A SMALL SCALE MACROECONOMIC MODEL OF INDONESIA

ENRICO TANUWIDJAJA

NATIONAL UNIVERSITY OF SINGAPORE

2005

A SMALL SCALE MACROECONOMIC MODEL OF INDONESIA

ENRICO TANUWIDJAJA
(*B.Soc.Sci.(Hons), NUS*)

A THESIS SUBMITTED

FOR THE DEGREE OF MASTER OF SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

NATIONAL UNIVERSITY OF SINGAPORE

2005

Acknowledgements

"…God's Grace is sufficient for me, for His power is made perfect in my weakness…and I can do all things through Christ who strengthen me" (2 Corinthians 12:9 and Philippians 4:13)

Glory be to God, that we know in Jesus Christ, for all the strengths and passions He has bestowed upon me to complete this study. He comforts me in every step of the way for the past two years as I struggle to complete my master's course and provides me not only with sufficient wisdom, but also with great people to support me. Let this thesis be my humble offering for Him who deserves all the glory.

Recognition and respect are due to my outstanding supervisors Dr. Choy Keen Meng and Associate Professor Jose Tongzon for lending their expertise to help me in writing this thesis. I am truly blessed to have Dr. Choy to supervise me in the quantitative, modeling, and econometrics-related part of my thesis. He is an excellent macroeconometrician with superb econometric skills and his in-depth analysis has helped me tremendously to improve the quality of my thesis. For all of these, I am truly honoured to be working with him and my utmost gratitude for all the time he spent in advising me and reading through my drafts numerous times. I am also indebted to A/P Jose Tongzon for his kind attention and his valuable feedbacks in the qualitative part of my thesis. Things might not be as complete as of now without his enthusiasm in helping me to understand the economic development in ASEAN and Indonesia, in particular. I will always cherish the time that I have spent with my supervisors, especially all the insightful discussions I had with them. Once again, thank you Dr. Choy and A/P Tongzon!

Appreciation and my deepest gratefulness are for my family and friends who have given their supports and prayers without fail. To my parents in Jakarta, I want to thank you for the encouragement throughout these years. Your prayers and supports have sustained me and I hope that what I have achieved can bring the confirmation of what a wonderful parents you have been to us. To my angels, Juanita and Maureen, I want to thank the two of you for helping me and comforting me when things were not going smooth, as most of the time they aren't. In times when the workload seems to be an uphill task and I daunted about my study, you are always there to lend ears and hands. Thank you angels!

Conference participants and organizers for the Xth Spring Meeting of Young Economists, Geneva, Switzerland, are people who I would like to thank as well. I want to express my sincere thank, especially, to Magnus Saxegaard (Nuffield College), Michele Lenza (European Central Bank), Sudip Ranjan Basu (HEI, Geneva) for valuable discussions during the conference. This opportunity has helped me to sharpen the analysis of my thesis and broaden my perspective about economic research as well.

Enrico would finally thank all my friends at the graduate programme, especially Randy, Shirley, Daniel, Mervyn, Sanja, Umar, Grace, and Kelvin. I appreciate and cherish all the intellectual discussions we had that motivate me in doing further economic research.

Table of Contents

Summary

This thesis aims to capture the fundamental structure of the Indonesian economy through the construction and simulation of a small scale macroeconomic model (SSMM). An SSMM is an aggregated model with considerable theoretical content that contains far fewer equations than large-scale macroeconomic models and provides direct analytical solutions. Recently, SSMM has been adopted by countries that target inflation directly, such as New Zealand, Canada, Brazil, the United Kingdom, Sweden, Finland, Australia, and Spain. Thus it is rather timely to devise an SSMM for Indonesia as it is currently moving towards an inflation targeting regime amidst the structural changes that had taken place since the Asian financial crisis.

Chapter 1 will state the motivation behind our thesis and it will be followed by an outline of the thesis. We discuss recent developments in the Indonesian economy, most notably before and after the financial crisis that struck Indonesia in 1997 before we move on with the construction of Indonesian SSMM in Chapter 2. This chapter contains an exposition of the macroeconomic developments in Indonesia with special attention devoted to certain economic variables that play key roles in promoting macroeconomic stability. This chapter is meant to be a narrative analysis of stylized facts. Moreover, this chapter is a building block for modelling the Indonesian economy using an SSMM and provides a background for the simulations in the later part of the thesis. Chapter 3 deals with the review of theoretical foundations for small scale macroeconomic models. Specifically, we will take a closer look at three different small scale models, namely: The Batini-Haldane model for the United Kingdom, the Reserve Bank of Australia model, and Brazilian model. In addition, we will also discuss several types of policy rules that are commonly used to close an SSMM.

We build the Indonesian SSMM in Chapter 4 with the specific objectives of discussing the empirical findings from the model; to understand the important macroeconomic factors affecting the Indonesian economy; and to identify key policy vehicles that can play central roles in sustaining non-inflationary economic growth in Indonesia. In this chapter, we will also have a detailed discussion about the determinants of the inflation rate in the Indonesian economy. Finally, we end Chapter 4 by reviewing the recent trend of monetary policy conduct in Indonesia before we specify the policy rules for the Indonesian SSMM. Chapter 5 deals with the estimation and simulation results from the Indonesian SSMM that we have built earlier. We carry out several dynamic simulations of the economy to investigate the effects of external shocks such as an increase in external demand; to understand the role of central bank credibility; and to experiment with different policy rules, such as interest rate rule and money supply rule, in the Indonesian SSMM. In line with the ultimate goal to achieve a non-inflationary economic growth for the Indonesian economy, we also put some emphasis in understanding two different measures of inflation (core and headline) through the simulation exercises. In particular, we trace out the policy frontier for the Taylor rule in the Indonesian economy and discuss the issue of appropriate policy response. Finally, Chapter 6 summarizes the main empirical findings and discusses some policy implications based on this study. All in all, we desire to understand viable policy options to support the objective of achieving sustained and continuous economic growth for Indonesia.

List of Tables

List of Figures

Chapter 1

Introduction

*A vessel of 1,919,440 sq km in size began sailing in the year 1945 with an inspiring hope to reach the dream land called **“Prosperity”**. It went through some good and bad experiences along the way until it faced a very heavy storm fifty two years later. The storm had struck the vessel and caused heavy damage to it. The vessel’s experts argued that it was because of the vessel’s weak and frail fundamental structure such that it was unable to withstand the heavy storm, while some other specialists argued that the storm was too heavy for the vessel to held back, since other vessels nearby experienced the same thunderstorm and collapsed, though a few did not. Years after, some repairs have been made and the vessel continues to sail to reach the dreamland. It has been eight years now but still the fears and doubts of whether the structure of the vessel has regained its strength remain. All the experienced experts of the vessel still argue intensely about this matter, until somebody from the vessel asks: “Where are we now? What reasonable speed should we take to reach our destination?”... He then paused a while before asking: “where is the dreamland and how to get there?”... The vessel is called … Indonesia.*

1.1 Motivation for the Study

Indonesia, a country with a vast archipelago, has always been the subject of fascination by people in the world for her richness in cultural diversity, abundance of her natural resources, and the remarkable economic success achieved over the last few decades—setting aside the incidence of the Asian financial crisis in 1997. A country that has always amazed many observers is now facing uncertainties regarding her future economic direction which makes her an intriguing case study for economic discussion, policy studies, and debates at international forums. Furthermore, the current trend of an integrated and borderless world economy forces countries to adapt to an ever-changing global economic environment and to compete effectively in order to maintain their significance in the world marketplace and to enhance their future growth potential. Indonesia is no exception.

After the inception of the so-called “new order” regime under the leadership of Soeharto in 1967, Indonesia began to experience a period of sustained economic growth and expansion in several sectors of the economy. Not long after, this “sweet dream” of marvelous economic growth for around three decades was followed by a sudden economic crisis that was sparked off by the Asian financial crisis of 1997. This significant incident has created major structural changes for the Indonesian economy, leading the country to undergo several major policies changes in the areas of the exchange rate system, debt restructuring, tighter bank regulation, and inflation targeting mechanisms and policies, *inter alia*.

The anecdote at the beginning of the chapter might be just a glimpse about the situation that is currently faced by Indonesia. Hill (1999) depicts this situation in his own words: *“… Indonesia is in deep crisis. A country that achieved decades of rapid growth, stability, and poverty reduction, is now near economic collapse … no country in recent history, let alone one the size of Indonesia, has ever suffered such a dramatic reversal of fortune”*. Indonesia has undergone one traumatic experience, namely the financial crisis that has led to adverse changes in economic conditions. Starting with the intense debates about the economy around the year 1996, the question boils down to whether the Indonesian economy is overheating or not (Soesastro 1995; James 1995; Bird 1996; Manning and Jayasuriya 1996). Indications of overheating such as the rapid rise in the inflation rate, as measured by the CPI change, though contradicted by some other indicators, should have functioned as a clear warning of the impending financial crisis in Indonesia. Soon after the occurrence of the Asian financial crisis in 1997 and 1998, most discussions were focused on the causes of this crisis in Asian countries. We will not pursue further the causes of the financial crisis in this thesis—although quite a detailed summary will be provided in chapter 2—since there has been a large literature discussing this matter thoroughly (see for example: Hill 1999; Mann 1998; Sadli 1999; McLeod 1997a; Radelet and Sachs 1998a,b; Iriana and Sjoholm 2001).

Leaving the political factors aside and recognizing all the developments that have occurred over the past three and a half decades as well as drawing an important lesson from the Asian financial crisis, the primary objective of this thesis is to capture the present structure of the Indonesian economy through the construction and simulation of a small-scale macroeconomic model (SSMM). We need to emphasize that Indonesia is a big economy in terms of area and inhabitants and SSMM is a small scale model, not a model for a small economy. A small-scale macroeconomic model (SSMM) of the Indonesian economy will be constructed since it provides very useful intuition about the fundamental structure of the economy and policies that are feasible for the country. The use of an SSMM raises the question of why we choose it over a large-scale macroeconometric model. An important reason is that an SSMM is an aggregated model with considerable theoretical content that can provide a stylized and compact representation of the whole economy as opposed to larger models with the usual complexities involved. In comparison with a typical macroeconometric model, an SSMM contains far fewer equations and provides direct analytical solutions. It is also more transparent in that the results of policy simulations can be easily understood in terms of the workings of the economy. In other words, it is relatively more straightforward to trace the transmission of policy actions to key variables such as output and inflation while policy exercises using an SSMM can function as a cross-check on the results of simulations from larger and more sophisticated macroeconometric models developed by the central bank and other researchers (for example, Fukuchi 1968; Wang 1983; Kobayashi et al 1985; Simatupang 1986; Kuribayashi 1987; Azis 1988, 1990; Bautista et al 2001) or vector autoregression (VAR) models (for example, Siregar and Ward 2002). To sum up, an SSMM is often small enough to allow its key properties to be investigated analytically and thus it provides powerful insights with a relatively less complicated structure.

Concerning the economic literature that deals with the Indonesian economy, there are some macroeconomic models that focus on the dynamic simulation of the economy given external shocks, with special attention being devoted to trade sector analysis (Azis and Ekawati 1990). However, some of the research on large-scale macroeconomic models has been rendered outdated by time and data limitations.[1] Other researchers have dwelled on analyzing the behavior of the Indonesian macroeconomy by studying the importance of aggregate demand versus aggregate supply shocks (Siregar and Ward 2002) and the importance of exchange rate mechanisms and inflation targeting in Indonesia (Siregar 1999).

The specific objectives of this thesis are to estimate an SSMM for Indonesia and to discuss its empirical findings; to understand some important macroeconomic factors affecting the Indonesian economy; and to identify key policy vehicles that can play a

[1] Refer to Appendix 1 for the complete tabulation of macroeconomic models for Indonesia.

central role in sustaining non-inflationary economic growth. The focus will be on the formulation and implementation of monetary policy by the central bank—Bank Indonesia (BI). Examples of the ultimate objectives of such policy are exchange rate targeting, inflation-targeting, output-targeting, or combinations of these targets, to be achieved through interest rate or money supply instruments. Towards this end, several dynamic simulations of the economy will be conducted to investigate the effects of external shocks on the Indonesian economy, such as a positive shock in external demand. We will also examine the role of credibility in central bank policymaking and also in its choice of inflation target. Different policy rules will be analyzed with the aim of obtaining the best policy responses. The outcomes based on both deterministic and stochastic simulations will be assessed in order to fully understand the macroeconomic dynamic of the Indonesian economy and recommend ways to achieve non-inflationary economic growth and macroeconomic stabilization.

Thus far, SSMM has been adopted by countries that target inflation directly, such as New Zealand, Canada, Brazil, the United Kingdom, Sweden, Finland, Australia, and Spain (see Haldane 1995; Leiderman and Svensson 1995). To date, Indonesia has one small macroeconomic model called the Bank Indonesia Small Quarterly Model (BI-SQM). An additional motivation for us to construct an SSMM for the Indonesian economy is to improve upon the BI-SQM by separating the aggregate demand equation into oil and non-oil sectors. Furthermore, in view of the usefulness of such a model for the countries mentioned above, we also believe that the Indonesian SSMM can be an important tool for Indonesian economic policy-makers.

1.2 Organization of Chapters

We will begin this thesis by providing a comprehensive summary of the major macroeconomic features of Indonesia along with recent developments in Chapter 2. Specifically, this chapter will discuss three major milestones affecting the Indonesian economy, namely, the primary oil boom from 1963 to 1980, the economic slowdown period in conjunction with global recession from 1981 to 1986, and the secondary boom due to economic recovery that was boosted by the surge in non-oil manufacturing exports that resulted from the FDI boom during 1987 to 1996. In addition to that, we will also discuss the impact on and significance of the Asian financial crisis in 1997 and 1998 to Indonesia. We will point out several major events since the occurrence of Asian financial crisis that has led Indonesia to experience policies reform.

This discussion is necessary since it provides crucial background for the rest of the study. In essence, we will argue that it was weak macroeconomic fundamentals that were responsible for the economic turmoil during the Asian financial crisis as opposed to the alternative view that argued for contagion effects across ASEAN economies. Our view leads us naturally to the construction and simulation of an SSMM so as to capture the inter-relationships between key macroeconomic variables and, based on that, to suggest measures to bring about improvements through appropriate policy responses.

Chapter 3 will be devoted to a discussion of the theoretical underpinnings of a small scale macroeconomic model. This chapter will first look at several variants of SSMM along with monetary policy rules. It will be followed by a comparison of their respective merits and suitability for modeling the Indonesian economy. We will pay particular attention to the Batini-Haldane (1999) model that has been developed at the Bank of England and used recently in several countries such as Brazil and Venezuela. The model embodies forward-looking expectations of rational agents in the economy, which is preferable because they are solved using model-consistent rational expectations and hence immune to the Lucas critique. We will then supplement the discussion of the Batini-Haldane (1999) model with alternative monetary policy rules such as the Taylor (1993) and McCallum (1988) rules.

Modelling the Indonesian economy using the small scale macroeconomic model will be the main focus of Chapter 4. In particular, this chapter will deal with the modification of the theoretical model (i.e. the Batini-Haldane model) to suit Indonesia's macroeconomic structure and circumstances. We will also review Bank Indonesia's small macroeconomic model, the BI-SQM, in this chapter. Furthermore, we have a subsection that deals with the inflation transmission mechanism in Indonesia in view of the emergence of an inflation-targeting regime in Indonesia recently. This is followed by a detailed discussion of Indonesian monetary policy before and after the Asian financial crisis that serves as a prelude to the specification of monetary policy rules in the Indonesian SSMM.

Chapter 5 will initially deal with the estimation of the SSMM. This chapter will discuss alternative estimation methods thoroughly. It also briefly introduces the datasets and variables required for our estimation and policy simulations. We list the sources of the data in the Data Appendix. The main purpose of Chapter 5 is to analyze and interpret the estimation and simulation results from the Indonesian SSMM. After estimating the model, we construct a baseline scenario for the Indonesian macroeconomy prior to conducting economic scenario analysis and policy simulations. We then study the monetary policy transmission mechanism through the simulation exercises with an aim to understand better how to achieve sustained non-inflationary economic growth in Indonesia with prudent and effective macroeconomic stabilization policies. Our investigations will use the baseline scenario as a benchmark against which the simulated scenarios will be compared.

Chapter 6 concludes the thesis by summarizing the main findings, drawing the policy implications, and making suggestions for further research. Specifically, it proposes certain monetary policy measures that can provide guidance on the best responses from Indonesian policymakers. All in all, we hope that the future direction for the Indonesian economy can be illuminated by the policy actions that we suggest in this study. At best, it is hoped that Indonesia can find her way again to "*sail to the dreamland of prosperity*".

Chapter 2

Macroeconomic Developments of Indonesian Economy

This chapter contains an exposition of the macroeconomic developments of Indonesia with special attention devoted to certain economic variables that play key roles in promoting macroeconomic stability. This chapter is meant to be a narrative analysis of stylized facts. Moreover, this chapter is a building block for modelling the Indonesian economy using an SSMM and provides a background for the simulations in the later part of the thesis. It will begin by giving a brief overview of the Indonesian economy, and continues with a concise, but detailed, discussion of stylized facts regarding the Asian financial crisis and its impact on Indonesia. The discussion has shown that the frail macroeconomic fundamental of the Indonesian economy is the one responsible for the collapse of the economy vis-à-vis the Asian financial crisis as opposed to the alternative view of the "contagion" effect. Consequently, this result will support further our analysis by providing an understanding about the key macroeconomic variables that are prone to similar shocks in the future. Finally we will conclude by outlining a brief analysis and insights regarding key macroeconomic variables in relation with the recent conduct of monetary and fiscal policy.

2.1 Overview of the Indonesian Economy: Trends and Developments

In this section, we will discuss the macroeconomic performance of Indonesia starting from the year 1970 onwards. Many economic observers and policy-makers, as well as academics, have been impressed and surprised by the remarkable and outstanding economic progress achieved by Indonesia during the 1970s and 1980s (see, for example, Booth 1981, 1986; Gillis 1984, 1988, Sundrum 1980; Warr 1986). This process of development has been studied thoroughly and intensely by economists and policy-makers in the international forum, which recognized Indonesia as one of the High Performing Asian Economies (HPAE) as coined by the World Bank. Tongzon (2002), in the second edition of his book, gives a number of important insights regarding the economies of ASEAN countries, their developments, and future challenges. In particular, we would like to draw on some crucial points and to tap into the insights in his book regarding the Indonesian economy in the following exposition.

Indonesia is basically a market-based economy, just like most of the ASEAN[1] economies, with prominent state intervention in several major sectors (e.g. provision of public roads, highways, public schools and state-funded universities, electricity services, etc). Secondly, Indonesia's trade performance is worthy of emphasis since it is highly comparable to the rest of the Asian Tigers in terms of export-led performance.[2] In the 1960s up to 1980s Indonesia experienced an average export growth of 7.6680%. Subsequently, the export growth rate surge up to an average of 9% from the middle of 1980s to the middle of 1990s. Her export-oriented economy has provided strong evidence for the proposition of export-led growth as shown by the high volume of trade and especially the high degree of export-import dependence[3]. Jung and Marshall (1985) and

---

[1] ASEAN currently consists of Singapore, Indonesia, Malaysia, Thailand, The Philippines, Vietnam, Brunei Darussalam, Cambodia, Laos, and Myanmar.

[2] Asian Tigers refer to the Asian countries that have achieved a remarkable economic growth and performance over this last decade or so, such as Singapore, Malaysia, Hong Kong, South Korea, and Taiwan.

[3] See Feder (1983), Balassa (1985), Ram (1985), Salvatore and Hatcher (1991), Greenaway and Sapsford (1994) for discussion regarding export-led growth theory and evidence.

Bahmani-Oskooee et al (1991) found supporting evidence for the export-led growth hypothesis in Indonesia. The former found that only Indonesia, Egypt, Costa Rica, and Ecuador pass the Granger causality test from export growth to output growth, suggesting evidence in favour of export promotion in Indonesia. However, we note that Jung and Marshall (1985) did not include East Asian NICs that include countries with notable export promotion strategy such as Hong Kong and Singapore, thus in that regard Indonesia's export performance was not able to be compared side by side with them. Nevertheless, we know that the Indonesian economy, especially with respect to trade, is not as open as Hong Kong or Singapore. Bahmani-Oskooee et al (1991) uses improved methodology of Granger's causality test with Akaike's Final Prediction Error (FPE) criterion to overcome shortcomings found in Jung and Marshall (1985) and they also found evidence of causality from export growth to output growth, but not vice versa.

Thirdly, the economic aspirations of Indonesia are heavily centred on the importance of enhancing economic growth since Indonesia has a substantial history of poverty, under-provision in the labour market, and under-development in major social and economic sectors. Lastly, the Indonesian economy is of the dualistic type whereby more than 60% of the population live in the agricultural and rural areas with the rest of the population living in the major cities.

However, Indonesia is blessed with rich agricultural and mineral resources (i.e. oil, natural gas, sulphur, etc). Moreover, her abundant supply of human resources makes her labour costs relatively low as compared to similar economies around the region. The large domestic market and an extensive period of political stability, most notably during the mid 1970s to mid 1990s, as well as impressive economic development and expansion during the Soeharto regime have attracted foreign and domestic investments in sectors like manufacturing, services, and financial industries.

The strengths of the Indonesian economy are not without its weaknesses. The main drawback is the low level of efficiency in the bureaucracy and the quality of the rural and suburban basic infrastructures. Although it will not be discussed at all in this thesis, political stability is one vocal point worth noting as an important ingredient to ensure the sustainability of economic development. This is especially the case after the fall of Soeharto's new order regime in 1998, whereby a number of domestic disputes and incidents remained unsolved, such as the Aceh Freedom Movement (Gerakan Aceh Merdeka (GAM)), incidents in Ambon and Maluku, and the recent Bali bombings amongst others. Thus, they expose the country to some unfavourable effects in promoting economic stability and sustained growth.

From the 1970s onwards, Indonesia faced a major economic problem, namely the persistence of high inflation rates, mainly caused by lack of financial discipline, and perhaps coordination, from both the central bank and ministry of finance, reaching their peak during the oil-induced economic boom in 1974[4]. Within this decade, major monetary and fiscal policies were directed to fight inflation and they have proven to work

[4] During this period, the hike in oil price was more than quadrupled as can be seen from the world oil price index that rose from 5.8 to 126.4 within the time frame of 1970 – 1981. It then fell to 100 in 1982 – 1985, before it rose again slightly from 64.7 to 77.8 in 1986 – 1990. The latter figures shown more stable figure as compared to the initial oil price hike (van der Meulen Rodgers, 1994).

successfully and effectively. Some studies have also been conducted to analyze the performance of the Indonesian economy such as Aghevli (1977), Aghevli et al (1979), Arndt (1979), Nasution (1983), Gillis (1984), Parikh et al (1985), Warr (1986), and Sundrum (1986, 1988) in the areas of macroeconomic development, monetary sector, financial institutions, as well as fiscal and monetary policies.

During the time period of 1970–1981, income per capita in Indonesia has risen steadily from US$ 80.4 to a remarkable US$ 486.3, recording an excellent growth around five-fold over the period. Real GDP has been quite stable throughout 1970–1990, recording an average growth of around 6.9 % annually with standard deviation of 1.88%, higher than average Asian real GDP growth of around 6.4%. Inflation was reasonably stable (although some sub-periods still recorded high figures such as 21.7% in 1973–1978 and 15.5% in 1979–1981) at around 7–9 % and it settled down to a level of 7.4% at the end of 1980. The share of exports in GDP rose steadily to a record of 29.3% in 1979–1981 before it fell to 22.3% in early 1990. Correspondingly, non-oil exports have risen steadily over the decades as the contribution and significance of this "new" source of growth increased. Non-oil exports recorded a 12.2% share of GDP in 1990, much higher than the 7.8% in early 1970. Imports have been rising steadily as well but the growth rate of imports has been rather constant from 12.3% in 1970 to 16.6% in 1990. Current account deficits have always been a staple feature of the Indonesian economy but it reached a lower level of 2.7% of GDP in 1990 as compared to 4.3% in the previous sub periods of 1982-1985. The latter was the period where the global economic recession took the repercussion effect and Indonesia was affected as well. Reflecting these structural changes, the share of agriculture in the economy has fallen steadily from 42.0% to a mere 23.4% in early 1990 whereas the industrial and services sectors have recorded substantial increments from 21.6% and 36.4% to 36.8% and 39.8% respectively. During the time period of 1970–1990, Indonesia has witnessed a vast recovery and rapid economic growth and this time period up to the early 1990 can be viewed as the resurgence of the Indonesian economy after her independence.

The development process and progress of the Indonesian economy during the period of 1970-1995 can be divided into three major time frames. This is done to provide comprehensive descriptions of the major economic milestones of the economy. The period after 1995 will be discussed separately and can be considered as the most recent development of the Indonesia economy that involves numerous dynamic adjustments and structural changes such as the notable incident of the Asian financial crisis in 1997.

The resurgence of the Indonesian economy and the primary oil boom (1963-1980)

It appears that history dictated that during the first two decades after Indonesia proclaimed its independence, she was to face some major economic obstacles such as the problem of hyperinflation, extreme unemployment, and uncontrollable population growth that created major structural problems for the newborn nation. It then reached the brink of economic disaster when the inflation rate soared up to 600% annually in the period of 1959–1965 when the first Indonesian president, Soekarno, printed money as needed despite falling exports and access to hard currency causing hyperinflation, coupled with economic stagnation[5].

The resurgence in the economy began with the inception of the so-called "new-order" regime under Soeharto's leadership with the well-known and successful Five Year Development Plan (REPELITA: Rencana Pembangunan Lima Tahun) which started in the year of 1968. During this period and subsequently, Indonesia has shown a remarkable improvement in economic growth, a substantial reduction in the inflation rate, and job creation in several sectors of the economy. Export-led growth was identified as the main source of this magnificent increase in the country's economic performance along with the voluminous amount of foreign aid received from 1970 to 1972 (Kokko 2002). Moreover, the first oil shock from 1973 to 1974 which was followed by the second one from 1979 to 1981 have enabled Indonesia to experience strong and improved macroeconomic performance as well as her remarkable trade activities. This was because Indonesia was a net oil exporter country and enjoyed great benefits from hikes in oil price and moreover, during that period, some concerted efforts have been made by the Organization of Petroleum Exporting Countries (OPEC) to sustain a reasonably high oil price.

---

[5] Altogether, this condition is referred to as "stagflation" by some economists and has been a subject of thorough discussion since the oil price shocks of the 1970s.

Table 2.1 Selected Key Macroeconomic Indicators of Indonesia, 1963-1980 (%)

Year	Real GDP Growth	Inflation Rate	GDP Per Capita Growth	Nominal Exports Growth
1963	-2.25	145.91	-4.33	-6.23
1964	3.45	108	1.21	11.83
1965	0.95	306.76	-1.28	-3.60
1966	2.85	1136.25	0.54	-1.26
1967	1.13	106	-1.18	0.36
1968	12.03	128.84	9.45	9.98
1969	7.48	15.52	4.97	14.85
1970	8.15	12.35	5.61	17.10
1971	6.70	4.36	4.46	15.71
1972	7.88	6.51	5.28	21.21
1973	9.78	31.04	7.13	18.64
1974	8.26	40.60	5.67	6.56
1975	6.18	19.05	3.71	-2.42
1976	5.60	19.86	3.40	17.02
1977	8.64	11.04	6.14	9.45
1978	9.21	8.11	6.82	1
1979	7.10	16.26	4.84	2.29
1980	8.73	18.02	6.50	5.53
Average	**6.25**	**118.64**	**3.83**	**7.67**

Source: World Development Indicators CD ROM (World Bank, 2004)

Consequently, this increase in the oil revenue has benefited the whole economy during that period. In addition to that, the export of Liquefied Natural Gas (LNG) starting from the year 1977 boosted the economic performance of Indonesia even further.

This improvement, however, has pushed the domestic inflation rate up but not as severely as was experienced before. Some prudent economic policies have also been implemented in order to maintain her economic performance. In 1978, a preventive measure of exchange rate devaluation also helped Indonesia to restrain the diminishing value of her relative non-oil exports price incentives to less than 5% (van der Meulen Rodgers 1994). This was Indonesia's first major devaluation of the exchange rate as a response to the external shocks hitting the economy.

Table 2.1 shows selected key macroeconomic variables of Indonesia and we can see that after the year 1963, GDP growth has been fairly stable and it recorded an extensive period of positive growth. Most notably, in 1968 when the government started the first five-year development plan, GDP growth recorded the highest growth of 12.03%. On average, Indonesia recorded 6.25% output growth (standard deviation of 1.3%) through the primary oil boom period. The GDP per capita growth averaged 3.83% in this 18-years period (1963–1980) with most notable achievement during the initial implementation of REPELITA (Five-Year Development Plan) that recorded a remarkable growth of 9.45%. After 1968, GDP per capita growth has been positive throughout the years and recorded an average rate of 5.7%. The inflation rate, by and large, still recorded high volatility ranging from a maximum of 1136% in 1966 to a minimum of 4.36% in 1971. The IMF-sponsored stabilization and debt restructuring program in the early 1970s has successfully resulted into a fall in the inflation rate to reach 8.11% in 1978. Nevertheless, inflation has been, and still is, the major enemy of the Indonesian economy as we can see from the high inflation record and it tends to fluctuate with business cycles and changes in monetary and fiscal policies. Export growth has recorded a substantial progress from a negative range in 1963–1966 to a startling growth after the inception of the five-year development plan. It recorded a 15.77% growth during the first REPELITA as compared to only 7.67% for the whole period within this first milestone. Needless to say, export has been a new source of economic growth for Indonesia during this time period as we have mentioned above, being further fuelled by the oil boom.

Economic slowdown and global recession (1981-1986)

The fall in oil prices and increasing current account deficits ushered Indonesia into a period of economic slowdown beginning from the early 1980s. The GDP growth figure dropped considerably during this period and was falling behind other Asian countries. The global recession in the early 1980s was acknowledged as the main cause of this slow economic growth. Both domestic and foreign investments fell during this period and government expenditures on large capital intensive projects were also reduced as a response to lower oil revenues —the major source of income for the economy. Export earnings fell and the volume of debts increased in response to higher world interest rates during this tough economic period for the global economy and in particular, for Indonesian economy.

Many jobs were also lost since many firms were unable to operate due to capital withdrawal or the cancellation of some major projects that required major capital and labour expenditures, especially by government. The drop in investments figures also catalyzed the worsening trend of unemployment during that period. Auspiciously, Indonesia was still able to report a modest real GDP growth of 4% annually and still maintain a much lower figure for debt costs as compared to other problematic debtors and stagnant economies during that period such as Mexico and the Philippines. Indonesia's second major devaluation also occurred within this economic slowdown period in 1983. This step was supported by government efforts to control money growth with the implementation of new monetary policy instruments which was aimed specifically at realigning the exchange rate system in order to maintain Indonesia's competitiveness in the trade sectors.

Table 2.2 Selected Key Macroeconomic Indicators of Indonesia, 1981-1986 (%)

Year	Real GDP Growth	Inflation Rate	Current Account (% of GDP)	Nominal Export Growth
1981	8.15	9.48	-0.61	-18.05
1982	1.1	11.79	-5.62	-9.0
1983	8.45	10.46	-7.42	1.65
1984	7.17	4.73	-2.09	6.55
1985	3.48	5.83	-2.17	-7.80
1986	5.96	9.28	-4.67	15.21
Average	**5.72**	**8.60**	**-3.76**	**-1.91**

Source: World Development Indicators CD ROM (World Bank, 2004)

Table 2.2 shows that GDP growth fell substantially to 1.1% in 1982 as the world entered into global recession. Inflation soared into double digits in 1982 and 1983 to record 11.79% and 10.46% respectively. The current account deficits widened in this time of recession and export growth shrunk considerably by 18% and 9% in the early 1980s. The second major devaluation of the exchange rate in 1983 did help Indonesia to record a substantial GDP growth of 8.45% which is comparable to the level of sustained growth and subsequently inflation was brought down to around 4.8% in 1984. Export growth also showed signs of recovery near the end of this second milestone to record 15% growth.

The secondary boom: non-oil recovery period and non-oil export revival (1987-1996)

This period was marked substantially by the improvements in real income growth and the current account —through reductions in the current account deficit— fuelled by non-oil domestic exports growth. The falling trend of oil price stabilized in 1986[6] and most economies started to realign its major policies and expenditures programs in this period as well. Indonesia also conducted her third major devaluation in 1986 whereby the government allowed the Rupiah to depreciate far more rapidly than before by letting the money supply growth rate to increase. This policy, however, resulted in a lower inflation rate than the previous period which might be explained by the resurgence in the non-oil exports that was boosted by devalued currency, a relatively small decline in fiscal expenditures, and the price controls imposed by the government on several key commodities and services.

Agriculture, the sector that has always contributes significantly to Indonesia's economy, was superseded by the manufacturing production sectors that recorded an excellent real growth during this period from 1991 as shown by Table 2.3. Investments, domestically and from abroad, regained its momentum by comprising almost one third of the aggregate demand elements (van der Meulen Rodgers, 1994). This fact can be seen from Table 2.3 whereby manufacturing value-added as a percentage of GDP has outpaced agricultural value-added most notably from 1991 onwards. The manufacturing sector recorded a quarter's share of GDP in 1996 whereas agriculture sector only recorded around 16% of GDP as compared to almost 23% in the early 1990s. Both GDP growth and inflation rates were more stable during this period although the inflation rate was still considered high. Perhaps at that point in time, the goal of the authorities was to keep inflation from recording double digits. The current account deficits have been relatively stable at around 1–3% of GDP over the years. Exports growth showed double

[6] See the Data Appendix.

digit growth occasionally in 1987, 1991, and 1992, with the rest of the years showing a relatively stable, but lower, rate of export growth.

