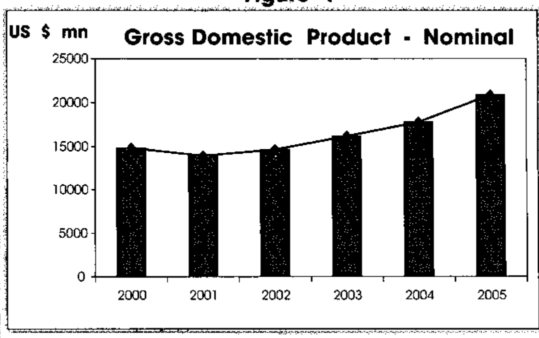
THE IMPACT AND POLICY RESPONSE TO OIL PRICE SHOCKS: THE CASE OF SRI LANKA

by D. M. Rupasinghe
Central Bank of Sri Lanka

1. Introduction

Sri Lanka is a small open developing economy. During the five decades since independence in 1948 from the British, the economy grew by 4.2 annually. However, the economy recorded a negative growth of 1.4 in 2001.The per capita nominal income in 1948 was estimated at US$120 or Rs. 397.This reached US$ 1,197 (Rs.120, 282) by 2005, an annual increase of 11 per cent.The year 1977 was a landmark in the economic and social policies of the post-independence period. In 1977, a package of economic reforms was introduced, making Sri Lanka the first country in the South Asian region to liberalise its economy.These reforms included relaxation of exchange control regulations, dismantling of import controls, rationalisation of trade policies, liberalisation of the financial sector, gradual disengagement of the government from direct investment in commercial activities, encouragement of private sector investment (both local and foreign) and setting up of free trade zones.

Figure 1



Having realised the benefits of liberal economic policies, all successive governments in the power after 1978, have accepted market oriented policies, thereby reducing the risks of frequent policy changes with changes in government.The successive governments have shown a firm commitment to maintain open economic policies since 1977, through structural reforms, including an extensive privatisation programme and a medium term budget fiscal consolidating programme to promote non-inflationary growth. While welfare programmes have been better targeted in recent times, free education and free health services have continued since independence. Due to the new policy implemented by governments since 1977, the GDP has increased by annual average rate of 5 per cent during 1978-2005 periods.

2. Energy Sector

The major sources of energy in Sri Lanka are the bio-mass (47 per cent), used mostly by households and on a limited scale in the processing of plantation crops, petroleum (45 per cent) and hydropower (8 per cent). The contribution from alternate energy sources such as solar power and wind power is insignificant. However, the most commercially intensive energy sources are electricity and petroleum. Hydro-electric power generation expanded under the public sector and became a major indigenous source of energy. Due to capacity limitations in hydro- power generation and its vulnerability to weather conditions, the reliance on hydro power is being reduced, with diversification towards thermal power based electricity. The demand for energy increased with the rapid expansion in transport activities, increased industrialisation, growth of the population and per capita incomes and urbanisation. The demand grew faster after the economic liberalisation in the late 1970s. The share of petroleum in the total energy supply has been rapidly increasing from 32 per cent in 1996 to around 45 per cent in 2005 as a result of increasing demand. Therefore, Sri Lanka is heavily and increasingly dependent on petroleum products as a major source of energy and hence is highly vulnerable to oil price shocks.

Figure 2
Total Energy Consumption

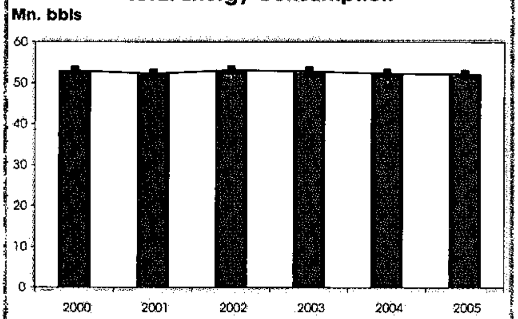
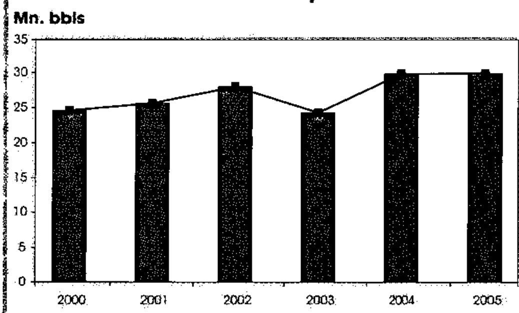


Figure 3
Petroleum Imports



3. Policy Changes in The Energy Sector

At the time of independence in 1948, State involvement in the energy sector was very minimal and the import and distribution of petroleum was handled entirely by the private sector of the three major foreign oil companies of Shell, Esso and Caltex. However, after independence, the importance of state intervention in developing energy activities was recognised and therefore, the supply, distribution and import of energy were brought under a government monopoly. Accordingly, the institutional base was created to undertake electricity generation and distribution, imports, refine and distribution of petroleum products and import and distribution of LP gas. The major institutions responsible for those activities in the energy sector were the Ceylon Electricity Board (CEB), the Ceylon Petroleum Corporation (CPC) and Colombo Gas Company respectively. The Ceylon Electricity Board (CEB) was established in 1969 with the enactment of the CEB Act No 17 of 1969 with monopoly power in the electricity sector identifying the need to have a national grid with a centralised ownership and management of the power supply system by a single utility company. In the case of petroleum products, imports and distribution were nationalised in 1961 and the Ceylon Petroleum Corporation (CPC) was established with monopoly power in the petroleum industry. Subsequently, CPC has invested in developing storage facilities, blending and marketing of lubricants, refining of crude oil, Agro Chemicals, Bunkering and Aviation. The petroleum refinery was established in 1963 with foreign assistance.

Commencing from 1990, the government has been introducing measures aimed at liberalisation and improving the efficiency of energy use. The energy policy was therefore, characterised by reduction of dependence on hydro power, diversification of energy sources, adoption of appropriate pricing policy, and private sector participation to improve the efficiency of energy supply and distribution. Within this policy framework; expansion of the power generating capacity through private sector participation is being encouraged. The first such private power generation project (51 MW) under this policy frame work was completed in 1995 on BOO/BOT basis.

The petroleum sector restructuring process commenced in the early 1990s. In line with Government's policy to make each division to be viable in a competitive environment, all subsidiary business of CPC was given to private investors excluding Refinery (at Sapugaskande), Agro business and Aviation. Accordingly, the bunkering and aviation segment of the CPC was handed over to the private sector in 1990. Meantime, the Colombo Gas Company was privatised in 1995. The local retail petroleum market was also opened for competition in 2003 ending the monopoly held by CPC since its inception. In 2002, the Government of India was invited to enter into downstream retail marketing of petroleum of Sri Lanka by offering the China Bay Tank Farm (in Trincomalee), 100 Filling Stations and one third of storage facilities, Pipe line network and bowser fleet to their nominee Indian Oil Corporation (Lanka IOC). Accordingly, Lanka Indian Oil Corporation (LIOC) entered the local market for importing and retailing petroleum products in 2003. A storage and distribution company called Ceylon Petroleum Storage Terminals Ltd. (CPSTL), was incorporated in November 2003 to manage common user facilities such as oil terminals, storage facilities and pipelines. With these reforms and improving competition, the petroleum sector was expected to operate efficiently, based on market principles, for the benefit of consumers.

For the adoption of appropriate pricing policy, the petroleum pricing formula was introduced in 2002. Prior to the introduction of a pricing formula in January 2002, the Minister in charge of Petroleum was empowered to decide the domestic prices of petroleum products in consultation with the Minister of Finance. The main objective of the pricing formula was to pass any benefit or cost arising from the changes in the cost of petroleum products to consumers in a transparent way and to maintain commercial viability of the petroleum industry. According to the new system, price adjustments were to be implemented monthly, based on the average international prices of the previous month. In the case of price increases, the maximum pass-through permitted per month was Rs. 2.00 per litre and the minimum was Rs. 0.25 per litre per month. However, domestic prices have not been adjusted strictly according to the formula when the required adjustments were excessive during sharp rises in international prices since February 2004. Therefore, the government had to pay the difference between formula prices and retail prices as subsidy. Total subsidy payments to oil companies amounted to Rs. 17.5 billion in 2004 and Rs 26.0 billion in 2005. As claimed by oil companies, total subsidy obligation of the government has been estimated to be Rs. 9.4 billion for January - June 2006. The government decided in June 2006 to discontinue subsidy payments and CPC and LIOC were permitted to decide their retail prices on commercial terms from July 2006. To stream-line the energy sector, the National Energy Policy and Strategies for Sri Lanka was introduced in 2006. Among the policy areas are providing basic energy needs, ensuring energy security, promoting energy efficiency and conservation, promoting indigenous resources and adopting an appropriate pricing policy. In this regard, it is noted that the government will endeavour to reach a level of 10 per cent of grid electricity using Non-conventional Renewable Energy (NCRE) by 2015.

4. Petroleum Sector

Sri Lanka imports around 30 million barrels of petroleum products per annum. Of this, 50 per cent represents crude oil usually imported by the CPC. The balance of 50 per cent are refined products imported by CPC, LIOC and other private sector institutions, which import various types of products such as LP Gas, lubricants and furnace oil. The CPC imports crude oil mainly from three countries, namely Iran (70 per cent), Malaysia (20 per cent) and Saudi Arabia (10 per cent). Since the refinery does not operate on a single variety, it needs a blend of crude oil imported particularly from these countries. Refined products are usually imported from Singapore and the Middle East. The value of petroleum imports increased by 44 per cent to US$ 1,210 million in 2004 from US$ 838 million in 2003 reflecting a 28 per cent increase in prices and a 9 per cent increase in volume. Expenditure on petroleum imports increased by 37 per cent to US$ 1,655 million in 2005 driven by an equal increase in prices. In 2006, the cost of petroleum imports was US$ 2,070 million with the average crude oil import price of US$ 65 per barrel. The average import prices of CPC are usually lower than Brent prices by US$ 1 to 4 per barrel as CPC imports a mix of crude varieties.

Table 1
International Crude Oil Prices and Crude Oil Import of CPC

(US$ per bbls)

Period	Brent	Iranian light*	Difference
2004	38.29	37.4	0.89
2005	54.48	50.92	3.56
2006	65.18	64.31	0.87
2006			
January	63.18	55.91	7.27
February	60.15	62.62	-2.47
March	62.12	62.24	-0.12
April	70.08	65.53	4.55
May	69.89	70.77	-0.88
June	68.56	67.08	1.48
July	73.77	71.74	2.03
August	73.13	72.03	1.10
September	61.86	68.04	-6.18
Octomber	57.59	59.71	-2.12
November	59.42	55.49	3.93
December	62.46	60.51	1.95

* CPC import price
Source: Energy Information Agency Ceylon Petroleum Corporation

A summary of the salient features of the petroleum sector in Sri Lanka is given below.

Salient Features of Petroleum Sector

1. Imports of petroleum	30 million barrels per year
2. Share of Crude Oil	50 per cent
3. Average import price of crude oil	US $ 29 in 2003, US $ 37 in 2004, US $ 52 in 2005 and US $ 64 in 2006 per barrel.
4. Total import cost	US $ 838 mn in 2003, US $ 1,210 mn in 2004, US $ 1,655 mn in 2005, and US $ 2,070 mn in 2006.
5. Domestic Taxes	Excise Duty per ltr: Rs. 20.00 on petrol and Rs. 2.50 on diesel VAT : 15% on petrol Provincial TT: 1% on imports, 1% on sales
6. Subsidy	Rs. 17.5 bn in 2004, Rs. 26.0 bn in 2005, Rs. 9.4 bn in the first half of 2006
7. Sectoral Consumption	Transport 50%, power 25%, other 25%
8. Thermal power generation	65 per cent of total power generation

5. Petroleum Consumption in Sri Lanka

Sri Lanka is increasingly dependent on petroleum as a major source of energy. The largest petroleum user in Sri Lanka at present is the transport sector (50 per cent) followed by power generation (25 per cent), and the remaining 25 per cent being consumed by industries and households. As seen further in Table 2, usage of petroleum in power generation is rapidly increasing due to serious limitations in hydropower generation. In 2005, thermal power generation was 60 per cent of total power generation. To meet the needs of increased economic activity, in addition to power generation, the fuel usage may increase and future imports of petroleum products are expected to be around 32-35 million barrels in 2008-2010. Since petroleum consumption is comparatively less elastic in Sri Lanka, a price increase may not result in substantial reductions of consumption. The price elasticity of diesel consumption in Sri Lanka is estimated to be around 0.15 while that of petrol consumption is 0.3. Thus, for example, assuming an average price elasticity of 0.2, a 25 per cent increase in fuel prices would result in a reduction of about 0.15 million barrels demanded per annum.

Table 2
Petroleum Consumption by Sectors

(Mn bbls)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Transport	7.4	8.1	8.6	9.7	10.3	11.1	11.5	11.5	10.3	13.8	13.8
Industry	1.5	1.8	1.9	2.3	2.3	2.1	2.1	2.1	1.7	1.8	1.9
Commercial	0.2	0.3	0.3	0.2	0.3	0.3	0.4	0.3	0.3	0.3	0.2
Power	0.7	2.3	3.1	2.5	3.1	6.3	5.9	7.1	6.8	8.3	8.0
Agriculture	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Household	1.8	1.8	1.8	1.9	1.9	1.8	1.8	1.8	1.6	1.6	1.5
Aviation	0.7	0.9	0.8	0.9	1.1	1.2	1.1	0.9	1.1	1.4	1.4
Grand Total	12.4	15.2	16.6	17.6	19.1	22.9	22.9	23.8	21.9	27.3	27.1

Source: Central Bank of Sri Lanka

Table 3
Petroleum Consumption by Products

(MT '000)

Year	Petrol (90 Octane)	Petrol (95 Octane)	Auto Diesel	Super Diesel	Kerosene	Furnace Oil	Avtur	Naptha	LP Gas	Total
1996	197	-	1,048	26	228	336	110	-	88	2,033
1997	193	-	1,295	33	225	372	104	-	99	2,321
1998	204	n.a.	1,224	38	236	706	113	-	117	2,638
1999	213	3	1,377	40	243	676	143	-	140	2,835
2000	220	4	1,715	47	229	785	157	-	146	3,303
2001	244	5	1,675	49	228	811	138	14	141	3,305
2002	277	9	1,728	47	297	758	114	56	157	3,375
2003	375	16	1,663	42	207	715	139	102	161	3,419
2004	417	20	1,890	36	204	748	170	96	166	2,747
2005	443	20	1,674	16	209	973	178	125	165	3,803

Sources: Ceylon Petroleum Corporation
Shell Gas Lanka Ltd
Laugfs Gas (Pvt) Ltd
Lanka IOC Ltd

6. Impacts of Oil Price Hike

As mentioned earlier, since the petroleum sector in Sri Lanka entirely depends on imports, the oil price hike in 2004/05 led to severe external and internal imbalances. It had an adverse impact on macroeconomic stability especially on inflation, the balance of payments and the fiscal deficit. Further, the impacts of the oil price hike on an oil importing developing country like Sri Lanka is largely dependent on the resilience of the economy to external shocks and to the policy responses to mitigate the impacts. In the meantime, the magnitude of the impact would also depend on the energy intensity, efficiency of energy use and the availability of alternative energy sources. Since Sri Lanka is entirely depending on petroleum imports, an oil price hike always leads to severe external and internal imbalances until corrective measures are taken. As witnessed in recent years, this has led to a widening of the trade deficit, leading to a worsening of the overall balance of payments and a decrease of the country's foreign reserves which brought more pressure on the exchange rate. The correction of the domestic imbalance would depend largely on the extent to which a pass-through of the high oil prices is permitted, but this on the other hand, is a highly politically sensitive issue.Therefore, the absorption of high oil prices by the government through the payment of subsidies led to compounded economic issues such as a widening of the budget deficit, rising public debt and interest rates and reduction in public investment creating more pressure for long-term inflation.