Table 2.3 Selected Key Macroeconomic Indicators of Indonesia, 1987-1996 (%)

Year	Real GDP Growth	Inflation Rate	Current Account (% of GDP)	Nominal Export Growth
1987	5.30	9.28	-2.66	14.62
1988	6.36	8.04	-1.57	1.05
1989	9.08	6.42	-1.09	6.74
1990	9.0	7.81	-2.61	3.36
1991	8.93	9.41	-3.32	18.78
1992	7.22	7.53	-1.10	13.71
1993	7.25	9.68	-1.33	6.11
1994	7.54	8.52	-1.58	9.94
1995	8.40	9.43	-3.18	7.72
1996	7.64	7.97	-3.37	7.56
Average	**7.67**	**8.41**	**-2.27**	**8.96**

Source: World Development Indicators CD ROM (World Bank, 2004)

Year	Agriculture Value-Added	Manufacturing Value-Added
1987	22.48	16.33
1988	22.48	19.70
1989	22.02	17.02
1990	20.42	18.30
1991	12.79	14.21
1992	17.45	19.08
1993	17.88	22.30
1994	17.29	23.35
1995	17.14	24.13
1996	16.67	25.62
Average	**18.66**	**20**

Source: World Development Indicators CD ROM (World Bank, 2004)

2.2 The Asian Financial Crisis

In the discussion of the survey of recent developments published by the Bulletin of Indonesian Economic Studies (BIES) during late 1995 and early 1996, the issue of “overheating” in the Indonesian economy was prominent and debatable (see, for example, James 1995; Bird 1996; and Manning and Jayasuriya 1996). Soesastro (1995) pointed out that there were threats of economic overheating by the second half of 1995. Factors such as rising inflation, massive capital inflows from foreign investors that were used to finance property purchases in the face of a significant jump in residential and commercial property demand, and a widening current account deficit contribute to the fear of overheating. Massive capital inflows triggered property developers in Indonesia to borrow money from abroad and mostly denominated in US dollars which was stable at that time. Some sceptics argued that the inflation rate in Indonesia was still in an acceptable rate of 2.3%, which cast doubt on the overheating of the economy.

In addition to that, the widening current account deficit is not in itself a threat to economic stability and thus alleviates any possible danger of overheating that will lead to economic collapse. This is exactly the case for Indonesia since she believed that the economy was being driven by excess investment over national savings and the attraction of foreign capital to Indonesia was not used to finance the current account deficit *per se* but to accumulate foreign reserves (James 1995). Advocates of the threats of "overheating" argued that the deficits may push Indonesia into an exchange rate crisis and substantial capital outflow but Bird (1996) counter-argued this view by arguing that import growth is rather volatile and decreasing and one should not "extrapolate" the recent rapid growth into the future. Moreover, she argued that export growth has shown signs of recovery and thus reducing the current account deficit and the accumulated foreign reserves should guard Indonesia against any possible threat of capital outflow.

Manning and Jayasuriya (1996) argued that there are two factors underpinning fears of overheating. First, private capital movements have replaced public capital utilization to play a much larger role. This means that the most likely source of any major external shocks would be from the capital account given the volatility of short-term private capital flows. Second, the source of fluctuations in the capital account is none other than the ever-changing political climate in Indonesia. Speculations and political uncertainty were very pervasive in Indonesia and thus made Indonesia very vulnerable to any destabilizing capital movements due to the loss of investors' confidence.

However, the attention which has not been paid enough by the authorities to the indications shown by the economy rendered Indonesia into the Asian Financial Crisis that occurred in 1997 that was initiated by the depreciation of Thai Baht. The high private sector capital outflow has caused many banks and firms to collapse, resulting into many non-performing loans (NPLs) since they were not able to clear most of the loans they made. This adverse condition necessitated the Indonesian central bank (BI) to bail out banks in order to restore people's trust and investors' confidence. Consequently, it meant a depletion of Indonesia's foreign reserves and indicated that major portions of capital inflows were used to finance current account deficits and only minor parts were being accumulated as foreign reserves.

Those who argued that the fear of overheating was "groundless" disregarded the fact that political uncertainty is likely to affect economic developments and trends in Indonesia. Given that, investors' confidence would be harder to sustain and it was somehow overlooked that the 1998 presidential election was a critical point for the Indonesian economy that will heighten the level of foreign investors' awareness and cautions.

The widening of current account deficits was argued mainly because of faulty interpretation of crude trade data (Manning and Jayasuriya 1996). Yet, if that was the case, should it not be the reason and concern for an even more alarming danger of economic collapse that was heading on Indonesian way? At least, this should prompt the officials to study carefully the most credible data to avoid any misinterpretation, especially concerning high and short-term capital flows. The reason was that there might be a high possibility that projected investments as well as exports-imports flow data that are used in order to record any trade balance in the current account and this projected investments and exports-imports were sometimes overestimated. This only available information was perceived to be the *actual* scenario and given only this kind of *projected* information; it is rather straightforward for the investors to question the soundness of their investment returns and for analysts to point out that there were alarming dangers of economic downturn.

Indonesia's crisis in 1997 began with massive capital outflows from the country[7]. This massive capital outflows eventually brought about the collapse of the Indonesian Rupiah. In the beginning of the crisis, July 1997, the Rupiah depreciated by 7%. Then finally on 14 August 1997, the Rupiah was floated and marked the end of a long history

[7] Indonesia experienced a $ 22 billion reversal of private capital flows, from an inflow of $ 10 billions in 1996/1997 to an outflow of $12 billion in 1997/1998. (World Bank 1998b)

of crawling peg exchange rate system. We are going to discuss two fundamental reasons behind the financial crisis that led to economic downturn in Indonesia, namely the over-reliance on short-term borrowing (Pincus and Ramli 2001) and the second is the contagion effect[8]. To discuss the first reason, we will start by looking at the structure of foreign debt owed by Indonesian domestic banks and private corporations in 1995 until the period before the crisis in the middle of 1997.

Table 2.4 International Claims Held by Indonesian Banks – Distribution by Sectors and Maturity (in Billions of US Dollars)

Period	Total Outstanding	Obligation by Sector			Debts and Reserves		
		Banks	Public Sector	Non-Bank Private	Short Term	Reserves	Short Term/ Reserve
End 1995	44.5	8.9	6.7	28.8	27.6	14.7	1.9
End 1996	55.5	11.7	6.9	36.8	34.2	19.3	1.8
Mid 1997	58.7	12.4	6.5	39.7	34.7	20.3	1.7

Note: the data excludes offshore issues of commercial paper and other non-bank liabilities.
Source: Bank for International Settlements (1998).

Table 2.4 shows that there was a sharp increase in foreign borrowing with significant increases in the short-term debt borrowed by private firms and banks from the end of 1995 up to the middle of 1997. The short-term debt held by the public sector remained relatively stable. These massive capital inflows (foreign borrowing) were caused by several factors amongst which we will elaborate on three important ones[9]. First, the liberalization in the banking and financial sector adopted by the Indonesian government

[8] Contagion is defined here as the spread of economic difficulties across countries and often manifest itself as a co-movement of, for instance, exchange rates (World Bank 2000).

[9] There were other factors that contributed to the massive capital inflow into Indonesia. First was the high economic growth of Indonesia (about 7–9 % of GDP rate) that gave foreign investors confidence to invest in the country. Second was the historically predictable exchange rate that reduced perceived risks and in turn encouraged investors (Indonesia government has been successful in maintaining its real exchange rate target ever since the last major devaluation of 31% in rupiah in September 1986).

in the early 1990s have paved the way for firms and domestic corporations to seek access to the foreign capital. Second, the deregulation in the banking and financial sector was not accompanied by adequate supervision from the authorities, thus creating an environment conducive to high rates of short-term borrowing as it allowed banks to take on sizeable foreign currency and maturity risks. Third, low interest rates in Japan have induced outward investment from this country to Indonesia in particular and to other Southeast Asian countries in general[10].

The increase in short-term debt was particularly significant since it exceeded foreign reserves.[11] In fact short-term debt in excess of reserves does not necessarily cause a crisis. However, it renders a country vulnerable to a financial panic.[12] Relatively speaking, countries with large foreign exchange reserves compared to short-term debt are much less vulnerable to a panic, since each creditor can be assured that sufficient funds are available to meet his claims (Radelet and Sachs 1998b). Hence, the fact that pre-crisis Indonesia's short-term debt to foreign reserves ratio exceeded 1 as shown in Table 2.4 made the country vulnerable to a financial panic.

Apart from the fact that Indonesia's short-term debt exceeded its foreign reserves, the underlying problem with this massive short-term debt is that apparently most of it was

[10] The main factor that drove the Japanese banks into heavy lending to Indonesia and other Southeast Asian countries was the existence of relatively higher interest rate in these countries. The low interest rate in Japan was due to its fragile banking sector, which was affected by the burst out of the 1980's asset bubble and weakened by its stagnant economy in the 1990s.

[11] Note that the actual amount of Indonesia's short-term debt borrowing would be even larger if offshore issues of commercial paper and other non-banks liabilities were included.

[12] Panic is defined here as an adverse equilibrium outcome in which short-term creditors suddenly withdraw theirs loans from a solvent borrower. Under these circumstances, even sound corporations may be unable to roll over their debts (Sachs and Radelet 1998b).

used to finance speculative and unhedged investments in real estate markets (or other non-traded goods) rather than being used to increase productive capacity for manufactured exports (traded goods) as in the earlier periods.

Table 2.5 Indonesia's Gross Domestic Product Share by Industrial Origin (%)

Item	Share	
	1985	**1995**
GDP	100.0	100.0
GDP (non petroleum)	78.7	91.3
Traded sector	40.2	38.9
Non-traded sector	59.8	61.1

Note: traded sector includes non-food crops, forestry and fishery, mining and quarrying, manufacturing industries.
Non-traded sectors includes farm food crops; livestock and products; electricity, gas and water supply; construction; trade, hotel and restaurant.
Sources: Centre Bureau of Statistics, Economic Indicators (various issues).

Table 2.5 shows that Indonesia’s GDP share of traded goods decreased from 40.2 % in 1985 to 38.9 % in 1995 while the share on non-traded goods increased from 59.8 % in 1985 to 61.1 % in 1995. Although the figures reflect a relatively small change in the GDP share on traded goods to non-traded goods, Radelet and Sachs (1998b) suggested that it probably understated the true amount as firms apparently diverted their own working capital and other loans towards real estate investments.

This analysis has also been highlighted by Nasution (1999) where he argued that the low quality of investment was funded by massive short-term capital inflows as can be seen from the widening current account deficit and mounting of external debt. This phenomenon arguably left the country prone to exchange rate risks, since Rupiah revenue streams were expected to repay dollar liabilities. To make matters worse, most of this short-term debt was unhedged. This was partly due to the historical nature of predictable and low rate of the Rupiah appreciation (Nasution 1999) and due to similar reasons that encouraged capital inflows into Indonesia that were mentioned earlier.

A second factor that caused the crisis was the contagion effect from the region. According to Radelet and Sachs (1998b), Indonesia appears to be the clearest case of contagion in the region. Their argument was that, though it was true that there were many problems and weakness in the Indonesia economy before the crisis, yet by most measures[13], Indonesia's imbalances were among the least severe in the region. These can be seen in Table 2.6 and Table 2.7.

Table 2.6 Current Accounts of Four Southeast Asian Countries (% of GDP)

Countries	1990	1991	1992	1993	1994	1995	1996	1997
Indonesia	-4.40	-4.40	-2.46	-0.82	-1.54	-4.27	-3.30	-3.62
Malaysia	-2.27	-14.01	-3.39	-10.11	-6.60	-8.85	-3.73	-3.50
Philippines	-6.30	-2.46	-3.17	-6.69	-3.74	-5.06	-4.67	-6.07
Thailand	-8.74	-8.01	-6.23	-5.68	-6.38	-8.35	-8.51	-2.35

Note: current account used here is based on NIA Definition.
Source: International Financial Statistics of the International Monetary Fund.

Table 2.7 Government Fiscal Balances of Four Southeast Asian Countries (% of GDP)

Countries	1990	1991	1992	1993	1994	1995	1996	1997
Indonesia	0.43	0.45	-0.44	0.64	1.03	2.44	1.26	0.00
Malaysia	-3.10	-2.10	-0.89	0.23	2.44	0.89	0.76	2.52
Philippines	-3.47	-2.10	-1.16	-1.46	1.04	0.57	0.28	0.06
Thailand	4.59	4.79	2.90	2.13	1.89	2.94	0.97	-0.32

Sources: International Financial Statistics of the International Monetary Fund.

[13] Most measures are defined here as the usual few macroeconomic statistics which are regarded as relevant to measure the economic fundamentals of a country, such as the size and the rate of growth of current account deficits, and government fiscal balances (Radelet and Sachs 1998b).

From Table 2.6, we can see that Indonesia's current account deficits in 1996-1997, at an average of 3.5 %, was the lowest as compared to the other three countries and from Table 2.7, we can see that Indonesia's budget had been in surplus by an average of over 1% of GDP for four years.

In analyzing Radelet and Sachs' argument, Jap (2003) started by looking at the contagion factors that suggested the most prominent contagion effect came from the Baht crisis and the weakening Japanese economy. The Baht crisis started on 2 July 1997 with floating of the exchange rate and spread quickly to Indonesia, Malaysia, and the Philippines (Hill 1999). The two possible transmission mechanisms for the spread of the Thailand crisis into Indonesia were, firstly, by means of trade links. The crisis in Thailand might spread into Indonesia if the declining economic activity and imports in Thailand decrease Indonesia's exports. However this possibility seems implausible since the merchandise trade connections between Indonesia and Thailand are quite weak compared with Indonesia's exports to Japan and U.S., as shown by Table 2.8.

Table 2.8 Share of Indonesian Exports to Selected Countries, 1991-1997 (%)

Period	**Thailand**	**USA**	**Japan**
1991-1995	1	14	31
1996	2	14	26
1997	2	14	24

Source: Direction of Trade Statistics Yearbook, IMF (1998).

The second is due to sharing a common creditor—a country with large share of lending in the region. As has also been discussed by Karminsky and Reinhart (2000), besides trade links, different countries are interdependent if they borrow from the same creditors. It seems this was the case for Thailand and Indonesia as these two countries borrowed mainly from the same creditors, which was Japan. This is shown in Table 2.9 whereby both Indonesia and Thailand borrowed substantially from Japan with the highest share of claim amounted to 47%, 40%, and 40% for Indonesia and 58%, 60%, and 54% for Thailand during 1995, 1996, and 1997 respectively.

Table 2.9 International Claims Held by Indonesian and Thailand Banks–Distribution by Country of Origin (Billions of US Dollars)

Country/ Period	Total Outstanding	Claims Held by Banks From			
		Japan	USA	Germany	All Others
Indonesia					
End 1995	44.5	21.0	2.8	3.9	16.8
End 1996	55.5	22.0	5.3	5.5	22.7
Mid 1997	58.7	23.2	4.6	5.6	25.3
Thailand					
End 1995	62.8	36.9	4.1	5.0	16.8
End 1996	70.2	37.5	5.0	6.9	20.8
End 1997	69.4	37.7	4.0	7.6	20.1

Source: Bank for International Settlements (1998).

So it seems likely that the Thai contagion effect spread to Indonesia through capital accounts and not by the mean of trade links as has also been discussed by Hill (1999).

On the two different views, we believe that there was insufficient evidence that The Baht crisis was the fundamental reason behind the crisis in Indonesia. If we were to consider Hong Kong, Singapore and Taiwan, they also lie within the region but they were relatively less affected by the regional downturn. During the crisis, Hong Kong managed to maintain its currency parity against the US dollar despite strong speculative attacks[14], while Singapore[15] and Taiwan opted to float their currencies rather than lose their reserves in an attempt to stabilize the exchange rate. The depreciation rate of both the Singapore and Taiwan currencies was about 18% over the year. This figure was well below that in Indonesia, Malaysia and the Philippines whose depreciation rates were 151%, 52% and 52% respectively (Corsetti et al. 1998a). We will not pursue further such cross-country comparisons since it is not of a particular interest of this research. However, it is worth emphasizing the fact that the Thai crisis was only a triggering factor that brought the underlying fragile macroeconomic structures of Indonesia to the surface. This fact has also been suggested by Iriana and Sjoholm (2001) who found that contagion from Thailand served only as a trigger for the Indonesian crisis.

Now, another possible explanation related to contagion was the deepening crisis experienced by Japan in 1997. The deepening crisis experienced by Japan in 1997 caused many of its banks, which had heavily lent to Indonesia (and other Asian economies) since the eighties and nineties (due to low interest rates in Japan as discussed previously), to suffer capital losses as they were required to re-balance their portfolio in order to meet the Capital Adequacy Ratio (CAR) standards. Since the capital adequacy requirement was higher for international than national lending, it has forced many of those banks to recall foreign loans lent to Indonesia and other Asian countries. Jap (2003) argued that

[14] Hong Kong's ability to defend its exchange rate parity was due to the increment in the short-term interest rate by the Monetary Authority. With high nominal and real interest rate, it helps prevent an acceleration of the capital outflow and hence convince the international market about the credibility of the Hong Kong's commitment to keep its exchange rate parity fixed. However, it was misperceived as due to the presence of Currency Board System (CBS) in Hong Kong that motivated President Soeharto to practice it in order to stop the downward fall of rupiah in face of the 1997 crisis (Corsetti et al. 1998b).

[15] Singapore has been engaging in a managed-float exchange rate regime since around 1981 and it widened the band during the crisis period.

this was an important factor, which contributed to the sudden capital flight experienced by Indonesia during the crisis, as most of the Indonesia credits (about 35% of its total debts) were borrowed from Japan. This can be seen from Table 2.9 as well.

Again, we do not share the same belief that this is the fundamental reason behind the crisis in Indonesia. If only Indonesia managed its short-term debts prudently and used them to invest in the manufacturing sectors to boost exports by optimizing the productive capacity of the economy, then those short-term debts would be able to generate dollar revenues needed to pay the debts back. Although the revenues generated from export may not necessarily be enough to cover all the debts but at least it will buffer the country from significant exchange rate risks. Jap (2003) argued further that if only Indonesia managed its short-term debt more prudently, the impact of the sudden capital flight, due to the Japanese weakening economy that forced its banks to call back their loans from Indonesia, would not be as severe as it has happened. So to reiterate again, the underlying problem is in the country itself. A weakening Japanese economy had the same role to play as the Thai crisis in relation to Indonesia's crisis. It only served as a triggering factor which brought the internal distortions within the country to the surface.

In conclusion, we believe that the fundamental reasons behind Indonesia's crisis in 1997 were weak corporate governance and the frail macroeconomic policies of the country. Weak corporate governance has resulted in a large ratio of short-term debt to foreign reserves and thus exposed the country to a financial panic. Frail macroeconomic policies has resulted in the mismanagement of the short-term debts and left the country even more vulnerable to exchange rate risk. Contagion effects from The Baht crisis and a weakening Japanese economy contributed to blow up the distortions that were already in place. In light of this consideration, a study carried by IMF (1999) confirmed the importance of economic fundamentals and shows that several countries affected by the financial crisis shared similar weaknesses.

However, it is important to note that though these contagion effects were not the fundamental reasons behind the Indonesia's crisis, their role in initiating the Asian financial crisis is significant and should not be overlooked (as noted earlier, the economic imbalances of a country alone may not be enough to produce a crisis). This is particularly very true in the type of crisis that originates from a financial panic which is exactly the type of crisis that hit Indonesia in 1997. Under normal circumstances, short-term debts can easily be rolled over. However, the Baht crisis has alarmed international investors to re-evaluate their investments within the whole region (including Indonesia). Thailand crisis also amplified Japanese banks to further call in their loans. These revealed the distortions that took place (i.e. a relatively large short-term debt to foreign reserves) in Indonesia and translated them into financial panic. Once a crisis started, each creditor knows that there might be insufficient liquid foreign exchange reserves for each short-term creditor to be fully paid, so every involved party rushed to be the first in line to demand full repayment.

Once creditors begin to believe that the other creditors are no longer willing to roll over the debt, each of them will try to call in their loans ahead of other investors[16], so as not be the one left without repayment out of the limited supply of foreign exchange reserves (Radelet and Sachs 1998b). Here, it is clear that the Thai crisis and a weakening Japanese economy played important roles in starting the crisis. If it was not the Thai crisis that 'encouraged' investors to reassess their investment and weakening Japanese economy that forced Japanese banks to recall their loans from Indonesia, Indonesia's weaknesses would not be revealed and panic among investors could be avoided as short-term debt can be easily rolled over under normal circumstances.

Furthermore, if Indonesia had sufficient foreign reserves compared to short-term debt and strong economic fundamentals, a reassessment carried by investors might not lead to a panic (or if there it did, at least it would not be so severe), and the crisis might have been avoided or mitigated. In a recent study by Siregar and Rajan (2003), they indicated that Indonesia should at least holds an average reserve of about 5 months of imports. This is to re-emphasize and justify the points made earlier that the fundamental reason behind Indonesia's crisis in 1997 lied in the country's frail economic fundamentals itself.

All in all, we should take note about the important domestic factors that caused Indonesia to suffer severely during the crisis years. As we have argued earlier, the authorities' failure to dampen the overheating pressures is the first and foremost reason. Secondly, Indonesia adopted a managed exchange rate regime with a downward crawling

[16] A situation called *creditor grab race*.

peg such that exchange rate might change predictably and smoothly according to government's policy announcements. Consequently, the maintenance of this crawling peg exchange rate with predictable rates of depreciation has encouraged inadequate hedging of external borrowing by both the financial and the corporate sectors. Failure to do this has caused tremendous debt and huge capital flow reversal that has resulted from massive depreciation of the Rupiah. Next is the weak prudential regulations and financial oversight that led to a sharp deterioration in the quality of domestic bank's loan portfolios. The high figures of non-performing loans (NPLs) have caused many bank runs and collapse, which in turn destabilize the economy further. Lastly, non economic factors that include political uncertainties, lack of transparency, and loss of confidence in the government have also played a part.

2.3 Indonesian Macroeconomic Conditions and Developments Post Asian Financial Crisis

Macroeconomic conditions in Indonesia still remain quite frail even after some remedies have been applied to bring back the sustained level of development in Indonesia. In short, the progress of economic recovery has been rather slow. The repercussions from the devastating financial crisis are very persistent since many key macroeconomic indicators continue to show sluggishness in recent years.

The GDP growth fell to historical low of –13.13% in 1998 coupled with a declining –14.30% per-capita growth. The economy shrunk substantially in the 1997-1998 peak financial crisis period mainly due to the capital flights from foreign sectors, high debt service ratio both in the public and private sectors as well as the loss of investors' confidence in the Indonesian economy.

Table 2.10 Key Macroeconomic Variables of the Indonesian Economy: Crisis and Post-Crisis Periods, 1997–2001 (%)

Year	GDP Growth	GDP Per Capita Growth	Unemployment Rate	Inflation Rate
1997	4.70	3.27	4.7	6.73
1998	-13.13	-14.30	5.5	57.64
1999	0.80	-0.55	6.4	20.49
2000	4.90	3.53	6.1	3.72
2001	3.32	1.97	8.1*	11.50

Year	Real Interest Rate	Export Growth	Import Growth	Money Growth
1997	8.21	7.80	14.72	25.25
1998	-24.60	11.18	-5.30	62.76
1999	11.83	-31.81	-40.68	12.23
2000	6.59	26.50	21.09	16.62
2001	5.31	1.88	8.05	12.84

Source: World Development Indicators CD-ROM (World Bank, 2004).
* Source: Economist Intelligence Unit Country Data.

Furthermore, many jobs have been lost in these periods thus creating even a severe recessionary pressure in the domestic economy that brought back the recurrent inherent structural difficulties such as high unemployment figures, income gap, as well as poverty incidence in Indonesia.

Inflation rate shot up to 58% in 1998 and 20% in 1999 during the crisis period and effectively resulted in a negative real interest rate of –24.6% in 1997 and subsequently recorded a positive 11.8% in 1998 due to the inducement of high nominal interest rate to attract domestic savings and deposits to bail out certain banks' insolvency and to curb further inflationary pressures. Nevertheless, the speculative motives within the same period have worsened the Indonesian economy instead of helping to speed up the recovery process. This condition put another pressure on the Central Bank to expand the money base within the crisis period as shown by table 2.10 above that money growth amounted to 25.25% and 62.76% in 1997 and 1998 respectively. Export and import growth have shown decreasing rates within this crisis period as well due to many halted domestic productions and major reduction in the purchasing power resulted from several depreciations of the Rupiah as well as the breakdown of historically crawling peg exchange rate system into a market-determined (free-floating) exchange rate system during the crisis period. Years after the 1997-1998 crisis period has shown slight improvements in these key macroeconomic variables as depicted in table 2.10 above.

Despite progress after the Asian financial crisis, the Indonesian macroeconomic condition still suffered fragility due to certain challenges from domestic and foreign sides[17]. Domestically, a relatively slackened performance of exports and low investment coupled with historically high incremental capital to output ratios (ICOR) indicated long-lasting repercussion effects of the financial crisis on growth prospects and economic stability of Indonesia (Nasution 2002). ICOR is an important determinant of economic growth in the Indonesian economy because it contributed more to growth performance as compared to other factors such as labour productivity or increase in efficiency. More than that, fiscal stimulus has been used to offset both external and domestic debts as well as supporting price subsidies on some state-sold products, limiting the impact of this expansionary fiscal policy in boosting economic growth. In the banking sector,

[17] Apart from these economic factors, political features are worth noting as well. The pace of transition, or the so called “reformation”, into democracy has been very slow and an increasing demand for local autonomy has made a coordinated decision-making process even more difficult. This problem is even magnified by the incumbent social and political stability that are to be restored in such as short period (Nasution 2002).

deregulation, banking, and corporate restructuring have taken place, yet the banking system remained fragile and sluggish in restoring its core intermediation functions. On the other hand, the lack of commitment to sound and coherent economic policies has begun to erode the confidence of the international community and foreign investors to root their capitals in Indonesia. Not to mention the rising costs of production due to new policies designed by the government to regularly raise the minimum wages and generous severance benefits, which have dampened the willingness of foreign investors to invest in Indonesia (Nasution 2002). Furthermore, all these uncertain economic policies and lack of soundness in policy direction, plus the unfortunate global condition such as the September 11 attacks and international economic slowdown on top of the inherent domestic problems, have posed greater challenges for Indonesia to sustain macroeconomic stability and economic development.

The economy grew by 4.9%, 3.3%, and 3.5% in 2000, 2001, and 2002 respectively according to the BI report in January 2003[18] with the per capita growth rates to record some positive figures of 3.5%, 2%, and 2.7% in 2000, 2001, and 2002 accordingly[19]. These figures were relatively higher than in pre-crisis period. However, these rates of economic growth are not large enough to absorb the new batch of labour entering the job markets (Nasution 2002) as depicted by the open unemployment rate of 6.1% in 2000, 8.1% in 2001, and 8.3% in 2002 as compared to 4.9% in 1996[20]. Nasution (2002) affirmed that the economic recovery is mainly driven by an increase in the private consumption whereby in 2002, consumption expenditures amounted to 60% of GDP and

[18] http://www.bi.go.id/bank_indonesia2/utama/publikasi/upload/SUPLEMEN%202003-Final_Engl.pdf
[19] The latest figure is based on the Economist Intelligence Unit (EIU) estimates.
[20] The 2002's unemployment rate is EIU's estimate.

of this amount 80% was private consumption. This makes the effective share of private consumption almost half (approximately 48%) of the GDP in that particular year.

Unfortunately, this economic recovery is not driven by the usual growth engines such as investment, exports, and productivity improvements. This might explain some scepticism about the development prospects in Indonesia whereby positive and reasonable growth rates were recorded but the unemployment figures remained high and an increasing portion of the people fell below the poverty line. As argued earlier, there are many factors that discouraged inflows of foreign direct investments as well as an exports resurgence such as the uncertain course of economic direction, political instability, increasing costs of domestic production, slow pace of banking and corporate restructuring, fiscal distress, and high non-performing loan ratios. The historically high ICOR indicated that high economic growth prior the crisis was due to a high investment ratio that boosted GDP growth rather than efficiency improvements (Nasution 2002). In addition to that, most of these investments were financed by the government savings that yielded growing budget deficits over the years including those during the crisis years and subsequently. All these conditions have substantially reduced government earnings and thus put a halt to many state-funded projects, which in turn will contribute to a higher unemployment rate.

2.4 Fiscal Policy in Indonesia

This subsection discusses about the importance of the recent conduct of fiscal policy in the Indonesian economy. Sustainability of the government budget is the main inherent problem in the Indonesian economy for the present time and years to come (Nasution 2002). The inflexible and inefficient tax system is a factor that responsible for the insufficiency of government taxation revenues that is used to finance state projects and state-sold products apart from the rising company bankruptcy, reduction in trade flows, and consequently decreasing personal income after the financial crisis. In addition, high subsidies on petroleum and electricity add more pressure on sustaining balanced-budget system. Furthermore, the government also has several other short- to medium-term plans such as revamping the financial system, providing social-safety nets for the low-income families, and the decentralization plans[21] that require an additional expenditure to be added on government balance sheet.

Another problem that has caused widening budget deficit is the mounting debts waiting to be repaid and the pressure is worsen by the recent financial crisis that has made the problem seemed to be larger than it seems.[22] Soaring debt repayment has been partially due to Rupiah's depreciation, interest rate increases, and inflation hike (Nasution 2002). As a response to tackle this budget deficit, the government cut non-debt expenditures by cutting subsidies on state-sold products, petroleum, and electricity services; freezing the salary of civil servants; and selling government bonds to rich regions (Nasution 2002). At the same time, the reduction in subsidies was also meant to reduce the gap in domestic and international prices as to prevent illegal exports for arbitraging activities. To avoid inflationary pressures created from government fiscal policies, the monetary authority finance the budget deficit through official development

[21] The latest plan requires the state to disburse 25% of the government revenue to the contributing region.
[22] The total of domestic and foreign debts amounted to 455 and 528 Trillions Rupiah in 1997 and 1998 respectively, which is the peak crisis period (The data is from the *International Financial Statistics*).

aid from foreign creditors and consultative group on Indonesia (CGI). Moreover, inflationary finance is rule out by both government policy and Bank Indonesia Act in 1999 that bans central bank from buying government bonds in the primary market except for bailing out banks.

In fiscal year 2000, the government debt outstanding reached 100.7% of GDP that consisted of 50.8% and 49.9% domestic and external debt respectively (Nasution 2002). During the "new order" era, the strategy adopted is to obtain long-term official development assistance with low interest rates to finance and thus relaxing the foreign exchange constraints and put less pressure on domestic market ability to settle the government debts. At this point in time, the government use the method of a rudimentary domestic financial market to finance the outstanding debt. However, the interest rates on government bonds that is very much sensitive to 1-month SBI rates, the inflation rate, and the exchange rate increases the burden on the fiscal side of the economy as these macroeconomic variables subjected to high volatility and uncertainty[23].

In summary, the fiscal policy in Indonesia has to find its way to increase the tax base revenue apart perhaps by revamping the current tax system and to boost more trade activities by creating export incentives. The relatively underdeveloped and inactive secondary market for government bonds should be another concern for the authority to rely on this method for financing budget deficits. If this could be a viable strategy, then focused attention should be put on developing effective rules and regulation about this

[23] Some other mechanisms adopted by the government are the sale of public assets and privatization. Refer to Nasution (2002) for other related issues regarding the external sector's influence on debt issues.

secondary market and encourage banks to include government bonds for their liquidity purposes. The function of fiscal policy as an "automatic stabilizer" as a counter measure for recessionary pressures does not seem to be the case for Indonesia due to massive debt restructuring that has drained most of the government's resources. However, at least, the domestic political goal of creating more employment through labour-intensive public and state works should be achieved by government spending to ease the burden of the poor that has already hit by adverse impact of financial crisis. Lastly, the method of relying on foreign official development aid might work only for long-term fiscal sustainability. The government should take more proactive fiscal policies and methods to increase revenues in order to ensure the short- and medium-term fiscal goals especially in restoring the economic conditions after the structural changes took place.

2.5 The Conduct of Monetary Policy in Indonesia

This section will discuss the recent conduct of monetary policy in Indonesia during and after the financial crisis[24]. We will also bring the importance of monetary policy during the period of financial crisis in Indonesia. In addition to that, the discussion of key macroeconomic variables that are important in explaining the conduct of monetary policy is particularly crucial to suit our purpose in developing an SSMM for the Indonesian economy and to evaluate any responses from future unexpected shocks to the economy. Furthermore, it will be useful for us to determine the appropriate measures to be taken in the monetary policy elements to ensure the effectiveness of any policy actions in tackling

[24] For a discussion of the monetary policy framework before the crisis, refer to Alamsyah et al. (2001).

any future shocks to the economy which is done through the dynamic simulation of the Indonesian SSMM.

Before we discuss the conduct of monetary policy in Indonesia, it is necessary to define some terminology used, such as target, instruments, indicators, and goals of monetary policy[25]. An instrument variable can be directly manipulated or controlled by the central bank on a day-to-day or week-to-week basis. Goal variables are the eventual objectives of monetary policy conducted by the central bank, which are usually expressed in terms of statements involving economic progress or the sustained level of welfare of a particular economy. This is to be contrasted with a target variable which is an operational concept that is more closely related to the goal variables than instruments, in the sense that the former can be considered as the tangible form or manifestation of goal variables. Finally, indicators are those variables which provide policy makers and central bank authorities with important information but are not (or cannot!) be kept on some targeted paths.

Following these distinctions, we are now in a better position to describe several alternative instruments that have been used to achieve targeted paths for the Indonesian economy. The instruments will include the money supply controlled by the BI or interest rates set by BI[26]. Target variables are the inflation rate and output gaps or output levels[27].

[25] These clear and elegant definitions can be found in McCallum (1998).
[26] Fiscal expenditure governed by the Ministry of Finance is an instrument of fiscal policy that is worth noting. In general, fiscal policy is supposed to be controlled by the Ministry of Finance but BI seems to have a role to play as well (See McLeod, 2003).
[27] Or, the unemployment rate operating through Okun's law.

2.5.1 Monetary Policy Before and During the Financial Crisis

The Indonesian authority was engaged in setting up credible targets for some nominal variables such as the base money (M0), broad money (M2), the price level, inflation rate and the gross domestic product during the successful period of crawling peg system from the early 1980s to mid 1990s. Basically, the underlying goal of the Indonesian monetary policy during that time was to achieve non-inflationary economic growth in the medium to long term. During that time, monetary policy was centred on the use of base money as the operational instrument and it has been proven to be effective in the 1980s and early 1990s (Alamsyah et al. 2001)[28].

As stipulated in Act No. 13 of 1968 concerning the central bank, the de jure exchange rate regime in Indonesia was to manage, safeguard, and maintain the stability of the Rupiah. In practice, the de facto regime prior to the financial crisis is a crawling peg exchange rate system. Specifically, the nominal exchange rate was managed stringently within a narrow band that followed a steady depreciation path (McLeod 1997). When the financial crisis struck the country causing massive capital outflow, BI finally gave up the crawling peg regime of the Rupiah on 14th August 1997 and switched to a market-determined system. Right after failing to hold the quasi-fixed exchange rate system in place, the authority adopted an extremely tight monetary policy of raising interest rates and forcing state enterprises to purchase the SBI (Alamsyah et al. 2001). As a lender of last resort, BI was also obliged to provide massive liquidity support to prevent bank runs and financial sector collapse. This came at a cost of loosing substantial control

[28] See Boediono (1998) on the effectiveness of using base money as an operational tool after the early 1990s.

over base money in late 1997 to early 1998[29]. This raised a concern that BI had to stabilize the price level to strengthen the value of the Rupiah as well as to maintain macroeconomic stability. Furthermore, the financial crisis that hit Indonesia in 1997–1998 massively drained foreign exchange reserves from Indonesia, which subsequently resulted in the collapse of the Rupiah.

During the period of financial crisis, there are two main differing views and arguments regarding how BI should rectify the problems and find a way out for the ailing Indonesian economy. The first concerns the use of interest rates to stabilize the economy. In May 1998, BI placed ceilings on deposit rates and inter-bank rates for bank liabilities aimed at preventing banks from adopting imprudent and destabilizing measures. We believe that although interest rate decisions will eventually affect the movements of the money supply, it was for a different purpose that BI resorted to the use of interest rates. To prevent a relatively small proportion of people who held substantial assets in Indonesia from "running away", BI needed to use high interest rates to prevent them from "parking" their funds elsewhere, which would further destabilize the economy. In other words, BI used interest rates to control exchange rate movements but during the crisis period Grenville (2000) argued that the highly volatile exchange rate movements were not offset by higher interest rates since they were driven by other forces.

The use of the interest rate instrument was complemented by BI's policy to set quantitative targets for base money through open market operations, with the support of

---

[29] Alamsyah et al. (2001) pointed out that base money grew by 115% between November 1997 and July 1998.

the IMF. However, due to the underdeveloped market for SBI, open market operations were not that effective in absorbing excess liquidity in the economy. To tackle this issue, BI used the auction method to determine the SBI rate to help strengthen open market operations. Another innovation was the “Rupiah intervention” (for more details see Alamsyah et al. 2001, pg. 313). There were also some intense debates about whether the strategy of targeting base money was feasible as opposed to using interest rates to stabilize the economy (see Grenville 2000 and Fane 2000a, b). Another important point was raised by Iljas (1999) arguing that BI had targeted monetary base during the crisis period only as a temporary measure to offset the monetary expansion that resulted from providing liquidity to support the banking and financial system. It was not based, he argued, on fundamental reasons such as a stable relationship between base money and inflation.

We personally feel that there are some shortcomings in using the level of base money, or base money growth, to achieve the inflation target for the Indonesian economy. Thus, it will be difficult to assess the effectiveness of base money as an instrument to control inflation during the crisis. First of all, BI was under pressure at that point in time to breach its monetary targets by Soeharto as to facilitate the provision of large subsidised loans to the Texmaco group (Fane 2000b). This means that BI has not been independent in setting up its own target, be it the inflation rate target or the level of base money or base money growth. Secondly, after BI was given independence in conducting its monetary policy and goals (McLeod 1999), the target level might change over time if BI seemed unable to meet the target and there are no penalties imposed on it (see McLeod 2003). This is because BI was not only given “instrument independence”, but it determined the inflation target in each calendar year. Thus, there is an inclination to “forgive” itself whenever BI missed the target level, causing it to have loose objectives in setting up the target. Thirdly, the causal relationship between base money and inflation is very much in doubt (de Brouwer 2003).

We can see from the arguments above regarding the conduct of monetary policy during the crisis period that both interest rates and base money were used in the stabilization of the economy and the inflation rate. However, we agree with Iljas (1999) that base money is used only as a temporary measure to prevent bank runs and collapse and to satisfy day-to-day demand from public. This is very much in line with the economic conditions of Indonesia whereby majority of her people needed nominal cash to meet their daily needs and transactions instead of worrying about what will happen to the value of their assets due to inflation. Thus, if BI had kept its base money in check according to IMF’s prescription—which means restricting the level of base money and reducing the ability of meeting the public’s demand for cash—the majority of the Indonesian people would have suffered more from the impact of rising inflation (as history has shown in the 1960s when inflation surged to 600% per annum). Our stand is precisely that of Iljas (1999) when he argued that the expansion of base money was not because there is (or was) a stable and one-to-one relationship between money supply and inflation, but it was because of rising inflation that needed to be accommodated by expanding the money supply. Thus, money supply expansion has resulted from an upsurge in inflation and it was not monetary expansion that caused high inflation. We therefore specify an appropriate money supply rule for the Indonesian SSMM in the next section.

2.5.2 The Recent Conduct of Monetary Policy

The cornerstone of the post-crisis monetary policy framework in Indonesia is the enactment of a new central banking law in May 1999[30]. This law gives BI full autonomy to formulate and implement monetary policy with the fundamental legislation adopted from best international standards such as the erstwhile Bundesbank of Germany (now, it is the European Central Bank). This new law directly prescribes BI to focus on the sole objective of maintaining the stability of the Rupiah. Although there are ambiguities in interpreting the new central banking law as pointed out by Alamsyah et al. (2001), McLeod (2003) and de Brouwer (2003), we believe that stability of the Rupiah can be translated directly into the maintenance of a low and stable inflation rate. Furthermore, exchange rate and price stability are closely related such that the ultimate goal of maintaining stable and low inflation could also mean that variability in the exchange rate should be minimized.

In pursuing this goal, BI is given full authority to decide the inflation target (goal independence) and the choice of several monetary instruments such as interest rates, base money, or exchange rates (instrument independence), as well as a guarantee that policies and strategies adopted by BI will be free from any governmental or other institutional interference. We believe that the third feature of the law is undoubtedly needed to ensure

[30] Refer to Sabirin (2000) for a concise discussion about this new central banking law, the BI Act No. 23 (1999).

the credibility of the central bank in implementing its monetary policy, thus ensuring a higher level of effectiveness and efficiency. The second feature ensures flexibility for BI to choose an appropriate tool of monetary policy to fulfil the aim of domestic price stability. The first one, by far, is the most questionable because it does not explicitly specify the optimal target level of inflation.

For developing countries like Indonesia, relatively higher inflation is acceptable in return for economic growth and the creation of more jobs. But high inflation rates have been a major feature of the Indonesian economy for some time now, as we will discuss later on. The concern is whether BI will misuse this law to meet the inflation target it set even though that target seems to be suboptimal. A credible central bank is one which can fulfill the specified target. Specifying the exact target level, either a point or an interval target, is a different issue. In Indonesia's case, the goal of BI is to achieve the desired rate of inflation. But what inflation target that BI will set is a rather troublesome question, as economists and policymakers might have different views. What is important here is the underlying issue that BI should not mistreat this law to behave "loosely" in specifying the target level and thus attempting to achieve it. The monetary policy framework should be laid accordingly to ensure the effectiveness of this new law with the ultimate goal of maintaining Rupiah stability in a broad sense.

Regarding the recent conduct of monetary policy, some differing views are again found. McLeod (2003) proposed that Bank Indonesia would be well advised to adopt slow and steady growth of base money as the nominal anchor for monetary policy to fulfil the ultimate goal of having a reasonably low inflation rate in the short to medium term. This is especially true after the pre-crisis policy of slow and steady depreciation of the Rupiah has been abandoned. In line with his suggestion, recent quarterly reports published by Bank Indonesia aims at targeting inflation at a reasonable rate in the short to medium term but did not explicitly state the instruments. It has also been extensively argued that base money growth should be monitored closely by the BI since this is expected to be the key driving factor for inflationary pressures (Grenville 2000; Fane 2000a, b; McLeod 2003). Their arguments were based on the fact that the 1999 BI law stipulated that the central bank has instrument and some goal independence with base money growth and stability of Rupiah as the instrument and goal correspondingly. However, this might contradict the new central banking law that stated the freedom to choose the instruments to stabilize the economy. Furthermore, some extreme views regarding the use of base money might cause the policy to focus exclusively on tightening (or loosing) base money.

We tend to agree instead with de Brouwer's (2003) analysis stating that underlying inflation is much more important for Indonesia rather than attempting to achieve a short-term inflation target by controlling base money. He argued first of all that seasonal variation of prices in Indonesia is a common feature and responding too much and too often might create larger output variability which might be detrimental to the economy. A careful reading of de Brouwer's (2003) comments and responses to the view and analysis expressed by McLeod (2003) gives us a lot of insights about how BI conducts monetary policy and the monetary transmission mechanism. The most convincing argument in de Brouwer (2003) is that the evidence is not sufficient to conclude that inflationary pressures in Indonesia come from excessive base money growth, as suggested by McLeod (2003). *"The collapse of the Rupiah created the inflation, not the injection itself of funds [i.e. base money] into the banking system"* (de Brouwer 2003, pg. 327). Interest rates were totally dismissed by McLeod in his argument favouring base money-driven inflation. However, de Brouwer (2003) correctly pointed out that interest rates could be the monetary policy tool used in response to inflationary shocks. Thus, if the evidence shows that inflation leads interest rates, this could reflect a causal relationship coming from the policy response to inflationary pressures.

de Brouwer (2003) also attacked McLeod's (2003) view by stating that an inflation-focused policy is relevant and appropriate for Indonesia, but not because of the monetarist reasons given by McLeod (2003). He provided empirical evidence to show that traded goods prices rose substantially more than non-traded goods prices especially during the financial crisis. If base money is indeed driving inflation in Indonesia, then inflation in both traded and non-traded goods would result. In other words, if base money was responsible for inflation, then we should see a trivial difference in the fluctuations of traded and non-traded goods prices. However, if the exchange rate was the key driver of inflation, then traded goods prices should have risen faster than non-traded goods. The stylized facts show that traded goods prices did indeed rise substantially more than non-traded goods in 1998. This clearly shows that exchange rate depreciation is the main cause for surging inflationary pressures in the Indonesian economy due to the pass-through effect[31].

The foregoing arguments lead us to doubt that base money has a robust cause-and-effect relationship with inflation in Indonesia. Rather, changes in base money should be viewed as a policy response to accommodate an ongoing inflation process. Interest rates, on the other hand, appear to be a more appropriate monetary policy tool that can be aimed at stabilizing the value of the Rupiah. This is important for the control of inflation due to the high import content of domestic consumption and production. In view of this, we also specify an interest rate policy rule in Chapter 4 that takes into consideration the effect of the exchange rate on monetary policy.

2.5.3 Key Macroeconomic Variables in Monetary Policy

This sub-section discusses important macroeconomic variables such as base money, inflation rate, domestic interest rate, and exchange rate.

Base money

As mentioned earlier, the anchor of monetary policy has changed from exchange rate targeting into inflation- and monetary base-targeting whereby the monetary base target can be understood as a channel between the operational rule and the inflation target. In addition to that, it is important to note that the Central Bank has a direct control only in the domestic credit —the domestic component of monetary base— as outlined by the

[31] Note that traded goods include some commodities subject to price controls, e.g. rice, in a greater proportion as opposed to non-traded goods with a relatively lower proportion of price controls.

enforcement of new Bank Indonesia act in May 1999. The actual growth of monetary base has been consistently higher than the original target which is partly due to structural changes in the supply and demand of monetary aggregates because of administrative reforms and major adjustments in the political and social system.

Thus far, Indonesia has not adopted a fully-fledged inflation targeting as the nominal anchor of the monetary policy (Nasution 2002) because of several reasons. Firstly, inflation in Indonesia is not only affected by the monetary policy directly but influenced by some other factors such as high capital flows, exchange rate movements, changes in the minimum wage rules and regulations, as well as innovations in the aggregate demand and supply of the economy. Secondly, chief components of the price index are very volatile and some of these domestic price index components are set by the authorities or subject to the standards in the international market. This will result into uncertainty and high degree of volatility in the inflationary processes in Indonesia thus creating a substantial bias within the inflation-target range that magnifies the problem in determining the sources of forecast errors. Thirdly, a great deal of information is required in the decision-making process for inflation-targeting activities such as the information of public and government finances, labour market volatilities, financial markets, and the goods and services sectors. This information is more of a luxury even for the authority since the economy is highly subjected to the shocks in both supply and demand side as well as domestic- and foreign-sourced.

Thus, monetary-base targeting has been an important element of conducting the monetary policy in Indonesia especially in ensuring the cohesiveness between the fiscal stimulus from the government spending and the policy made by the Bank Indonesia. However, it is clear from the previous subsection that this monetary-base policy cannot be used by the Bank Indonesia to finance the government budget deficit through seigniorage that might create some inflationary pressures. The monetary-base targeting has been used to ensure the smoothness of day-to-day transaction activities conducted in cash.

Inflation rate

Post crisis, inflationary pressures have been rising steadily because of certain reasons. Firstly, the pressures that originated from government policies to raise administered prices resulted from the reduction of subsidies on state-vended products as in the case of fuels and electricity (Nasution 2002). In addition to that, the pressure to regularly revise the minimum wages is also affecting a further increase in the inflation rate. Periodically, the increase in minimum wage has contributed around 9.35% and 12.55% to the inflation rate in 2000 and 2001 respectively (Nasution 2002). Secondly, the deteriorating value of Rupiah under the present floating exchange rate system has contributed to a higher inflation rate by magnifying the effect from the increase in the price of imported goods. This means that inflationary pressures also come from the exchange rate pass-through effects of the Rupiah depreciation. Nasution (2002) stated that this pass-through coefficient is estimated to be around 0.13-0.23 in the post-crisis periods.

A lot of explanations could come from this persistent and high pass-through effect due to the depreciation of Rupiah. First of all, greater import penetration most notably in 2000 makes import prices to have more influencing-powers in the domestic general price level for all goods—raw, intermediate, and finished goods—and this has a persistent effect throughout the years. Next is the lack of confidence in holding the Rupiah, thus Rupiah-denominated assets that causes an increase in the demand of dollar-denominated assets and aggravates the pass-through effect from depreciations of the Rupiah. Subsequently, this has caused a "bandwagon" effect on the domestic producers as well even if they do not have any import content in their production processes in argument to protect themselves against high and volatile inflationary pressures in the goods and services market. Thirdly, during the crisis periods and after some companies can still transfer the effect of Rupiah depreciation in the form of higher prices due to higher costs. Fourthly, Indonesia has been known to have a constant battle with variable inflation records and measures to curb this problem have always been short-lived and temporary in nature since they are mainly made to address short-term and immediate issues with some lack of planning for the long-run. Lastly, the slow progress of structural reform activities and the uncertainty about future economic conditions and directions has contributed to a slow recovery in regaining economic efficiency that could help to strengthen the Rupiah.

Interest rate

In the middle of 1998, at the peak of the financial crisis, the domestic benchmark interest rate —1-month sertifikat bank Indonesia (SBI) rate, the equivalent of short-term interest rate measure— reached a staggering 70%. Subsequently, after some interventions and slight improvements of the economy, it fell to an average 11% in 2000 and rose again to 17.62% by the end of 2001. Real interest rate has been maintained to be around 5% annually since the year 2000. Gradual increment in the level of interest rate since the middle of year 2000 was a reflection of a tight bias monetary policy adopted by BI to mitigate the pressure on inflation and the exchange rate. In addition to that, the continual interest rates increment was due to slowness of bank restructuring effort and the narrow secondary government bond market that was reflected in small trading activities (Nasution 2002).

The authority, thus, started to put extra attention in developing the secondary market for government bonds in order to boost liquidity and to dampen the increment in the interest rate. The efforts yielded less favourable results since banks continued to rely on the inter-bank money market to ensure their liquidity instead of relying on the shallow and relatively premature the secondary market for government bonds. This condition explains the driving forces behind the persistent increase in the interest rate level in the Indonesian economy. The effect of this high interest rate is none other than the difficulty in repaying domestic debts reflected in the government budget deficits and at the same time put extra pressure on banks and their respective borrowers that relied mostly on external debt financing. Furthermore, this also explains a growing number of NPLs and widening budget deficits that caused fiscal distress. These have caused the sustainability of economic progress even more difficult.

Exchange rate

Following the crisis, Rupiah has been depreciated substantially from Rp 2450 in June 1997 to a low Rp 14900 in the middle of 1998 (Nasution 2002). The monetary authority has also formally switched the exchange-rate regime from crawling peg into a fully-float system. The persistent depreciation of Rupiah was mainly due to both internal and external factors. Internally, a limited supply of foreign currencies in the domestic foreign exchange market due to lack of public and private capital inflows since most exporters are less willing to repatriate major portion of export revenues because of Rupiah's volatility. Externally, the disbursement of loans from the IMF and World Banks were uncertain and the debt-rescheduling activities have raised the requirement of foreign exchange, thus putting extra pressures on depreciation of Rupiah[32].

Subsequently, Bank Indonesia has taken some exchange rate-related policies such as open market operations of selling SBIs and using its foreign exchange reserves to meet the demand of foreign currencies and correspondingly to guard the Rupiah from depreciating further. In addition, BI also restricted Rupiah transactions between banks in Indonesia and non-residents to reduce the extent of speculations in the offshore market[33].

Furman and Stiglitz (1998) found in their analysis on emerging economies including Indonesia that the level and duration of high interest rates affect the exchange rate depreciation significantly. In other words, this means that a rise of the interest rate

[32] Some other reasons include panic buying of dollars to repay corporate debts, increasing speculative activities in the rupiah offshore market, and unfavourable ratings from international agency such as S&P 500 regarding the country's economic and political risks.
[33] The negative consequence is that the limited supply of foreign exchange from non-residents has reduced the appeal of domestic foreign exchange market.

will further depreciate the Rupiah. However, Goldfajn and Baig (1999) and Basurto and Gosh (2001) found little supporting evidence that higher interest rates affect exchange rate depreciation in their study on some Asian countries that include Indonesia. This study has provided us with an understanding that during the crisis period whereby the interest rate was high, the Rupiah has depreciated tremendously. However, the link becomes less clear when the interest rates level have went down to a much lower region but we still witnessed a persistent depreciated value of Rupiah after the crisis subsided.

The importance of exchange-rate as one of the monetary policy element is worth noting. Although the recent system of floating exchange rate system take place, Bank Indonesia still monitors the movement of Rupiah closely since this is a very central issue in Indonesia’s trading activities as well as the issues regarding outstanding public and private debts. It is important to know the supply and demand side of the exchange rate movement in Indonesia depend substantially on the public and investors’ confidence on the economic policy course and sound macroeconomic management of the country. Thus, in conducting a useful monetary policy, BI has to ensure that foreign exchange earnings will be repatriated back by guarding the stability of Rupiah through some prevention in the offshore market and other speculative activities. Furthermore, BI needs to correct the negative market sentiment about Rupiah that is heavily related to domestic condition and the soundness and integrity of their policy discretion. With stable exchange rate, Indonesia can further enhance the macroeconomic performance and to ensure the sustainability of non-inflationary economic growth.

2.6 Summary and Conclusion

To summarize once again, Indonesia's pre-crisis condition was vulnerable to an impending crisis due to the over-reliance on short-term borrowing. The over-reliance on short-term borrowing has, in turn, placed Indonesia vulnerable to financial panic and exchange rate risk. Indonesia was vulnerable to a panic, as it possessed large proportion of short-term debt to foreign reserves coupled with the country's weak corporate governance, e.g. the adoption of the banking and financial sector deregulation without adequate supervision. Second, Indonesia was vulnerable to an exchange rate risk since most of the short-term debts were used to finance less productive investments that yielded Rupiah revenue which were expected to repay dollar liabilities. These factors have magnified the country's weak macroeconomic policies and pointed out a need for better and more coordinated policy design and implementation.

Subsequent periods have witnessed the recovery periods which progress at a "snail pace". Indonesia is still left largely with the problem of rising unemployment and huge debts to be settled upon. These structural changes happen at the same time where the reformation era took place which gives birth to the so called "true democracy" period. These two factors have made the direction of economic course for the Indonesian economy to be rather uncertain. This is understandably so because without a stable government coupled with the hurdles of structural changes that Indonesia has to deal with, it will be very difficult to achieve the ultimate economic goals and increase the welfare of the Indonesian economy. More changes are expected to take place as the country embraced herself in a direct presidential election in July 2004 (and possibly

September 2004) that will determine further whether stability could be sustained, at least geo-politically, in the short- to medium-term. The result of the coming election and consequently the new government is hoped to come up with more certain future economic policy and direction. This is highly required to provide an added force to boost slacken economic recovery and regaining momentum to reach the ultimate goal of sustained economic growth.

Most notably, the conduct of monetary policy and fiscal policy has changed. The exchange rate regime has changed from the long-history of fixed and managed floating system into a market-determined exchange rate system. Monetary policy is aimed specifically at stabilizing the domestic medium-term inflation to promote sustained economic growth to provide added momentum towards economic recovery (BI 2003, 2004). At the same time, monetary policy tries to maintain the stability of the Rupiah in the face of other foreign currencies to boost the trade activities and to minimize fluctuations by prudent intervention that is necessary to absorb excess liquidity and fiscal expansion. Further cuts in interest rates are also on its way at a gradual pace that is consistent with the achievement of inflation targets (BI 2003, 2004).

Fiscal policy, by and large, is still aimed specifically at developing major infrastructures for the suburban areas and under-developed provinces as to restore the public confidence on government. In addition to that, fiscal policy is also aimed at stimulating the domestic economy as well as to settle the domestic debts. Major efforts have also been put to revamp the banking system, to ensure financial system stability, and to promote the banking sector's recovery and restoring its intermediary function to stimulate progressive economic recovery as well as enhancing the effectiveness of the payment system (BI 2003, 2004). An agency like IBRA (Indonesian Banking Restructuring Agency), for example, has been set up to deal with the debt-financing issue through the divestation of public assets and privatization of state-owned companies that is hoped to provide a better way in financing the mounting debt without the need of losing the conventional fiscal policy's function as an "automatic stabilizer" during recession time, i.e. through sustained government spending.

All these facts have led us to an understanding of the developments of the Indonesian economy which will be very useful for developing the small-scale macroeconomic model of the Indonesian economy and simulating the Indonesian economy in the face of certain unexpected shocks. Issues such as the structural change in the exchange rate system from the fixed and managed-floating into a free-floating type and the change in the intermediate target from boosting trade performance and improving growth performance through external trade into stabilizing the short- and medium-term domestic inflation are examples of the importance of this chapter in relation with the later part. By acknowledging these structural changes, we are now in a better position to develop an Indonesian SSMM and subsequently to analyze the main features of it and accordingly to simulate the SSMM in the lights of uncertainties to the Indonesian economy. At the very end, we hope to be able to provide a new and insightful way in conducting monetary and fiscal policy by the Indonesian authorities in order to achieve the ultimate target of reaching the *"dreamland of prosperity"*.

Chapter 3

Theoretical Foundations of Small-Scale Macroeconomic Models

*"The challenge of monetary policy is to interpret current data on the economy and financial markets with an eye to anticipate **future** inflationary forces and to countering them by taking action in advance"* (Alan Greenspan's Humphrey-Hawkins Testimony, 1994)

The issue of modelling the structure of a country's macroeconomy is not a recent idea. Central banks all over the world have engaged in these activities for numerous years and have devoted a lot of effort to shed light on the macroeconomic structures and workings of their respective economies. In the process, they have produced state-of-the-art macroeconomic models that capture most, if not all, features that are peculiar to their own countries. In the late 1990s, small-scale macroeconomic models (SSMM) emerged as one particular innovation that covers a wide variety of model types. An SSMM is an aggregated model with considerable theoretical content that provides a stylized and compact representation of the whole economy. In this chapter, we review the theoretical foundation of SSMM and describe their variants.

3.1 Overview

An SSMM models the whole economy with typically less complex behavioural and structural relationships than some other optimizing models that attempt to analyze the deep structural behavioural relationships in the economy, which allows the responses of individual variables to shocks to be explicitly identified. The latter is deemed to have certain simplified and plainly unrealistic assumptions such as the assumption that all economic agents are performing dynamic optimization problems that require a sophisticated understanding of the economy. In addition, most of these models assume that all consumers are homogenous.

At the same time, it should be highlighted that an SSMM is not a single-equation or partial equilibrium model such as the Philips Curve model that explains the trade-off between inflation and unemployment[1] (or, sometimes with output). SSMMs tend to impose more structure than the vector autoregressive (VAR) model which make minimal assumptions about the underlying structure of the economy and instead focus entirely on deriving a good statistical representation of the dynamic interactions between economic variables. However, VAR models are not completely devoid of economic theory, since the choice of variables to include in the system and the length of lags allowed represent types of restriction, which can have important implications. Structural VARs (SVAR) also have some limitations such as the disagreement that might occur between econometricians regarding what theoretical restrictions to impose on and more importantly, it is not so convenient and less suitable for policy simulations.

To date, some countries have adopted SSMM as a tool for analyzing the macroeconomic structure and relationships between key macroeconomic variables. The Bank of England is an early pioneer (Bank of England, 1999). SSMM has been adopted by countries such as New Zealand, Canada, the United Kingdom, Sweden, Finland, Australia, Spain, Brazil, Chile, and Venezuela (see Haldane 1995, Leiderman and Svensson 1995, de Freitas and Muinhos 1999, Arreaza et al. 2003). Among the countries we have mentioned, it may not be coincidental that most of the countries that employ

[1] Nevertheless, the reduced form of SSMMs could result in a Philips curve.

SSMMs are inflation targeting countries. At this point in time, SSMM has not been applied extensively to Asian countries in general and Indonesia in particular. Hence, we hope to pioneer the study of SSMM in the Asian context, with Indonesia being our choice of country in this regard.

To date, mostly big macroeconomic models have been built to analyze the Indonesian economy (see Fukuchi 1968; Wang 1983; Kobayashi et al 1985; Simatupang 1986; Kuribayashi 1987; Azis 1988, 1990; Bautista et al 2001; and others in Appendix 1). Some other models for the Indonesian economy tend to focus more on investigating income distribution, welfare economics, socio-economic phenomena, poverty, transfer of technology, and financial crises.[2] None of these topics focus specifically on explaining the island-wide economic structure in the framework of a small scale model except the one developed by Alamsyah et al. (2000) very recently. We can say that the big models mentioned above are more segregated and focused on individual segments of the economy. As mentioned in Chapter 1, certain papers do focus on the dynamic simulation of the Indonesian economy given external shocks, with special attention being devoted to the trade sector analysis (Azis and Ekawati 1990, Azis 1994; Kobayashi, 1989; Ichimura, 1979). However, this research is now outdated as the statistics and characteristics on some economic variables have been updated and changed, thus making it rather irrelevant in today's context. Some other papers are concerned with the importance of aggregate demand versus aggregate supply shocks (Siregar and Ward 2002) and the importance of inflation targeting and exchange rate mechanisms in Indonesia (Siregar 1999).

---

[2] See, for example, the articles in *Bulletin of Indonesian Economic Studies* (BIES).

There are several macroeconomic models available and developed in Bank Indonesia, both large structural macroeconomic models and small scale macroeconomic model. The discussion of the small-scale model developed by Bank Indonesia, by Alamsyah et al. (2000), can be found in Chapter 4. We will briefly discuss one large-scale macroeconomic model developed at Bank Indonesia in this chapter, called Macroeconomic Model of Bank Indonesia (MODBI). MODBI is an annual large-scale macroeconomic model developed jointly by the Netherlands Central Planning Bureau and Bank Indonesia in 1996[3]. This is basically an annual model[4], thus it is not suitable as a tool for analyzing the economy in the short- to medium-run. MODBI focuses on the long-term objectives of the central bank such as maintaining a low inflation rate according to the target set by the BI and creating a favourable monetary environment. The model consists of approximately 200 equations that distinguish two markets, namely the goods market and the money market. The description of the goods market contains the traditional multiplier and accelerator mechanisms as well as neoclassical elements. Potential supply is determined by the capital stock, while labour plays no role in this model due to lack of data. The model contains a rather elaborate description of financial markets. The monetary sub-model is based on the portfolio approach.

---

[3] Due to restricted access to the full technical details on MODBI, we can only discuss several distinguishing features of it. The description summary of MODBI can be found in the Netherlands' CPB website (http://www.cpb.nl).

[4] In 1999, after the new central bank legislation was enacted, there is a rising need for a quarterly macroeconomic model for the analysis and forecasts of shorter-term macroeconomic developments. Thus, a model called Short-term Forecast model for Indonesian Economy (SOFIE) was built. The building block of this model reflects the corresponding theory suitable for the purpose of inflation targeting (Warjiyo 2001). SOFIE is more disaggregated since the purpose is to provide the behaviour of macroeconomic variables that are consistent with the inflation forecast. SOFIE employs the error-correction technique to analyze the quarterly macroeconomic variables.

MODBI reflects some major differences between the less-developed Indonesian economy and the economies of developed countries. The first major difference involves the role of labour in the model which is not modelled explicitly due to lack of data and some other problems. A second striking characteristic is the expenditure elasticity of imports which was empirically found to be 1.35. This high value reflects the opening up of Indonesia to international trade. During the period 1976-1996, the volume of annual imports rose on average by more than 10% and the ratio of imports to GDP rose by 27%, implying a substantial increase in the degree of openness of the Indonesian economy. The third striking feature is that the capital market and the long-term interest rate do not appear in the model due to the underdeveloped financial markets.

Persistent, albeit moderate, inflation and the consequent depreciation of the rupiah against the dollar are the fourth characteristic of MODBI. This characteristic recognized the policy pursued by the monetary authority in Indonesia, which historically is to have staggered exchange rate depreciation as the main tool to control inflation in the economy. This was meant to guard and stimulate the competitiveness of Indonesian exports. A fifth striking characteristic is the important role of foreign capital. In Indonesia, the inflow of capital dominates the outflow (which is not true after the occurrence of financial crisis in 1997). In the model, capital inflows are modelled by scaling the net private capital inflow by the fast growing private investments. A last striking feature in older versions of the MODBI model was positive rather than negative consumer price elasticity in the consumption equation, which is typical of countries with high inflation.

Recognizing some deficiencies in the MODBI, we feel that some improvements can be made. First of all, as we have argued earlier, the trend of economic modelling is to move towards the small-scale models. In contrast, MODBI consists of around 200 equations, for which analytical solutions are impossible to obtain[5]. Hence, it seems more productive to develop an SSMM for Indonesia. Secondly, MODBI was built in 1996 which meant the financial crisis as well as recent changes in the Indonesian exchange rate system are not captured. Lastly, the exclusion of a labour sector, e.g. the wage contracting specification, might create further problems in the future as correctly pointed out by the MODBI model-builders. However, in Chapter 4 we argue that wages might not be very important in explaining inflationary pressures in developing countries and especially Indonesia.

3.2 Why Small Scale Macroeconomic Model?

Macroeconomic models have usually been developed in a large-scale setting comprising hundreds, or even thousands, of equations. This is meant to capture all possible components in the economy. While this substantial effort should be recognized, some pitfalls are nevertheless inevitable such as the partial failure of forecasts and some theoretical shortcomings of a large macroeconomic model (Deaton 1981; Barker 1985;

[5] Hence, Bank Indonesia has developed a stochastic dynamic macroeconomic model called General Equilibrium Model of Bank Indonesia (GEMBI) for policy simulation purposes. GEMBI employs modern stochastic dynamic macroeconomic theory. The model uses some stylized fact parameters to perform calibration and to provide long-term relationships of a number of key macroeconomic variables such as consumption, inflation, exchange rate, etc (Warjiyo 2001). The purpose of GEMBI is for policy simulation that can provide the dynamic paths of the mentioned key macroeconomic variables in the medium- to long-term horizon based on simulation of some alternative policy rules. MODBI, SOFIE, and GEMBI complements one another so as to understand the behaviour and future conditions of the Indonesian macroeconomy. Specifically, SOFIE and MODBI are suitable for quarterly and annual analysis as well as forecasts. A combination between SOFIE and GEMBI can be used to provide the expected dynamic paths of key macroeconomic variables based on some policy rules.

Lawson 1992; Wallis 1989). Another drawback is mentioned by Holden (1989) who questioned whether policy simulations from large macroeconomic models really give insights into economies in the real world or merely demonstrate the properties and the beliefs of the model and the model-builders respectively. Yet, a macroeconomic model is an indispensable tool for policy analysis and gives valuable insights to the authorities for making decisions that affect the economy.

In the early 1990s, small scale macroeconomic model (SSMM) emerged as an alternative tool for comparing the results obtained from larger macroeconomic models. An SSMM is deliberately kept small with a substantial level of aggregation, thus forcing the model to focus on key issues rather than to look at excessive details in the economy. An SSMM is characterized by a compact system of equations that describe the behaviour of key macroeconomic aggregates such as output (GDP), inflation, money demand, exchange rates (for a very open economy), interest rates, etc. Although the SSMM is not meant primarily for forecasting, it helps to clarify and understand the developments of key macroeconomic variables, for example those relevant in the process of determining the inflation rate in the economy. This is an advantage of an SSMM which is highly aggregated—it could help to mitigate the problem of poor fit in large macroeconomic models. This might explain the recent trend of employing SSMM in central bank modelling activities to counter-check the results from larger macroeconomic models.

The aim of this study is to come up with an SSMM of a forward-looking nature that captures the characteristics of the Indonesian economy and which can be potentially useful for carrying out policy analysis, in particular, analyzing the effects of monetary policy. The goal is to better understand the options available to Indonesia policy-makers to deal with economic shocks. A natural question to be asked is why we choose a small-scale macroeconomic model instead of a larger one in modelling the whole economy. There are several reasons why SSMMs are chosen in this research methodology:

- SSMM is typically designed to carry out policy analysis. The simplicity and flexibility of the underlying structure of these models makes them ideally suited for this purpose. Note that Indonesia is a big economy in terms of area and inhabitants and an SSMM, in essence, is a small-scale model, not a model for small economy. SSMMs provide powerful insights for policy analysis too: it is relatively straightforward to trace the transmission of policy actions onto key variables such as output and inflation.

- Estimation or calibration of parameters may be more straightforward for smaller models. For example, it is easier to impose some restrictions suggested by economic theory such as the vertical long-run Philips curve which can be explicitly accommodated by SSMMs so that it is possible to examine directly what the model implies with respect to the inflation/output trade-off.

- Because there are fewer parameters and equations in SSMMs than in larger models, it is easier to experiment with alternative assumptions, such as those concerning the formation of expectations by economic agents or the degree of credibility in the central bank.