Table 4
Petroleum Dependency

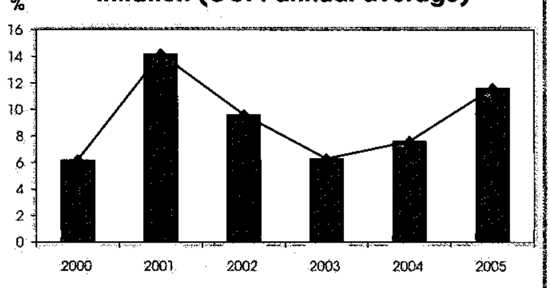
Year	GDP at Market Price (US$ mn.)	Total Imports (US$ mn.)	Total Exports (US$ mn.)	Total Petroleum Import (US$ mn.)	Total Petroleum Import as % of GDP	Total Petroleum Import as % of Total Import	Total Petroleum Import as % of Total Export
1996	13,898	5,439	4,095	479	3.4	8.8	11.7
1997	15,092	5,864	4,639	539	3.6	9.8	11.6
1998	15,761	5,889	4,798	345	2.2	5.9	7.2
1999	15,712	5,979	4,610	500	3.2	8.4	10.8
2000	16,596	7,320	5,522	901	5.4	12.3	16.3
2001	15,750	5,974	4,817	731	4.6	12.2	15.2
2002	16,537	6,105	4,699	789	4.8	12.9	16.8
2003	18,247	6,672	5,133	838	4.6	12.6	16.3
2004	20,055	8,000	5,757	1,210	6.0	15.1	21.0
2005	23,539	8,863	6,347	1,655	7.0	18.7	26.1

Source: Central Bank of Sri Lanka

6.1. Impact on Prices

Along with the increases in international oil prices, domestic prices were also expected to increase according to a pricing formula introduced in January 2002. The main objective of the pricing formula was to pass any benefit or cost arising from the changes in the cost of petroleum products to consumers in a transparent way in addition to maintaining commercial viability of the petroleum industry. According to the formula, price adjustments were to be implemented monthly, based on the average international prices (basically Singapore prices) of the previous month. However, domestic prices have not been adjusted strictly according to the formula when the required adjustments were excessive during sharp rises in international prices. Though not increasing in tandem with international prices, domestic prices of petroleum products nevertheless increased substantially since 2003, raising the cost of petroleum products in the domestic market. Prices of petrol, auto-diesel and kerosene at end 2006 were higher by 74 per cent, 88 per cent and 87 per cent, respectively, compared to end 2003 prices.

Figure 4
Inflation (CCPI annual average)

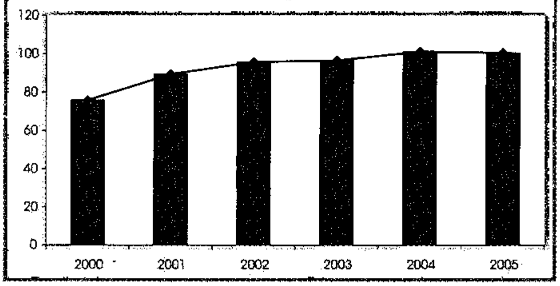


The sharp rises in energy prices had a significant impact on domestic price levels and inflation as transport, power and industrial sectors of the country are heavily dependant on petroleum products as the major source of energy. Although it was not a full pass through, the increase in diesel price had a direct impact on the cost of transportation and thermal power generation. The indirect impacts were mainly through the increase in transport cost of goods and services and increase in electricity tariff. With respect to inflation as measured by the Colombo Consumers' Price Index (CCPI), the official cost of living index, the direct impact of a 10 per cent increase in oil prices results in a 0.173 per cent increase in the CCPI, while the indirect impact results in a 1.21 per cent increase during the first month. A sharp increase in domestic petroleum prices was one of the factors that contributed to higher inflation in 2004. Monetary policy measures have helped to contain further inflationary pressures and inflation was on a declining trend from early 2005. Point to point inflation measured in terms of the CCPI declined to 8 per cent by end 2005 from the peak of 15.9 per cent at end February 2005. However, this trend was reversed by end 2006.

6.2. Impact on the Balance of Payments

The impact of the oil price shock was clearly witnessed in the country's balance of payments in 2004 when the BOP recorded a deficit of US$ 205 million following the BOP surpluses in 2001-2003 period. The share of expenditure on oil in total imports was rising and was 19 per cent in 2005 compared to 15 per cent in 2004 and 12 per cent in 2003. Total expenditure on petroleum imports in 2004 amounted to US$ 1,210 million with an average crude oil import price of US$ 37 per barrel. The BOP deficit in 2004 was largely the result of the increase in expenditure on oil imports by US$ 373 million. Although expenditure on oil imports further increased in 2005 and 2006 and estimated as US$ 1,655 and 2,070 million respectively, the adverse impact on the BOP was mitigated through higher financial inflows by way of external financial arrangements for oil imports, higher worker remittances and higher export earnings. As a result, the BOP recorded a surplus of around US$ 460 and US$ 204 million in 2005 and 2006.

Figure 5
Exchange Rate

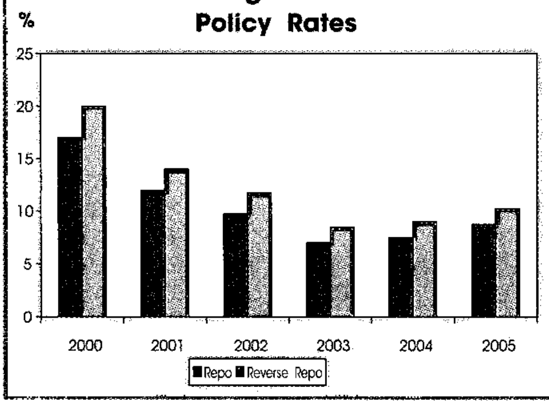


6.3. Impact on the Fiscal Sector

The sharp increase in international oil prices has caused severe implications for the fiscal sector in Sri Lanka mainly through subsidies and loss of revenue. The non-adjustment of domestic petroleum prices in line with international oil prices has increased fiscal expenditure through higher subsidies. Similarly, the government had to reduce or exempt some taxes (VAT, excise duty etc) on petroleum products, resulting in a loss in revenue. These measures have largely contributed to widening the fiscal deficits from the original targets in 2004 and 2005.

Domestic prices of major petroleum products are supposed to be revised monthly as per the pricing formula. However, domestic prices have not been adjusted according to the pricing formula since February 2004. Since it is difficult to pass sharp increases in international prices to domestic prices immediately in countries like Sri Lanka, due to severe welfare implications especially on the poorer segments of the population, the government absorbed a significant part of the higher oil prices by providing subsidies.The non-adjustment of prices has also caused severe losses to oil companies CPC and LIOC requiring the government to intervene with heavy subsidies which contributed to the large fiscal deficit in 2004 and 2005. Total subsidy payments to oil companies amounted to Rs. 17.5 billion in 2004 and Rs 26.0 billion in 2005. As claimed by oil companies, total subsidy obligation of the government has been estimated to be Rs.9.4 billion for January - June 2006. The delays and inadequate adjustments in prices also resulted in the continued increase in domestic consumption of fuel and further raising the losses incurred by the oil distributors. This led to both increases in the subsidy payments by the government and deterioration in the Balance of Payments (BOP). In addition, the government had to incur additional expenditures on the fertiliser subsidy as chemical fertiliser prices increased in international markets in line with the increases in oil prices. On the revenue side, there was a net loss in revenue due to the adjustment and removal of certain taxes on petroleum products and sales to some state owned enterprises, For example, the Ceylon Electricity Board (CEB) has been exempted from paying the excise duty of Rs 2.50 per litre for diesel used in power generation. Unexpected higher expenditure and lower revenue from petroleum products was largely responsible for increasing the budget deficit in 2005, which was 8.7 per cent of GDP compared to the original estimate of 7.5 per cent. Higher oil prices have also increased the borrowings of state owned enterprises (SOEs) especially CPC and the CEB from the banking sector, particularly in 2004. The CPC has been able to improve its financial position in 2005 through various measures but the CEB's position still remains a concern. Higher borrowings by SOEs and the government from the banking sector have contributed to the higher monetary expansion during 2004 and 2005. However, tighter monetary policy measures introduced since late 2004 have contained inflationary pressures arising from higher monetary aggregates.

Figure 6
Policy Rates



7. Policy Issues

The recent oil price shock has given rise to several policy issues as well as short-term and medium to long-term energy resource planning in Sri Lanka during the last two years. The policy issues relate to the domestic pricing, monetary management, reserves management, development of low cost energy sources and discouraging inefficient use of energy, while encouraging non-traditional renewable energy sources and promoting energy conservation. The Sri Lankan government has taken a series of measures (short-term as well as medium to long-term measures) to mitigate the adverse impact of high oil prices on the economy on a sustainable basis. Domestic prices of petroleum products, particularly petrol and diesel have increased substantially, to reflect increased international prices to a large extent thereby mitigating the fiscal implications arising from subsidy payments, while minimising the impact on the most vulnerable segments of the economy. The government successfully negotiated several bilateral agreements with oil exporting countries that permits the import of oil on an extended supplier's credit facility or on a credit basis to reduce the impact of the oil price increase on the BOP. Iran granted six months suppliers' credit for oil imports up to the value of US$ 150 million during the first half of 2005. India has granted a concessionary loan of US$ 150 million repayable in seven years with a one year grace period for oil imported from India. The government also raised the import duty and VAT on luxury and fuel inefficient heavy vehicles as an energy saving measure.

Moreover, the government has encouraged the development of alternative renewable energy sources, particularly mini hydropower plants and dendro power plant by the private sector. There are 48 such power plants with a capacity of 102 MW already in operation and 11 power plants with a capacity of 25.5 MW are under construction. It is encouraging that some processing industries such as tea factories have been shifting to their own sources of energy like mini hydro power plants or bio-mass (dendro), thereby reducing the dependence on petroleum. The government has already taken steps to expedite the construction of the proposed coal power plant, at Norochcholai initially with a capacity of 300 MW. The construction work of the long delayed 150 MW Upper Kotmale hydropower plant has also commenced in 2005. Two thermal power projects, each with the capacity of 300 MW are also to be installed at Kerawalapitiya to meet the rising demand during 2008 - 2011. Proposals to construct two more coal power plants at Trincomalee (500 MW) and Hambantota (600 MW) are at initial stages of negotiations. In the meantime, the government is also examining possibilities of importing electricity from India to meet the rising demand. Further, the Budget for 2006 has allocated Rs. 500 million to promote the installation of solar power units in rural areas for which a project has already been implemented. The government has declared Gliricedia as the 4th national plantation crop (next to tea, rubber and coconut) considering its importance as a source of input for dendro power generation. Meantime, the government is planning to enhance Sri Lanka's capacity for refining oil with foreign collaboration.

The most noteworthy step taken during this period is expediting the off-shore oil exploration activities. Sri Lanka has made several attempts at oil exploration since the 1970s. The most current attempt at oil exploration commenced in 2001. Several hydro-carbon location surveys were carried out with donor assistance. These surveys show that the likelihood of finding hydro-carbon deposits in off-shore areas of the Western and North-Western regions is high. Several promotional conferences have already been held in the USA, the UK, and India and in China with a view to persuade private investors to commence oil exploration activities in Sri Lanka. In view of rising oil prices in the international market, the Sri Lankan government has taken initial steps towards the exploration of oil in the North Western offshore area in 2006. Tenders will be called from international oil companies in 2007 and awarding of tenders will take place in 2008 in addition to the preparation and drafting of rules and regulations to implement a formal procedure in the commercial operation of oil extraction in Sri Lanka.

8. Conclusion

It is clear that the recent oil price shock has had adverse economic impacts, particularly during 2004/05. The shock contributed broadly to the worsening of the macroeconomic imbalance through higher inflation, and a widening of the external sector and fiscal deficits. In response, Sri Lanka introduced several short and medium-term measures to mitigate the adverse impact. The economy has responded positively to these measures and as a result, macroeconomic imbalances have improved during 2005/06. As mentioned earlier, a sharp increase in domestic petroleum prices was one of the factors that contributed to higher inflation in 2004. Monetary policy measures have helped to contain further inflationary pressures and inflation was therefore on a declining trend from early 2005. The external position remained strong in 2005 and 2006 except 2004, recording BOP surpluses. Any adverse impact on the BOP was mitigated through higher financial inflows by way of external financial arrangements for oil imports, higher worker remittances and higher export earnings. GDP growth in 2004 and 2005 has been remarkable and rising above the average of 5 per cent during last two decades. The growth of 5.4 per cent and 6.0 per cent in 2004 and 2005 respectively were largely driven by the service sector in response to the conducive policies. Amidst relatively higher inflation and fiscal deficit, GDP growth for 2007 is projected to be around 7.0 per cent. The larger subsidy claims during 2004 and 2005 were a major concern but the government was able to manage it by discontinuing subsidy for diesel and petrol in June 2006. Petroleum distributors, CPC and LIOC are now permitted to decide their own retail prices on commercial terms from July 2006. The need for the consolidation of domestic prices was highlighted and the government through CPC initiated hedging of oil purchases against adverse price movements. Hedging of oil purchases is vital in light of volatile international oil prices, to ensure stability in prices and other economic variables in Sri Lanka. In spite of macroeconomic imbalance in light of higher inflation and a widening of the external sector and fiscal deficits, it is encouraging to note that there are prospects for finding oil reserves in Sri Lanka.

Chapter 12

THE IMPACT AND POLICY RESPONSE OF OIL PRICE SHOCKS IN TAIWAN

by Jyh-Miin Lu[1]
The Central Bank of the Republic of China (Taiwan)

1. Introduction

The rising oil prices in the past few years have caused great concern among policy makers of central banks in the world. Taiwan, which imports almost all of the oil it consumes, unavoidably has to confront the impact of rising oil prices. Although Taiwan seems to be quite vulnerable to oil price shocks, statistics have shown the contrary. In the past three years, Taiwan's economy exhibited steady growth while inflation was quite stable.

Oil price shocks may affect real output through several channels. Leduc and Sill (2001) summarised these channels from their survey of the literature: (1) Oil enters the production function of firms, so increases in oil prices lead firms to demand less oil and capital, bringing about a fall in production. (2) An increase in oil prices transfers income from oil importing nations to oil exporting ones. And if the oil exporters do not spend all of their oil revenues on the goods and services from oil importers, demand for output will fall in the latter. (3) Oil price movements will increase the risk that investors face, causing them to delay new investment projects with a subsequent lowering of future output. 4) As emphasised by Hamilton (2000), oil price movements may not affect all firms equally, and if it is costly to shift labour and capital across sectors of the economy, then employment and output will fall following a rise in oil prices.

In addition to the shocks on output, oil price rises may affect the general prices of a nation. Oil price increases not only make the prices of oil related products rise but also may spill over to the prices of other goods and services, causing general prices to increase.

As price stability is one of the main tasks of a central bank, it becomes very important for central banks to implement monetary policy properly, so as to maintain price stability while keeping the impact of oil prices on output to the minimum.

This Paper will try to find out the extent to which oil price shocks affect the economy of Taiwan and how the policy maker of Taiwan responds to oil price shocks. Section 2 will measure the impact of oil price shocks on Taiwan's economy. Section 3 will discuss the monetary policy responses to oil price shocks in Taiwan. And Section 4 concludes the previous discussion.

2. The Impact of Oil Price Shocks on Taiwan's Economy

2.1. Methodology

In analysing the impact of oil prices, a lot of literature has been based on empirical Vector Autoregression (VARs) models. For example, Leduc and Sill (2001) calibrated the output response to an oil-price shock by using a four-variable VAR that includes the ordering oil-price, output, prices, and interest rates. They found that, at its maximum, output falls 4.5 percent in response to a doubling of the price of oil. Mork (1989) argued that the effects of positive and negative oil price shocks on the economy need not be symmetric. Hamilton

1 The views expressed here are those of the author and do not necessarily reflect those of The Central Bank of the Republic of China (Taiwan)

(1996) proposed a complicated measure of oil price changes and found that oil prices have a relatively stable relationship with macroeconomic variables. Jimenez-Rodriguez and Sanchez (2004) utilised multivariate VAR analysis to empirically assess the effects of oil price shocks on the real economic activity of the main industrialised countries, and found evidence of a non-linear impact of oil prices on real GDP. In particular, oil price increases are found to have greater impact on GDP growth than oil price declines, which have statistically insignificant impacts in most cases.

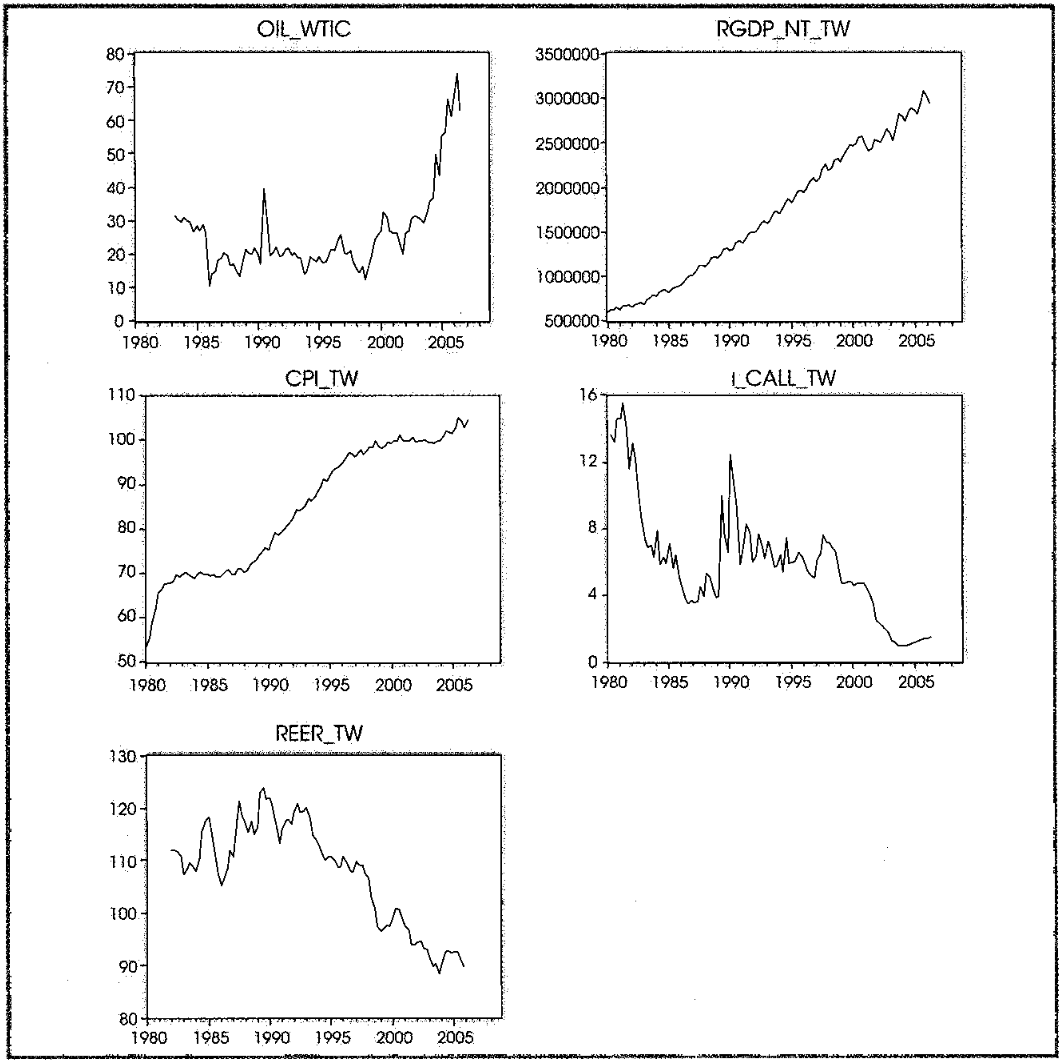
In analysing the impact of oil prices on Taiwan's economy, this Paper will establish a VAR model to measure the extent of the impact. The empirical study covers the sample period from 1983Q4 to 2005Q4, excluding the asset price bubble period from 1989Q2 to 1990Q2 when the central bank tightened its monetary policy dramatically, causing money market interest rates to over shoot. The model is a VAR model with five variables in this order: (1) international oil prices represented by the log of the price of West Texas intermediate crude, (2) the log of real GDP, (3) the log of the consumer price index, (4) the level of the inter-bank call-loan rate and (5) the real effective exchange rate. With such ordering, it is assumed that the error terms of the model are identified by Cholesky decomposition. The international oil price is chosen to be the first variable, as it affects other macro-economic variables and financial variables. The inter-bank call-loan rate is used as an indicator of monetary policy. As Taiwan is a small open economy, the real effective exchange rate is included to reflect the influence of the external sector on the economy. The VAR model is estimated based on quarterly data, and the lag length is determined by final prediction error and is set at two quarters. Besides the above five variables, a constant term and three centred seasonal dummy variables are also included. The model satisfies the stability condition because all of the inverse roots of the characteristic polynomial lie within the unit circle.

2.2. Data

The data used in this article are shown in Table 1. As almost all of Taiwan's need for petroleum is imported from foreign countries, this Paper uses the price of West Texas intermediate crude to represent the international oil price. As can be seen from the following figures, international oil prices moved along a steep upward trend in the past three years, while output and consumer prices were very stable. The inter-bank call-loan rate moved along a downward trend after the Asian financial crisis until the second quarter of 2004, and began to rise mildly from then on. The real effective exchange rate in general reflected a trend of depreciation after the outbreak of the Asian financial crisis in 1997.

Table 1
Data Specifications

Notation	Variable Descriptions	Unit	Sample Range	Base Period
Oil_WTIC	International crude oil price West Texas intermediate crude	US$/barrel	1983:2 2005:4	
RGDP_NT_TW	Real Gross Domestic Product at 2001's constant price	Million NT$	1981:1 2005:4	
CPI_TW	Consumer price index		1981:1 2005:4	2001
I_CALL_TW	Interbank call-loan rate	Percentage points	1981:1 2005:4	
REER_TW	Real effective exchange rate		1982:1 2005:4	2000

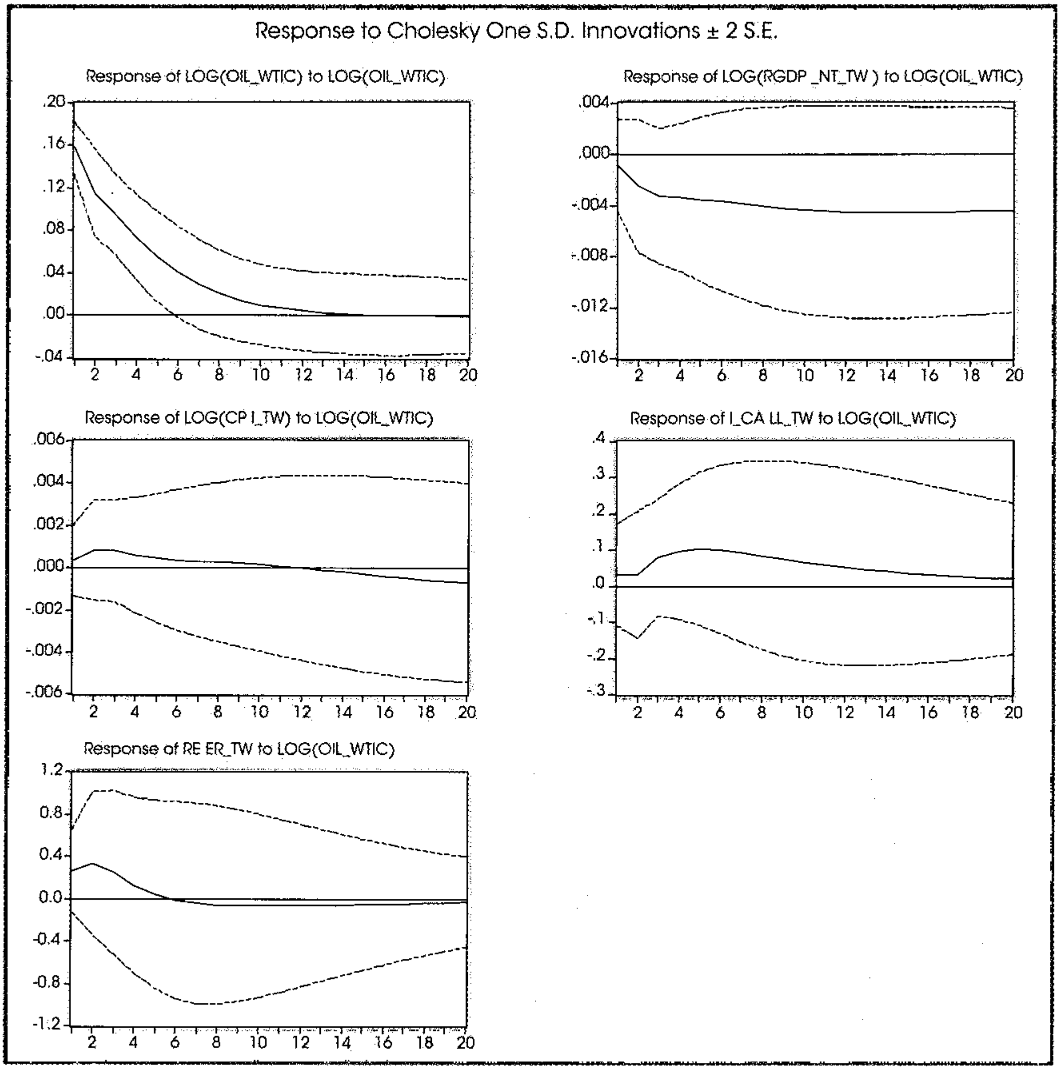


The unit root test for the endogenous variables LOG(OIL_WTIC), LOG(RGDP_NT_TW), LOG(CPI_TW) and REER_TW shows that these series are I(1), while I_CALL_TW is I(0).This Paper further goes on to test the co-integration relationship among these variables. However, the maximum Eigenvalue test indicates no co-integration at the 5% level.This result may be due to the prolonged swing in the inter-bank call-loan rate and the sample size being too small to lead to meaningful results. As a consequence, the above-mentioned VAR model will be used in the later discussion.

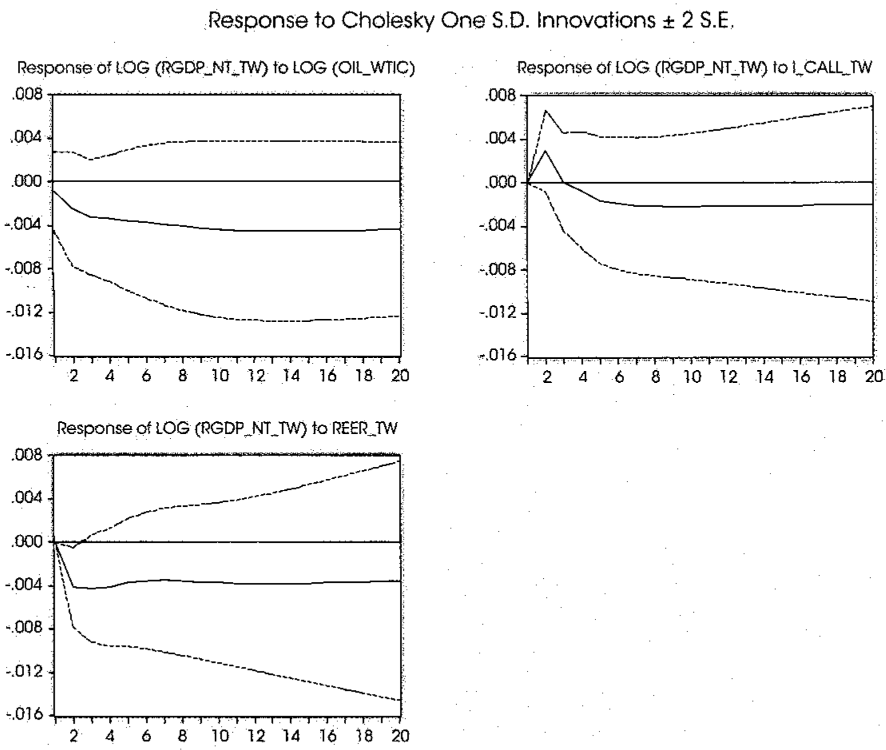
2.3. Empirical Results

The empirical results of the above VAR model are reported in appendix A.The following figure shows the responses of all the endogenous variables to one standard deviation of the international oil price shock.

In response to this oil price shock, real GDP will decrease, consumer prices increase moderately for about two and a half years, the inter-bank call-loan rate (the monetary indicator) increases and reaches a peak at the fifth quarter, then gradually dies out, and the real effective exchange rate responds with appreciation in the first five quarters.