- Exercises with SSMMs can function as a cross-check on results, such as policy simulations from larger and more sophisticated macroeconometric models. Although the aggregation inherent in SSMMs means that they are lacking in details, they are still often structural models. Hence, meaningful economic interpretations that are directly linked to policy options can be derived from SSMMs.

- SSMMs are often small enough to allow their key properties to be investigated analytically.

Some caveats, however, need to be acknowledged in using SSMMs as well, such as:

- The high level of aggregation in SSMMs means that they lack detail about certain macroeconomic variables. For example, SSMMs do not provide a breakdown of aggregate demand into expenditure categories such as consumption, investment, or net exports. One consequence is that it will provide little information about movements in the balance of payments.

- Since SSMMs abstract from the detailed and multiple lag dynamics that are typically required to describe quarterly macroeconomic data accurately, they will be less suitable for complex macroeconomic forecasting and simulations as compared to large-scale macroeconometric model.

To sum up, an SSMM is particularly useful for carrying out policy simulations and experiments that can provide valuable analytical insights. The SSMM is simple and tractable and can also provide a cross-check on the results of large macroeconometric models. Some other assumptions suggested by economic theory can also be imposed in SSMM in order to investigate the implications for policy.

It is hoped that as the research in this area makes progress, more insights and modifications and also additional features can be implemented to improve the SSMM further. This relatively new variant of macroeconomic models can benefit Indonesian authorities by providing better analyses for policymaking and implementation.

3.3 The Variants of SSMM

There is no binding rule to determine whether a model can be called a small scale macroeconomic model. However, as long as the model is highly aggregated with a small number of structural equations involved, we can view it as an SSMM, or a variant of SSMMs. As a rule of thumb, an SSMM usually consists of not more than 10 equations, including the choice of a policy rule equation. As background to the SSMM that we plan to construct for Indonesia, we will outline several variants of SSMM that have been adopted by some countries in the following subsections[6].

3.3.1 Batini-Haldane Model (BH)

In this subsection, we will examine the basic model of Batini-Haldane (1999, hereafter BH) that is employed at the Bank of England and discuss the relative merits of this small scale model. The model comprises six equations as follows:

$$y_t - y_t^* = \alpha_1 y_{t-1} + \alpha_2 E_t y_{t+1} + \alpha_3 (i_t - E_t \pi_{t+1}) + \alpha_4 q_t + \varepsilon_{1t} \tag{1}$$

$$m_t - p_t = \beta_1 y_t + \beta_2 i_t + \varepsilon_{2t} \tag{2}$$

$$e_t = E_t e_{t+1} + i_t - i_t^f + \varepsilon_{3t} \tag{3}$$

$$p_t^d = \frac{1}{2}(w_t + w_{t-1}) \tag{4}$$

$$w_t - p_t = \gamma_0 (E_t w_{t+1} - E_t p_{t+1}) + (1-\gamma_0)(w_{t-1} - p_{t-1}) + \gamma_1 (y_t - y_t^*) + \varepsilon_{4t} \tag{5}$$

$$p_t = \theta p_t^d + (1-\theta) e_t \tag{6}$$

Excluding the policy rule, which we will discuss later, the model consists of both the behavioural equations and the identities, whereby the former can be estimated or calibrated. All variables, except interest rates, are in logarithms. Equally important to note is that in the simulations, all behavioral relationships are expressed as deviations from equilibrium.

---

[6] There are other SSMMs that are not discussed in this thesis, for example: Vincent (2002) on small-scale model of the US economy, and Arreaza et al (2003) on Venezuelan economy.

We will discuss in detail each equation found in the BH small scale macroeconomic model. Equation (1) is a typical IS curve with the usual expected signs such as the negative relation between the *ex-ante* real interest rate and real output ($\alpha_3 < 0$), y_t, and the positive relation between the real exchange rate—q_t = $e_t + p_t^f - p_t$ with e_t being the nominal exchange rate that represents the domestic currency price of foreign currency—and real output ($\alpha_4 > 0$).[7] In the BH model, the short-term real interest rate is used instead of the long real interest rate[8]. In order to determine whether it is more appropriate to employ the long- or short-term real interest rate, we should analyze and judge the responsiveness and sensitivity of expenditures to either real interest rate as well as looking at the debt instruments used in practice.

A distinguishing feature of this IS specification is the existence of a lead term in addition to the usual model whereby output depends on its own lag because of adjustment costs. The lead term is motivated by the McCallum and Nelson (1999) optimizing IS-LM specification for monetary policy and business cycle analysis. They consider a dynamic, optimizing general equilibrium macro-model of the Sidrauski-Brock type that corresponds to the traditional IS-LM functions. Their work has shown that this IS specification is different from the conventional one in that an additional variable reflecting the expected next-period income is included. The modified IS specification yields a dynamic, forward-looking aspect to the economy's saving behavior. This is an

---

[7] The representation of the exchange rate found in Batini and Haldane (1999) is the converse of this, i.e. e_t being the nominal exchange rate that represents the foreign currency price of domestic currency. Thus we would expect a negative relation between the real exchange rate and the real output in this case. We employ this definition to be consistent with the Indonesian SSMM in Chapters 4 and 5.

[8] We could include a long-term interest rate by linking long- and short-term interest rates through an arbitrage condition, as in the Fuhrer and Moore (1995a) model.

important modification since we acknowledge the forward-looking behaviour of economic agents in the decision-making process, thus enabling monetary policy to work more effectively by recognizing these responses[9]. Finally, ε_{1t} is the demand shock or innovation in the IS specification, such as shocks to foreign output and fiscal policies.

Equation (2) is an LM curve with the conventional arguments that depicts real money balances as being dependent on a nominal interest rate and real output. McCallum and Nelson (1999) show that this conventional LM function can be derived as the reduced form of an optimizing stochastic general equilibrium model. The innovation element ε_{2t} is named "velocity" shocks. Altogether, the IS-LM specification in this model, based on McCallum and Nelson (1999), provides a model of aggregate demand behavior that is rather tractable and also usable with a variety of aggregate supply specifications from full price flexibility to sticky prices. McCallum and Nelson (1999) also argued that traditional IS-LM specifications need to be modified especially for the conduct of monetary policy by adding a forward-looking element.

Equation (3) is an uncovered interest parity condition for the open economy, expressing the dynamic relationship between the exchange rate and the spread between domestic and foreign interest rates, without the exchange risk premium being made explicit. It depends on the expected level of the nominal exchange rate and the interest rate disparity between domestic and foreign nominal interest rates. The shock, ε_{3t}, comprises foreign interest rate shocks and possible disturbances in the foreign exchange

[9] This is to be contrasted with the traditional IS specification, unless we believe that income per capita is expected to be constant in the future.

market, including exchange risk premium shocks and arbitrage elements. Equations (4) and (5) define the model's supply side that takes a similar form to the staggered wage contract models[10]. The former specifies a (constant) markup equation of domestic output prices over the weighted average of the current and preceding period's contract wages. The latter is the wage-contract equation that specifies wage contracts for two periods. The current real contract wage is a weighted average of the real contract wage of the other period's contract wages of labourers, i.e. the wages in the preceding period and the wages expected in the next period. This specification does not necessitate lag symmetry and allows for flexible mixed specifications (See Fuhrer and Moore 1995b; Blake 1996; Blake and Westaway 1996). Fuhrer (1997) found that this flexible mixed specification is preferred empirically. This will allow for a varying degree of forward-looking behaviour in the wage-bargaining process which is suitable for empirical testing and simulation. The sum of lead-lag weights are restricted to be unity to preserve price homogeneity in the wage-price system that translates into a vertical long-run Phillips curve. Also present in the wage bargaining equation is the output gap term that measures the tightness in the labour market. The innovation term ε_{4t} captures the shocks to the natural rate of output and other types of supply shocks.

Equation (5) has great theoretical and empirical appeal. For example, Duesenberry (1949) argued that wage relativities were a key consideration when wage-bargaining activities are initiated. The empirical attraction of this wage-price specification is that it generates inflation persistence (Batini and Haldane 1999) which is

[10] Refer to Fuhrer and Moore (1995a) for detailed treatments and Buiter and Jewitt (1981) for an early formulation.

absent in the Taylor (1980) specification as found by Fuhrer and Moore (1995a) and Fuhrer (1997). Lastly, Equation (6) defines the consumption price index that comprises the prices of domestic goods and imported foreign goods. The weights of these two components sum up to 1. Note that the equation implies full and immediate pass-through of import prices into consumption prices. Batini and Haldane (1999) come up with the following reduced-form Phillips curve specification using equations (4)-(6) as follows:

$$\pi_t = \chi_0 E_t \pi_{t+1} + (1-\chi_0)\pi_{t-1} + \chi_1(y_t + y_{t-1}) + \mu\left[(1-\chi_0)\Delta c_t - \chi_0 E_t \Delta c_{t+1}\right] + \varepsilon_{5t} \tag{7}$$

where $c_t = e_t - p_t$ (real exchange rate), $\mu = 2(1-\phi)$, Δ is the backward difference operator, and $\varepsilon_{5t} = \varepsilon_{4t} + \chi_0\left[\left(p_t - E_{t-1}p_t\right) - (w_t - E_{t-1}w_t)\right]$ whereby this composite error term includes expectation errors made by wage bargainers.

The transmission of monetary impulses in this model is very different from the closed economy case. We will look in particular at the transmission of policies through the channel of money supply and interest rates. As we know, there is a conventional real interest rate channel that works through the output gap and thereof onto inflation. In addition, there is a real exchange rate effect that operates through two distinct channels, namely: an indirect output gap route running through net exports and thence onto inflation; and secondly, direct price effects via the cost of imported consumption goods and wages and hence, via domestic output prices. Under certain specifications of tastes and technology, the system of equations (1)–(6) can be derived as the linear reduced-form rational expectations macromodel of a fully optimizing general equilibrium model (McCallum and Nelson 1999).

3.3.2 Small Model of the Australian Macroeconomy

The second variant of SSMMs that we are going to discuss is the one developed by the Reserve Bank of Australia (RBA). In their paper, Beechey et al. (2000) presented an empirical based model for the Australian macroeconomy that consists of five equations—non-farm output, the real exchange rate, import prices, unit labour costs, and consumer prices—which can be used to analyze developments in the economy and effects from several types of shocks, as well as to generate forecasts of the future macroeconomic direction of the Australian economy. In accordance with typical small scale macroeconomic models, the RBA model is highly aggregated and makes use of a simple framework for examining macroeconomic developments as well as the effects of monetary policy on the economy.

This model is aimed at a short to medium-term analysis although it also has a well-defined steady state which necessitates some restrictions to be imposed on some of the coefficients. The RBA model differs from many other macroeconometric models, both for Australia and other countries, by combining the characteristics of an empirical, aggregate, non-monetary[11], and stylized-facts driven econometric model. Based on the

[11] Non-monetary implies that there is no explicit role for monetary quantities. For more on this issue, refer to de Brouwer, Ng, and Subbaraman (1993), and Beechey et al (2000).

stylized-facts driven model characteristic, all these five equations are estimated using a total of ten exogenous variables found in the model[12].

The equations are estimated individually by ordinary least squares since their cross-equation variance-covariance matrix for the estimated residuals show little cross-equation correlations. The authors argued that by doing so, it will curb the spreading of mis-specification from one to another equation(s). They used a general-to-specific modelling approach with all the equations appearing in the equilibrium-correction form. Additional issues that were discussed are parameter stability, testing for structural breaks, as well as the tariff-adjustment and Balassa-Samuelson effect in relation to import prices.[13] Finally, the sample period is from 1985:Q1 to 1999:Q3. We will present the five equations in the RBA model and discuss some of their important features[14].

Output

The output equation representation is as follows:

$$\Delta y_t = \alpha_1 + \sum_{i=2}^{7} \alpha_2^i r_{t-i} + \alpha_3 y_{t-1} + \alpha_4 y_{t-1}^{US} + \alpha_5 s_{t-1} + \alpha_6 (\Delta y_{t-1} + \Delta y_{t-2}) + \alpha_7 \sum_{i=3}^{6} \Delta ip_{t-i}^{OECD} + \varepsilon_t \quad (8)$$

y is Australian real non-farm GDP, y^{US} is real US GDP, s is a de-trended real share price accumulation index for Australian shares, ip^{OECD} is real OECD industrial production and r is the real cash rate as measured by the nominal cash rate i less consumer price inflation

---

[12] Although it is rather straightforward to augment the model with a policy reaction function, such as a Taylor rule, the RBA model does not incorporate this. Hence, in the model, the presumed link from current and expected future outcomes for consumer prices and the output gap to the policy interest rate is not formalized, which means it cannot be used to examine monetary policy transmission to the economy.
[13] Refer to the appendices in Beechey (2000).
[14] Readers who are interested in knowing the estimation results, please refer to Beechey et al. (2000). In this thesis, we are going to discuss only the small scale macroeconomic structures.

over the past four quarters, $r_t = i_t - (p_t - p_{t-4})$. The inclusion of the real interest rate allows for flexibility in the estimated near-term pattern of the effect of monetary policy on output (Beechey et al. 2000). In addition, they also experimented with alternative assumptions about inflation expectations which are not exclusively backward-looking. This is given by $r_t = i_t - \left[\mu(p_t - p_{t-4}) + (1-\mu)\pi_t^e\right]$, where μ $(0 < \mu < 1)$ is the assumed weight on backward-looking expectations and π_t^e are inflation expectations derived from the bond market. The authors found that this change made an insignificant difference to the model's goodness-of-fit.

Real exchange rate

For an open economy like Australia, the exchange rate is an important factor in macroeconomic fluctuations, especially in determining relative prices. Among the existing models, there are two approaches in modelling the Australian exchange rate. The first is based on an uncovered interest parity condition and the second is a reduced-form single-equation framework, which is adopted in the RBA model. Three fundamental determinants of the Australian real exchange rate were identified: the terms of trade, the differential between domestic and foreign real interest rates, and net foreign liabilities. Nevertheless, the third variable was excluded from the model due to its insignificant effect. The real exchange rate in the RBA model is modelled in an unrestricted equilibrium-correction framework that contains a long-run relationship between exchange rate and the terms of trade as well as the short-run dynamics:

$$\Delta\theta_t = \beta_1 + \beta_2\theta_{t-1} + \beta_3 tot_{t-1} + \beta_4(r_{t-1} - r_{t-1}^*) + \beta_5\Delta tot_t + \omega_t \tag{9}$$

where θ is the Australian dollar against a trade-weighted average of the currencies of major trading partners, *tot* is the terms of trade, r^* is the foreign real interest rate and *r* has been defined earlier. One striking result suggests that the exchange rate overshoots in the short-run. A possible reason for this, as argued by the authors, is the endogeneity of the terms of trade in relation to the real exchange rate. This may arise due to changes in the exchange rate passing through faster to import prices than to export prices, thus implying that exchange rates changes can cause terms of trade changes in the same direction and can persist up to one year or so.

Import prices

The import equation is:

$$\Delta pm_t = \phi_1 + \phi_2 pm_{t-1} + \phi_3 p^{*x}_{t-1} + \phi_4 e_{t-1} + \sum_{i=0}^{1} \phi_5^i \Delta p_t^{*x} + \sum_{i=0}^{1} \phi_6^i \Delta e_{t-i} + \phi_7 D_t^1 + \phi_8 t + v_t \qquad (10)$$

pm is FOB import prices in Australian dollars, p^{*x} is foreign export prices, *e* is the nominal exchange rate, and *D* is dummy variable that takes a value 0 for t < 1998 Q2 and 1 for t $\geq$ 1998 Q2. Two sets of restrictions are imposed on the equation as motivated by economic theory. First, traded goods prices should satisfy purchasing power parity in the long run, translating econometrically into $\phi_2 = -\phi_3 = \phi_4$. The second one is that the margin between import prices and domestic-currency cost of imports, $pm_t + e_t - p_t^{*x}$, should be unaffected by changes in the steady-state rate of inflation. This translates into the restrictions that $\phi_6^0 + \phi_6^1 = -1$ and $\phi_5^0 + \phi_5^1 = 1$. The former restriction is easily accepted by the data and hence imposed whereas the latter is overwhelmingly rejected by the data and thus not imposed.

Unit labour costs

An expectations-augmented Philips curve is used to represent unit labour costs whereby inflation expectations are assumed to be a combination of backward and forward-looking expectations. The output gap, as opposed to the unemployment gap, is used to model wage bargaining pressures. The initial econometric specification of unit labour costs was expected to yield a vertical long-run Phillips curve, implying the restriction that the coefficients of inflation variables sum up to one. However, this restriction is flatly rejected by the data[15]. When the sample was divided into two parts, through the use of dummy variables, the restriction was accepted by the data. The final specification using quarterly data is as follows.

$$\begin{aligned}\Delta_4 u_t = {}& \rho_1 D_t^2 + \rho_2(1-D_t^2) + \rho_3 \Delta_4 p_{t-1} + \rho_4 \pi_t^e + \rho_5 D_t^2 \pi_{t-1} + \rho_6 \Delta_4 u_{t-1} + \rho_7 \Delta u_{t-4} \\ & + \rho_8 \Delta u_{t-5} + \rho_9 (y_{t-4} - y_{t-4}^p) + \eta_t\end{aligned} \tag{11}$$

where u is unit labor costs, π^e is the bond market's inflation expectations, and y^p is potential output. D_t^2 is a dummy variable that is 0 for $t \le 1995:Q4$ and 1 for $t \ge 1996:Q1$, and finally π^t is the average rate of annual inflation over the past three years, $(p_t - p_{t-12})/3$.

Consumer prices

Consumer prices are modelled as a mark-up over the unit input costs of production, i.e. unit labour costs and import prices. This mark-up is allowed to vary cyclically with

[15] To understand the reasons behind this issue, please refer to Chapman (1990) and Stevens (1992).

output and moreover, it is influenced by oil prices as well. The final specification is in the equilibrium-correction form:

$$\begin{aligned}\Delta p_t = {} & \lambda_1 + \lambda_2 p_{t-1} + \lambda_3 u_{t-1} + \lambda_4 pm'_{t-1} + \lambda_5 \Delta u_t + \lambda_6 \Delta pm'_t + \lambda_7 \Delta oil_{t-1} + \lambda_8 (y_{t-3} - y^p_{t-3}) \\ & \lambda_9 \sum_{i=0}^{2} \Delta (y_{t-i} - y^p_{t-i}) + \lambda_{10} D^3_t + \lambda_{11} D^4_t + \xi_t \end{aligned} \tag{12}$$

pm' is import prices adjusted for tariffs and for an assumed productivity differential between traded and non-traded sectors (Refer to Appendix C, Beechey et al. 2000), and *oil* is the Australian dollar price of crude oil. The dummy variables, $D^3_t = 1$ at 1990 Q4 and $D^4_t = 1$ at 1991 Q1, and 0 otherwise. y^p is the potential output. The restriction imposed is that long-run consumer prices are a linear combination of unit labour costs and adjusted import prices that sums up to 1—the so called "static homogeneity" condition. This translates econometrically into the restriction $\lambda_2 = -(\lambda_3 + \lambda_4)$. The next restriction imposed is the so-called "dynamic homogeneity" restriction—the sum of the coefficients on inflation terms is one—that translates into $\lambda_5 + \lambda_6 + \lambda_7 = 1$. The former restriction is accepted by the data and thus imposed whereas the latter is not.

The five specified equations form the baseline RBA model. However, instead of directly using these specifications in dynamic simulation, the authors further specify the steady-state condition and a measure of potential output. Thus, the model was simulated and results reported as deviations from the steady state. We will discuss neither the empirical results of their baseline model nor the dynamic simulations below. Full details on their baseline regression results could be found in Beechey et al. (2000).

We will discuss several lessons that can be drawn from this second variant of small scale macroeconomic model. First of all, the model uses stylized facts to derive the equations to be estimated and used subsequently for performing dynamic simulations. Secondly, in the spirit of a small scale macroeconomic model, this variant includes most key macroeconomic variables such as output, the real exchange rate, import prices, unit labour costs, and consumer prices. These desirable features of small scale macroeconomic model have provided a simple framework to study, analyze, and quantify short- to medium-term macroeconomic developments and effects of monetary policy on the Australian economy. Thirdly, an important thing to note about this model is that it embodies both short-run dynamics and long-run steady state relationship that translates directly into several restrictions in the model. Fourthly, this model is sufficiently small so that it will be relatively easy to grasp the economic intuition and interrelationships between macroeconomic variables in the Australian economy, as the authors have shown through the dynamic simulation of the model. In short, these features are in line with the advantages of SSMM that we have outlined beforehand and further illustrate the usefulness of SSMM as a tool for policymakers.

However, there might be some questionable properties of this RBA model. First, although the stylized-facts driven econometric specifications might seem appealing and its capacity to fit the economic data might be good, it lacks theoretical microeconomic foundations for the behaviour of economic agents. In addition, the choice of parameters in some equations seemed rather arbitrary and some of them were kept or dropped just for the sake of accommodating stylized facts as close as possible. As the authors have pointed out, rational expectations do not play a role in the model. This might be a drawback, given the wide acceptance of the concept of rational expectations in theoretical and empirical macroeconomic modelling. Lastly, the absence of any explicit role for monetary quantities inhibits the examination of the transmission mechanism of monetary policy. Although it has been argued that there was no stable long-run relationship between money, income, and interest rates, there might be a good case to introduce at least a simple Taylor rule or a modified version of it[16].

3.3.3 Simple Model of the Brazilian Economy

The third variant of SSMMs that we are going to discuss in this subsection is a simple model of the Brazilian economy. This model was built ultimately to address the issue of inflation targeting in Brazil. In particular, the Central Bank of Brazil (CBB) developed the model to study the transmission mechanism of monetary policy after Brazil's Real Plan, that is, the switch in the exchange rate regime to a floating system. As opposed to the RBA model discussed in the previous subsection, de Freitas and Muinhos (1999) developed a small scale model based on the BH approach with embedded theoretical microeconomic foundations in it. The main difference with the BH model is the modifications they introduce so that only three equations are estimated (as opposed to six

[16] The authors argued that instead of augmenting the model with a policy reaction function such as a Taylor rule, they simply illustrate the model's properties with dynamic simulations and track their responses to shocks. For Australian models with a policy reaction function, refer to de Brouwer and O'Regan (1997); Lowe and Ellis (1997); Shuetrim and Thompson (1999).

structural equations in BH) plus the policy rule. They also focus mostly on studying the monetary policy transmission with respect to output and inflation. Thus the main aim of their study is to concentrate on the optimality of the policy rules employed by the central bank[17]. The discussion in this subsection is particularly useful to show an example of yet another variant in the class of SSMMs and it also provides a good starting point to understand how the BH model has been modified to suit other countries.

In early 1999, Brazil switched her exchange rate regime from a fixed exchange rate system to a floating regime with the implementation of the so-called “Real Plan”. Following that, in June 1999, Brazil joined some other countries such as the United Kingdom (UK) and Sweden in formally adopting an inflation targeting regime. The main aspect of this new monetary arrangement is to pay attention to expected future inflation when deciding on the current interest rate as an instrument. Thus, the forward-looking element is inherent due to the fact that most transmission mechanisms of monetary policy indicate that the interest rate affects inflation with a lag working through aggregate demand[18]. In other words, the decision on interest rates made today by the central bank will determine expected future inflation so that it is crucial to include forward-looking behavior of agents in this setting.

In their paper, de Freitas and Muinhos (1999) estimated an IS curve and a Phillips equation for Brazil that were used to simulate the effects of different interest rates rules in relation to the variability of inflation and the output gap. Their benchmark is the optimal

[17] To be precise, their focus is on comparing monetary policy rules with interest rates as the main tool of policy. They compare the policy rule that minimizes the loss function with Taylor-type rules.
[18] Refer to King (1997), Ball (1999), and Svensson (1998).

interest rate rule that is obtained from the Bank's minimization of a loss function which essentially is the weighted average of the variance of inflation and output gap (see Appendix 2 of their paper). de Freitas and Muinhos (1999) leveraged on the BH model to come up with a simplified three-equation model in studying the monetary transmission mechanism[19]:

$$y_t - y_t^* = \beta_1 r_{t-1} + \beta_2 g_{t-1} + \beta_3 (y_{t-1} - y_{t-1}^*) + \beta_4 \Delta c_{t-1} + \varepsilon_t \qquad (13)$$

$$\pi_t = \alpha_1 \pi_{t-1} + \alpha_2 (y_{t-1} - y_{t-1}^*) + \alpha_3 (e_t - e_{t-1}) + \eta_t \qquad (14)$$

$$e_t = e_{t-1} + \upsilon_t \qquad (15)$$

Equation (13) is an open economy IS curve with the output gap (y - y^*) depending on its own lags, on the lag of the real interest rate, r, on the lag of the first-difference of the real exchange rate (Δc), on the lag of the fiscal deficit denoted by g, and on a demand shock ε. Equation (14) is an open economy Phillips curve with inflation π depending on a lag of itself, on a lag of the output gap, on the change in the nominal exchange rate, e, and on a shock η. Finally, Equation (15) is the exchange rate process that is assumed to follow a random walk. It can be seen clearly that exchange rate affects inflation directly through the price of imports and indirectly through its effects on the output gap as shown by Equations (13) and (14). The model consists of aggregate supply and demand as given by the Phillips curve and the IS curve respectively. Furthermore, the transmission mechanism from the interest rate to inflation occurs through aggregate demand only, i.e. through the IS equation and it takes two periods for the interest rate decision by the CBB

[19] Excluding the policy rule.

to have an effect on inflation. An important point worth noting is that the random walk process for the exchange rate precludes the conventional uncovered interest parity (UIP) channel, whereby a home country appreciation follows an increase in the world interest rates, *ceteris paribus*. Wadhwani (1999) argued that although UIP is more attractive in modeling the exchange rate due to its theoretical appeal, predictions of future exchange rates using random walk specifications usually outperform UIP predictions. Given the three-equation model structure, it is straightforward to see that the choice of interest rate by the central bank will affect inflation from two periods ahead. Hence, a policy rule is required for the central bank to make the decision. de Freitas and Muinhos (1999) consider Taylor-type rules and optimal rules to close the model[20].

Estimation of the CBB model used quarterly data whereby inflation is measured by the general price index, the output proxy is GDP, and thus the output gap is GDP minus potential output. The Hodrick-Prescott filter is used to estimate potential output. The nominal exchange rate is the period average of the ask prices, the nominal interest rate is the Selic rate[21], and the fiscal variable is the federal government primary deficit (as % of GDP). The sample period is 1992:Q4 to 1999:Q1 for the IS equation and 1995:Q1 to 1999:Q2 for the Phillips curve. The equations were estimated using OLS. The IS curve does not contain the real exchange rate term or a fiscal term in their final estimated results[22]. In addition, dummy variables were introduced for the “Real Plan” and third quarter of 1998.

---

[20] Refer to section 3.4 for the discussion of policy rules in SSMMS.
[21] The equivalent of the US Fed funds rate.
[22] The authors might have dropped them due to insignificance.

de Freitas and Muinhos (1999) imposed a long-run vertical Phillips curve that translates into the restriction that the sum of the coefficients of lagged inflation and nominal exchange rate changes is 1 in Equation (14). This means that any devaluation in the exchange rate will be completely passed through to prices in the long run and it has a contemporaneous pass-through effect of 20% in the short run. As mentioned earlier, the effect of interest rate changes on inflation takes two quarters to realize. A one percentage point increase in the real interest rate will negatively affect the output gap by 0.39 percentage points. Similarly, a decrease of 1% in the output gap reduces inflation by 0.31 percentage points. The final result from these effects is that an increase of 1 percentage point in the interest rate will reduce inflation by 0.12 percentage points in the short run. As for the long run, the ultimate effect of a 1 percentage point increase in interest rate would be a 0.6% reduction in inflation[23].

The CBB model shows that even with a (super) small scale model, an SSMM can aid in providing recommendations and guidance to the central bank in making its decisions. However, some caveats also need to be added. First, the relatively short sample period (as mentioned beforehand) posed the problem of having too few degrees of freedom as the authors mentioned. This is especially so when they decided to use quarterly data for such a short period. In addition to that, there are some variables dropped in their final estimation results such as the real exchange rate and the fiscal term that might appear to be important from an economic point of view. Second, their random walk exchange rate process lacks theoretical content. It also does not take into account

[23] Taking into account the autoregressive coefficient in the Phillips equation, which is 0.80, we have 0.12 / (1 – 0.80) = 0.6 as the long run elasticity.

the effects of the interest rate on the exchange rate, which is inappropriate since the interest rate is the central bank's main tool of monetary policy.

All in all, the CBB model (and the BH model in general) has shown the usefulness of a small-scale macroeconomic model for analyzing the major macroeconomic variables of a country and for performing dynamic simulations to understand the monetary transmission mechanism. The CBB model has provided us with indirect evidence that using a reasonably small macroeconomic model which embodies important macroeconomic variables and having just a simple monetary policy rule could still lead to some very important insights regarding the conduct of monetary policy by central banks. In building a good SSMM, an appropriate balance of relevant theoretical content with important stylized facts needs to be struck in order to yield a robust SSMM that can produce meaningful policy simulation results. In the next subsection, we discuss several types of policy rules that are required for the conduct of policy simulations.

3.4 Policy Rules in SSMMs

To close the models discussed above, we consider two types of monetary policy rules. The first is the celebrated Taylor rule that attempts to model the monetary policy behaviour of most central banks in practice. The second rule we discuss is a generic form of the Taylor rule that feedbacks from expected values of future inflation, or *forward-looking* policy rules. Most inflation targeting central banks adopt the latter rule due to its desirable feature of approximating the optimal feedback rule.

3.4.1 Simple Taylor Rules

The Taylor rule is a simple, yet robust, description of the relationship between the monetary policy instrument—in this instance, a short term interest rate—and a measure of the inflation gap and deviation of output from its steady-state (or natural) value. This simple rule of thumb depends on variables that are easily available in a timely fashion. The Taylor rule itself can be estimated by econometric methods. This rule is also able to explain the historical paths of monetary policy instruments in most industrialized countries and it also provides simple guidance to monetary policy-makers. Taylor (1993) has initially shown that the rule with coefficients of 1.5 on inflation and 0.5 on the output gap can explain USA monetary policy starting from 1986 very well[24]. Recent evidence in Taylor (1999, 2000, 2001) indicate that improvements can be achieved by introducing forward-looking measures of inflation, as suggested by Batini et al. (2001), and an exchange rate variable to reflect an open economy dimension, as in Ball (1999) and Svensson (2000, 2003b).

The Taylor rule has been examined empirically for some countries. For example, Clarida et al. (1998) estimate a forward-looking Taylor rule (see below) for the G3 countries (USA, Japan, Germany) and the E3 countries (United Kingdom, France, Italy) using the generalized method of moments (GMM) for the sample period between 1979 to the early 1990s for the G3 and from 1979 to a period prior to the "hard" exchange rate mechanism (ERM) for the E3. The results have shown that G3 countries respond aggressively to inflation as evidenced by greater than unity coefficients on inflation and

[24] Ball (1997) and Svensson (1997c) suggested that "optimal weights" that minimize the variances of inflation and the output gap might be higher than the values proposed by Taylor (1993).

rather small coefficients for output gaps. On the other hand, E3 countries have below unity coefficients on inflation and it seemed that they followed a disinflation strategy that does not correspond to the Taylor rule. The recent evidence by Nelson (2000), however, implied that the responses to the UK nominal rate of inflation and output gap are very close to Taylor's (1993) weights during the time period 1992–1997. In short, the Taylor rule provides a good summary of *ex-ante* central bank behavior and thus gives comprehensive guidance to policy-making by central bankers[25].

The Taylor rule is a mechanical rule that requires only two sets of information, namely, the inflation gap and the output gap. Taylor (1993) suggested a simple rule by which the central bank adjusts the nominal short-term interest rate. The movements of short-term interest rates are captured by this rule according to the deviation of actual inflation from targeted inflation and the level of output relative to the long-run steady-state value (thus referred to as the inflation gap and output gap respectively). Originally, Taylor's specification used current levels of inflation and the output gap, but in practice the information regarding current inflation rate and the output gap are known only with a lag. The following specification of the Taylor rule includes the inflation and output gaps after a lag of one period:

$$i_t = r^* + \pi_{t-1} + \alpha(y - y^*)_{t-1} + \lambda(\pi - \pi^*)_{t-1} \tag{16}$$

[25] Questions remain whether the Taylor rule offer a good guide for *future* monetary policy as pointed out by King (1999). Furthermore, Chote (1996) argued that the Taylor rule is "spuriously precise" in describing the behaviour of monetary policy in several countries.

π_t is the current period's inflation rate and π^* is the inflation target. r^* is the equilibrium real interest rate which is constant in the Taylor rule[26] and $(y - y^*)$ is the output gap. α and λ are the weights given to the output and inflation gaps respectively. This equation shows that the current period's nominal interest rate, i_t, depends on expected inflation (as proxied by the last period's inflation rate), the previous period's value of the output gap and the last period's deviation of the inflation rate from its target.

As an example of a Taylor rule in the Brazilian SSMM, de Freitas and Muinhos (1999) tested the equation:

$$r_t = \rho r_{t-1} + \alpha(\pi_t - \pi^*) + \beta y_t \tag{17}$$

Setting α =1.5 and $\beta = 0.5$, they found that this Taylor rule yielded a poorer performance as compared to the optimal rule based on a loss-minimizing function. For stability, it is necessary to impose the restriction that α should be greater than unity. They also experimented with different values of α and β and found that as the weights on both the inflation and output gaps are increased, this simple type of rule provides a good alternative to the optimal one as long as the central bank has a strong bias against variability in the level of inflation.

[26] Woodford (2001) favors a time-varying real interest rate according to Wicksell's "natural rate".

3.4.2 Forward-Looking Rules

An example of a forward-looking rule can be found in the BH model as follows[27]:

$$r_t = \delta r_{t-1} + (1-\delta) r_t^* + \rho (E_t \pi_{t+j} - \pi^*) \tag{18}$$

r_t denotes short-term *ex-ante* real interest rate whereby $r_t = i_t - E_t\pi_{t+1}$, with i_t being the nominal interest rate; r^*_t denotes the equilibrium real interest rate; $E(\bullet) = E(\bullet \mid \Omega_t)$ where Φ_t denotes the information set available at time t and E is the mathematical expectations operator. The distinguishing feature of this simple forward-looking rule is that it feedbacks from the expected values of future inflation, i.e. there is a forward-looking element in inflation[28]. It resembles monetary policy behaviour in most inflation targeting central banks in reality. According to this rule, the central bank controls the nominal interest rate (i_t) to hit a path for the desired short-term real interest rate. The feedback term implies that any deviation of *expected* future inflation from the inflation target prompts an immediate policy action today. In addition, this simple forward-looking rule may approximate the optimal feedback rule (Batini and Haldane 1999).

The policy choice variables for the authorities are the parameter triplet $\{j,\rho,\delta\}$. The variable δ dictates the degree of interest rate smoothing (Williams 1997) while the parameter ρ is a policy feedback parameter that determines the degree of aggressiveness of the monetary policy response to inflation. Ω_t denotes the information available up to time t to the central bank. Finally, j is the targeting horizon used by the central bank for

[27] Note that this rule could be augmented with explicit output terms.
[28] Batini and Haldane (1999) called this the inflation-forecast-based rule.

simulation and calibration purposes. Usually this targeting horizon is about two years or eight quarters equivalently. Batini and Haldane (1999) calibrated this policy rule by setting $\delta = 0.5$—a halfway point in the degree of interest rate smoothing—$\rho=0.5$ and $j=8$. They calibrated the model so as to match the quarterly profiles of the endogenous variables in the United Kingdom economy.

There are several theoretical justifications for the simple forward-looking rule and some reasons why it might be preferred to the simple Taylor rule. It has been argued that expected-inflation targeting rules of the sort discussed here have desirable properties such as in the case when authorities only care about inflation; in this case, the optimal rule is the one that sets interest rates to bring expected inflation into line with the inflation target at a particular horizon. In addition to that, the central bank might also care about non-inflationary output growth; hence the optimal rule is to less than fully close any gap between expected inflation and the inflation target[29]. In other words, the simple forward-looking rule is directly analogous to the simple Taylor rule.

Having explained some variants of small scale macroeconomic models along with policy rules, we will specify and estimate an SSMM that makes use of theoretical underpinnings similar to the BH model in the next two chapters. In Chapter 4, we will combine the understanding of the Indonesian economy in Chapter 2 with the theoretical foundations of small scale macroeconomic models in this chapter to construct and

[29] See King (1997), Svensson (1997 a, b) and Haldane (1998).

analyze our very own Indonesian SSMM. Chapter 5 will deal with the estimation and simulation of the Indonesian SSMM.

Chapter 4

A Small Scale Macroeconomic Model of the Indonesian Economy

In this chapter, we develop a small scale macroeconomic model for the Indonesian economy. To reiterate, this thesis aims to meet the challenge of improving the small model for Indonesia developed by Bank Indonesia and hopes to pave the way for future research in this area so as to gain a better understanding of the key macroeconomic structure of Indonesia and to improve on the conduct of monetary policy. In this chapter, we will synthesize our knowledge of the Indonesian economy and construct an SSMM for Indonesia, as one of the few countries in Asia for which an SSMM is built.

We will begin by reviewing the existing small scale model developed recently by Bank Indonesia. This will be followed by a description of the equations in our Indonesian SSMM. In doing so, we employ a model structure that is similar to the BH model reviewed in the previous chapter. However, we modify the BH model by taking into account some notable macroeconomic features of the Indonesian economy. We also explain the choice of variables that we are going to employ in the Indonesian SSMM. Finally, we end the chapter with the specification of policy rules based on our understanding of the conduct of monetary policy in Indonesia, most notably during the Asian financial crisis and the period thereafter, which has been discussed in Chapter 2.

4.1 The Bank Indonesia Small Quarterly Macromodel (BI-SQM)

Before we develop the Indonesian SSMM, we will discuss in some detail the recent small macroeconomic model built by Bank Indonesia, called the small quarterly macromodel (BI-SQM). BI-SQM was set up initially to forecast inflation in a more accurate way and consistently. The model is a simultaneous quarterly model that consists of the following equations: output gap, aggregate demand, real money balances, the Phillips curve, import price, and exchange rate. Finally, BI-SQM is closed by considering a monetary policy rule in the spirit of the Taylor rule, with the control of inflation as the ultimate goal.

The BI-SQM output gap equation consists of an output growth variable, short-term interest rate, and the oil price. It is represented as follows with all the α coefficients are positive:

$$(Y - Y^*)_t = \alpha_1 + \alpha_2 \Delta Y_t - \alpha_3 i_t + \alpha_4 o_{t-3} + \alpha_5 seasonal\_fac + \varepsilon_{1t} \qquad (1)$$

Y is real output and Y^* is the potential real output level. ΔY is an output growth variable, i_t is the real short-term interest rate, o is an oil price gap, and finally *seasonal_fac* is a dummy variable to capture seasonal events. This equation postulates that the output gap—the difference between real output and potential output— depends on the growth of actual output, which is a proxy for aggregate demand. The output gap is also directly affected by a change in the short-term interest rate. Since changes in the oil price affect revenues from oil exports, an important component of GDP, the model postulates that the deviation between the actual oil price and the one assumed in the state budget also affects the output gap positively (when actual price is greater than the projected price in state budget) or negatively (when actual price is smaller than the projected price in the state budget).

Next, the aggregate demand (AD) equation states that the change in output is due to the growth of government consumption[1] and the short-term interest rate, the exchange rate, the real money balances, and the oil price gap:

$$\Delta Y_t = \alpha_6 + \alpha_7 \Delta Y_{t-1} - \alpha_8 i_t - \alpha_9 e_t + \alpha_{10} \Delta(m_t - p_t) + \alpha_{11} o_t + \varepsilon_{2t} \qquad (2)$$

e is the real exchange rate variable defined as the domestic currency price of foreign currency, m_t is the money supply, p_t is the price level and hence, m_t - p_t is the real money balances. The negative effect of the exchange rate on Indonesia's GDP growth is due to the high import content in the production of the domestic economy. Thus, a rupiah depreciation reduces the value-added (domestic profit) of domestically produced goods, which in turn reduces national income as argued in Alamsyah et al. (2000).[2] Although the addition of the real money balances variable can be justified as a proxy for the wealth effect, it is puzzling that the interest rate and the oil price appear for a second time in Equation (2), considering their presence in Equation (1).

[1] In Alamsyah et al. (2000), we found these descriptions for the specification of AD equation but no government consumption variable actually appeared in the equation itself. It might have been dropped from the specification due to an insignificant or trivial effect on output growth. Nevertheless, this remains a puzzle for us.
[2] This statement is rather intriguing since economic theory postulates that the exchange rate should have a positive effect because an appreciation reduces export competitiveness and hence, national income.

The real money balances equation is as follows:

$$m_t - p_t = \alpha_{12} + \alpha_{13}(m-p)_{t-1} + \alpha_{14}Y_t - \alpha_{15}\Delta p_t - \alpha_{16}\Delta i_t + \varepsilon_{3t} \tag{3}$$

The income level, inflation, and changes in interest rate are used as explanatory variables. This is a standard specification for real money demand in developing countries. Next, the Phillips curve equation is described by the trade-off between inflation and the output gap:

$$\Delta p_t = \alpha_{17} + \alpha_{18}\Delta p_{t-1} + (1-\alpha_{18})\Delta p_t^* + \alpha_{19}(Y - Y^*)_t + \alpha_{20}\Delta wpi_t + \varepsilon_{4t} \tag{4}$$

where Δp and Δp^* are the current inflation rate and the inflation target respectively. In this equation, the current inflation rate depends on the lagged inflation rate, reflecting inflation inertia, and the inflation target set by the authority. In addition, the BI-SQM specification of the Phillips curve also includes supply side pressures on inflation as captured by the output gap and the growth of the import-wholesale price index (WPI), with the WPI itself influenced by fluctuations in the Rupiah and the foreign price level:

$$\Delta wpi_t = \alpha_{21} + \alpha_{22}e_t + \alpha_{23}\Delta p_t^F + \varepsilon_{5t} \tag{5}$$

where Δwpi represents changes in the import-wholesale price index and Δp^F is foreign inflation. Next, the exchange rate equation consists of domestic and foreign interest rate differentials (id_t) and a dummy variable to proxy for the unobserved variables that partly determine the exchange rate risk premium:

$$e_t = \alpha_{28} + \alpha_{29} dummy - \alpha_{30} id_t + \varepsilon_{6t} \quad (6)$$

Finally, BI-SQM employs an interest rate policy rule called the inflation forecast with contemporaneous output gap rule:

$$i_t = \alpha_{24} + \alpha_{25} i_{t-1} + \alpha_{26} (\Delta p - \Delta p^*)_{t+j} + \alpha_{27} (Y - Y^*)_t + \varepsilon_{7t} \quad (7)$$

This policy rule dictates the reaction of monetary policymakers to deviations between projected inflation and the inflation target, as well as between actual and potential output. It also allows for interest rate smoothing.

4.2 The SSMM for the Indonesian Economy

Because of the relatively less attention given to the small-scale macroeconomic model, we are motivated to set up an SSMM for the Indonesian economy so as to complement other larger-scale macroeconomic models for Indonesia and, hopefully, to offer an improvement to the BI-SQM.

The Indonesian SSMM in this thesis is based on the BH model as discussed in Chapter 3. There are several reasons to leverage on the BH model in setting up the Indonesian SSMM. First, there is a complete treatment of both the supply and demand sides of the economy in a compact manner. Second, the forward-looking nature of the BH model is rather appealing. Third, the model takes explicit account of the impact of the exchange rate on the dynamics of inflation and output which is a crucial channel of the monetary transmission mechanism in the Indonesian economy. Finally, the main benefit of using this model is that it is thought to be disaggregated enough to capture the main characteristics of the monetary transmission mechanism, but is still simple enough to be analytically tractable. Thus, based on the last point, this small model of Indonesian economy can provide a vehicle for analyzing the effects of monetary policy which is credible enough to be of interest to policy-makers and academics alike. In the presentation of our SSMM for Indonesia below, lower case variables are in logarithms (except for interest rates) while upper case variables refer to levels.

The IS equation

The first equation in our model is:

$$\begin{aligned}(y^{no} - y^{no*})_t = {} & \alpha_1 (y^{no} - y^{no*})_{t-1} + \alpha_2 (y^{no} - y^{no*})_{t+1} + \alpha_3 (i_t - E_t \pi_{t+1}) + \alpha_4 g_t \\ & + \alpha_5 q_t + \alpha_6 y_t^f + \varepsilon_{1t}\end{aligned} \tag{8}$$

y_t^{no} denotes non-oil GDP while y_t^{no*} denotes non-oil potential output. $q_t = e_t - p_t + p_t^f$ represents the real exchange rate with e_t, the nominal exchange rate, being the domestic currency price of foreign currency (Rupiah/Foreign Currency). p_t and p_t^f are the domestic and foreign price levels respectively. y_t^f is real foreign output, representing external demand and i_t is the short-term domestic interest rate. The term $E_t \pi_{t+1}$ is expected inflation and will be explained later in the inflation equation. Equation (8) explains the non-oil component of aggregate demand for the Indonesian economy. It is a typical IS curve with the usual sign expectations such as the negative relation between the *ex-ante* real interest rate and the non-oil output gap, $(y^{no} - y^{no*})_t$, as well as the negative relation between the real exchange rate and the non-oil output gap.

A distinguishing feature of Equation (8) is the existence of a term allowing the output gap to depend on its own lag to capture the effect of adjustment costs. The lead term for the non-oil output gap is motivated by the work of McCallum and Nelson (1999) on the optimizing IS-LM specification for monetary policy and business cycle analysis, as discussed in Chapter 3. This is an important modification that needs to be considered for Indonesia's case since we have to acknowledge the forward-looking behaviour of economic agents in decision-making processes, thus enabling monetary policy to work more effectively by recognizing these responses. Moreover, the recent tendency for the BI to move to an inflation targeting regime requires a certain degree of forward-lookingness about future economic conditions.

Real non-oil output corresponds to non-oil nominal output deflated by the consumer price index. It is expected that $\alpha_3 < 0$ and $\alpha_5 > 0$ in equation (8) as postulated by the IS specification found in the BH model. In the BH model, the short-term real interest rate is used instead of the long real interest rate. Similarly, in our Indonesian SSMM, we employ the discount rate published by Bank Indonesia, which is the rate on one-month Bank Indonesia Certificates (SBIs). The variable g is detrended government spending and is assumed to be exogenous. Despite this, government spending is a crucial element in the infrastructural development of the Indonesian economy, especially for some sectors such as transportation, public schools and other public physical infrastructure (see for example Nasution 2002). Finally, ε_{1t} captures other demand shocks or innovations, such as consumption shocks or changes in tax rates that affect both investment and consumption.

The oil output equation

The AD equation in BI-SQM takes into account the effect of oil prices by including the oil price variable directly. Rather than taking this shortcut, we recognize the contribution of oil value-added to total GDP in our model by specifying a second equation for real oil output instead:

$$(y^o - y^{o*})_t = \beta_1 y_t^f + \beta_2 oil_t + \varepsilon_{2t} \tag{9}$$

y^o and y^{o*} denote oil output and potential oil output Since oil revenues are critical to the Indonesian economy, we feel that a separate treatment of the non-oil and oil sectors is necessary and that by specifying the oil output as in Equation (9), we can better explain how the oil price affects the non-oil output gap in the Indonesian economy and thus the dynamics in overall output movements. Specifically, we explain the oil output gap using the real oil price[3] (*oil*) and the income of Indonesia’s foreign trading partners as explanatory variables.. The oil price is assumed to be exogenously determined because of

[3] The variable that we use is an average real oil price from the *International Financial Statistics* published by the IMF.

the price-setting mechanism instituted by OPEC (Organization of Petroleum Exporting Countries), whereby it specifies certain target ranges in influencing the world oil price. Furthermore, although Indonesia is one of the main oil-exporting countries, the amount exported by Indonesia is not substantial enough for it to influence the movement of the world oil price. This makes Indonesia a price-taker in the global oil market.

National income identity

In the SSMM, non-oil and oil output are linked through:

$$Y_t = Y_t^{no} + Y_t^{o} \tag{10}$$

Equation (10) is an identity that states that the sum of the real non-oil output and the real oil output is equal to real GDP. This equation highlights the vulnerability of Indonesia's real GDP to fluctuations in the world oil price and the income from the oil sector.

The LM equation

The demand for real money balances is given by:

$$m_t - p_t = \beta_3 y_t + \beta_4 i_t + \varepsilon_{3t} \tag{11}$$

Equation (11) is an LM curve with the conventional explanatory variables that depict real money balances as being dependent on a nominal interest rate, reflecting the opportunity cost of holding money, and real output. This is a standard type of a real money balances equation and thus we feel that this specification will suit Indonesia. The innovation ε_{3t} is called "velocity" shocks on the demand for money. Together, the IS-LM specifications in our Indonesian SSMM—based on McCallum and Nelson (1999)—provide an improved model of aggregate demand compared to the equations found in BI-SQM.

The UIP equation

Equation (12) below is the uncovered interest parity (UIP) condition for an open economy, with the exchange risk premium being captured by the error term. Given the financial openness of the Indonesian economy, it is plausible to assume that UIP holds at least approximately:

$$e_t = E_t e_{t+1} - i_t + i_t^f + \varepsilon_{4t} \qquad (12)$$

The exchange rate depends on the expected future nominal exchange rate and the interest rate disparity between domestic and foreign nominal interest rates. The UIP condition implies that if the domestic interest rate is higher than the foreign interest rate in period *t*, the Rupiah will appreciate today, which leads to an expected depreciation in period *t*+1 so as to ensure the UIP relationship holds. The random shock ε_{4t} subsumes possible disturbances in the foreign exchange market, including exchange risk premium shocks and speculative activities. In our model, the domestic interest rate is endogenously determined by the monetary policy rule (see section 4.5) while the foreign interest rate is assumed to be exogenously given.

The inflation equation

The inflation equation in the Indonesian SSMM is the following open economy Phillips curve:

$$\pi_t = \theta E_t \pi_{t+1} + (1-\theta)\pi_{t-1} + \phi(y - y^*)_{t-1} + \gamma \Delta e_t + \psi \Delta p_t^f + \rho \Delta m_t + \varepsilon_{5t} \qquad (13)$$

π_t is the current rate of inflation, e_t is the nominal exchange rate as defined earlier, m_t is the nominal money supply, p_t^f is the foreign price level and ε_{5t} is the innovation in the inflation process. The inflation equation acknowledges the lag and lead terms in determining the current level of inflation rate, as given by $\theta E_t \pi_{t+1} + (1-\theta)\pi_{t-1}$. In other words, the inflation rate in the Indonesia SSMM is partially determined by a weighted average of past inflation and expected future inflation. According to this specification, inflation depends on its expected future value as well as its own lagged value. The presence of this lagged term produces a short-run trade-off between output and inflation as well as inflation persistence. Inflation expectations are given by $E_t \pi_{t+1} = \lambda \pi_{t+1} + (1-\lambda)\pi^*$ whereby π^* represents the inflation target and $0 \le \lambda \le 1$ represents a measure of credibility of the central bank. As λ approaches 1, monetary policy becomes less credible and vice versa and hence, λ can be interpreted as the *credibility* parameter for the central bank. Thus, the inflation expectations term implicitly allows for a targeted rate of inflation provided that λ is not equal to 1.

The specification differs from those typically considered in the literature due to the addition of an exchange rate effect on domestic inflation. The presence of the nominal exchange rate reflects the pass-through effect of foreign prices on the Indonesian economy. The lagged output gap found in this equation reflects the domestic sources of inflation. There is also a good reason why we should include a money supply term in this inflation equation, namely to verify whether inflation is a monetary phenomenon in Indonesia or otherwise. We want to see whether changes in money supply in Indonesia leads to inflation or vice versa, whereby a rise in inflationary pressures forces the central bank to expand the money supply in order to satisfy market demand.

We dropped the idea of including a wage equation in our Indonesian SSMM as found in the BH model. Although the earlier discussion of MODBI acknowledged that the role of wages was not recognized in the model, we doubt that the wage level really drives the domestic price level in Indonesia. Indonesia is a large country, geographically, and thus there is a dispersed wage gap across provinces. At this point in time, we feel that the available wage data might not accurately reflect this provincial dispersion. Moreover, there is hardly good annual data for average wages in Indonesia, not to mention quarterly data. In addition, Indonesia is employing a system of minimum wage (*upah minimum regional*) instead of a wage-contracting system as assumed in the BH model. Therefore, we believe that the domestic pressures on inflation in Indonesia are best represented by introducing an output gap and other explanatory variables such as the money supply.

4.3 The Determinants of Inflation in the Indonesian SSMM

We have introduced Equation (13) to model the inflationary process in the Indonesian economy. In this section, we provide a more detailed discussion of the determinants of inflation and the potential channels of monetary policy transmission.[4]

The aggregate demand (AD) channel

In general, monetary policy works mainly through its influence on aggregate demand of the economy. In our Indonesian SSMM, the AD channel reflects the traditional interest rate mechanism whereby the policy instrument (assuming it is a nominal interest rate) affects the real interest rate and thus the current output gap. This relationship is captured by the $(i_t - E_t\pi_{t+1})$ variable that represents the real interest rate. Subsequently, changes in the output gap will affect the inflation rate. Typically, changes in interest rate as a policy instrument will achieve its maximum impact on inflation after a 2-years lag (see for example Bank of England 1999, pg. 3).

The exchange rate channel

In our SSMM, changes in the nominal interest rate affect inflation indirectly through the exchange rate. This indirect effect comes about through the UIP relationship given in Equation (12). For example, higher domestic nominal interest rates will attract capital inflows which tend to appreciate the nominal exchange rate. Subsequently, imported products and raw materials will be cheaper domestically, thus putting downward

[4] The explanation of the transmission mechanism of monetary policy is by no means exhaustive. Readers are referred to Bank of England (1999) for further details.

pressures on inflation. This represents the pass-through effect of the exchange rate on the inflation rate in Indonesia.

The exchange rate also affects inflation through the aggregate demand channel. From the identity $q_t = e_t + p_t - p_t^f$, it is seen that the nominal exchange rate partly determines the real exchange rate, which in turn affects the IS equation. Specifically, a real appreciation lowers Indonesia's export competitiveness and consequently real GDP, thus acting to mitigate domestic inflationary pressures.

The expectations channel

The Indonesian SSMM incorporates the expectations of rational agents via the forward-looking terms in Equations (8), (12), and (13). The current output gap is determined by the expected output gap and expected inflation rate as specified earlier. The current nominal exchange rate is determined partly by the expected future nominal exchange rate. Expected future inflation is also crucial in determining the current level of inflation. All these expectations, which depend partly on anticipated changes in monetary policy, have effects on the current inflation rate either directly or indirectly.

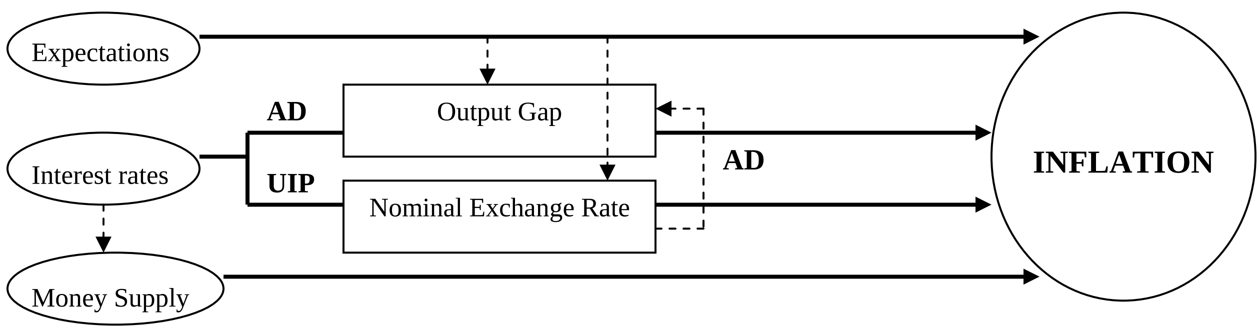
The money supply channel

The last factor that could determine the current level of inflation is changes in the money supply. In accordance with the quantity theory of money, changes in the money supply will eventually determine the nominal values of goods and services in the long run. Hence, it follows that both the general price level and inflation are potentially determined by decisions on the money supply. If this is the case, inflation is partially a monetary phenomenon.

Validating or disproving this monetary hypothesis for the Indonesian economy is another of our concerns in this thesis. However, the process of determining the money supply itself might be important in understanding the monetary transmission mechanism. We discuss this in greater detail in Section 4.5 on policy rules in the Indonesia SSMM.

The determinants of inflation in the Indonesia SSMM can be summarized by the following flowchart:

Figure 4.1 Flowchart of the Determinants of Inflation in Indonesian SSMM



Note:
Ovals denote originating variables that determine inflation, rectangles denote intermediate variables that determine inflation, and bold letters denote the equations that appear in the Indonesian SSMM. Solid arrows denote direct transmission onto inflation while broken arrows denote indirect transmission onto inflation.

4.4 Policy Rules for the Indonesian SSMM

The review of monetary policy during and after the crisis in Chapter 2 has paved the way for us to specify the monetary policy rules for the Indonesian SSMM in this section. There are two types of monetary policy that we feel are important for the Indonesian economy. Firstly, the money supply rule utilized before the Asian financial crisis hit Indonesia and during the financial crisis itself. Secondly, the switch in the policy regime after the 1997 crisis to an inflation targeting regime in order to meet the objective of reducing the inflation rate through an interest rate instrument. Given the importance of these policy rules, we believe that they should be tested out on our Indonesian SSMM. This strategy gives us considerable room to model the setting of monetary policies in Indonesia.

We will accordingly consider two types of monetary policy rules in this thesis: the backward-looking Taylor rule and the money supply rule due to McCallum (1988). The first rule has been described in Chapter 3. Our specification for the Indonesian SSMM modifies the rule as follows:

$$i_t = r^* + E_t \pi_{t+1} + \alpha_9 (y - y^*)_{t-1} + \alpha_{10} (\pi - \pi)_{t-1} + \alpha_{11} \Delta e_{t-1} + \varepsilon_{6t} \tag{14}$$

This is a standard Taylor rule to determine the interest rates path for the authority, with the notable extension of including an exchange rate variable. In addition to the inflation and output gaps, this rule reacts to the change in the nominal exchange rate *e*. It forces the central bank to respond automatically to currency shocks in order to stabilize both the nominal and real exchange rates. This may be very relevant for Indonesia as an emerging market economy with substantial deal of international trade but less than fully developed financial markets.

The exchange rate plays an important role in aggregate demand through its effect on net exports and also in inflation through its pass-through effect. Clearly, exchange rate and interest rates are linked through the capital markets. In the above policy rule, depreciation of the exchange rate is expected to cause the monetary authority to raise interest rates in the next period. This is because the unfavourable effect of depreciation on inflation requires an increase in the interest rates. The recent increase in interest rates by BI in the face of a depreciation currency can be viewed as an example of such a reaction (Taylor 2000)[5].

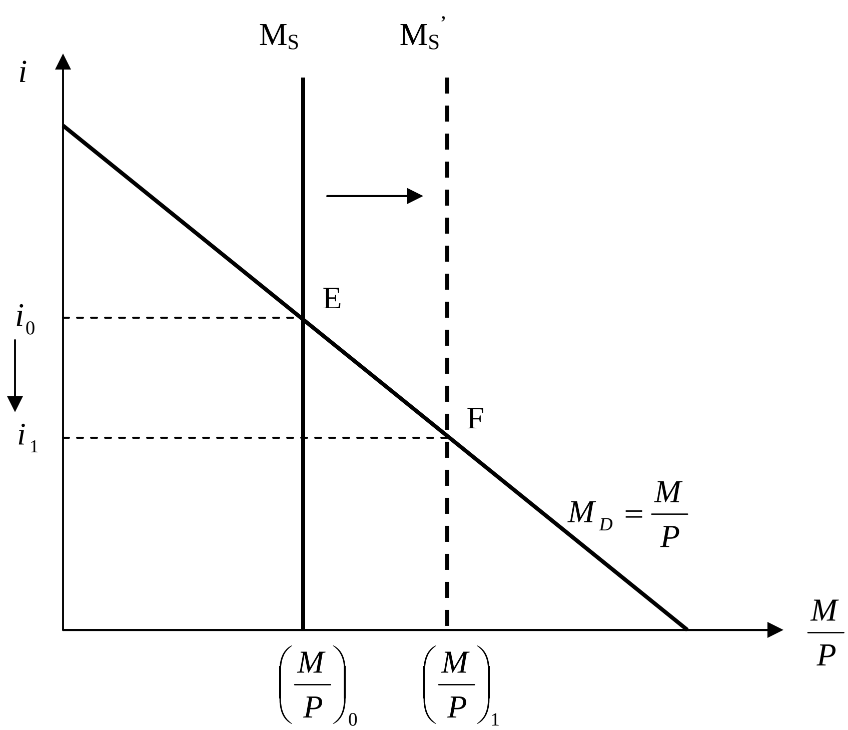
Alamsyah et al. (2000) argued that the current floating exchange rate system has caused volatility that is mainly driven by non-economic factors, thus BI will face continuously uncertain policies. This includes the difficulty of determining whether BI should include the exchange rate directly into its reaction function. Consequently, we want to validate the role of the exchange rate in our policy rule so as to enrich our model and gain further insights. Moreover, the exchange rate regime in Indonesia has switched

[5] From this example, Taylor implicitly pointed out the need for the Indonesian Central Bank, BI, to consider the role of exchange rate in its policy rule during the conference held by BI in July 2000. For more elaborate, but complex, micro foundations regarding the role of exchange rate in policy rules, see Ball (1999). He found that such a rule has only a minor improvement over the conventional interest rate rule. Readers are also referred to Svensson (2000) on small open economy models that examined the role of exchange rate in policy rules explicitly.

to a floating one, thus prompting the need to assess the significance of the exchange rate in determining the dynamics in the Indonesian economy.

When the modified Taylor rule in Equation (14) is used, we implicitly assume that movements of the domestic money supply are endogenous, being affected by policy changes in the nominal interest rate. In conventional macroeconomic theory, it is postulated that money demand and supply will clear at the equilibrium interest rate. Thus, by assuming a vertical money supply schedule, any change in the nominal interest rate made by the central bank will automatically require the money supply schedule to be shifted to clear the money market. We show this graphically below:

Figure 4.2 Relationship between Nominal Interest Rate and Money Supply



Under the Taylor rule, if the authority were to lower the nominal interest rate (from i_0 to i_1) in the next period and assuming the money market clears, then the money supply will have to be increased from M_S to M_S', leading to the new equilibrium point **F** with an increase in the real money balances from $\left(\frac{M}{P}\right)_0$ to $\left(\frac{M}{P}\right)_1$. Hence, we cannot use the second rule, which is the money supply rule, concurrently with the interest rate rule. Even in the new inflation targeting regime, the authority must use either the interest rate or the money supply but not both at the same time.

It follows that the money supply is exogenously determined only in the absence of an interest rate rule, as is probably the case during the pre-crisis period.[6] The money supply rule used in the SSMM comes from the work of McCallum (1988).

$$\Delta m_t + v_{t-1} = k^* + \lambda(x^* - x)_{t-1} + \varepsilon_{7t} \tag{15}$$

m is the logarithm of money and v is defined as the velocity trend of money which is given by a 16-quarter moving average[7], k^* is a constant term that fixes the path for steady-state nominal income growth, and x^* represents the nominal income target as given by $x_t^* = x_{t-1} + k^*$. λ represents the feedback parameter that captures the speed with which the deviations between actual and targeted nominal output are offset by monetary

[6] However, as we have argued earlier, the Indonesian authority might have used both instruments together at the same time for different purposes.
[7] This is meant to capture the long-lasting changes rather than cyclical factors. McCallum and Nelson (1999) formulated the velocity in the form of (1/16) $\{(y - m)_{t-1} - (y - m)_{t-17}\}$.

policy actions. This term allows monetary policy to be tightened or loosened according to whether nominal income exceeds or falls below the target.

Having specified and explained our Indonesian SSMM and the policy rules that will be employed in this thesis, we are ready to bring our analysis further by estimating the model and conducting dynamic simulations based on it. The next chapter will discuss the datasets used in our study, the estimation methods, and the empirical results and analyses from our simulations. In Chapter 6, some policy implications will be drawn to answer the challenges that we have posed earlier and to provide suggestions to policymakers so as to better understand the major features of the Indonesian economy along with effective policy responses.

Chapter 5

Empirical Analysis and Simulation Results

The equations in the SSMM and alternative monetary policy rules have been specified in the previous chapter. This chapter will deal with the estimation of the model and dynamic simulations of it. In particular, the chapter presents the empirical results and policy findings from the Indonesian SSMM.

The focus of analysis in our model involves key macroeconomic variables that are deemed to play significant roles in shaping the Indonesian economy, especially with regard to the transmission of monetary policy. As discussed in Chapter 2, the occurrence of the Asian financial crisis and its impact on the Indonesian economy have brought significant macroeconomic fluctuations and consequent changes in the economic system such as the exchange rate regime and the conduct of monetary policy. For example, the Indonesian authorities have given the Indonesian central bank, Bank Indonesia (BI), more independence to execute its role of stabilizing economic fluctuations and keeping inflation low. But how should BI go about performing its new role?

We will begin the analysis with a brief discussion in Section 5.1 regarding the datasets used. This will be followed by a discussion of estimation methods and other econometric issues in Section 5.2. The estimates of the model obtained from alternative estimation techniques are then presented in the next Section 5.3. Detailed discussions of the estimation results can also be found in this section. The simulation methods and results from the Indonesian SSMM under the baseline scenario are discussed next in Section 5.4. Then we perform simulations under several economic scenarios in Section 5.5. Stochastic simulations and alternative policy rule experiments will be presented and analyzed thoroughly in Section 5.6. In doing so, we assess the effectiveness of alternative monetary policies for stabilizing Indonesian macroeconomic fluctuations based on a policy frontier.

5.1 Datasets

In this section, we briefly describe the datasets used—their sources can be found in the Data Appendix. We also plot the graphs of the time series in that appendix. The domestic output variable is represented by the quarterly real GDP of Indonesia from 1983:Q1 to 2004:Q1 (seasonally adjusted), decomposed into non-oil output and oil output. We employ 1993 as the base year for our study.[1] For oil output, we have to resort to interpolated data from 1983 to 1992. We employ the Chow-Lin (1971) method for best linear unbiased distribution and interpolation of time series by related series, and use the oil price (in Rupiah) as the related series to convert annual oil output into quarterly oil output.[2]

The short-term nominal interest rate used in our analysis is the 1-month Sertifikat Bank Indonesia (SBI) rate, ranging from 1983:Q1 to 2004:Q1. Government expenditures data is from 1983:Q1 up to 2004:Q1 and interpolated from the annual frequency using the

[1] The reason is partly because the Indonesian statistical office started to compile quarterly data from 1993 (see footnote 2).
[2] The annual data for oil output from Indonesia's statistical yearbook has two base years, namely 1983 and 1993. We rebased the real oil output from the 1983 base year to the 1993 base year using growth rates. Subsequently, we obtained the quarterly oil price series as described in the text.

cubic spline method. The inflation rate is calculated by taking the difference in the natural logarithm of CPI from 1983:Q1 to 2004:Q1, which approximate quarterly growth rates. We specify the inflation target as a constant path in three different sub-periods (1983:Q1–1995:Q4; 1996:Q1–1998:Q4; 1999:Q1–2004:Q1). This constant path is the average inflation rate in every sub period mentioned before. We construct the inflation target in this manner because there are no officially announced inflation targets prior to the recent commitments of Bank Indonesia to move into inflation-targeting regime. The money supply data used in our SSMM is the M1 measure.

In constructing the foreign income index, we use a geometric average of the GDPs of Indonesia's major trading partners, weighted by nominal exports. These include 10 countries and 1 region: Malaysia, the Philippines, Thailand, Hong Kong, Singapore, South Korea, Taiwan, China, Japan, the U.S. and the rest of the OECD (ROECD). ROECD includes all members of the OECD except Japan, South Korea and the United States. Statistics for the ROECD are calculated as the weighted-average effect of all countries in the group, so that the ROECD can be interpreted as one large "country".[3] The construction of the nominal effective exchange rate follows the same principle as that of the foreign income index. Most, if not all, of Indonesia's foreign debt is denominated in US dollars, so we use the US 3-month Treasury Bill rate as the proxy for the foreign interest rate. Finally, we use the World CPI index from the *International Financial Statistics* as the proxy for the foreign price level, with the base year rebased to 1993.