These findings indicate that the output losses are caused not only by oil price hikes, but also by the appreciation of the exchange rate and the monetary responses of interest rate rises. As can be seen from the following figures, output responds with a loss to the positive shocks of oil prices, inter-bank call-loan rate and real effective exchange rate.



The size of the impact of a doubling of oil prices to output is found to be 4.7% to 7.2% in the first two years which is not too far away from the maximum output loss of 4.5% found by Leduc and Sill (2001).

The above analysis uses the log of the level of international oil prices. In addition to this, this article also tries alternative indicators of the oil market such as those used by Mork (1989) and Hamilton (1996). However, replacing oil price levels with these indicators do not lead to any meaningful results, because the output increases in response to positive oil price innovations.

To find the factors that cause the variation in output and consumer price index, Table 2 and Table 3 list the variance decomposition table of LOG(RGDP_NT_TW) and that of LOG(CPI_TW), respectively.

Table 2 shows that variations in output are mostly affected by itself, followed by oil prices and real effective exchange rates. Inter-bank call-loan rates only account for two percent of total output variations.

Table 2
Variance Decomposition of LOG (RGDP_NT_TW)

Period	S.E.	LOG (OIL_WTIC)	LOG (RGDP_NT_TW)	LOG (CPI_TW)	I_CALL_TW	REER_TW
1	0.157853	0.268632	99.73137	0.000000	0.000000	0.000000
2	0.200281	1.288210	93.05291	0.788834	1.611936	3.258109
3	0.225978	2.301886	91.12169	0.799625	1.130355	4.646443
4	0.240625	2.963422	89.61671	1.052374	0.934436	5.433063
5	0.249911	3.502832	88.57321	1.276333	0.987501	5.660120
6	0.257184	3.973743	87.69964	1.479153	1.108171	5.739290
7	0.264205	4.428653	86.91380	1.619444	1.248447	5.789654
8	0.271553	4.875760	86.17476	1.708128	1.373716	5.867637
9	0.279222	5.312675	85.47285	1.756822	1.481185	5.976465
10	0.286983	5.731636	84.81074	1.779098	1.571590	6.106933
11	0.294588	6.126372	84.19447	1.784612	1.648150	6.246392
12	0.301839	6.493117	83.62843	1.780002	1.713439	6.385015
13	0.308603	6.830634	83.11396	1.769425	1.769543	6.516438
14	0.314809	7.139450	82.64973	1.755453	1.818017	6.637346
15	0.320427	7.421162	82.23262	1.739640	1.860085	6.746493
16	0.325458	7.677884	81.85855	1.722931	1.896738	6.843898
17	0.329925	7.911907	81.52314	1.705900	1.928799	6.930253
18	0.333861	8.125491	81.22208	1.688898	1.956964	7.006564
19	0.337306	8.320763	80.95134	1.672138	1.981827	7.073933
20	0.340306	8.499666	80.70724	1.655749	2.003890	7.133452

As shown in Table 3, the consumer price index is primarily affected by output and itself, followed by real effective exchange rates and inter-bank call-loan rates. International oil prices have little effect on the variation of the consumer price index.

Table 3
Variance Decomposition of LOG (CPI_TW)

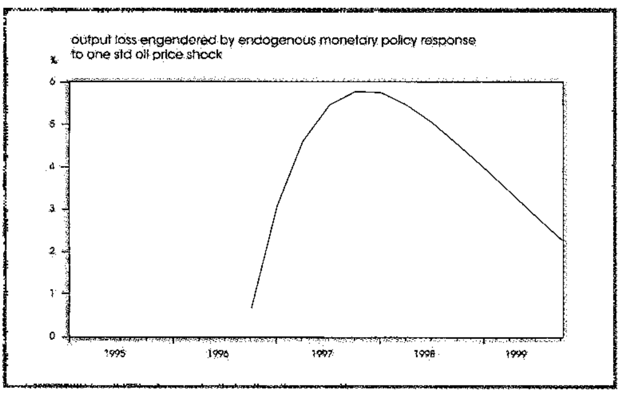
Period	S.E.	LOG (OIL_WTIC)	LOG (RGDP_NT_TW)	LOG (CPI_TW)	I_CALL_TW	REER_TW
1	0.157853	0.187133	3.342150	96.47072	0.000000	0.000000
2	0.200281	0.731946	6.400471	90.81653	0.607144	1.443912
3	0.225978	0.895996	9.696727	86.62879	0.785794	1.992692
4	0.240625	0.854994	13.34742	81.79508	1.524178	2.478330
5	0.249911	0.777026	16.70985	76.93665	2.746622	2.829850
6	0.257184	0.697024	19.86940	72.22667	3.942804	3.264099
7	0.264205	0.625555	22.81405	67.74117	5.007570	3.811653
8	0.271553	0.562029	25.56924	63.51475	5.879019	4.474968
9	0.279222	0.505068	28.13299	59.57719	6.572299	5.212452
10	0.286983	0.453951	30.50794	55.94779	7.112827	5.977485
11	0.294588	0.408937	32.69956	52.63260	7.529860	6.729036
12	0.301839	0.370803	34.71844	49.62396	7.847963	7.438838
13	0.308603	0.340414	36.57781	46.90460	8.086943	8.090230
14	0.314809	0.318454	38.29200	44.45191	8.262210	8.675431
15	0.320427	0.305323	39.87504	42.24134	8.385829	9.192468
16	0.325458	0.301131	41.34003	40.24862	8.467344	9.642875
17	0.329925	0.305751	42.69878	38.45092	8.514409	10.03013
18	0.333861	0.318872	43.96178	36.82743	8.533240	10.35868
19	0.337306	0.340055	45.43819	35.35944	8.528940	10.63337
20	0.340306	0.368783	46.23605	34.03033	8.505728	10.85911

3. Monetary Policy Responses to Oil Price Shocks in Taiwan

The above discussion shows that the monetary policy indicator, the inter-bank call-loan rate, rises in response to an oil price hike. However, such a response only generates a small portion of the total output loss due to oil price shocks. This result is in line with the findings of the literature. For example, Sims and Zha (1998) concluded "that little of observed postwar cyclical variation is attributable to unpredictable variation in monetary policy in the context of our model and that the real effects of monetary policy are probably smaller, and certainly are much less than is commonly believed." Bernanke, Gertler, and Watson (1997) agreed with the common view that erratic and unpredictable fluctuations in Federal Reserve policies are not a primary cause of the postwar U.S. business cycle. However, they suggest that systematic and predictable monetary policies could be used to eliminate any recessionary consequences of an oil price shock. Hamilton and Herrara (2000) challenged this view, saying that even the aggressive Federal Reserve policies proposed would not have succeeded in averting the downturn, had a preferred longer lag length been employed.

This paper does not intend to answer the question whether systematic monetary policy can have a significant impact in eliminating recessionary consequences of an oil price shock. Instead, it will focus on finding out, given the output loss due to an oil price shock, to what extent this output loss is attributable to endogenous monetary policy changes in a VAR context?

To answer this question, we follow the approach of Sims and Zha (1998) by shutting the endogenous monetary response that would otherwise be implied by the VAR estimates. That is, by setting the inter-bank call-loan rate at its baseline level (the value it would have taken in the absence of an oil price shock), it would be possible to take the difference between the total effect of an oil price shock on the system variables and the estimated effect when the policy response is shut down. This difference is considered as a measure of the contribution made by the endogenous monetary policy response.



The above figure shows the output loss engendered by the endogenous monetary policy response to a one standard deviation oil price shock at 1995q1. It indicates that at its maximum monetary policy response, as reflected in changes in the inter-bank call-loan rate, accounts for 5.8 percent of the total output loss. This result is consistent with the findings of the previous discussion that interest rates only play a small role in explaining the output loss due to an oil price shock.

4. Conclusion

This article implements VAR analysis in measuring the impact of an oil price shock to Taiwan's economy. The empirical results indicate that the economy responds to oil price shocks with losses in output, increases in consumer prices, hikes in inter-bank call-loan rates, and appreciation in exchange rates. The output loss is affected to a larger extent by increases in oil prices and an appreciation of the exchange rate, and to a much less extent by the endogenous monetary policy response as reflected in inter-bank call-loan rate rises. The smaller role of the inter-bank call-loan rate in explaining the output loss is further confirmed by a comparison between the total output loss and the output loss when the endogenous response of interest rates is shut down.

References

1. Bernanke, Ben S., Mark Gertler, and Mark Watson, (1997), "Systematic Monetary Policy and the Effects of Oil Price Shocks", *Brookings Papers on Economic Activity*, 1:1997, pp. 91-142.
2. Hamilton, James D. and Ana M. Herrara, (2000), "Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy", *Working Paper*, UCSD.
3. Jimenez-Rodriguez, Rebeca, and Marcelo Sanchez, (2004), "Oil Price Shocks and Real GDP Growth, Empirical Evidence for Some OECD Countries", *European Central Bank Working Paper* Series, no. 362.
4. Krichene, Noureddine, (2006) "World Crude Oil Markets: Monetary Policy and the Recent Oil Shock", *IMF Working Paper*, WP/06/62.
5. Leduc, Sylvan, and Keith Sill, (2001) "A Quantitative Analysis of Oil Price Shocks, Systematic Monetary Policy, and Economic Downturns", *Working Paper*, Federal Reserve Bank of Philadelphia.
6. Sims, Christopher A., and Tao Zha, (1998), "Does Monetary Policy Generate Recessions?", *Federal Reserve Bank of Atlanta Working Paper*, 98-12.

Appendix A
Vector Autoregression Estimates

Date: 11/26/06 Time: 21:52
Sample (adjusted): 1983:4 2005:4
Included observations: 82
Excluded observations: 7 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

	LOG (OIL_WTIC)	LOG (RGDP_NT_TW)	LOG (CPI_TW)	I_CALL_TW	REER_TW
LOG (OIL_WTIC (-1))	0.706859	-0.008175	0.002743	-0.072950	0.191751
	(0.11740)	(0.01217)	(0.00561)	(0.47047)	(1.33556)
	[6.02116]	[-0.67173]	[0.48891]	[-0.15506]	[0.14357]
LOG (OIL_WTIC (-2))	0.075522	0.001462	-0.001862	0.266731	-0.335448
	(0.11251)	(0.01166)	(0.00538)	(0.45091)	(1.28001)
	[0.67123]	[0.12535]	[-0.34639]	[0.59154]	[-0.26207]
LOG (RGDP_NT_TW (-1))	0.354823	0.976630	0.041635	2.800090	25.06602
	(1.12658)	(0.11679)	(0.05384)	(4.51484)	(12.8165)
	[0.31496]	[8.36210]	[0.77338]	[0.62020]	[1.95576]
LOG (RGDP_NT_TW (-2))	-0.732007	-0.011598	-0.000809	-4.728699	-21.18029
	(1.12943)	(0.11709)	(0.05397)	(4.52628)	(12.8490)
	[-0.64812]	[-0.09905]	[-0.01498]	[-1.04472]	[-1.64840]
LOG (CPI_TW (-1))	4.015926	0.286792	0.882888	-10.14502	-21.55869
	(2.52137)	(0.26139)	(0.12049)	(10.1046)	(28.6844)
	[1.59276]	[1.09718]	[7.32762]	[-1.00400]	[-0.75158]
LOG (CPI_TW (-2))	-2.906160	-0.243370	0.019142	17.75562	6.994704
	(2.49571)	(0.25873)	(0.11926)	(10.0017)	(28.3925)
	[-1.16446]	[-0.94063]	[0.16050]	[1.77526]	[0.24636]
I_CALL_TW (-1)	-0.006561	0.006147	-0.001728	0.524444	-0.261479
	(0.02930)	(0.00304)	(0.00140)	(0.11741)	(0.33331)
	[-0.22395]	[2.02383]	[-1.23409]	[4.46664]	[-0.78449]
I_CALL_TW (-2)	-0.033319	-0.007854	0.003184	0.216109	0.484238
	(0.02646)	(0.00274)	(0.00126)	(0.10603)	(0.30100)
	[-1.25932]	[-2.86344]	[2.51798]	[2.03817]	[1.60878]
REER_TW (-1)	0.012914	-0.002498	0.000747	0.124192	1.301275
	(0.01035)	(0.00107)	(0.00049)	(0.04149)	(0.11778)
	[1.24736]	[-2.32717]	[1.50911]	[2.99329]	[11.0483]
REER_TW (-2)	-0.015091	0.002277	-0.000586	-0.050889	-0.392667
	(0.01040)	(0.00108)	(0.00050)	(0.04166)	(0.11827)
	[-1.45159]	[2.11258]	[-1.17922]	[-1.22146]	[-3.32009]
C	1.554177	0.375679	-0.171406	-13.57980	17.92262
	(1.31083)	(0.13589)	(0.06264)	(5.25326)	(14.9127)
	[1.18564]	[2.76450]	[-2.73635]	[-2.58502]	[1.20183]
D_Q1	0.084124	-0.030550	-0.005582	0.622760	1.288010
	(0.05867)	(0.00608)	(0.00280)	(0.23511)	(0.66741)
	[1.43396]	[-5.02314]	[-1.99126]	[2.64885]	[1.92987]
D_Q2	0.115806	-0.002871	0.006263	0.430584	1.794257
	(0.07983)	(0.00828)	(0.00381)	(0.31992)	(0.90818)
	[1.45067]	[-0.34695]	[1.64174]	[1.34591]	[1.97566]
D_Q3	0.100952	0.020511	0.004540	0.572090	0.953875
	(0.05702)	(0.00591)	(0.00272)	(0.22851)	(0.64868)
	[1.77048]	[3.46983]	[1.66612]	[2.50358]	[1.47049]
R-squared	0.839823	0.998660	0.997841	0.920771	0.972101
Adj. R-squared	0.809201	0.998403	0.997428	0.905624	0.966767
Sum sq. resids	1.694400	0.018211	0.003869	27.21313	219.2981
S.E. equation	0.157853	0.016365	0.007543	0.632608	1.795821
F-statistic	27.42539	3897.370	2417.603	60.79018	182.2559
Log likelihood	42.70205	228.5585	292.0649	-71.12915	-156.6852
Akaike AIC	-0.700050	-5.233134	-6.782070	2.076321	4.163053
Schwarz SC	-0.289147	-4.822230	-6.371167	2.487224	4.573956
Mean dependent	3.135816	14.37068	4.472595	4.783293	106.2458
S.D. dependent	0.361381	0.409556	0.148748	2.059230	9.850931
Determinant Residual Covariance		4.00E-10			
Log Likelihood (d.f. adjusted)		305.4449			
Akaike Information Criteria		-5.742558			
Schwarz Criteria		-3.688041			

Chapter 13

IMPACT AND POLICY RESPONSE TO VOLATILE OIL PRICES: THAILAND'S RECENT EXPERIENCE

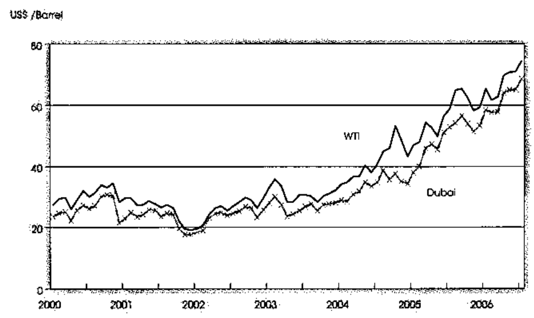
by Yunyong Thaicharoen
Watsaya Limthammahisorn and
Jariya Premsin[1]
Bank of Thailand

1. Introduction

The rise of crude oil price which has almost quadrupled since the beginning of 2002 and threatened to soar even higher owing to ongoing conflicts in the Middle East is a major risk factor to the stability of the world economy at present. While higher price will certainly bring in additional oil to the market, the development of new supply will face many difficult challenges in terms of higher investment, demanding technologies and geopolitical risk especially in those countries that own the majority of remaining world's oil reserves. Meanwhile, despite higher price, the demand for oil is projected to grow continuously, fueled particularly by strong demand from fast-growing China and India, which account for almost two-fifths of the world's population. As a result, most market experts agree that there is little chance for the return of oil price to the low levels observed during 1986-2000 period. Therefore, every country needs to reevaluate and adjust its own energy strategy to prepare for changing world energy landscape.