---

[3] I thank the Econometric Studies Unit (ESU) of the Department of Economics in the National University of Singapore for making the data available for the purpose of this research.

Unit root tests are carried out on all the variables employed and the results are shown in the Data Appendix. Where they are found to be integrated of order one i.e. I(1), their changes are used in the estimation of the SSMM, except in the case of the LM equation. The LM equation is specified and estimated in log levels because the variables in it are found to be cointegrated. The other exception to this rule is made for the non-oil and oil output series, both of which are taken as deviations from their potential, which is measured by the Hodrick-Prescott filter, as done in most of the other SSMM studies cited in Chapter 3.

5.2 Estimation Methods

This section deals with the estimation of the parameters in our model. We will discuss the issues underlying the choice of estimation method and justify our choice for the Indonesian SSMM. By way of doing this, we begin with a review of the techniques that are available for estimating simultaneous equation models.

5.2.1 Single Equation versus System Methods

A small-scale scale macroeconomic model attempts to explain the workings of an economy that is written as an interdependent system of equations describing some hypothesized behavioural relationships among economic variables. Consequently, a system of simultaneous equations appears quite naturally when estimating economic models. However, the use of simultaneous equations methods to estimate the unknown parameters of an interdependent system of equations such as an SSMM still generates considerable controversy and there is often disagreement over which are the best techniques to employ in practice.

Some critical issues are worth mentioning here. In building an economic model, the model builder must distinguish between *endogenous* variables which are determined by the system and *exogenous* variables which are determined outside the system. It is widely assumed that movements in the latter variables are autonomous or in other words, they are unexplained causes of movements in the former variables. If in any system of equations each of the endogenous variables can be expressed as a function of the exogenous variables, then the usual ordinary least squares (OLS) method warrants consideration and implementation. The main task here is to validly determine and distinguish what are the *endogenous* and the *exogenous* variables in the system and then subsequently derive the reduced form equations. However, even if reduced form equations can be found, such equations have no structural interpretation and thus they will not be useful for policy analysis and inference.

Our Indonesian SSMM has equations containing more than one *endogenous* variable. These so-called "structural" equations have interesting causal interpretations and form the basis for policy analysis and dynamic simulations. However, in doing so, we need a representation in which the postulated changes in explanatory variables are easily described—a concept that naturally leads to the degree of *autonomy* of an equation (Rothenberg 1990). The analysis of policy changes in our SSMM will be greatly simplified if our equations possess considerable autonomy whereby a policy change (or a kind of shock to a variable) changes one equation and leaves the other equations unchanged. Rothenberg (1990) made the observation that structural parameters in a simultaneous equation model cannot be well estimated using OLS because the logic of interdependent systems suggests that structural errors are likely to be correlated with all the endogenous variation. In this case, the usual least-squares techniques often turn out to have poor statistical properties in the face of *simultaneity*. However, if the correlation is small as compared with the sample variables, the resulting bias will also be small. Moreover, alternative estimation methods that have been developed often produce implausible and questionable estimates which render OLS still preferable.

All this boils down to a choice between estimating the Indonesian SSMM using a limited information method such as OLS or two-stage least squares (TSLS) that can be applied to one equation at a time, and system or full information maximum likelihood (FIML) methods that require a complete specification and joint estimation of all equations. The main difference between these two methods is one of statistical efficiency. It is generally accepted that the more that is known about the process being studied, the more precise the estimates that one can obtain of the unknown parameters with the available data. In a simultaneous equation model, information about the variables appearing in one equation can be used to get better estimates of the coefficients in other equations—the essence of full information estimation methods. Thus, in a small and theoretically sound model with restrictions across equations, it is worth exploiting the efficiency gains.

However, a trade-off does exist. Although full information methods are more efficient, they are prone to specification errors and are also subject to higher computational burden, although this is not a problem with the present computer technology. In particular, if we misspecify one of the equations in the system and estimate the parameters using single equation methods, only the misspecified equation will be poorly estimated. If we employ system estimation techniques, however, the poor estimates for the misspecified equation may "contaminate" estimates for the other equations.

5.2.2 Estimation Methods for Indonesian SSMM

As far as SSMM's are concerned, Batini and Haldane (1999) calibrated their small-scale macroeconomic model using the stylized facts found in the UK economy rather than estimating it. Beechey et al. (2000) estimated the equations in the RBA model individually by Ordinary Least Squares (OLS). They argued that performing single equation least squares is the best choice since their cross-equation variance-covariance matrix for the estimated residuals show little cross-equation correlations. They also argued further that by doing so, it will curb mis-specification from spreading to one or more equations. de Freitas and Muinhos (1999) also estimated the behavioural equations in the SSMM of the Brazilian economy using the OLS method. In contrast, Arreaza et al. (2003), in their paper on a small macroeconomic model for the Venezuelan economy, estimated two of the equations in their model using OLS methods and calibrated one of them.

Valadkhani (2004) has pointed out that data availability in developing countries is a restrictive factor in doing sound macroeconomic modelling. This is very true in the case of Indonesia where the quality of data might be somewhere in between the undependable and the reliable due to time lags in gathering island-wide economic data and frequent revisions. Given this, the model-builder should use robust and simple methods, such as OLS, which are not too sensitive to the quality of data. Klein (1989) also argued that applying a method of joint estimation such as maximum likelihood should be avoided when the quality of data is mediocre and it is subject to frequent revisions. Furthermore, in estimating our Indonesian SSMM, OLS may be acceptable since we do not impose any cross-equation restrictions.

Nevertheless, a simultaneous or system technique for estimating the SSMM equations cannot be dismissed immediately. The reason is that the Indonesian SSMM is constructed to depict and trace the relationships of key macroeconomic variables which are important for the Indonesian economy. The macroeconomic relationships among these variables—embodied in the IS, LM, and inflation equations—are simultaneous, so that joint estimation of the system is appropriate. A joint estimation method also ensures that all information, including restrictions on parameters, are taken into account in arriving at the final coefficient estimates, which is likely to make them more reliable. Provided that the contemporaneous errors have a joint normal distribution, the use of the FIML estimation method is therefore justified. In the following section, we present parameter estimates for the Indonesian SSMM based on both OLS and FIML methods.

5.3 SSMM Estimates

The OLS and FIML estimates for the four behavioural equations in the Indonesian SSMM are reported in Tables 5.1–5.4. The actual lags estimated are different with those set up a priori in our theoretical model and we will discuss reasons for dropping some of the variables in obtaining our estimates of the model. Being a stochastic identity, the UIP relationship is not estimated but is included in full model simulations while the policy rule is separately estimated later. A constant term was included in all the estimated equations. In the estimation of the model, we deal with uncertainty through the *perfect foresight* assumption i.e. rational agents make unbiased forecasts. Consequently, actual historical outcomes are used as a proxy for expectations, thereby combining expectational errors with structural residuals. The perfect foresight assumption was imposed in equations that contain the expected future values of macroeconomic variables viz. the IS and inflation equations, and the monetary policy rule.

Table 5.1 Estimation Results of the IS Equation

$(y^{no} - y^{no*})_t = \alpha_1 (y^{no} - y^{no*})_{t-1} + \alpha_2 E_t (y^{no} - y^{no*})_{t+1} + \alpha_5 \Delta q_t + \alpha_6 \Delta y_t^f + \varepsilon_{1t}$		
	Estimation Methods	
Parameters	**OLS**	**FIML**
Constant	-0.011122*** (0.004172)	-0.009738 (0.005995)
α_1	0.319205*** (0.071972)	0.390083*** (0.103484)
α_2	0.592953*** (0.070091)	0.533756*** (0.139241)
α_5	0.098944*** (0.019524)	0.077621*** (0.029107)
α_6	0.838210*** (0.370539)	0.721807 (0.578534)
Regression Statistics	**OLS**	**FIML**
R^2	0.795231	0.803021
DW Statistic	2.697984	2.762141
S. E. Regression	0.017837	0.017433

Notes: Standard errors are in parentheses; *, **, and *** denotes 10%, 5%, and 1% levels of significance.

Table 5.2 Estimation Results of the Oil Equation

$(y^o - y^{o*})_t = \beta_1 \Delta y^f_{t-1} + \beta_2 \Delta oil_{t-1} + \varepsilon_{2t}$		
	Estimation Methods	
Parameters	**OLS**	**FIML**
Constant	-0.005517 (0.006873)	-0.004212 (0.011947)
β_1	1.319650** (0.609045)	1.091665 (0.973400)
β_2	0.034184* (0.019878)	0.044052 (0.038913)
DUM_YEAR_86	-0.165715*** (0.016098)	-0.158070*** (0.021828)
DUM_GULF_WAR	0.129677*** (0.021884)	0.131479*** (0.026140)
DUM_POST_GULF_WAR	-0.089257*** (0.015747)	-0.086646 (0.085947)
Regression Statistics	**OLS**	**FIML**
R^2	0.732218	0.730203
DW Statistic	1.233915	1.207029
S. E. Regression	0.030242	0.030355

Notes: Standard errors are in parentheses; *, **, and *** denotes 10%, 5%, and 1% levels of significance.

Table 5.3 Estimation Results of the LM Equation

$m_t - p_t = \beta_3 y_t + \beta_4 i_{t-1} + \varepsilon_{3t}$		
	Estimation Methods	
Parameters	**OLS**	**FIML**
Constant	-8.662139*** (0.515315)	-8.847767*** (0.680593)
β_3	1.377676*** (0.047086)	1.393920*** (0.061407)
β_4	-0.279308*** (0.104414)	-0.222209 (0.247186)
DUM_YEAR_89	0.055347* (0.029380)	0.046257 (0.034845)
DUM_CRISIS	0.205031*** (0.043537)	0.178072** (0.084501)
Regression Statistics	**OLS**	**FIML**
R^2	0.980804	0.980157
DW Statistic	0.474413	0.468611
S. E. Regression	0.061960	0.062392

Notes: Standard errors are in parentheses; *, **, and *** denotes 10%, 5%, and 1% levels of significance.

Table 5.4 Estimation Results of the Inflation Equation

$\pi_t = \theta E_t \pi_{t+1} + (1-\theta)\pi_{t-1} + \gamma \Delta e_t + \phi \Delta m_t + \varepsilon_{5t}$		
	Estimation Methods	
Parameters	**OLS**	**FIML**
Constant	-0.008233*** (0.002960)	-0.008874* (0.004948)
θ	0.226553*** (0.066121)	0.219621*** (0.065641)
γ	0.110223*** (0.022083)	0.106864*** (0.030127)
ϕ	0.118805** (0.059316)	0.136527 (0.115933)
Regression Statistics	**OLS**	**FIML**
R^2	0.728036	0.727716
DW Statistic	2.679836	2.676501
S. E. Regression	0.017222	0.017232

Notes: Standard errors are in parentheses; *, **, and *** denotes 10%, 5%, and 1% levels of significance.

Table 5.5 Estimation Results of the Taylor Rule

$i_t = r^* + E_t \pi_{t+1} + \alpha_9 (y - y^*)_{t-3} + \alpha_{10} (\pi - \pi^*)_{t-1} + \alpha_{11} \Delta e_{t-2} + \varepsilon_{6t}$	
Constant	0.138692*** (0.006816)
α_9	0.249818 (0.190848)
α_{10}	1.283185*** (0.265146)
α_{11}	0.285744*** (0.059120)
Regression Statistics	
R^2	0.521021
DW Statistic	0.772114
S. E. Regression	0.054502

Notes: Standard errors are in parentheses; *, **, and *** denotes 10%, 5%, and 1% levels of significance.

The IS equation we estimated in Table 5.1 shows that the economy tends to be forward-looking, as evidenced by a larger estimate on the future output gap as compared to the previous period's output gap. The OLS method estimates the future output gap parameter to be around 0.6 while the lagged output gap parameter is estimated to be only

0.32. Similarly, the FIML method results in elasticities for the future and previous period's output gaps of 0.53 and 0.4 respectively. For both methods, the lag and lead parameters are significant at the 1% level.

The estimated coefficient on the real interest rate shows a negative sign as postulated by theory i.e. as the real cost of borrowing increase, investment is expected to fall and at the same time people will tend to save more and delay their spending, causing real output to fall and the output gap to narrow. However, the effect of the real interest rate is of a trivial magnitude and statistically insignificant. Thus, we conclude that the domestic interest rate does not significantly affect output movements but instead affects the economy indirectly through the exchange rate. We therefore decided to drop the real interest rate variable in our final IS equation. The government gap is found to have a positive elasticity in the OLS results but it is again statistically insignificant. This could be due to a data problem, since we had to interpolate the government spending data using the cubic spline method. Thus, we also dropped the government spending variable in our final estimated model.

In constructing the exchange rate index, we use the Rupiah per unit of foreign currency and hence, when the exchange rate depreciates, this index should go up and it goes down when the exchange rate appreciates. We found that the change in the real exchange rate has a contemporaneous effect on the economy and it is estimated that for a 10% depreciation of the rupiah, the non-oil output gap will increase by about 1% and 0.8% using the OLS and FIML methods respectively. Given that the anchor of monetary policy, historically, has been based on a staggered depreciation of the rupiah, we believe that the impact of the real exchange rate change should be relatively strong. In view of this, the OLS estimate seems to be more plausible. However, both the OLS and FIML parameters are found to be significant at the 1% level.

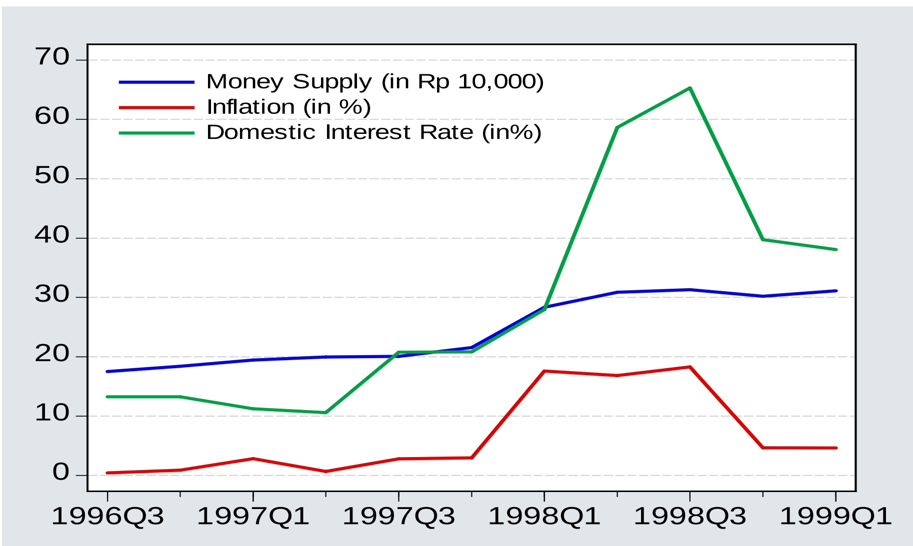
The effect of the contemporaneous foreign income change on the domestic non-oil output gap is found to be positive from both the OLS and FIML methods with estimated coefficients of 0.84 and 0.72 respectively. Again, the OLS estimate is higher and statistically significant compared to the FIML estimate. Interestingly, the impact of the Asian financial crisis on Indonesia in 1997/98 was adequately captured by the explanatory variables, thus there was no need to introduce additional dummy variables to account for the structural break in non-oil output. The fit of the equations as measured by R^2 is very high, or 0.8 for both the OLS and FIML methods.

Moving to the oil equation in Table 5.2, the foreign income elasticity is found to be 1.32 and 1.09 using the OLS and FIML methods respectively, with the former being significant at the 5% level and the latter being insignificant. The change in foreign income is found to have a one-quarter lagged effect on the oil output gap. The parameter estimate for the oil price variable is found to be 0.034 and 0.044 for OLS and FIML respectively, again with only the former being significant at the 10% level. We employ three dummy variables in the oil equation: DUM_YEAR_86 is a temporary break in 1986, signifying a noticeable sharp drop in the oil price and thus oil revenue (see Chapter 2). This is a period of global economic slowdown as well. DUM_GULF_WAR is another temporary break in 1991, when the oil price started to spike up again due to the Gulf war in late 1990. The last dummy is DUM_POST_GULF_WAR to capture the effect of oil price stabilization and adjustment after the war. The R^2 statistic for both the OLS and FIML equations is 0.73.

In the LM equation in Table 5.3, the income elasticity of the real demand for money is estimated to be about 1.4 and statistically significant at the 1% level, regardless of the estimation technique utilized. This estimate of above unity seems plausible for a developing economy such as Indonesia in view of the high volume of day-to-day transactions that use hard cash. The nominal interest rate is found to have a one-period lagged effect on the demand for money, with an estimated semi-elasticity which indicates that when the interest rate is raised by 100 basis points, the real demand for money is reduced by 0.2–0.3 of a percentage point. Such a relatively large interest semi-elasticity is expected of the Indonesian economy, given that the monetary authority has used punitive interest rates to control the real demand for money and consequently curb inflation. The most notable instance of this occurred during the period of financial crisis in 1998, as can be seen in Figure 5.1 below. To account for the structural break in money supply in 1998 and another one in 1989, two impulse dummy variables are included in the LM equation.

In the inflation equation in Table 5.4, we impose a long-run vertical Phillips curve restriction whereby the sum of future and past inflation terms adds up to one. Imposing this restriction gives us an OLS coefficient of 0.23 for the future inflation term (the FIML estimate is identical), which is very close to the calibrated value in the Batini-Haldane model. Thus, the implied elasticity for lagged inflation is 0.77. It seems that economic agents in Indonesia tend to be more backward rather than forward-looking in forming their expectations of inflation. The high persistence of inflation means that the current rate of inflation is strongly influenced by the previous period's inflation rate and not so much by expected future inflation. This might be partly due to the fact that during the financial crisis, for example, BI did not get much credibility for its attempt to target the inflation rate. Thus, the general public has tended to form their views about the current, and perhaps also the future, inflation rate based on past realized inflation. This conjecture will be re-examined in our simulation exercises.

Figure 5.1 Relationships between Money Supply, Inflation and the Interest Rate



The effect of a change in the nominal exchange rate is another robustly estimated parameter in the inflation equation. This parameter has an estimated value of 0.11 using either OLS or FIML methods. In other words, a 10% depreciation of the nominal exchange rate will cause the inflation rate to immediately rise by 1.1%. In line with our earlier finding in the IS equation, the exchange rate pass-through effect to the Indonesian economy is highly significant. The main domestic source of inflation seems to be increases in the money stock. However, the effect of money is only significant in the OLS estimates and moreover, it is not one-to-one. For a 10% increase in the money supply, the current inflation rate will increase by merely 1.2%. This casts doubt on the argument in McLeod (2003) that suggested excessive base money growth as the cause of inflationary pressures in Indonesia. Our empirical findings therefore confirm the earlier view we expressed that base money might not have a robust cause-and-effect relationship with inflation in Indonesia.

As for the total output gap variable, we decided to drop it after several attempts to include it at various lags failed to produce correctly signed and statistically significant estimates. Similarly, the impact of the foreign price change on domestic inflation is estimated to be small and insignificant using both OLS and FIML methods, so it was also omitted from the final specification of the Indonesian SSMM.

Lastly, we use the OLS method to estimate our policy rule. The estimated Taylor rule in Table 5.5 suggests that the long-run real interest rate for the Indonesian economy is around 14%. We also found that the total output gap affects the behaviour of the Central Bank with a lag of three, and not one, quarters. The estimated coefficient of the output gap is 0.25. The inflation gap lagged one period is found to have a coefficient of 1.28, which means that for every 1 percentage point increase in the inflation gap, BI will increase the policy rate by 1.28 percentage point. Finally, the pressure from exchange rate changes also contributes significantly to interest rate movements with a positive coefficient of 0.29 and it takes half a year for the BI to react to this change. We will use these estimated and other calibrated coefficients in our analysis of the performance of alternative monetary policy rules below. Our results are broadly similar to those in Taylor (1993), who obtained coefficients for the output gap and inflation gap of 0.5 and 1.5 respectively.[4] This suggests that the Taylor rule might be a satisfactory approximation to the conduct of Indonesian monetary policy.

To conclude this discussion, it is clear that the two alternative econometric techniques yielded parameter estimates that are quite similar. Where they differ, we found that the OLS method produced more significant, plausible, and interpretable estimates as compared to FIML. Furthermore, in most of the equations, we found that both the coefficients of determination and the Durbin-Watson statistics are higher for the OLS equations. Standard errors of regression are also lower for the equations obtained using OLS, except for the IS equation. Hence, we believe that employing OLS estimates may produce better results for our dynamic simulations.

5.4 Simulation Methods and Results

In this section, we will discuss our simulation methods and report our baseline simulation results. This discussion draws heavily on the Eviews (2005) software manual—subsequently, we use this econometrics software for the simulation exercises that we report.

[4] Note, however, the original Taylor rule is specified to with respect to the contemporaneous output and inflation gap.

5.4.1 Deterministic versus Stochastic Simulations

There are two types of simulations namely, deterministic and stochastic. In the deterministic setting, the inputs to the model are fixed at known values, and a single path is calculated for the output variables. In a stochastic environment, uncertainty is incorporated into the model by adding a random element to the coefficients, the equation residuals, or the exogenous variables.

As the first exercise in assessing our model, we would like to examine the ability of our model to provide one-period-ahead forecasts of our endogenous variables. One way to do so is to look at the predictions of our model against the historical data, using actual values for both the exogenous and the lagged endogenous variables of the model. We refer to this as a *static*-deterministic simulation. An alternative way of evaluating our model is to examine how the model performs when it is used to forecast many periods into the future. To do so, we must use our forecasts from previous periods, not actual historical data, when assigning values to the lagged endogenous terms in our model—a method we refer to as a *dynamic*-deterministic forecast.

The second set of exercises in our simulations is to use our model to trace the movements of the endogenous variables under different economic scenarios. To produce such forecasts, we change the path of one exogenous variable or parameter at a time while holding the rest constant. In the next section, we carry out three scenario analyses pertaining to the effects of a foreign income shock, the credibility of the central bank in inflation targeting and the choice between a headline inflation or core inflation target.

The first two deterministic exercises are carried out under the assumption that our stochastic equations hold exactly over the forecast period. In reality, we would expect to see the same sort of errors occurring in the future as we have seen in history. Random errors are therefore added to each equation with the condition that the average value of the chosen random errors is zero. We have also ignored the fact that some of the coefficients in our equations are estimated, rather than fixed at known values. We may like to reflect this uncertainty about our coefficients in some way in the results from our model.

Up until now we have thought of our model as producing point forecasts for each of our endogenous variables at each period. As soon as we add uncertainty to the model, we should think instead of our model as predicting a whole distribution of outcomes for each variable. In a non-linear model such as the Indonesian SSMM, the mean of the distribution need not match up to the deterministic solution of the model. Our goal is to summarize these distributions using appropriate statistics—this is the essence of *stochastic* simulation. We will perform a stochastic simulation to evaluate the performance of alternative monetary policy rules in macroeconomic stabilization of the Indonesian economy. This is our third and most important exercise.

5.4.2 Model-Consistent Expectations

In our Indonesian SSMM, we have several forward-looking variables in some of the equations. In general, future values of endogenous variables may influence the decisions made in the current period. Consequently, the treatment of expectations in econometric models should be given careful consideration. Although the way that individuals form expectations is obviously complex, if the model being considered accurately captures the structure of the problem, we might expect the expectations of individuals to be broadly consistent with the outcomes predicted by the model. In the absence of any other information, we may choose to make this relationship hold exactly. Expectations of this form are often referred to as model-consistent expectations.

Specifically, our Indonesian SSMM involves certain expectations of future periods such as those found in the IS equation (lead of the non-oil output gap), inflation equation (expected inflation), the UIP identity (expected exchange rate), and the Taylor rule (expected inflation). Model-consistent expectations will be applied to the two behavioural equations and the policy rule when we perform the deterministic simulations. If we assume that there is no uncertainty in the model, imposing model-consistent expectations simply involves replacing any expectations that appear in the model with the future values predicted by the model. As discussed earlier in the estimation context, this effectively amounts to the assumption of perfect foresight on the part of economic agents.

When it comes to performing stochastic simulations with the SSMM, however, we used the actual future values of output and inflation as the corresponding expectations. This is a much simpler computational alternative to the use of rational expectations, which would require a complicated procedure like the following: firstly, an initial guess needs to be made as to a path for expectations over the forecast period (for example, by calculating a solution for the expectations in the deterministic case).

Secondly, a large number of stochastic repetitions of the model is run holding these expectations constant, and calculating the mean paths of the endogenous variables over the entire set of outcomes. Finally, the mean paths of the endogenous variables are checked to see if they are equal to the current guess of expectations within some tolerance; if not, the procedure is repeated.[5]

The UIP identity in the Indonesian SSMM is given as $e_t = E_t e_{t+1} - i_t + i_t^f + \varepsilon_{4t}$, where the exchange risk premium is captured by the error term instead of being modelled explicitly. Although the UIP condition cannot be verified directly, since neither market expectations of the spot rate nor the currency risk premium are observable, economic models typically assume that this relationship holds and that if markets are efficient and investors are risk-neutral, then the excess return on domestic assets, defined as the interest differential net of the observed exchange rate movement, should be "unforecastable".[6] $E_t e_{t+1}$ is defined as the market's one-step-ahead expectations for the spot exchange rate made at time *t*. Thus, we must use survey data or forecasts as a proxy for this expectation. The former is not available at the quarterly frequency and, even if it is, the survey will just be based on the Rupiah/US$ exchange rate. We therefore resort to using forecasts of the exchange rate as a proxy for the market's expectation of the future exchange rate. Brigden et al. (1997) argued that although forecasts of next period's spot exchange rate might well be biased and inefficient, all that matters is that interest rate

[5] An alternative will be to perform numerical optimization techniques for solving the equilibrium conditions. We will not pursue this matter further in this thesis and interested readers are referred to Clarida et al (1999), Fuhrer and Moore (1995), Leitemo and Roisland (2000), McCallum and Nelson (1999), Rotemberg and Woodford (1999), and Svensson (1997).

[6] For some influential works on exchange rate issues and particularly on UIP, refer to Cumby and Obstfeld (1981), Fisher et al. (1990), Meese and Rogoff (1983).

differentials feed through one-for-one to exchange rate movements. We confirmed that for the UIP relationship in the Indonesian economy, using forecasts of the exchange rate works well (see the baseline simulation results below). We employ an ARIMA (1,1,1) model to obtain the forecasts of the exchange rate and subsequently take this to be the market's expectations of next period's exchange rate.

Finally, we need to specify the terminal condition that affects the way the model is going to be solved when one or more equations in the model contain future values of the endogenous variables. The terminal condition is needed to specify how the values of the endogenous variables are determined for leads that extend past the end of the forecast period. We use a constant difference specification for the terminal values. In this specification, terminal values are determined endogenously by adding the condition that the values of the endogenous variables follow a linear trend over the post-forecast period, with a slope given by the difference between the last two forecasted values. This option may be a good choice if the model is in logarithmic form and tends to converge to a steady state.

5.4.3 Solution Algorithms

There are two types of algorithm available in solving our SSMM. The first is the Gauss-Seidel algorithm, which is an iterative algorithm whereby at each iteration, we solve each equation in the model for the value of its associated endogenous variable, treating all other endogenous variables as fixed. This algorithm requires little working memory and has fairly low computational costs, but requires the equation system to have certain stability properties for it to converge. Although it is easy to construct models that do not satisfy these properties, in practice, the algorithm generally performs well on most econometric models.

The alternative to the Gauss-Seidel method is the Newton-Raphson algorithm. The Newton-Raphson method is also an iterative method whereby at each iteration, we take a linear approximation to the model, and then solve the linear system to find the solution of the model. Although this algorithm can handle more complicated models than the Gauss-Seidel method, it requires considerably more working memory. Consequently, we eschew this algorithm and employ the Gauss-Seidel algorithm for all the simulation exercises in our thesis.

The use of the Gauss-Seidel algorithm is also appropriate for another reason: the Indonesian SSMM requires iterative forward solution, which the method is able to handle well. Specifically, the solution of the model for a given period involves both past and future values of the endogenous variables. To arrive at the solutions, it is not possible to solve the model recursively in one single pass but instead, the equations from all the periods across which the model is going to be solved must be treated as a simultaneous system that requires terminal as well as initial conditions.

The econometric software that we use, Eviews 5.0, applies a Gauss-Seidel iterative scheme across all the observations of the sample. This involves looping repeatedly through every observation in the forecast sample, at each observation solving the model while treating the past and future values as fixed. The loop is repeated until changes in the values of the endogenous variables between successive iterations become less than a specified tolerance. This method is often referred to as the Fair-Taylor method.[7]

5.4.4 Baseline Simulation Results

In this section, we will present our first set of simulation results for the Indonesian SSMM in the dynamic-deterministic (DD) mode by comparing the baseline simulation results of the model with actual historical outcomes. In DD baseline simulations, our aim is to examine how the model performs when used to forecast many periods into the future. Specifically, the results shown in Figures 5.2–5.8 illustrate how our model would have performed if we had used it back in 1983 to make a forecast for the Indonesian economy over the next twenty years, assuming that we had used the correct paths for the exogenous variables.[8]

All the structural equations perform well during the period prior to the Asian financial crisis. However, the simulated total output, non-oil output, money supply, and exchange rate show deviations from actual outcomes after 1997/1998—a period when Indonesia was experiencing economic turmoil—although they do seem to follow the general trends in the data. In the case of the exchange rate, the discrepancy between the simulated and actual values most likely reflects a time-varying risk premium on the Indonesian Rupiah which our model did not allow for. The oil output and the inflation

[7] Note, however, that the usual Fair-Taylor algorithm includes a particular handling of terminal conditions (the extended path method) that is slightly different from the option that we use.
[8] In reality, we would not have known these values at the time the forecasts were generated.

equations show a good fit for the entire period under study. As for the Taylor rule, the simulated series broadly captures the cycles in the domestic interest rate but it is not able to reproduce the latter's volatility. This may not matter much since we are going to experiment with different coefficients in the rule when performing stochastic simulations later.

Figure 5.2 Baseline Simulation Results

(Endogenous Variable: Total Output)

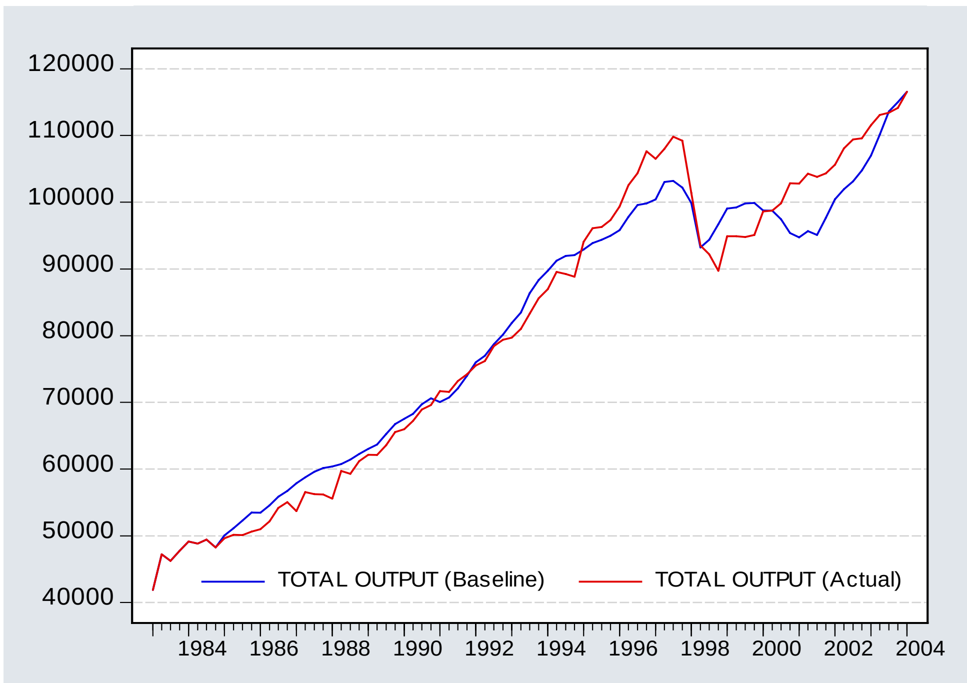


Figure 5.3 Baseline Simulation Results

(Endogenous Variable: Non Oil Output)

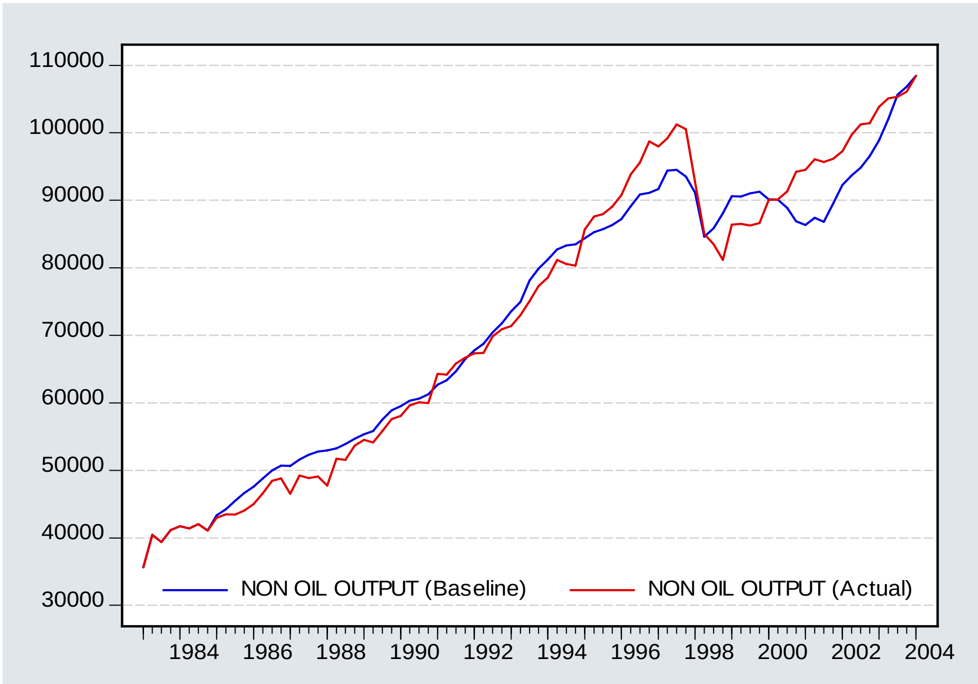


Figure 5.4 Baseline Simulation Results

(Endogenous Variable: Oil Output)

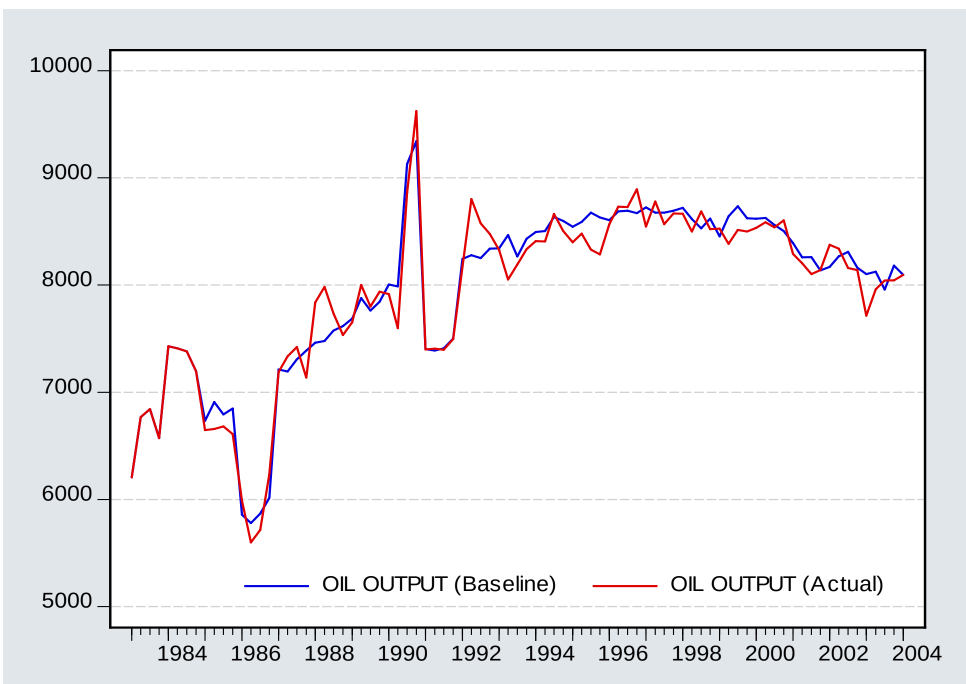


Figure 5.5 Baseline Simulation Results

(Endogenous Variable: Inflation)

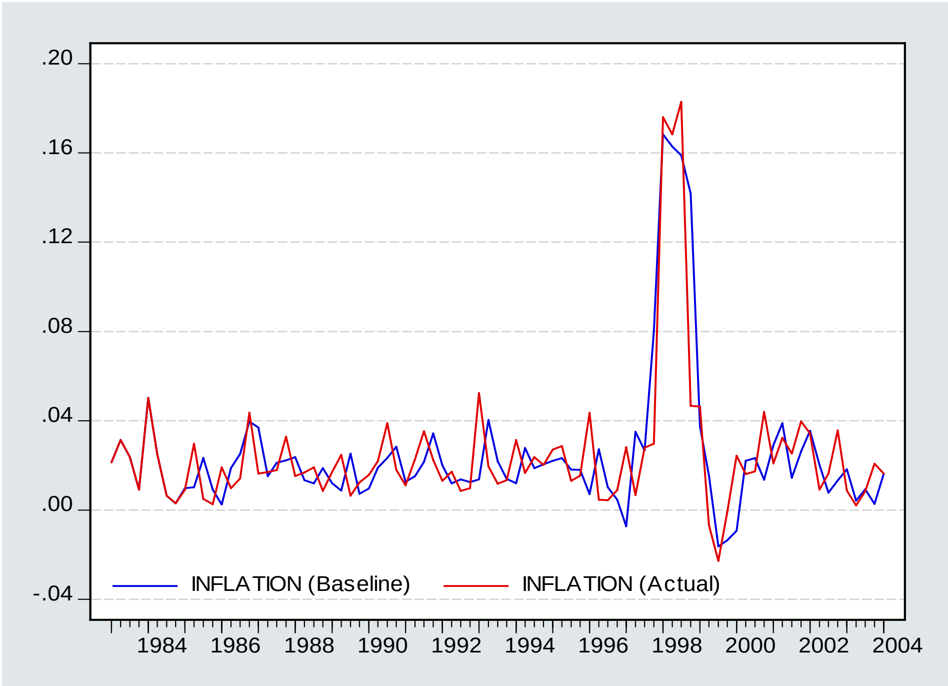


Figure 5.6 Baseline Simulation Results

(Endogenous Variable: Money Supply)

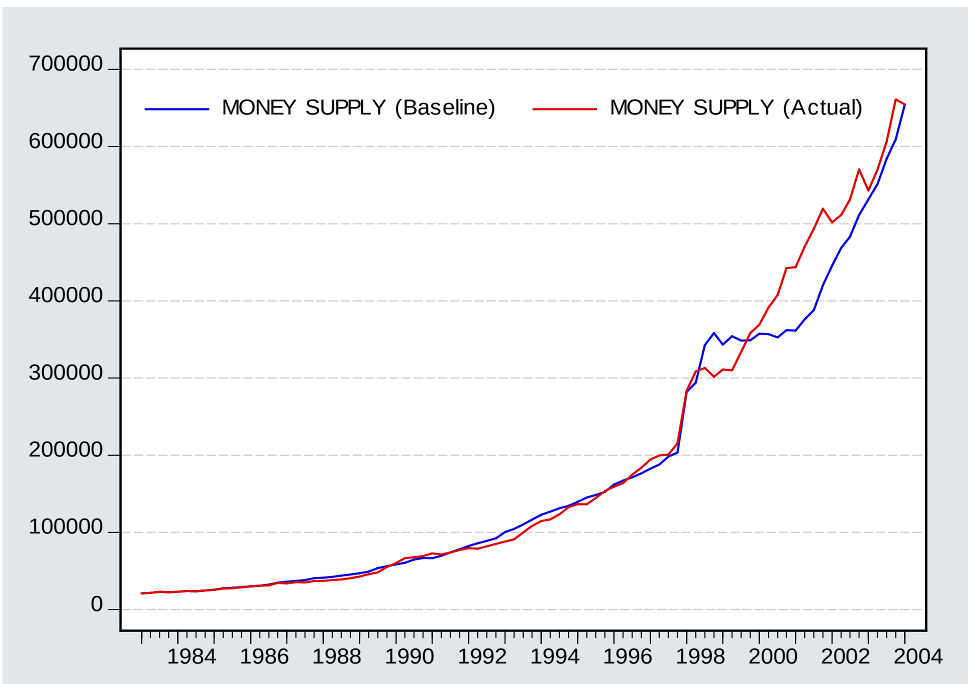


Figure 5.7 Baseline Simulation Results

(Endogenous Variable: Exchange Rate)

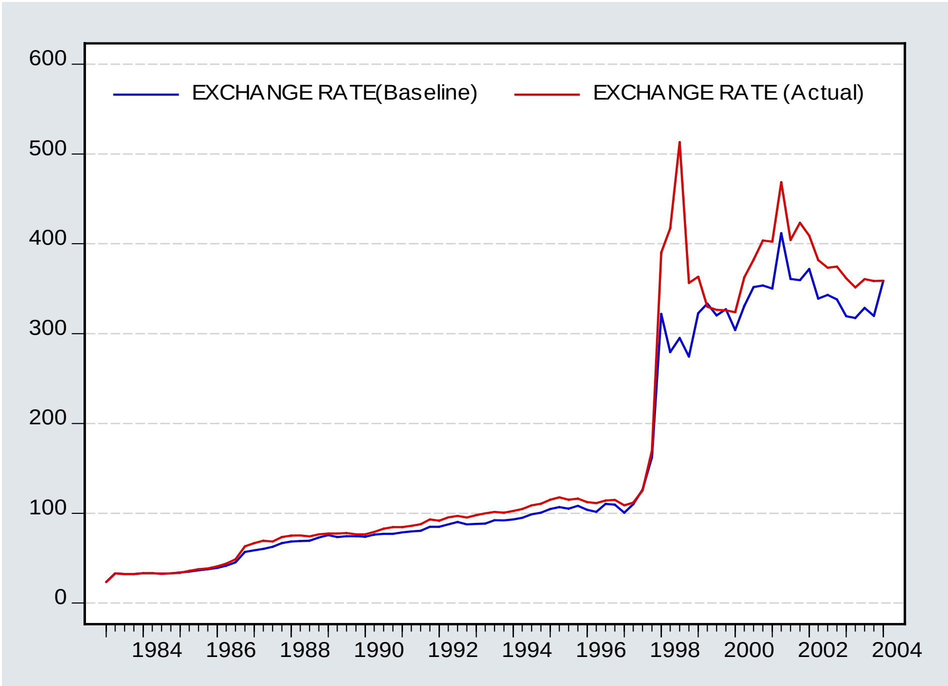
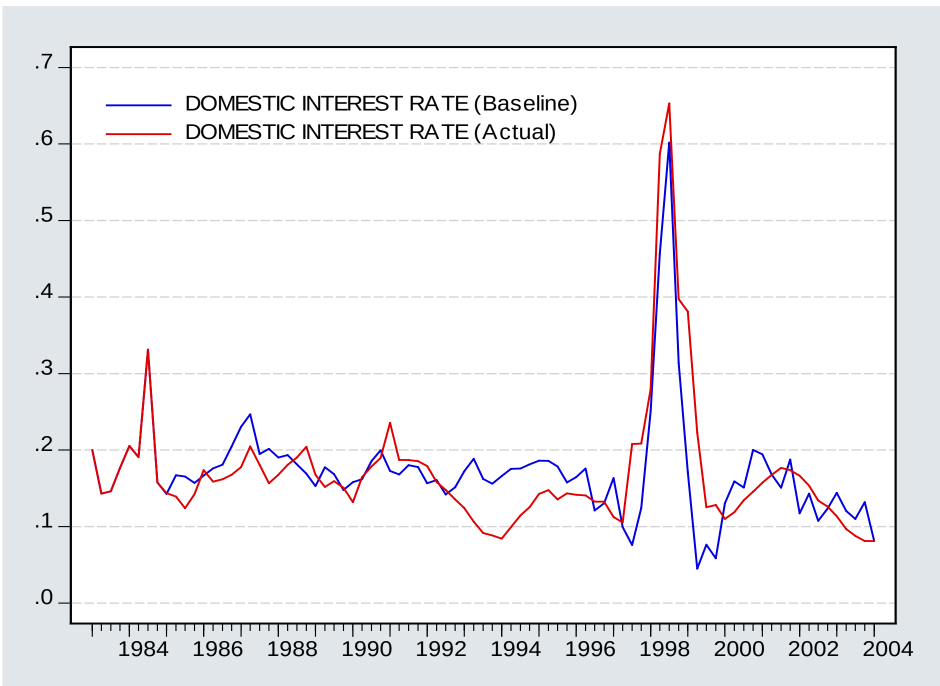


Figure 5.8 Baseline Simulation Results

(Endogenous Variable: Domestic Interest Rate)



5.5 Scenario Analysis

Having obtained the baseline simulation results of the Indonesian SSMM, we will move on to perform simulations under several economic scenarios. The scenarios specified are closely related to the goal of this thesis, which is to examine ways to achieve sustainable non-inflationary economic growth and to understand some viable policy options for the Indonesian economy.

5.5.1 A Positive Shock in Foreign Income

The first scenario that we are going to construct in a DD simulation is an increase in the foreign income of Indonesia's major trading partners. We choose a 10% increase in foreign income and plot the results in terms of deviations from the baseline scenario and how many quarters it takes for the deviations to stabilize (Figures 5.9 to 5.13).

As expected, the domestic output gap in Figure 5.9 increases for a year before it starts to come back down to the baseline level. The deviations of total output from the baseline level are trivial after 4 quarters. We computed the dynamic elasticity of output and found that for a 10% increase in foreign income, the output gap goes up by a maximum of 14% in the second quarter i.e. after 6 months. We calculated that after one year, the cumulative multiplier effect from a 10% increase in foreign income is a 31% increase in the domestic output gap.[9] The impact from an increase in the income of Indonesia's major trading partners on total output originates from both the non-oil equation (the IS equation) and the oil equation.

[9] This is equivalent to an average of a 7.5% increase for each quarter.

Subsequently, we found a similar effect on money demand in the economy coming from an increase in total output (Figure 5.10). Money demand immediately rises following an increase in the output gap with no change in the level of domestic interest rate for the first 3 quarters. After 3 quarters, there is a significant increase in the nominal interest rate that lasts for around 7 quarters (Figure 5.11). This comes from the Taylor rule whereby an increase in output gap will prompt BI to increase the interest rate 3 quarters later. Following an increase in the domestic interest rate, we find an appreciation of the nominal exchange rate through the UIP relationship and this effect lasts for 7 quarters as well (Figure 5.12).

Figure 5.9 Effect from a 10% Increase in Foreign Income on Total Output

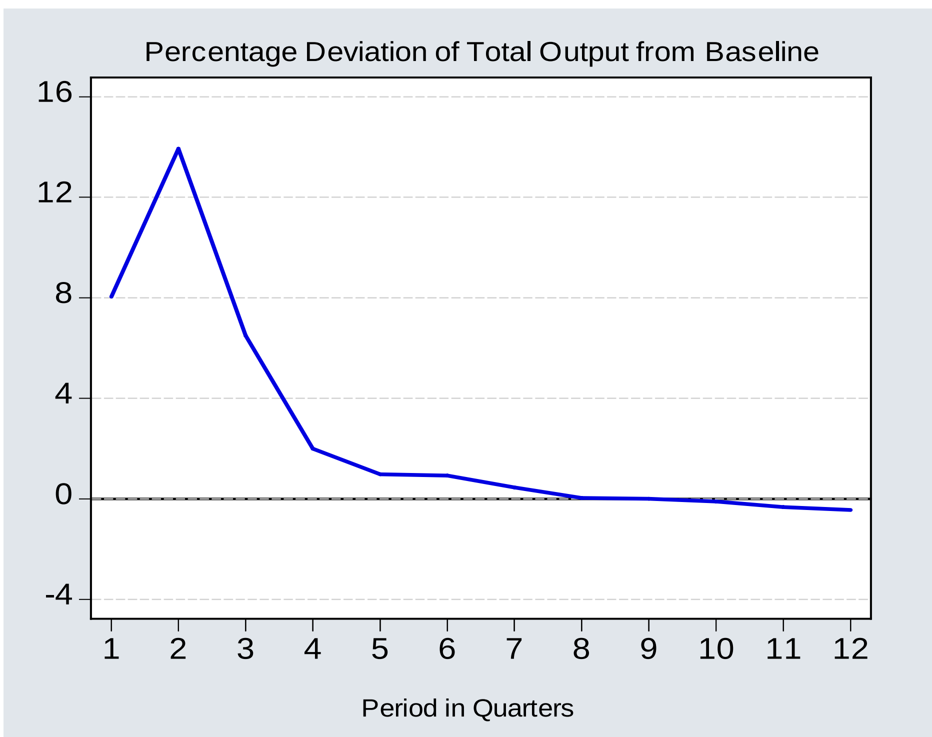


Figure 5.10 Effect from a 10% Increase in Foreign Income on Money Supply

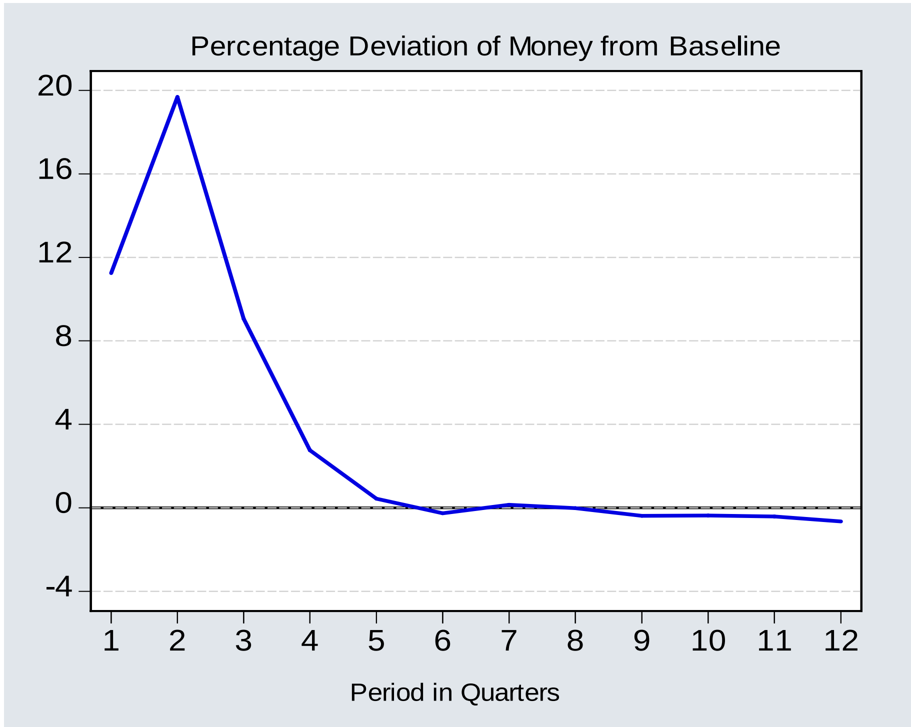


Figure 5.11 Effect from a 10% Increase in Foreign Income on Interest Rate

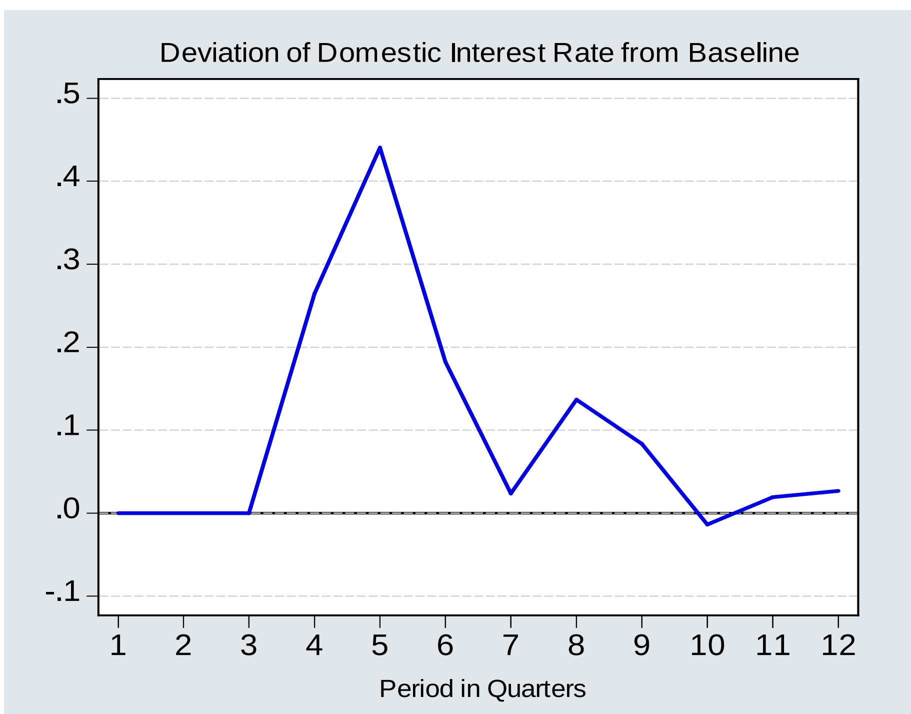


Figure 5.12 Effect from a 10% Increase in Foreign Income on Exchange Rate

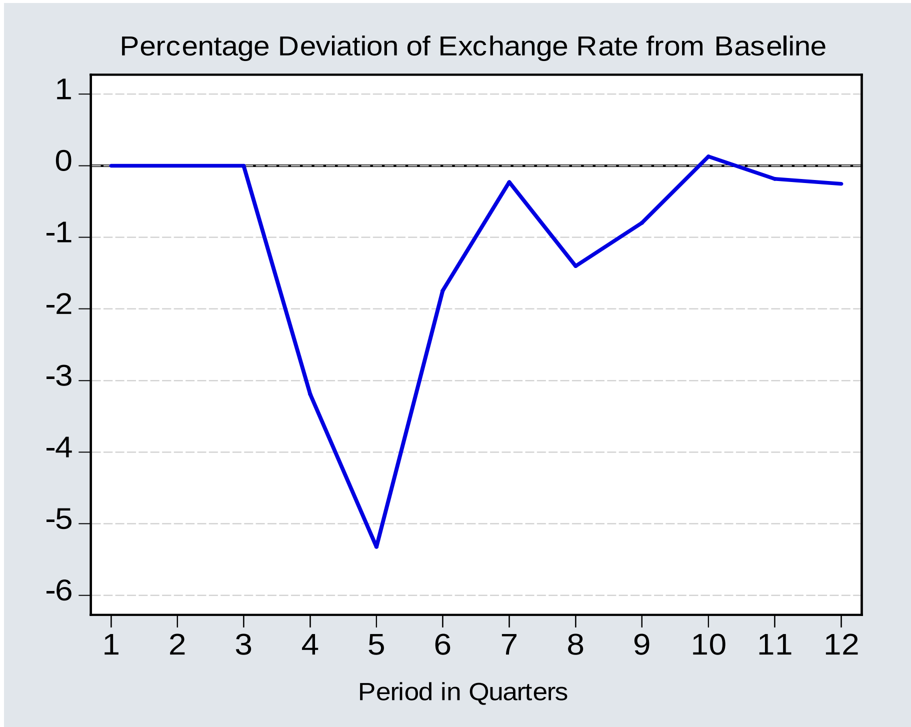
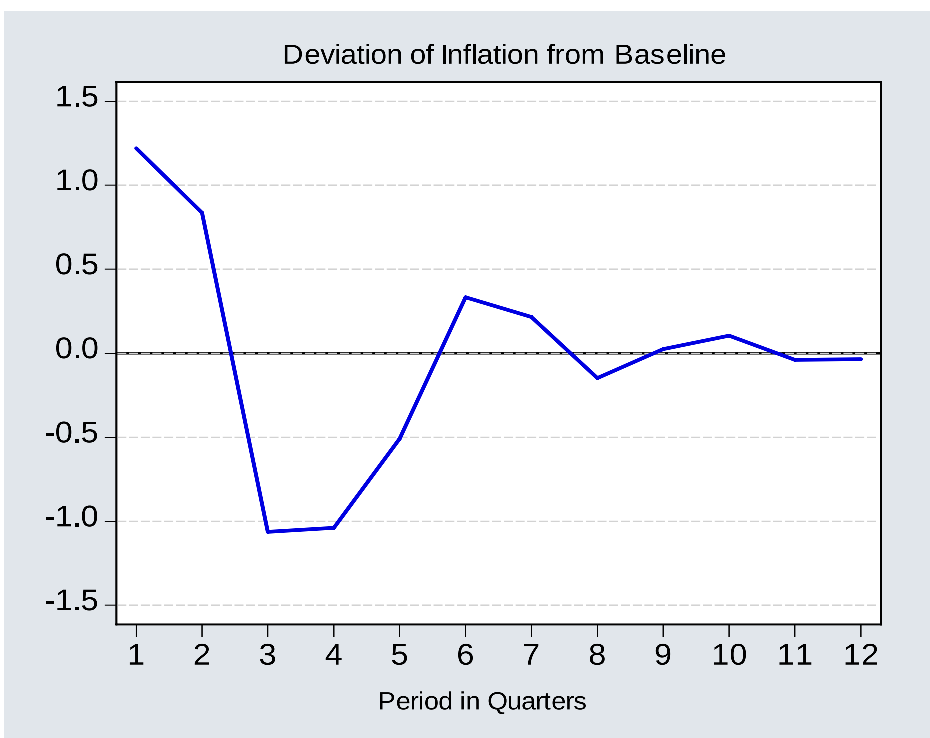


Figure 5.13 Effect from a 10% Increase in Foreign Income on Inflation



In Figure 5.13, the inflation rate rises immediately following an increase in output and then falls after 3 quarters. There are two effects that come into play in determining inflation viz., the effect from the money supply change, due to an increase in total output, and the exchange rate change. As can be seen from the simulation results, there are initially no effects from exchange rate appreciation on the inflation rate for the first 3 quarters so that we see a rise of 1.2% and 0.8% in the inflation rate for the first and second quarters before it falls by 1% in the third quarter. The changes in these three quarters, which are due to an increase in the money supply, cause inflation to rise by cumulative amount of 1%. After that, the effect from exchange rate appreciation sets in so as to reduce the inflation rate by a total amount of 1.2% for the next 3 quarters before the price level settles back down to the baseline level after about 2 years.

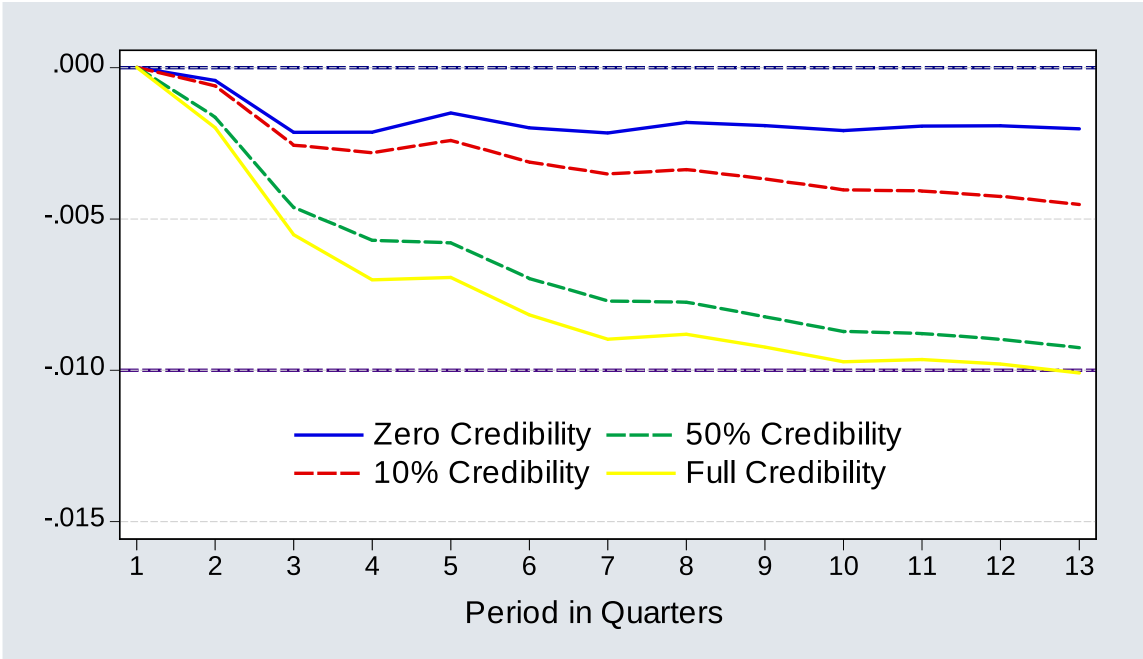
The simulation results under our first scenario seem to be plausible, thus validating our Indonesian SSMM. In the next two scenarios, we will study the role of central bank credibility and the choice between core and headline inflation measures under an inflation targeting regime.

5.5.2 The Role of Credibility in Inflation Targeting

The next scenario in our DD simulation is to experiment with different degrees of credibility that people put in the central bank when making their expectations of future inflation. This is reflected in the formation of inflationary expectations. Earlier in Chapter 4, we specified expected inflation as $E_t \pi_{t+1} = \lambda \pi_{t+1} + (1-\lambda)\pi^*$, whereby π^* represents the inflation target and $0 \le \lambda \le 1$ represents a measure of credibility of the inflation targeting monetary authority. As λ approaches 1, the policy becomes less credible since very little weight is given by economic agents to the inflation target in the formation of inflationary expectations. The opposite is true as λ approaches 0. Therefore, the parameter λ can be interpreted as the credibility parameter for the central bank.

In our inflation targeting scenario, we will look at several cases whereby the credibility given to the central bank is zero (the credibility parameter is 1); between zero and full credibility (the credibility parameter is between 0 and 1); and finally full credibility (the credibility parameter is 0). We will then compare the disinflation effects of different degrees of credibility in the face of a reduction in the inflation target. We specify a scenario whereby the inflation target is reduced by 1 percentage point for the out-of-sample DD simulations (this is equivalent to having a quarter-on-quarter inflation target of 0.8%). We present the results in Figure 5.14.

Figure 5.14 Effects of Central Bank Credibility in Achieving Inflation Target



In Figure 5.14 above, we see that when the central bank has zero credibility—as shown by the blue line—it takes an extremely long time for the inflation target to be achieved. This is because, if the public do not have any confidence in the Central Bank, they rely more on the past inflation rate to form their expectations of future inflation, thus introducing substantial inertia into the actual inflation rate. If we look at the coefficient of the lagged inflation term in our estimated SSMM, the elasticity of 0.77 supports our claim. Even when we replace the headline inflation rate with the core inflation rate, the lagged inflation coefficient still remains at around 0.67. Although somewhat extreme, our scenario of zero credibility might not be so unrealistic. In Indonesia, the inflation target is not publicly announced, so people have to form their expectations on the inflation rate in the next period based on the past inflation rate and other information. Moreover, the (implicit) inflation target in Indonesia tends to change frequently, causing people to lose trust in the Central Bank's determination and ability to achieve the inflation target.

Our simulation results also show that if the Central Bank is able to gain just 10% of the public's confidence with respect to credibility in achieving the inflation target, then inflation can be brought down to the targeted level in a much faster time. The red line in Figure 5.14 shows the case of 10% credibility. Within a period of 3 years, the quarter-on-quarter inflation rate can be reduced by half a percentage point. In fact, if the Central Bank can successfully build up at least 50% credibility, i.e. when people put equal weights on the model-consistent expected inflation rate and the inflation target announced by the Central Bank, the inflation target can be reached by 15 quarters, as shown by the green line in Figure 5.14. This result is of even more interest to the BI—the central bank must show a strong commitment to the public that it is determined and able to achieve the announced inflation target in order to attain non-inflationary economic growth for the Indonesian economy.

When the Central Bank gains full credibility from the public, then the inflation target will be met in 3 years' time as shown by the yellow line in Figure 5.14. The implication of our results is that the Central Bank does not require an extremely high level of confidence on the part of economic agents in order to achieve the inflation target, but as long as it can "signal" its commitment to meet the inflation target clearly to the public, then inflation can be brought down much faster. As a comparison of the red and green lines show, the biggest improvement occurs when the credibility parameter λ achieves the critical value of 50%.

5.5.3 Headline or Core Inflation: Which Measure Should Be Used?

Alamsyah et al (2000) stated that CPI-based inflation in Indonesia is very much characterized by extreme changes for certain goods that result from supply shocks due to seasonal factors. In a recent study, Panggabean (2004) found that the foodstuff and prepared food components, accounting for almost 40% of the CPI, has a reasonably high volatility as measured by the standard deviation (Table 5.6). These two components are the ones which supply shocks primarily originate from.

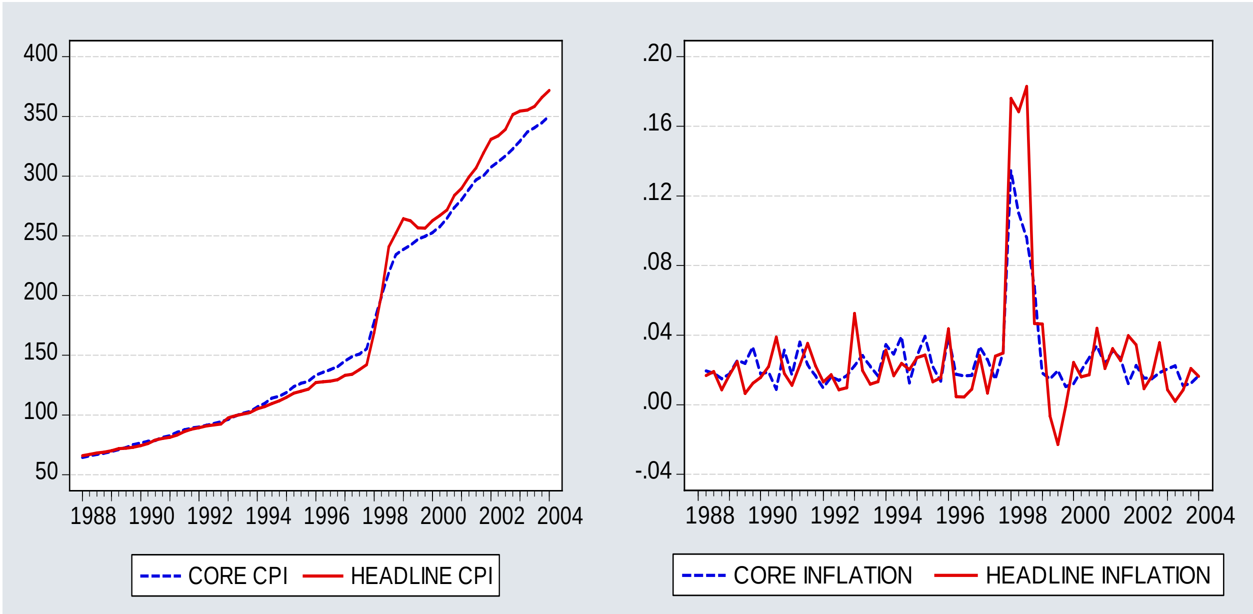
In relation to inflation targeting, the BI faces a dilemma on whether to use headline or core inflation as the target. Definitions of core CPI and inflation generally exclude the components with extreme volatility in the basket of goods and services in order to derive the “true” measure of inflation in the economy. However, headline inflation is familiar to the general public whereas core inflation is not. Furthermore, if the inflation target is expressed in terms of core inflation, the credibility of the target will be questioned if the calculation of core inflation is done by BI. Thus, it has been suggested that the job of calculating core inflation should be given to a separate body such as the national statistical agency (Alamsyah et al. 2000). The characteristic of inflation in Indonesia makes it difficult to use headline inflation as a target because so many price changes are due to supply rather than demand shocks. Thus, the use of core inflation might be more appropriate for inflation targeting. For example, if there is a demand shock that leads to higher inflation, BI can react by monetary policy tightening, but if inflation increases because of a supply shock, then tight monetary policy will only lead the economy into recession.