Figure 1

Crude Oil WTI and Dubai Prices



Source: PTT Public Company

As for Thailand, though the discovery of natural gas in the Gulf of Thailand in 1980s helped reduce our oil dependency compared to the past oil shocks, significant vulnerability of the Thai economy to higher oil price remains. Oil continues to be our main source of primary energy, and we need to rely on imports for roughly 90% of our oil consumption. In case of natural gas which has become the energy of choice for electricity generation, it is expected that both price and import share will also rise in the future, adding to the concern over energy cost and supply security. In addition, the Thai economy also exhibits relatively low level of energy and oil efficiency by international comparison, reflecting an imbalanced approach of past development policies which gave priority to economic growth, while too little attention was paid to energy efficiency improvement. Addressing these structural problems successfully, thus, will be crucial in guarding economic stability and advancing competitiveness in the years ahead.

As a nation, we must turn this energy crisis into the opportunity to strengthen our long term energy security. That will call for effective management for both demand and supply aspects of energy equation. To promote energy efficiency, the government must accelerate the upgrading of public transportation and logistics system, raise efficiency in energy use in the manufacturing sector, especially in energy intensive sub-sectors, adjust energy pricing structure to better reflect their actual costs to society as well as utilise a balanced menu

1 Dr. Yunyong Thaicharoen is Senior Economist at the Domestic Economy Department, Monetary Policy Group, Bank of Thailand. Ms Watsaya Limthammahisorn and Ms Jariya Premsin are Economists of the Domestic Economy Department, Monetary Policy Group, Bank of Thailand. The views expressed in the paper are of the authors, and do not necessarily represent those of the Bank of Thailand.

of measures aimed at providing market incentives and enforcing regulations. As for the supply security, the policy should focus on diversifying main energy sources and promoting the development of renewable energies by establishing appropriate pricing framework and supporting researches especially for those energy types that best leverage our comparative advantage. Lastly, the conduct of national energy policy must place priority on achieving long term objectives of sustainable development, setting clear operational targets and building consensus through honest and transparent communication with the public.

This paper is divided into 4 parts. After a brief introduction in Section 1, Section 2 will assess current energy positions of Thailand in various dimensions, highlighting key developments and important vulnerabilities to volatile oil prices as well as the implications on economic stability and competitiveness going forward. Section 3 will then examine the key lessons learned from recent energy policies with particular emphasis on energy pricing policy. Section 4 will conclude and provide recommended policies to strengthen Thailand's resiliency against volatile oil prices in the future.

2. Thailand's Fundamentals on Energy Positions

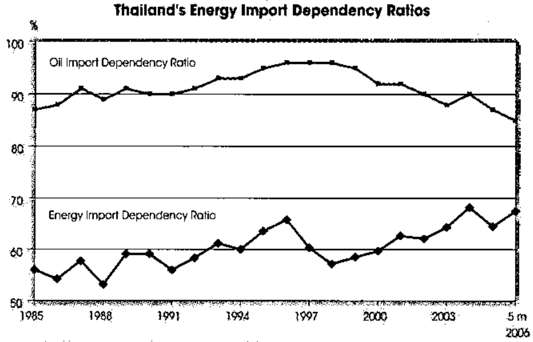
In this section, we will analyse Thailand's fundamentals with regards to energy positions in important dimensions to assess the strengths as well as vulnerabilities against volatile energy prices. We will also examine the implications of these vulnerabilities on economic stability and competitiveness going forward.

2.1. Dependency on Imported Energy

Thailand has been relying heavily on imported energy, and over the past 20 years, the dependency on imported sources of energy has been on a rising trend. Indeed, Thailand's energy import dependency ratio (Figure 2) which is calculated as the ratio of net commercial import energy to total consumption of commercial energy rose from 56% in 1985 to 67.4% during the first five months of year 2006. Moreover, the trend is likely to continue as Thailand will need to import more natural gas in the future. The import dependency ratio for Thailand is even higher for oil, with imported oil accounting roughly for 85-90% of total domestic oil consumption.

Figure 2

Thailand's Energy Import Dependency Ratios

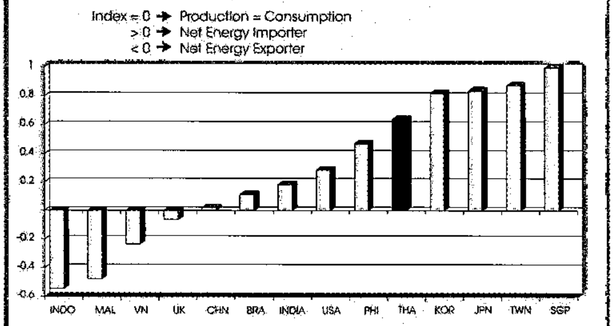


Source: Energy Policy and Planning Office (EPPO) and Authors' calculations

Figure 3 compares Thailand's energy import dependency ratio with that of other countries. It shows that Thailand's dependency ratio is relatively high. This implies that the Thai economy will be relatively more vulnerable to increased volatility of energy prices. Should energy prices in the global markets rise substantially, it will impose significant pressure on Thailand's trade and current accounts as well as expose the Thai economy more to the risks of potential supply disruption. It is worth noting that most of the countries in the sample group with higher ratio of energy import dependency tends to be developed economies (e.g., Korea, Japan, and Singapore) and thus could rely on higher margin export bases to provide cushion for risks from volatility of energy prices, compared to Thailand.

Figure 3

Energy Import Dependency Index for Selected Countries (2004)



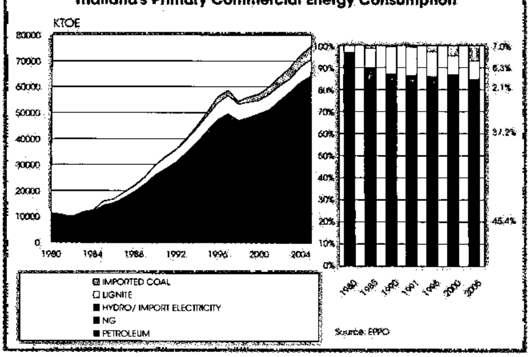
Source: World Bank

2.2. Diversification of Energy Types and Sources

The discovery and utilisation of natural gas from the Gulf of Thailand since early 1980s has helped reduce Thailand's energy dependence on oil considerably. Figure 4 shows that the share of oil consumption to total primary energy consumption has declined from 96% in 1980 to 45% in 2005. At the same time, the share of natural gas has increased steadily, reaching 37% in 2005.

Figure 4

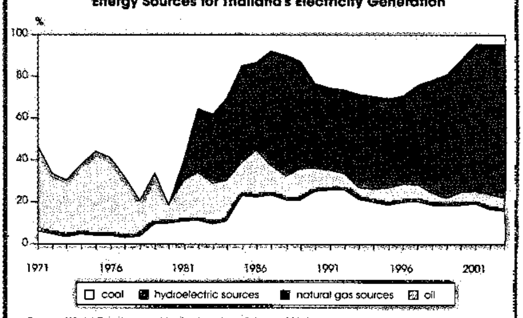
Thailand's Primary Commercial Energy Consumption



Source: EPPO

Figure 5

Energy Sources for Thailand's Electricity Generation



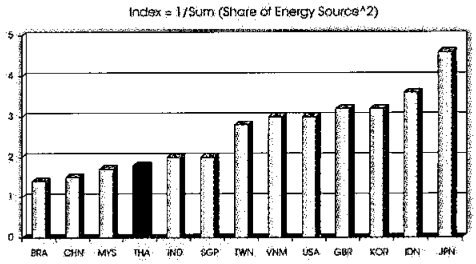
Source: World Development Indicators (World Bank (2004))

Due to its relatively lower cost and more environmental-friendly properties compared to other types of primary energy, natural gas has been the energy of choice for electricity generation. Since 1980s, its share for total primary energy for electricity generation has risen rapidly, accounting for more than 70% at present. (Figure 5) Despite its relative short term attractiveness, too much concentration on natural gas as the energy type for electricity generation has exposed the Thai economy to the risks of potential supply disruption either to the gas production sites or pipeline system which could significantly threaten Thailand's supply security for electricity. Moreover, as overall use of natural gas continues to grow over time, there will be need for Thailand to import higher share of natural gas for domestic consumption from abroad, both through pipeline systems from neighbouring countries and via special tankers in the form of liquidified natural gas (LNG). This will reduce the ability of the authority to manage domestic prices of natural gas as the prices of imported gas will fluctuate more with the global prices, compared to the prices of domestically-produced gas which have been regulated by the long term contract and currently are much lower than regional and global prices.

Figure 6 compares the degree of energy diversification in the production of electricity between Thailand and other selected countries, as measured by energy diversification index which is calculated as 1/(sum of energy share for each main type of energy for electricity generation). The index thus reflects the number of energy types that currently could serve as main alternatives for electricity generation in each country. The higher the index is, the lower the risks of potential supply disruption and greater price volatility to any particular type of energy will be. Thailand's index at 1.8, is considered to be low, reflecting relative high concentration on natural gas as the energy type for electricity generation. Meanwhile, the indices for most developed economies tend to be close to or higher than 3, indicating higher energy diversity, or lower concentration risks. Partly, this is the result of the adoption of nuclear power in electricity generation in many developed countries including US, Japan and Germany. Nevertheless, for many countries with no nuclear power, their indices are also higher than Thailand's, suggesting greater diversification of energy type. Therefore, it could be said that Thailand's energy policy either has not given priority or has failed to attain greater energy diversity for electricity generation over the past few decades.

Figure 6

Energy Diversification Index for Electricity Generation (2004)



Source: World Bank

Moreover, the Thai economy is also vulnerable in terms of high concentration of crude oil sources as 80% of Thailand's crude oil imports mainly come from three Middle-East countries (UAE, Saudi Arabia and Oman). Should military conflicts in the Middle-East region flare up and disrupt crude oil production and transportation route in the Gulf of Persia, the impacts on Thailand's energy security will likely be considerable.

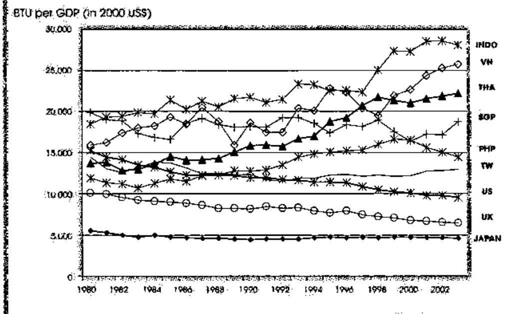
2.3. Energy Efficiency

To measure the efficiency of energy usage in any countries, one of the most common indicators is energy intensity, which is the ratio of total energy consumption to GDP. It measures how many units of energy are needed to produce one unit of GDP. Therefore, the higher the figure is, the less efficient the country's energy usage.

Figure 7 demonstrates the trend of energy intensity in selected countries over 1980-2003. The emerging pattern is that Thailand's energy intensity is relatively high and has been on a increasing trend over the past 20 years. Thailand's rising energy intensity is broadly consistent with the patterns observed in other developing Asia countries, which is in contrast to the intensity pattern of developed countries which have much lower level and declining or stabilising trends. For example, compared to Japan, Thailand needs to spend up to 4 times of energy in producing one US dollar of GDP.

Figure 7

Energy Intensity for Selected Countries
(Total Primary Energy Consumption Per Dollar of GDP*)



Source: EIA	* Using Market Exchange Rate

The differences in energy intensity trend could be attributable to both overall economic structure effect and sectoral-level intensity effect. In most developed economies, especially those with relatively high energy import dependency, a concerted effort has been directed over the past 2-3 decades, in response to the energy crisis in 1970s, to restructure the economy by lowering the GDP share of the manufacturing sector, particularly those of the energy intensive sub-sectors (e.g., basic metals, cement and food production) while raising the GDP share of the service sector which tend to be less energy intensive by nature. In terms of energy efficiency at the sectoral level, developed economies has also been more successful in adopting effective measures aimed at promoting energy efficiency both by providing incentives and penalties.

The overall level of efficiency in energy usage of the economy could also be measured by its energy elasticity, which is the calculation of the increase in energy consumption in percentage terms given a one percentage increase in GDP. During 1995-2001, Thailand's energy elasticity averaged at 1.4, implying that on average Thailand's annual growth of energy usage is higher than annual growth of economic activities. Even though the energy elasticity has been lower during the past few years, due mainly to much higher oil prices, it remains above one, implying that Thailand's energy intensity continues to rise.

Table 1: Thailand's Energy Elasticity over Time

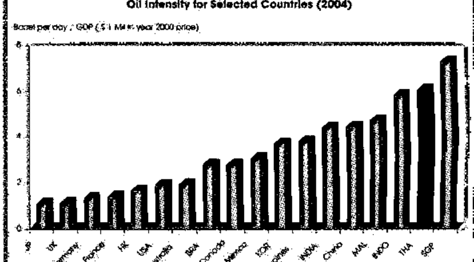
	1980-1985	1986-1990	1991-1995	1996-2000	2001-2005	Avg 85-2001	Avg 02-2005
Elasticity	1.7	1.3	1.3	0.1	1.3	1.4	1.1

Source: Ministry of Energy and authors' calculation

Particularly of concern is Thailand's relative inefficiency in oil usage. Figure 8 shows oil intensity for selected countries in 2004, measured as the ratio of the amount of oil consumption (barrel/day) over GDP (in million US$ in 2000 price term). For Thailand, the data indicates that to produce 1 million US$ (in 2000 price) in one year, the Thai economy needs to consume 6.1 barrels/day (or 2,226.5 barrels/year), among the highest intensity in the world. Thailand's high oil intensity could be mainly traced to relatively inefficient oil usage in the transportation sector which accounts for more than two-thirds of total domestic oil consumption.

Figure 8

Oil Intensity for Selected Countries (2004)



Note: High oil intensity for SGP reflects Singapore's large refinery and petroleum related sectors relative to its economy.
Source: BP Statistical Review of Energy, World Bank

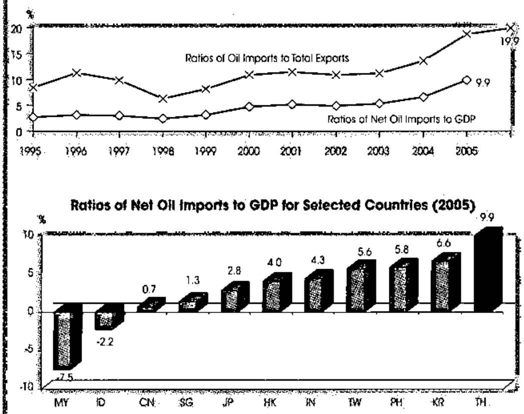
2.4. Implication of Thailand's Energy Position on Economic Stability and Competitiveness

Looking at the various indicators on Thailand's energy dimensions, we can conclude that the Thai economy faces a number of challenges especially in the terms of the high import dependency, high concentration and low usage efficiency. These structural weaknesses have left the Thai economy more vulnerable to volatilities in energy prices.

These vulnerabilities, together with ill-conceived oil price subsidy, have clearly manifested itself over the past few years in the form of a rapid increase in the ratio of the value of net oil imports over GDP. As the upper panel of Figure 9 shows, the value of net imports of crude oil and petroleum products as a share of GDP stood at 2.7% of GDP in 1995. In the face of the recent run up in oil prices, the ratio has risen sharply, reaching 9.9% of GDP in 2005, among the highest level in the regional economies (the lower panel of Figure 9). This implies that the Thai economy spend almost 10% of its income on imported oil, revealing its structural fragility in terms of external stability to changes in global oil prices. The marked jump in net oil import values in 2005 was the main reason for Thailand's current account turning into a deficit of 3.7 billion US$ in 2005, or equivalently to 2.1% of GDP, the first annual deficit since the 1997 financial crisis.

Figure 9

Thailand's Ratio of Oil Imports to GDP and to Exports

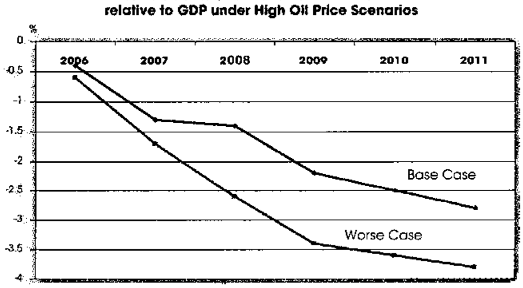


Source: CEIC, Customs Department and NESDB

To assess the potential impacts of higher oil prices on Thailand's current account position, expected paths of the current account position have been estimated using the marginal analysis under two scenarios of Dubai oil prices, the base case averaging at 71 US$ per barrel over the next 5 years, while the worst case averaging at 80 US$.[2] Figure 16 shows the results of the estimation. In both scenarios, the current account would continue its deficit trend. In the base case, the deficit would average at 1.8% of GDP during 2006-2011. While in the worse case, the deficit over the same period would average 3.0% of GDP, which is the level that could begin to exert destabilising pressure on Thailand's external stability. Therefore, given that the risks of possible further rise in global oil prices is quite real, it is imperative that the Thai economy pay priority to policy reforms that effectively reduce its energy import dependency as well as promote its energy efficiency in order to raise the resiliency against energy price volatilities going forward.

Figure 10

Possible Paths of Current Account Positions relative to GDP under High Oil Price Scenarios



*** Base case Dubai price = 71 USD/BBL**
Worse case Dubai price = 80 USD/BBL

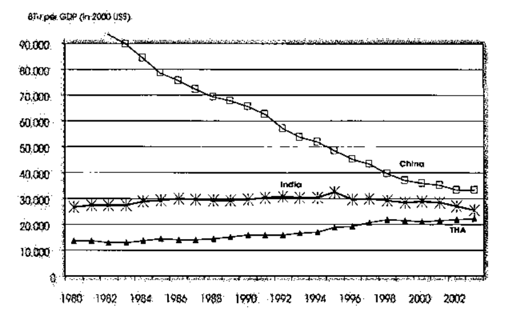
Source: Author's estimations

2 These estimates are meant to be only suggestive of possible adverse effects of higher oil prices on Thailand's external position. They were carried out under the assumptions that the current level of oil intensity is maintained, and reflect all exogenous economic variables as projected in June 2006. Other subsequent developments such as changes in energy pricing policies, trend of non-oil imports, could affect the actual outcome of future's current account position.

Thailand's structural vulnerabilities on energy also present important challenges on its future competitiveness. Until now, Thailand's energy policy has given priority to promote the business sector's competitiveness by producing adequate amount of energy to meet rising demand at relatively low prices. Such focus on supply security, though important, is an incomplete solution to attaining long-term energy security. What is needed is serious policy attention on improving Thailand's energy efficiency, the true measure of a country's competitiveness on energy dimension. Unfortunately, for the most part, the effort on efficiency improvement has been undermined by lack of policy vision and consistency on the part of the authority and private sectors alike, caused in no small part by the fact that energy prices have been relatively low after the price hikes during the two oil crisis in 1970s. Thus, over the past two decades prior to current oil price run up, investment on upgrading energy efficiency had not been regarded as an urgent issue. In other words, Thailand's weakness associated with relative energy inefficiency has been masked by cheap energy prices. However, as the outlook of global energy markets has changed, such weaknesses will increasingly affect Thailand's future competitiveness both at the business and overall economy level. At the business level, Thai firms will be faced with much sharper increase in energy-related expenditures, compared to those foreign firms with higher energy efficiency. At the overall economy level, the terms of trade will be worsened, while more income will be needed for importing energy, which means fewer resources for investment in improving Thailand's competitiveness in other dimensions.

The Institute of Management and Development (IMD) employs energy intensity index as one of the indicators in assessing the country's basic infrastructure which is one of the four areas in measuring country's competitiveness. In 2006, it ranked Thailand at 50th out of 61 countries in terms of energy efficiency. Also worth noting is the fact that both China and India which historically are disadvantaged in comparison to Thailand in terms of their use of energy, has reduced their energy intensity significantly. China, in particular, has cut down its energy intensity by 70% over the past two decades (Figure 11). Moreover, the Chinese authority has continued to embark on an ambitious plan to further reduce its energy intensity by another 20% during the 2006-2010 period. Meanwhile, the current plan of the Thai authority calls for a reduction of energy elasticity to one by 2010, implying that even if the plan attains its goal, Thailand's energy intensity will only stabilise, and not decline by the end of the decade. Thus, in addition to already lower labour cost advantage, the expected reduction of energy efficiency gap of China and India represents another major challenge for the Thai economy in terms of its competitiveness in the coming decade.

Figure 11: Energy Intensity for China, India and Thailand (Total Primary Energy Consumption Per Dollar of GDP*)



ที่มา: EIA

* Using Market Exchange Rate

In summary, we have highlighted existing structural vulnerabilities of Thailand's energy positions, namely, in the form of high import dependency, high energy concentration and low usage efficiency as well as their implications on economic stability and competitiveness. Compared to regional economies with similarly high energy import dependency, such as Japan, Singapore and Korea, Thailand's energy efficiency and energy diversification is among the lowest. These outcomes reflect high priority that other countries have put on promoting their energy efficiencies and developing alternative energies in order to minimise the risks associated with high import dependency. On the other hand, when compared to regional economies with similarly low energy efficiency, such as China, Indonesia or Vietnam, Thailand is more dependent on imported energy. These leaves the Thai economy even more vulnerable relative to other regional economies in the event of potential energy supply disruption or abrupt increase in energy prices. Thus, we can conclude that current energy position put the Thai economy at a fragile and unsustainable path. In order to increase Thailand's resiliency against oil market development, a bolder and more effective energy policy especially on the promotion of energy efficiency and the development of alternative energy will be needed.

3. Lesson Learned from Thailand's Energy Pricing Policies

Establishing appropriate energy policy framework consistent with changing realities is essential in promoting the country's energy security in the long run. In this section, we will assess Thailand's experiences with energy policy especially in the area of pricing policy which have had important implications to the success or failure of government's efforts to promote energy efficiency and develop alternative energy. Due to the limited scope of the study, we will focus only the key policy issues and important lessons which could be drawn from the conduct of past energy policy in Thailand and should be useful in implementing more effective policy strategy in the future.

Energy pricing structure is an important mechanism in determining incentives for production and consumption of various types of energy. To understand the poor record of energy efficiency for the Thai economy, we need to assess energy pricing policy in Thailand. As always, energy prices which are conducive to efficient allocation of resources should reflect the true costs associated with the process of energy production and consumption. However, in the presence of market failures, market prices of energy tend to reflect only the cost in the production process (and margins for producers and those in the supply chain), but fail to incorporate costs in other dimensions, leading to either excessive demand or supply for each type of energy from the public's perspectives. Policymakers thus have the tasks of setting optimal energy pricing structure that reflects the true costs, using appropriate taxation or subsidy measures. Examples of market failures which could render free market-based pricing for energy, especially petrol prices, to be suboptimal and thus may call for the implementation of taxes and subsidies are:

- **Costs associated with the construction and maintenance of road, or road pricing.** In most cases, road pricing or collection based on the amount of road usage may not be feasible due to technological limitation. In such cases, introducing taxes into oil price structure may be the best option in raising adequate funds for road construction and maintenance, since the amount of oil used is highly correlated with the amount of mileage traveled in the road system.
- **Costs to the environment.** Energy consumption imposes some costs to the society through its adverse impacts on the environment. However, such costs are not necessarily included into the production cost of energy. Without adding taxes to reflect these costs, consumers will likely end up consuming too much energy from the environmental perspectives. Example of such tax measures is the carbon tax.
- **Other negative externalities.** Transportation and automobile usage usually increase the costs to others by creating additional traffic jams and road accidents
- **Added risks from over-concentration of energy type and source:** Tax could be implemented to reflect added risks from high import dependency or over-

concentration on certain type of energy. This will help induce greater energy conservation as well as promote alternative energy, which will strengthen long-term energy supply security.

- **Wealth redistribution** through cross subsidies between different energy products in cases where the share of product usage correlates with consumer's income level.

In addition, if tax is introduced to correct the problem of market failures, it should be applied on the same basis for all types of energy products. For example, if carbon tax is to be introduced to reduce the amount of CO2 released, the tax should be applied to all types of energy products at the same rate and calculated based on the amount of carbon released into the environment. The equal treatment in tax application will help avoid the distorted decisions by consumers on the choice of energy products.

As for price subsidy measure, there could be situations in which it could be appropriate and necessary to create positive externalities or improve public welfare. The example includes price subsidy for better access of commercial energy in the remote areas which would help address the deforestation problem, or price subsidy for the low income group. However, it is important that such programmes be targeted at the right group. Otherwise, the blanket subsidy should be avoided since it will mostly benefit the high income group which tends to consume more energy.

3.1. Current Pricing and Tax Structure for Petrol Products in Thailand

Table 2 illustrates the current pricing and tax structure for retail petrol products (as of November 2006). Details on pricing of petrol products can be divided into three main steps, namely the ex-refinery price, the wholesale price and the retail price. The ex-refinery price represents the price at which the domestic refinery sells the petrol products to the wholesale distributors in Thailand. In the current regulation, it is set to the actual ex-refinery reference prices reported in Singapore markets on import parity basis. In practice, this means that ex-refinery price will be equal to the Singapore reference price plus allowances for quality adjustment and transportation cost minus discounts. Usually, the price will come out higher than the price observed in Singapore markets as the addition terms almost always exceed the subtraction terms. The rationale for import parity pricing is to promote efficiency in the domestic refiners.[3] The wholesale price adds a number of tax collections (i.e., excise tax, municipal tax and VAT) as well as the contributions to the Oil Fund and the Conservation Fund to the ex-refinery price. Lastly, the retail price reflects additional VAT as well as the marketing margin which represents the revenue to be shared between wholesalers and retailers to cover related expenditures and profits for retail distribution.

Though various forms of taxes are being collected on retail prices of petrol products in Thailand, it is not obvious that they are being applied in any relation to the true costs to society in various dimensions in order to address the market failure problem. One thing we can say is that the taxes are not being applied on the same basis on all the petrol products, with taxes and contributions collected from diesel and LPG being much lower than those from gasoline. Such pricing policy reveals the clear intention of the authority for wealth redistribution and cross subsidisation among petrol products. Currently, not only do LPG users benefit from lower tax rate, they are also being subsidised by the users of other type of petrol products through the operation of the Oil Fund.

3 It is worth considering whether it is appropriate to add the transportation costs (from Singapore to Bangkok) to the ex-refinery price, given that almost all petrol products consumed are being produced by domestic producers. The issue is even more pertinent in the face of currently high global oil prices. Temporary reduction or removal of this supposed transportation costs would be helpful in lowering the retail prices paid by consumers.

Table 2: Pricing Structure of Retail Petrol Prices in Bangkok Area (as of November 2, 2006)

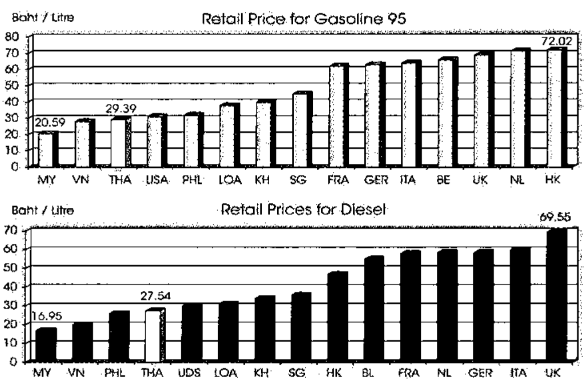
Baht/litre	Gasoline 95	Gasoline 91	Gasohol	Diesel	LPG (kg)
Ex-refinery price	**14.15**	**13.70**	**15.50**	**16.43**	**11.71**
Excise tax	3.69	3.69	3.32	2.31	2.17
Muni tax	0.37	0.37	0.33	0.23	0.22
Contribution to the Oil Fund	3.46	3.26	1.50	1.50	-1.64
Contribution to the Conservation Fund	0.04	0.04	0.04	0.036	0
VAT	1.52	1.47	1.45	1.44	0.87
Wholesale price	**23.22**	**22.52**	**22.13**	**21.95**	**13.33**
Marketing Margin	2.31	2.20	1.92	2.14	3.26
VAT	0.16	0.15	0.13	0.15	0.23
Retail price	**25.69**	**24.89**	**241.9**	**24.24**	**16.81**

Source: EPPO

Another distinct feature of Thailand's petrol pricing lies in its relatively cheap prices by international standard. Figure 12 compares the retail prices of gasoline and diesel in Thailand and other selected countries (as of June 2006). It shows that retail prices in Thailand are relatively low for both products. The two countries with lower retail prices, namely Malaysia and Indonesia, are both major oil exporters. A survey by the German Technical Cooperation (GTZ) on retail petrol prices in 172 countries conducted in November 2004 reveals a similar pattern, with the Thai price being ranked 37th out of 172 countries (from cheapest to most expensive). In fact, the countries in which petrol prices are lower than Thailand's prices fall roughly into two categories, being either net oil exporters or very poor countries.

Figure 12

Retail Prices of Gasoline and Diesel in Selected Countries (as of June 29. 2006)

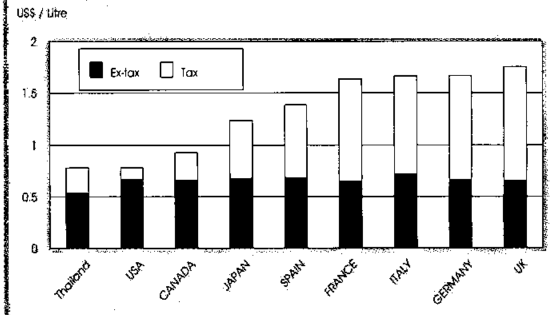


Source: Ministry of Energy

Cheaper retail petrol prices in Thailand are largely due to lower petrol taxes compared to other countries, especially those in developed world. Figure 13 shows the breakdown of retail gasoline prices into ex-tax price component and tax component in selected economies as of May 2006. For Thailand, the tax component accounts for roughly 29% of retail price, while for most European economies, the tax accounts for about 60% of retail prices. The higher ratio of petrol tax to retail prices helps cushion the impact of higher global oil prices on retail prices. This implies that in percentage term, retail petrol price changes become less sensitive to fluctuations in the global oil prices. This was among the key factors contributing to relatively small increase in inflation in developed economies with relatively high tax share on petrol prices compared to the impacts observed in most developing economies, during the run up of global oil prices over the past few years.

Figure 13

Retail Gasoline Prices in Selected Countries (May 2006)

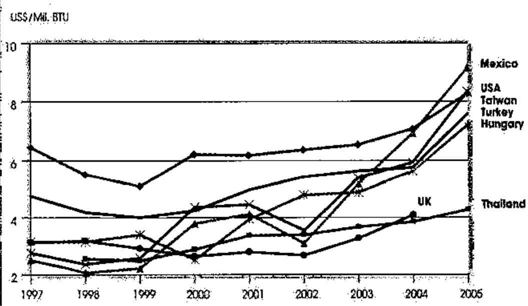


Source: IEA

Central to our policy analysis is the fact that many countries with high dependency on imported energy have raised their petrol taxes considerably during 1980s to promote greater energy conservation as well as encourage the development of alternative energy. However, for Thailand, relatively low petrol prices due to smaller tax by international standard, have failed to provide proper incentives for the business sector especially in the transportation sector, to push seriously for improved energy efficiency. Moreover, the failure of petrol prices to reflect true costs of oil production and consumption has made the development of alternative energy much more difficult since, without heavy subsidy, new alternative energy with usually initial high developmental costs cannot compete with low petrol prices. However, the subsidy takes up a significant amount of the budget which the authority simply does not have. In addition, the current petrol prices do not adequately incorporate the risks of supply security arising from the energy structure that concentrates too much on imported oil. As a result, it is of no surprise that the Thai economy continues to be relatively inefficient in its oil usage.

Figure 14

Comparisons of Natural Gas Prices for Electricity Generation



Source: EIA and EPPO

A similar situation can also be found in the pricing of natural gas. The price of natural gas in Thailand is relatively low by international standard. Figure 14 shows prices of natural gas used in the production of electricity in selected countries. In 2005, the price of natural gas sold for electricity generation averaged at 4.3 US$/Mil. BTU, almost half of the price in the US, which averaged at 8.3 US$/Mil. BTU. The low natural gas price in Thailand is possible in part because of the favourable pricing formula stipulated in the long-term contract between the Thai authority and private concessionaires. However, it also reflects the Thai government's priority in providing low electricity prices to augment the competitiveness of Thailand's manufacturing industry. However, this raises a policy question as to whether, by failing to incorporate all the costs/risks to the society including the risks from relying too much on natural gas for electricity generation, the pricing of natural gas is too low from the perspectives of long-term optimality. This explains partly both the low efficiency of energy usage and heavy reliance of natural gas as the energy of choice for electricity generation. Going forward, the ability by the government to control the domestic prices of natural gas will decline as a result of the expiry of the old contracts which require new rounds of negotiation on pricing. More importantly, the fact that Thailand will need to import more natural gas for domestic consumption will cause the domestic price of natural gas to move closer to the international prices, which could have significant implications on how the private sector would adjust to higher natural gas and electricity prices in the future.

3.2. Price Control Schemes

3.2.1. Retail price subsidy

After the market liberalisation in 1991, retail petrol pricing has been determined by market mechanism instead of price control by the government. However, the government is still able to intervene the market through the operation of the Oil Fund, which was established as a public agency tasked with preventing a shortage in oil as well as maintaining the stability of domestic retail petrol prices in the event of rising global oil prices in order to minimise adverse impacts on consumers and the overall economy.

The usual operation of the Oil Fund involves collecting contributions from oil users during the normal and low oil price periods, and dispensing the surplus fund in form of subsidies during the high oil price periods. It does not receive any financial assistance from the government budget as all revenues come from oil users. Thus, its goal is to stabilise retail petrol prices without jeopardising the survival of the Oil Fund. However, in reality, the subsidies from the Oil Fund have often been used for cross subsidisation among products, while the subsidy could be prolonged and continued even if the Fund incurs deficits.

The operation of the Oil Fund and its implications on the economy came into focus following the recent oil price increase. Early in 2004, the prices of crude oil and oil products in the global markets had risen substantially, causing retail petrol prices in Thailand to escalate. Citing concerns of potential adverse impacts of high oil prices on the economy, the government decided to fix the retail prices of gasoline and diesel prices on January 10, 2004, using the Oil Fund's operation. However, as the global oil prices continued to rise, the Fund's deficits escalated which needed to be financed by borrowings from local financial institutions and bond markets. As it became clear that the subsidy scheme was not sustainable, the government decided to terminate the scheme, first for gasoline prices in October 2004 and later for diesel prices in July 2005. Figure 15 compares the prices of petrol at the pumps and the prices which should have been without subsidy as well as the cumulated losses of the Oil Fund.

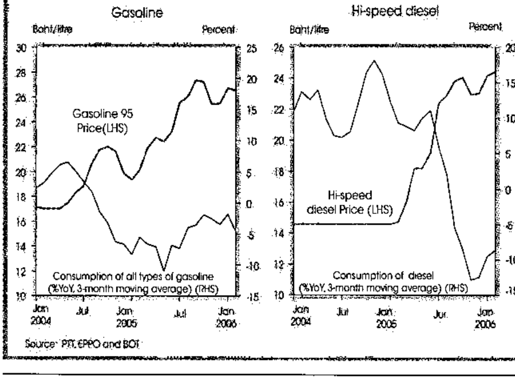
The implementation of the oil price subsidy programme in 2004-2005 have many negative implications on the Thai economy. **First, the subsidy needed to maintain the retail prices below the market prices which led to huge financial deficits of the Oil Fund, reaching 92.07 billion baht, equivalently to 1.4% of GDP (in year 2004).** This amount of financial resources could have been spent more wisely and more productively. A good alternative would be the financing of public transportation infrastructure projects such as subway/skytrain system to alleviate the traffic congestion problem in Bangkok and metropolitan area. This would be considered a much more effective way to assist consumers to deal with high energy prices in the long run. Moreover, the substantial deficits, both from principles and interest payment, required subsequent increases in the contributions that the Oil Fund needed to collect from oil users, implying the public ended up paying much higher oil prices after the termination of subsidy programme. Thus, the Oil Fund's operations not only failed to stabilise the retail oil prices, but also added to its volatility by requiring oil users to pay higher contributions during the high oil price period.

Adding to the problem is the way in which the contributions are being administered. While most of the financial losses come from diesel consumption which account for 85 billion baht out of the total loss of 92 billion baht with the rest (7 billion baht) owing to gasoline subsidy, the burden to make up for the losses have been unfairly and disproportionately placed on gasoline users. In fact, the losses stemming from gasoline users have already been paid up within a few months of the termination of the gasoline subsidy. However, gasoline users continues to pay much higher contributions to the Oil Fund compared to what they were paying prior the beginning of the subsidy programme, in order to alleviate the financial burden on diesel and LPG users. For example, on November 2, 2006, users of gasoline 95 and gasoline 91 had to pay 3.46 and 3.26 baht/lire for contributions to the Oil Fund, much higher than what they were paying at 0.5 and 0.3 baht/litre respectively, prior to January 2004. This is also much higher than what diesel users' contribution was at 1.5 baht/litre (increase from 0.5 baht / litre, prior to January 2004).

The government's rationales for shifting part of the payback burden from diesel users to gasoline users likely lies in the belief that diesel users tend to be low-income households and that diesel is used mainly in the business sector especially for the transportation of goods and passengers. Thus, by reducing the payback burden of diesel users, the government can achieve better distributional impact of higher oil prices as well as help contain its adverse impact on inflation and economic growth. However, this rationale is questionable on its assumptions and unfair administering due to lack of transparency. Many of diesel users are not from low income families as increasing number of motorists turn to new passenger cars and high-end pickup trucks designed for diesel engines, in no small part, to take advantage of lower retail prices of diesel, compared to gasoline. Meanwhile, the main users of gasoline 91 are motorcyclists, hardly a high income group by any standards.

But even more problematic with the policy is its lack of transparency. Though the information on the amount of contributions to the Oil Fund for each type of petrol products is available on the government's website, the government has never come out to explain to the public, its policy and rationales for requiring gasoline users to bear part of the Oil Fund's losses incurred from diesel subsidies. It is likely that the majority of gasoline users would not be very happy if they find out that the prices for gasoline over the past two years could be lower almost by 3 baht per litre if the government just simply asks the diesel consumers to be responsible for losses incurred from diesel subsidies.[4]

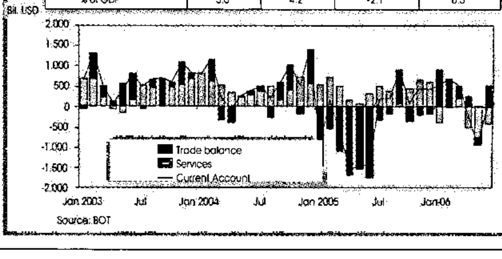
Figure 15
Retail petrol prices and domestic petrol consumption



Source: PTT, EPPO and BOT

Figure 16
Effect of High Oil Prices on Current Account

unit. billion USD	2003	2004	2005	2006 H1
Net oil import value	7.5	10.6	17.5	9.9
% of GDP	5.2	6.6	9.9	10.1
Trade balance	3.76	1.46	- 8.58	-1.93
Current account	7.97	6.87	- 3.7	0.50
% of GDP	5.6	4.2	-2.1	0.5



Source: BOT

4 The government may point out that the contributions on gasoline 91 & 95 must be high in order to create a pricing gap between normal gasoline and gasohol (90% gasoline + 10% ethanol) which is part of government policy to promote gasohol use. However, the same pricing gap could still be created with contributions on gasoline being much lower than what it is. The fact is that the surplus contributions from gasoline users have been used to help pay down losses from diesel subsidy as well as help continue subsidy programme on LPG.

Second, the price subsidy scheme undermines the government's own efforts to promote greater energy conservation among the public. During the subsidy period (2004-mid 2005), the consumption of petrol products in Thailand continued to expand in the face of rising global oil prices (Figure 15). Only after the termination of subsidy scheme for gasoline in October 2004 and for diesel in July 2005 did the public respond by cutting down on their petrol consumption. As a result of the subsidy, Thailand's net oil import values grew rapidly in 2004 and 2005 (Figure 16), resulting in current account deficits of 2.1 % of GDP in 2005, the first annual deficit since the 1997 Asian crisis.[5] Moreover, lower domestic prices of diesel and gasoline reportedly led to oil smuggling along the border of Thailand and its neighbouring countries. Therefore, it is likely that a significant portion of the financial burden borne by Thai consumers is used to subsidise oil users in neighbouring countries as well. The key lesson learned here is that consumers respond mostly to the price signals. Without sending out proper pricing signals, the government's efforts, both to encourage the public to conserve petrol use and to promote alternative energies such as gasohol, bio-diesel and NGV during the oil subsidy period, would be unsuccessful.

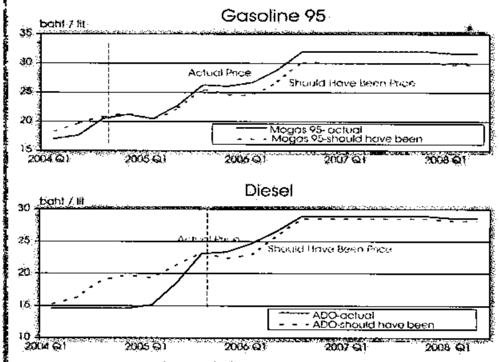
In fact, the only clear winner of the oil price subsidy policy is the domestic petroleum business sector. In general, as the prices of any normal products increase, sellers or producers will be able to sell fewer of their products since consumers will cut back demand in response to higher price signals. However, in the case of the oil price subsidy, both domestic refiners and retail petroleum service providers actually gain. For domestic refiners, their margins rose along with the Singapore reference prices, while the sale volume continued to grow owing to price subsidy. Without price subsidy, their domestic sale would have declined, causing them to rely more on export markets which have lower margins due to transportation costs. Similarly, for retail petroleum service providers, their marketing margin during the price subsidy was fixed at the level of past average, while sale volume continued to increase.

The government often cites a number of reasons for the oil price subsidy in the midst of high global oil prices which include the lessening of the impacts on consumers as well as prevent economic slowdown and minimise inflation. However, the most important objective that the government should focus on is how to facilitate the adjustment of the consumers and business sector to higher oil prices as efficiently as possible. The best way to achieve this goal is to allow the market mechanism to function through proper price signals. This can be supplemented by a carefully designed measure to provide assistance, particularly to the poor. The government and the public must resist the temptation to adopt price fixing or subsidy schemes by taking into account the long term perspective and reminding themselves that there is no free lunch. Despite supposedly good intentions to help consumers in the short run, the price subsidy measure entails many negative medium to long-term implications as described above, especially in the event that the global oil prices do not come down as expected.

5 The trade and current account deficits in 2005 contributed greatly to the depreciation of the baht during the first half of 2005, and overall slow appreciation of the baht compared to other regional currencies in 2005. The trend reversed with a strong recovery in current account position following the end of oil subsidy and a significant appreciation of the baht against US$ (by 16% in 2006), which was the main reason for the Bank of Thailand's implementation of the reserve requirement measure in December 2006 to curb excessive baht appreciation.

In order to better understand the overall impacts of oil price subsidy programme during 2004–mid 2005 on the Thai economy, we have employed the BOT Macro Model to estimate the different paths of key macroeconomic variables under 2 scenarios of domestic retail petrol prices.[6] The base case is the price subsidy scenario where oil prices moved according to that in reality. The alternative case is the scenario where there are no oil subsidies and oil prices moved according to what should have been. Thus, compared to the base case, the retail oil prices under the alternative case would be higher initially (no subsidy) and lower towards the end (no need to pay back the losses associated with the subsidy). Figure 17 shows the alternative paths of retail oil prices which will be used in the simulation.

Figure 17
Comparisons of Retail Oil Prices between W/ and W/O Subsidy



Source: Q1 2004-Q2 2006 from EPPO, Q3 2006-Q1 2008 from BOT (as of July 2006)

In both scenarios, we set the values of exogenous variables based on information available in July 2006 and then allowed the Model to calculate the estimated paths of endogenous variables. We focus mainly on the estimated paths of GDP growth, inflation and current account positions under different scenarios. Table 3 demonstrates the estimated results of the simulation.

Table 3: Comparisons of Simulation Results between Subsidy Case and No Subsidy Case

	2004		2005		2006	
	Subsidy	No Subsidy	Subsidy	No Subsidy	Subsidy	No Subsidy
GDP growth (%)	6.2	6.2	4.46	4.51	4.38	4.38
Headline Inflation (%)	2.78	3.36	4.54	4.47	5.48	4.91
Current account ($ Mil)	6,865	7,953	-3,714	-2,130	-1,503	-1,278

Source: Forecasting and Modeling Team, BOT and authors

The estimated results indicate that, in terms of economic growth during 2004- 2006, the differences between the two cases are negligible.[7] On the other hand, the outcomes in the economic stability dimension under the price subsidy scheme would have significantly worsened, both in terms of higher current account deficits and more volatile inflation dynamics. As mentioned earlier in the paper, consumers responded to oil price subsidies by continuing their oil consumption in the normal pattern. As a result, oil imports continued

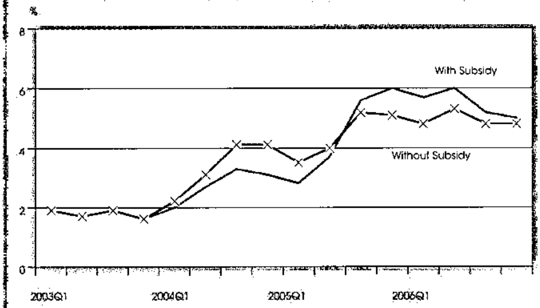
6 Based on data and information available in July 2006. The results are only meant for illustrative purposes to highlight the different paths of key macro variables under alternative assumptions of retail oil prices, and do not in any way represent the BOT's official economic forecasts.

7 The model indicates that higher domestic oil prices under no subsidy scenario would lead to slight slowdown in domestic demand. However, external demand would improve owing to higher exports (benefiting from depreciation of the baht following initial acceleration of inflation).

to grow both in volume terms and especially in value terms, given much higher global oil prices, leading to much higher current account deficits. In terms of inflation performance, though price subsidy may reduce inflationary pressure at the beginning, the abrupt end to the subsidy after the losses to the Oil Fund becomes unsustainable, caused inflation to increase markedly in the second half of 2005. Headline inflation reached 6% in the fourth quarter of 2005. In contrast, under the no price subsidy case, domestic oil price and inflation would have increased gradually, with inflation reaching the peak of only 5.1% in the fourth quarter of 2006.

Lower current account deficits and smoother path of inflation would help the economy to adjust to higher oil prices in a more efficient manner. (Figure 18) In addition, the sharp acceleration of headline inflation following the end of oil price subsidy in July 2005, has an important implication on subsequent monetary policy conduct by making it more likely for the central bank to raise the policy interest rate more aggressively to contain inflation expectations compared to the no subsidy case where the inflation path was smoother. Therefore, the oil subsidy scheme could also have negative implications on subsequent growth even after the termination of the subsidy. The bottom line is that the simulation here demonstrates that the subsidy policy is likely to produce less efficient outcomes in terms of growth and stability relative to the no subsidy case.

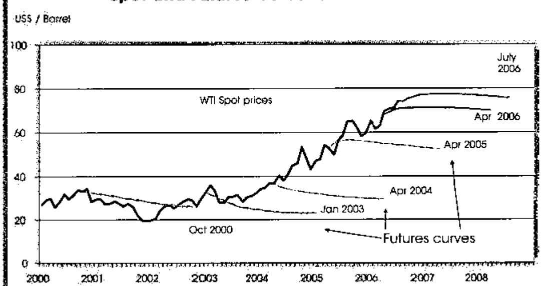
Figure 18
Comparisons of Headline Inflation Paths under Two Scenarios (with and without Price Subsidy)



Source: BOT'sForecasting and Modeling Team and Authors

The results of the simulation reflects the underlying problem with price control or subsidy policy in which the decision is dominated by short term growth objective more than consideration for medium-term risks and economic stability. Moreover, the only situation in which the subsidy may partly achieve its objective is when the increase in global oil price is temporary. This would allow the Oil Fund to collect more contributions when the global oil price decline to pay off the losses incurred during the price increase. However, from the experience during 2004-2005, it could be said that the government failed to pay enough attention to the true nature of the oil price increase and likely future path of oil prices which could have been obtained from the futures market. Figure 19 shows the spot and futures price of WTI crude oil during 2004-2005. It shows that in 2004, the futures market's perspectives of oil price outlook has changed significantly. The relatively flat futures curve signals that the market expects that the oil price would stay relatively high in foreseeable future, reflecting the market's belief that the shocks currently hitting the oil market is likely to be permanent in nature. This is in contrast to past futures curves which tended to decline to low levels following the spikes in oil prices, indicating the transitory nature of the shock.

Figure 19
Spot and Futures Curve for WTI Crude Oil



Note: futures curves reflect the average prices during the first two weeks of specified month of WTI futures prices with delivery dates up to two years.
Source: Bloomberg

Thus, price control under the circumstances that oil price were being driven up by sustained robust demand and tight spare capacity was likely to lead to substantial losses for the Oil Fund. This signal of sustained high price became increasingly apparent especially after October 2004. However, the government continued with the subsidy for diesel, the decision of which is likely to be partly driven by political motives as the general election was scheduled for January 2005. The decision led to prolonged market distortions and much higher losses for the Oil Fund. This underlines the importance of proper and transparent framework of the Oil Fund's operation to ensure that the policy is based on public interest and not driven by inappropriate motives.

3.2.2. LPG Subsidy

Over the past few years, the government has set the retail price of LPG at below the market value, using the Oil Fund subsidy. The main rationale for this is to assist the household sector which uses LPG mainly for cooking purposes. However, since the government cannot prevent users from using LPG for other purposes, the Oil Fund ended up subsidising all LPG users, regardless of whether they are the household, manufacturing or transportation (auto) sectors. At present, the Oil Fund's LPG subsidy scheme involves 3 steps:

1) The Oil Fund enters into an agreement with all domestic LPG producers to maintain the domestic wholesale price for LPG at US$315/ton, and to provide adequate supply of LPG to satisfy domestic demand at such price before being allowed to export LPG abroad.

2) The Oil Fund provides subsidy in order to maintain the domestic retail price of LPG at 16.81 Baht/Kg (recently, the subsidy amounted to around 2 Baht/Kg, depending on the exchange rate)

3) The Oil Fund also provides additional subsidy of around 40 million baht per month for transportation costs to ensure the uniform retail price of LPG around the country.

Such a policy has created considerable market distortions and reduced efficiency of energy usage, especially over the past few years when the LPG prices in the global markets have risen substantially. Given that the average global price of LPG in 2005 and during the first half of 2006 was around US$430 and US$517 per ton, respectively, this means that domestic LPG producers have to incur significant losses in revenue as well as the loss in value added for the economy. Moreover, the gap between controlled LPG price and gasoline price has been widening, especially after the gasoline price has been allowed to rise substantially to reflect its fair market value. As a result, many car owners of both taxi and passenger cars have switched from gasoline to LPG, leading to a marked increase in LPG consumption growth in the transportation sector of 36% yoy in 2005 and 4% over the first six months of 2006 (Table 4). The greater use of LPG in the transportation sector has largely accounted for an increase of the subsidy required to maintain the price control to roughly 550 million baht per month. This loss has added up to more than 10 billion baht of debt owed to domestic LPG producers, which was a burden that was shifted to users of both 91 and 95 gasoline during the period of already high oil prices.

Table 4: LPG Uses (by Purposes)

				2006		YOY%		
Sector	**2003**	**2004**	**2005**	first 5 month	**share**	**2004**	**2005**	**2006**
Household	1,502	1,513	1,604	675	53	0.7	6	4.6
Manufacturing	435	441	450	202	16	1.4	2.1	11.9
Auto	**210**	**223**	**303**	**166**	**13**	**6.3**	**35.7**	**48**
Petrochemical	405	425	567	230	18	5	33.4	3
Total	**2,551**	**2,602**	**2,923**	**1,273**	**100**	**2**	**12.4**	**9.6**

Source: EPPO

In addition, such price control for LPG also present hindrances and raises costs on the government's campaign to promote usage of alternative energies such as NGV. At present, the retail LPG price is at 9.09 baht per litre. In order to induce consumers to switch from LPG to NGV, the government through the operation of the PTT Public Company Limited must allot greater price subsidy in order to set a lower price for NGV than LPG price (at 8.50 baht/litre). Thus, this is an example of one distortion created by the price subsidy scheme leading to another market distortion.

4. Policy Recommendation

Thailand must turn the current oil crisis into an opportunity to strengthen long-term energy security by setting a strategic framework for national energy policy. This would give serious priority on energy efficiency improvement and alternative energy development. The policy should consist of 5 key components:

(1) Adjusting energy pricing structure to better reflect the actual costs

The lack of progress in improving energy efficiency and developing alternative energy over the past 2 decades did not happen by chance. Relatively lower prices of energy in Thailand, especially when compared to other high energy import-dependent countries, contributed to half-hearted efforts to improve energy efficiency and served as impediments to alternative energy development. After all, consumers and producers are alike in responding to price signals. Therefore, the energy pricing structure should be adjusted to better reflect the actual costs of energy production and consumption. We suggest two specific recommendations.

- Short run - gradually reduce the subsidy for LPG consumption in order to minimise distortions in energy production and consumption and promote fairer pricing across types of energy user groups. If assistance to the poor households is deemed necessary, the subsidy should be targeted specifically for them.
- Long run - adjust the energy pricing structure to better reflect the actual costs. This could involve additional tax collection based on carbon

emission applied on the same basis for all energy products. The timing for tax implementation needs to be considered carefully though. For example, it should be introduced when the global oil price declines somewhat. Part of the tax revenue should be used to develop public transportation infrastructure in order to provide real alternatives for public commuting. Part of the revenue should be spent on R&D projects to promote energy efficiency and alternative energy.

(2) Redefining the role of the Oil Fund

Up till now, the operation of the Oil Fund in trying to achieve its goal of oil price stability and minimise the impacts of oil price increase on the public, has suffered from the lack of clear principles and guidelines. This has often led to price control measures that fixes retail oil prices too low and for too long. In fact, the Oil Fund does not have the operational capacity to manage oil price risks for the public. It only serves as a refinancing vehicle on a temporary basis for consumers, while the consumers continue to bear the risks themselves. The Oil Fund's operation also suffers from a lack of transparency in providing adequate information and explanation to the public of their policy decisions. For example, it never gave a clear justification to the public why it forces gasoline users to pay for part of the losses which stemmed from the diesel subsidy. Lastly, Thailand still does not have adequate strategic oil reserves to prepare for potential oil shortage. At present, the government only requires each domestic private oil company to stock oil up to 5% of its annual sale, equivalently to 18 days of consumption. This is very low compared to international standards, especially among the IEA countries whose strategic reserves capacity is for a minimum of 90 days of consumption. Given these shortcomings, there should be an overhaul of the Oil Fund's operation in the following areas:

- Specify proper principles and guidelines for price intervention including clear exit strategy and loss ceiling in order to reduce the opportunity for policy interference for short term political gain. The Fund should also prepare thorough analysis of benefits and costs of price intervention for the overall economy before making such decisions with heavy emphasis on long term energy security as main objective.
- Consider the possibility of employing financial instruments such as oil futures and other derivatives to hedge risks of oil price volatility for the public. If it is considered to be appropriate, the operation must be subject to transparent and effective supervision.
- Gradually build the official strategic oil reserves. This will require huge investment but will be crucial in strengthening Thailand's energy security against potential future supply disruption.

(3) Promoting energy efficiency seriously and continually

In the past, the government's energy policy paid greater importance to promote economic growth by supplying adequate energy at low prices to improve the competitiveness of Thailand's manufacturing sector. It did not give importance to energy efficiency improvement which reflects true competitiveness in the long run.

- In the manufacturing sector: The government should reconsider its investment promotion policy by setting required targets for energy efficiency especially for firms in highly energy intensive sectors. It also should enhance energy efficiency on a sustainable basis, employing both carrots and sticks to provide proper incentives to business sector. In addition, greater attention should be given to the SME sector especially on knowledge sharing on energy efficiency improving techniques.

- In the transportation sector: The government should accelerate the construction of mass transportation system in the urban area to tackle the traffic congestion problem which is the main cause of considerable energy waste. It should also set standards and promote competition among auto manufacturers on fuel efficiency. Lastly, it may be necessary to implement road pricing schemes to encourage greater use of public transportation in the urban area.

(4) Supporting alternative energy development

The government should set a consistent policy framework to promote alternative energy. This would likely involve providing an appropriate level of subsidies to induce production and consumption while sparing the government of too high a financial risk. However, after the reform on energy pricing structure, the government should allow the market mechanism to play a greater role in selecting among the alternative types of energy.

The government should also support R&D projects, both to reduce production costs of various alternative energies and to enhance knowledge which would be useful for appropriate energy policy planning. While the government's support for each type of alternative energy should be based on Thailand's comparative advantage and commercial feasibility, it should not neglect the monitoring of the developments of those energies which may not be feasible for Thailand in the short run, but could be real alternatives in the long term.

(5) Enhancing Effectiveness of Energy Policy

To enhance the effectiveness of its energy policy implementation in promoting long-term energy security, the government should establish a national energy policy framework that is consistent with sustainable development with balanced consideration to all dimensions including economic, social and environmental objectives. A National Energy Policy Board, with representatives from academics, producers, consumers and civil servants should be set up to formulate a policy framework that is balanced, independent and transparent, placing priority on long-term energy security.

- Set key performance indicators to measure the progress of energy policy which is clear, challenging and verifiable. The results of these indicators as well as assessment of policy progress should be released to the public on a regular basis to promote policy accountability.
- Lastly, the government needs to increase public awareness and participation through effective communication. For energy policy to be effective going forward, it requires greater participation and sacrifice from every group of society. Thus, it is crucial that the government communicate effectively to the public concerning future energy challenges. This can be achieved via honest dialogues, transparent policy conduct and public hearing process, which will create public confidence, trust and cooperation.

The South East Asian Central Banks (SEACEN)
Research and Training Centre
Lorong Universiti A, 59100 Kuala Lumpur, Malaysia
Tel: (603) 7958-5600 Fax: (603) 7957-4616/7955-6561
Website : http://www.seacen.org