Table 5.6 Components of CPI and Volatilities

Component	Weight	Standard Deviation
CPI	100%	1.45
Foodstuff	22%	2.52
Prepared Food	17%	1.68
Housing	28%	1.04
Clothing	8%	2.08
Medical Care	4%	1.82
Transportation	13%	1.90
Education	9%	1.67

Source: Bank Mandiri (Figures are based on Panggabean's own calculation in year 2004)

Figure 5.15 Headline and Core (CPI and Inflation)



The literature dealing with these two measures of inflation has been concerned mostly with ways of measuring core inflation and which method can guarantee robustness. Some also strived to answer the question of which measure should be used or targeted by the Central Bank in their monetary policy conduct (Moron and Zegarra 1998, Alamsyah et al 2000, Monetary Authority of Singapore 1998). In this thesis, we are concerned more with the latter question since this issue is crucial for us to suggest the appropriate policy measure in achieving non-inflationary economic growth for the Indonesian economy.

Most of the research that attempts to answer the latter question offer answers by means of comparing the variability of the two different CPI and inflation measures, in which core measures usually emerge as a better measure with less volatility (e.g. Alamsyah et al 2000 and Moron and Zegarra 1998). However, this approach might not be legitimate because the core CPI, and hence core inflation, will always yield a lower standard deviation due to the way it is defined. As can be seen in Figure 5.15, the core CPI in Indonesia[10] is smoother as compared to the headline CPI measure and consequently we see less volatility in core inflation compared to headline inflation in Indonesia[11]. This result is very much in line with the general observation in the literature concerning core and headline measures of inflation.

---

[10] We thank Dr. Martin Panggabean for providing us with the core CPI data based on his own calculation employing a neural network method. Refer to Panggabean (2004) for more information.

[11] Alamsyah et al (2000) argued that given the characteristics of the inflation data in Indonesia, the method being used to calculate core inflation should be the so-called trimming method in combination with the percentile method. Essentially, this method excludes some very volatile components which are caused by transient factors. In their final conclusion, the measure of core inflation for Indonesia that gives the minimum absolute deviation (MAD) from the trend in CPI (that is calculated using Hodrick-Prescott Filter) is the one that uses the 77th percentile as the median and an asymmetric trimming size of 20% from the

In our simulation exercise to determine which measure BI should target, we will start by comparing the in-sample volatilities of the inflation, output gap and the domestic interest rate, the last of these representing BI's response to inflation fluctuations in the economy. Due to data unavailability, we use the time period between 1988:Q2 and 2004:Q1 for this exercise. In the DD simulation, we found that core inflation has a smaller standard deviation of 2.2% as compared to a standard deviation of 3.6% for the headline inflation.[12]

We then calculated the output gap deviations from their respective baseline values for headline and core inflation targets and found that the standard deviation of the output gap deviation based on the core inflation measure is 8.42% lower than the standard deviation based on the headline measure. The standard deviation of the domestic interest rate is about 16% lower for the core inflation simulation than the corresponding standard deviation for headline inflation. These results suggest that both output and interest rate volatility might be much lower under a regime that targets the core inflation rate.

To confirm this conjecture using our estimated Indonesian SSMM, we introduce a transient (i.e. lasting for only 4 quarters) supply shock in the form of a 10% increase in inflation represented by the two alternative measures of CPI. A priori, we would expect BI to respond less to changes in core inflation because of its lower volatility. Consequently, output fluctuations will also be less volatile. Figure 5.16 shows that the

median. Due to some restrictions, we are unable to obtain this data from Bank Indonesia and hence we use the core CPI data in Panggabean (2004).

[12] This calculation verifies that the measure of core inflation that we employ is appropriate. Before performing the simulation, we re-estimated the Indonesian SSMM with the core CPI and inflation variables. Except for the inflation equation, the coefficient estimates remain essentially unchanged.

simulated volatility of the policy tool—the domestic interest rate—in response to core inflation is around 35% lower than in response to headline inflation. In the case of the output gap plotted in Figure 5.17, its variability is almost 76% lower under core inflation targeting.

In Figure 5.16, the domestic interest rate responds to both measures of inflation according to the estimated Taylor rule. In particular, a rise in inflation will prompt the BI to raise the interest rate after one quarter so as to maintain the inflation target. Through the UIP equation, a higher interest rate causes both the nominal and the real exchange rate to appreciate, and this in turn causes the output gap to fall in Figure 5.17. All in all, we conclude that the volatilities of the policy instrument as well as the output gap are much lower when the central bank targets core inflation.

Figure 5.16 Effect from a 10% Temporary Increase in Domestic Price on Interest Rate

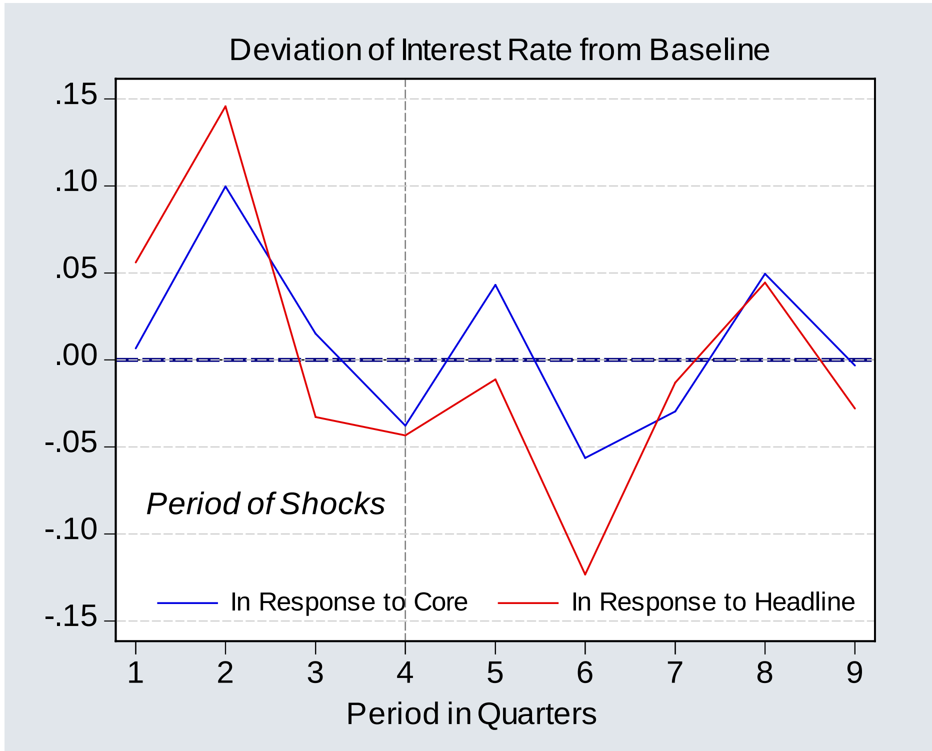
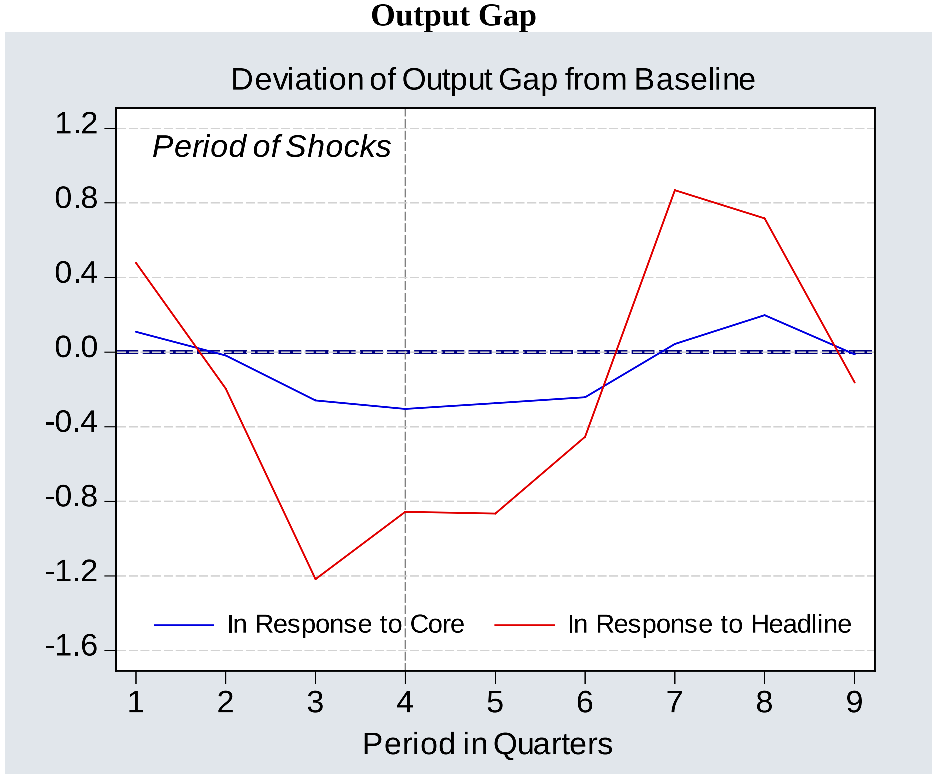


Figure 5.17 Effect from a 10% Temporary Increase in Domestic Price on Output Gap



5.6 Alternative Monetary Policy Rules

In this section, we perform stochastic simulations of our Indonesian SSMM. This technique is particularly useful for deriving the implications for output and inflation of different monetary policy rules, namely the Taylor rule and the McCallum rule. Following this, we sketch the trade-off frontier between output and inflation variability in the Indonesian economy for alternative specifications of the Taylor rule.

5.6.1 The Settings of Stochastic Simulations

Before we proceed with the stochastic analysis of policy rules, we will briefly outline the basic setup of our stochastic simulations. In a stochastic simulation, the model is solved repeatedly for different draws of the stochastic components of the model. We include coefficient uncertainty in the model, such that a new set of coefficients is drawn before each repetition, using the estimated coefficient variability from the SSMM whenever possible.[13] This technique provides a method of incorporating uncertainty surrounding the true values of the coefficients into our results. During each replication, random errors are generated for each equation according to the residual uncertainty, as described further below. Similarly, shocks to the exogenous variables are calibrated to have the same variances as in the historical data. At the end of each replication, the statistics for the endogenous variables are updated. When a comparison is being made with an alternative scenario, the same set of random residuals and exogenous variable shocks are applied to both scenarios during each replication. We set the number of replications in our

[13] Note that coefficient uncertainty is ignored in nonlinear equations.

stochastic simulation to be 1000 so that the sampling variation in the statistics that we obtain is relatively small.

In generating the innovations of the stochastic equations, we use the values of the standard deviations calculated from the behavioural equations in our model. The exception is exchange rate innovations in the UIP equation, which are assumed to be zero. To simulate the distributions of the random error components, we use a Monte Carlo approach as follows. At each replication of a stochastic simulation, a set of independent random numbers is drawn from the standard normal distribution, and then these numbers are scaled to match the actual variance-covariance matrix of the system.[14] This ensures that the correlations of the random draws match the correlations of the observed equation residuals. The model is solved many times with pseudo-random numbers substituted for the unknown errors at each repetition. Finally, we employ the same Gauss-Seidel algorithm to solve the model as in the deterministic case.

5.6.2 A Quest for Best Monetary Policy Response

In this sub-section, we will experiment with two types of monetary policy rules, namely, the Taylor interest rate rule and the McCallum money supply rule. Since the primary goal of monetary policy in the Indonesian economy is to achieve sustainable non-inflationary economic growth in the medium to long-run, our aim is to understand which policy rule is likely to be more effective in bringing inflation down to a targeted level with less variability in output. A comparison of the volatility of the economy under simulation with

[14] In the general case, this involves multiplying the vector of random numbers by the Cholesky factor of the covariance matrix. If the matrix is diagonal, this reduces to multiplying each random number by its desired standard deviation.

the volatility in the data will therefore provide some indication of the extent to which the conduct of monetary policy can be improved using these alternative policy rules.

In the presence of forward-looking variables in the Indonesian SSMM, the public and private sector's beliefs about the future course of monetary policy will affect the stability of the economy. Thus, an appropriate monetary policy will depend, to some extent, on whether BI chooses to make binding commitments with regard to future monetary policy or not. In the former case, BI should keep the policy rule fixed across periods whereas in the discretionary case, BI updates the optimal policy rule every period by taking into account new information. Although in practice discretionary monetary policy rule approximates reality better, this is feasible only if the central bank possess the necessary credibility to pursue monetary policy without adversely affecting inflationary expectations (Clarida, Gali, and Gertler 1999). As argued in the previous sub-section, we hesitate to assume that such credibility in the Indonesian monetary authority is present. Hence, we feel that employing a committed monetary policy rule seems to be more appropriate for our study.

Because of the issues mentioned above, we will focus on simple rules that feed back from a subset of the state variables, such as the inflation gap, the output gap, and the nominal exchange rate. We will specifically consider the Taylor rule augmented with the nominal exchange rate change estimated earlier. The dependence on imported goods for domestic production as well as our earlier empirical findings suggest that responding to movements in the exchange rate is likely to be important for output and inflation variability (see also Leitemo and Soderstrom, 2000). For comparison, we will employ another simple rule, i.e. the money supply rule due to McCallum (1988) that is described in Chapter 4 as $\Delta m_t + v_{t-1} = k^* + \lambda(x^* - x)_{t-1} + \varepsilon_{7t}$. Again, we use OLS to estimate the rule and follow the original McCallum specification in using money growth as the policy instrument.[15] The estimation yields a parameter estimate of 0.038 (or 3.8%) for the long-run nominal output growth that is quite close to the assumption made by McCallum of 4.5%. The elasticity of the output gap is found to be 0.45, which is again close to McCallum's assumed value of 0.5.

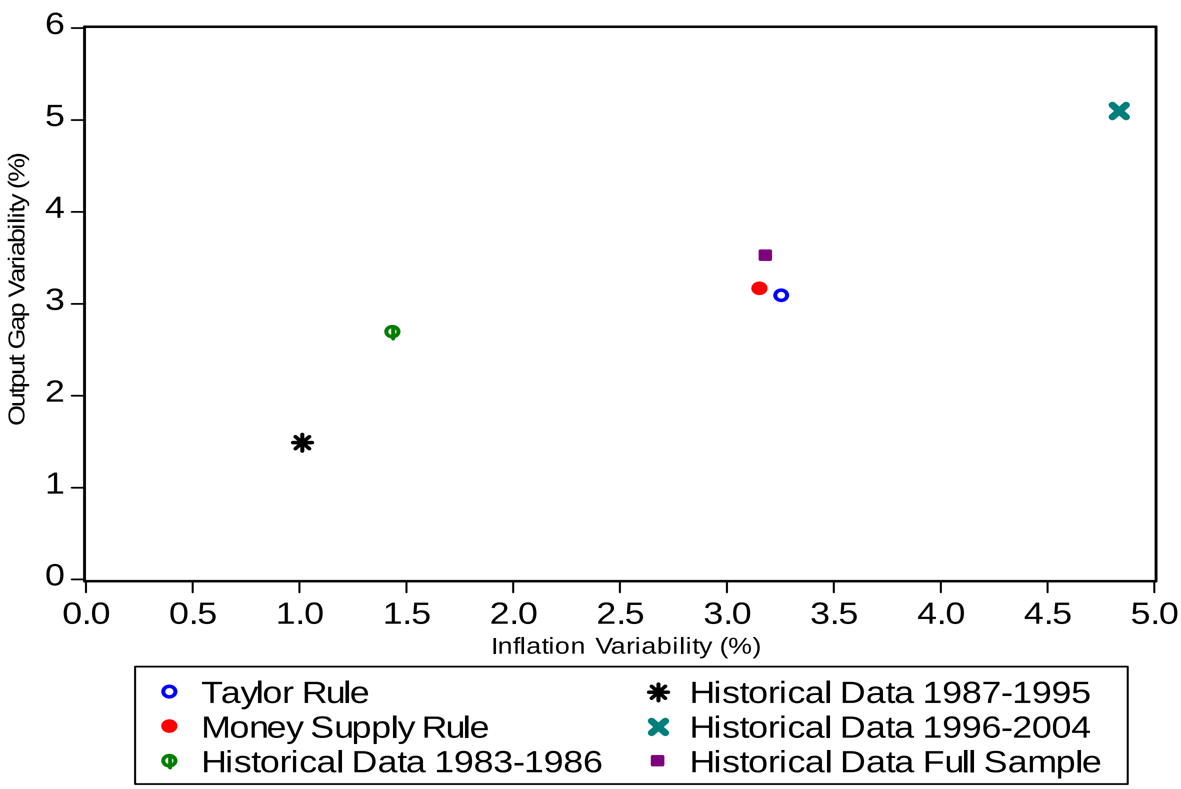
We follow the literature closely by evaluating the performance of the alternative rules according to the extent to which they are able to stabilize the target variables. Hence, we follow Taylor (1993) in tracing out and plotting the trade-off between output and inflation volatility, the so-called "policy points"[16], under our estimated Taylor and McCallum rules, and then comparing them to the historical pattern in the data. The policy points are traced out under the assumption of no cost to instrument volatility. We compare the trade-off points in the rules and the historical data for our full sample period and also three sub-periods: 1983:Q1–1986:Q4, 1987:Q1–1995:Q4, and 1996:Q1–2004:Q1.

[15] We use M1 money growth instead of base money growth in McCallum (1988) and follow McCallum and Nelson (1999) in formulating the velocity.

[16] This is a set of combinations of inflation and output gap volatility that can be attained given a particular form of policy rule. When we vary the relative weights on inflation, output, or the exchange rate, we trace out a "policy frontier" instead.

The variability of the total output gap is expressed as the standard deviation of the percentage deviation of output from its long-run trend.[17] The variability of inflation is measured directly by its simulated standard deviation. Our first result, presented in Figure 5.18, shows that during the period 1987–1995, the volatility of inflation and the output gap is the smallest. This coincides with the period of rapid growth and economic recovery in the Indonesian economy during which a lower inflation rate is combined with significant improvements in real income growth, as discussed in Chapter 2. Not surprisingly, after the Asian financial crisis hit Indonesia in 1997, the variability of both output and inflation increased substantially.

Figure 5.18 Comparison of Monetary Policy Rules



[17] To be consistent with the estimation procedure, we employ the Hodrick-Prescott filter to measure the long-term trend of output.

Table 5.7 Output Gap and Inflation Volatilities

Classification of Periods	Output Gap Variability	Inflation Variability
Taylor Rule (Full Sample)	3.08%	3.26%
Money Supply Rule (Full Sample)	3.16%	3.16%
Historical Data (Full Sample)	3.52%	3.19%
Historical Data (1983–1986)	2.69%	1.28%
Historical Data (1987–1995)	1.49%	0.88%
Historical Data (1996–2004)	5.1%	5%

When we compare the performance of the Taylor rule with the full sample's actual output and inflation volatilities, we find that the two trade-off points are quite close to one another. Nevertheless, by employing the rule, there will be smaller fluctuations in the output gap (Table 5.7). Similarly, the money supply rule does not improve much on actual historical outcomes in terms of the trade-off between output and inflation variability. This result is to be expected because during the bulk of the sample period under study, Indonesia's monetary policy was mainly conducted using base money as the operational target, with the nominal exchange rate being depreciated at a fairly steady rate in a crawling peg setting (Alamsyah et al 2000).

The empirical results suggest that the alternative monetary policy rules are substitutes for one another, given the similar trade-off points that they generated. It is perhaps surprising that the use of the Taylor rule augmented with the exchange rate change did not improve output and inflation outcomes considerably. To some extent, this could be due to the fact that the parameters in the rule used for the stochastic simulations are estimated and as such, are not optimal. In the next section, we will experiment with different calibrations of the parameters in order to derive a more optimal policy rule for inflation targeting.

5.6.3 The Policy Frontier

In this final exercise, we experiment with different weights for the inflation, output, and exchange rate variables in the Taylor rule equation to trace out the so-called *policy frontier*. Like policy points, the policy frontier is defined as a set of combinations of inflation and output gap volatility that can be attained given a particular form of the policy rule. However, it is traced out by varying the coefficients on the inflation and output gap in our Taylor policy rule given by Equation (14) in Chapter 4 and then plotting the standard deviations for these two target variables that are obtained from stochastic simulation of the SSMM.

In the exercise, we will deal with two cases. In the first case, we assume no exchange rate effect to be present in the Taylor rule and in the second case, the nominal exchange rate is explicitly included in the policy rule. Furthermore, we will restrict the sum of the parameters on the output and inflation gaps to be equal to one. We feel that by looking at recent trends, more meaningful policy implications can be drawn rather than by focusing on the whole sample because during the crisis period, the monetary authority seems to be looking for a “mechanical” rule to guide their policy-making management after the collapse of the managed-floating exchange rate system. Thus, we will focus on generating the policy frontier for the time period of 1996-2004.

The results from the alternative Taylor rules are traced out in Figures 5.21 and 5.22. The policy frontier (and its constituent points) that moves in the southwest direction corresponds to a better outcome for the economy since it will generate less volatility in both the output gap and inflation. Along each frontier, the points depict the trade-off between output and inflation volatility as measured by the standard deviations in percentage terms. Our results show that without assuming any exchange rate feedback in the policy rule, a Taylor-type rule with both inflation and output targeting generates a superior result for the economy in terms of lower variability in output and inflation. This means that by heeding concerns on both inflation and output stability, the authority can direct the economy into an improved state of welfare.

Figure 5.19 Policy Frontiers for the Taylor Rule (Without Exchange Rate)

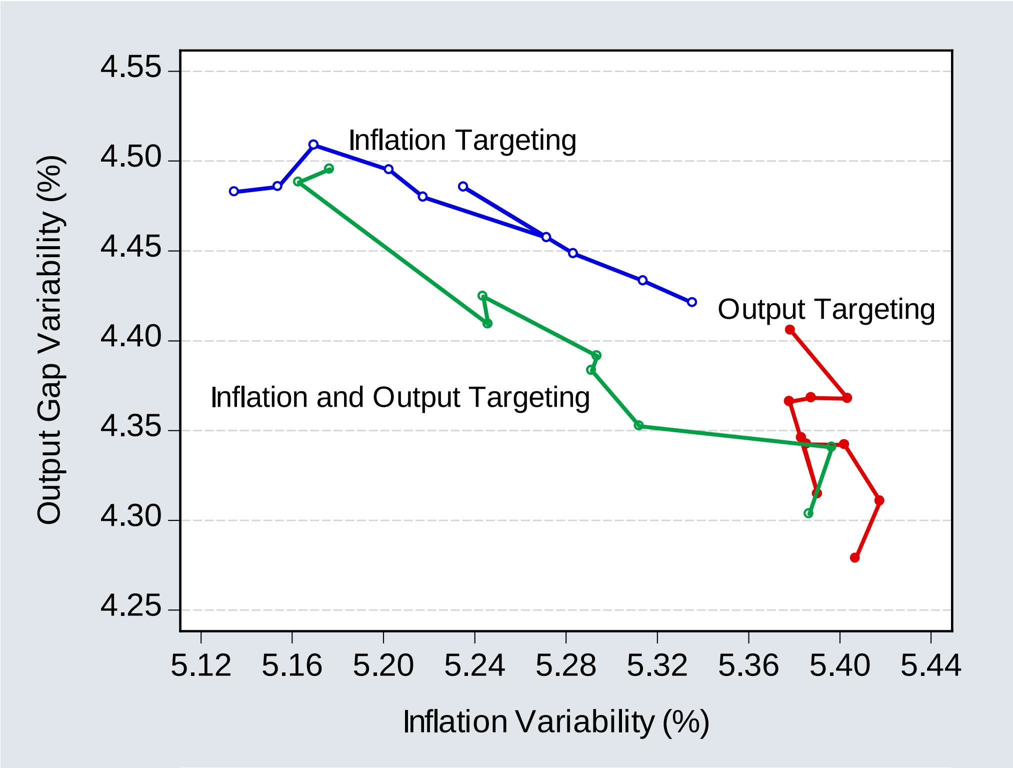
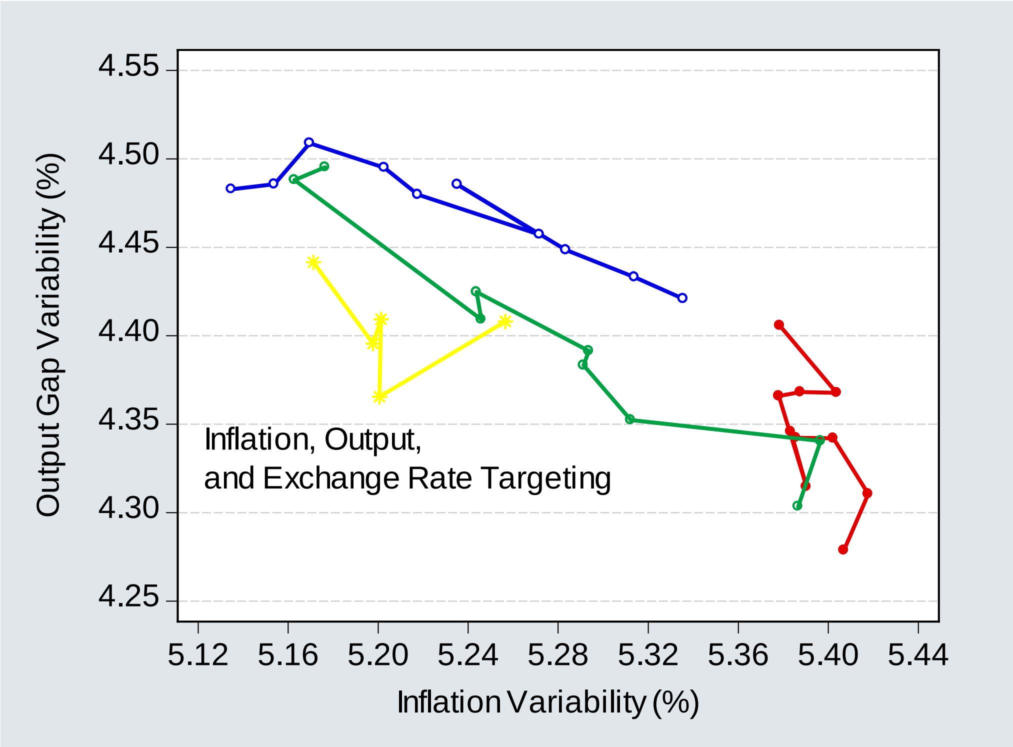


Figure 5.20 Policy Frontiers for the Taylor Rule (With Exchange Rate)



In Figure 5.19, the blue line corresponds to a zero weight for the output gap in the policy rule and varying the weight attached to the inflation gap—a strict inflation targeting regime. As the weight on the latter is gradually increased, we move in the northwest direction. The red line is obtained by changing the weight attached to the output gap while assigning a zero weight to the inflation gap (an 'output targeting' regime). As the weight on the former is gradually increased, we move in the southeast direction. The results are in line with research in this area which found that, when the authority targets only the inflation rate, the variability of inflation will be lowered at the cost of increased volatility of the output gap (Saxegaard 2000; de Freitas and Muinhos 1999). The same logic applies when the authority only cares about output stability. However, the green line in Figure 5.19 lies below the blue and red frontiers in the southwest direction, suggesting an improvement when the authority cares about both output and inflation stability. In particular, we find that equal weights given to the output and inflation gaps in this policy rule will generate the lowest possible combination of output gap and inflation volatility of 4.39% and 5.3% respectively.

When we introduce the modified Taylor rule with the exchange rate present, the simulation results show that there is a further improvement in terms of reducing both output gap and inflation volatility. Figure 5.20 reproduces the three frontiers in figure 5.19 but with the modified Taylor rule added. The yellow line, representing the results from this modified rule, lies below the green line, suggesting a further improvement in terms of macroeconomic stabilization policy is possible.[18] Specifically, the results show that for a weight of 0.2 given to the exchange rate term in the policy equation, the best combination of output gap and inflation volatility of 4.36% and 5.2% can be achieved.

To understand our results better, we will explain the economics behind them. The blue frontier in Figure 5.19 that corresponds to strict inflation targeting tells us that BI will only respond to the change in the inflation gap and as the weight attached to it is increased, the magnitude of the policy response to a change in the inflation gap will also increase. In other words, as the weight attached to the inflation gap is increased, the policy rate—the interest rate—will be raised by a bigger amount. A higher interest rate will then cause the money demand to fall, as is evident from the LM equation whereby the interest rate has a negative elasticity with respect to money demand. As money demand and supply falls, the inflation rate also declines. Furthermore, there is an indirect effect working through the UIP equation that reinforces the drop in the inflation rate because an increase in the policy rate will appreciate the Rupiah, thus reducing domestic inflationary pressures.[19] The result is that inflation volatility will be brought down at the cost of an increase in output gap volatility. Output gap volatility increases due to the change in the real exchange rate. Through the UIP relationship, the nominal exchange rate will appreciate but at the same time the domestic price level falls for the reason we

[18] We vary the weight attached to the exchange rate term starting from 0.1 up to 0.5 only since increasing the weight to more than 0.5 generates unstable results. The weights attached to the inflation and output gap is whatever 1 minus the weight attached to the exchange rate term and then divided equally among them.

[19] Note also that when we trace out the policy frontier in the context of strict inflation targeting, we set the coefficient on exchange rate to be equal to zero. Thus, we eliminate any pressures from the exchange rate unto the interest rate as specified by the modified Taylor rule.

have given above. The fall in the domestic price must have been greater than the nominal appreciation, resulting in a real exchange rate depreciation that increases the output gap.

The red line in Figure 5.19 traces the policy frontier whereby the authority is only concerned about minimizing output volatility regardless of inflation volatility. In this case, BI will only respond to any deviation that occurs in the output gap term in the Taylor rule equation. When output falls below trend, the domestic interest rate is lowered in response, leading to an immediate depreciation of the exchange rate which in turn improves the competitiveness of the economy, resulting in a rise in exports and thus output. The depreciation now leads to an increase in the domestic price level. At the same time, money demand increases with the output level, which aggravates inflation. Consequently, output variability is reduced under an output targeting regime, but at the expense of higher inflation variability.

Nevertheless, what remains interesting and important is that when BI actually targets both inflation and output, then their variability can be reduced. This means that by caring not only for output but also inflation, the total variability of the economy can be mitigated. Furthermore, by acknowledging the role of the exchange rate, the ability of the central Bank to reduce the volatility of the output gap and inflation is improved further, as is evident from the fact that the yellow frontier rests entirely below the green line in the southwest direction in Figure 5.20. The implication is that, apart from responding to output and inflation gaps, BI is now also reacting to exchange rate fluctuations in a way that is beneficial to the economy. The marginal improvement resulting from the inclusion of the exchange rate argument is consistent with the conclusion stated in Ball (1999), Svensson (2000) and Taylor (2000). We will discuss the policy implications of our empirical findings in Chapter 6.

Chapter 6

Summary of Findings and Policy Implications

Through the construction, estimation and simulation of a small scale macroeconomic model (SSMM) for Indonesia, we have captured the fundamental structure of the Indonesian economy. With separate equations for the oil and non-oil sectors and forward-looking economic agents, we have made an improvement over the BI-SQM model. The Indonesian SSMM has considerable theoretical content yet contains far fewer equations than traditional macroeconometric models. Furthermore, our model is highly tractable and transparent. This provides insights and understanding about the interactions between key macroeconomic variables in Indonesia and helps policymakers to formulate appropriate policies.

We have also discussed recent developments in the Indonesian economy, most notably before, during and after the financial crisis that struck Indonesia in 1997. The understanding of Indonesian economic development is very useful for interpreting our empirical findings and for drawing policy implications. To reiterate, the specific objectives of this study are to discuss the empirical findings from the estimated Indonesian SSMM; to recognize some important macroeconomic factors affecting the Indonesian economy; and to identify key policy vehicles that can play a central role in sustaining non-inflationary economic growth.

6.1 Summary of the Main Findings

Our main findings suggest that the domestic economy tends to be forward-looking when anticipating future economic growth, in accordance with the main postulates of the rational expectations school of thought in macroeconomics. However, the economy tends to be rather backward-looking in terms of formation of expectations on inflation, suggesting high inertia in the public's perception of inflationary pressures. The exchange rate plays a very central role in the goods and services market (the IS equation) as well as in determining the rate of inflation. The role of external demand is quite important in boosting the output level of Indonesian economy as evident in our estimation results and in one of our scenario exercises. The money supply is found to have some impact on inflation. In our final exercise, we also found that the inclusion of an exchange rate term in the policy rule helps in terms of reducing output and inflation variability.

With some reference to the exchange rate, we want to highlight some empirical findings. Svensson (2000) outlines several channels through which monetary policy in the context of an open economy affects the economy. Firstly, a change in the real exchange rate implies a change in relative prices between domestic and foreign goods that will reinforce the aggregate demand channel of the transmission mechanism. Secondly, a change in the exchange rate will alter the domestic currency price of imported goods and hence contribute directly to consumer price inflation. These effects are apparent in the Indonesian economy, as our SSMM has shown. Given the high import content in the domestic production sphere, the role of the exchange rate pass through is crucial in determining the inflation rate in the economy. It is also worth noting that the transmission lag of the exchange rate channel is relatively short and hence monetary policy reaction should be tailored accordingly to avoid any inflationary bias.

For the reasons we have mentioned, there is a growing consensus that an explicit modeling of the exchange rate is a necessary condition for a macroeconomic model to provide a credible description of the monetary transmission mechanism in a small open economy. This is also evident from the rapid increase in the number of structural models with an explicit role for the exchange rate such as Dornbusch (1976), Blake and Westaway (1996), Ball (1999), Svensson (2000), Batini and Nelson (2000), Leitemo and Røisland (2000), and Leitemo and Söderström (2000). Our study shows that the exchange rate plays a crucial role in the conduct of monetary policy and in ensuring the stability of the Indonesian economy. Our results regarding the exchange rate is in line with key findings from Siregar and Ward (2002), who built a structural vector auto-regression (SVAR) model for Indonesia. In their study of the monetary transmission mechanism, they found that monetary policy shocks affect domestic output through the effect of the short-run interest rate on the real exchange rate using the impulse response analysis. This result validates our finding that the interest rate does not affect non-oil output directly but instead through the exchange rate channel.

Based on dynamic simulations of our model, we have investigated the effects of an increase in external demand on the economy. As we have mentioned earlier, the economy will benefit from this increase in the external demand since it functions as additional economic fuel to enhance the economic growth of the Indonesian economy. In the simulation exercises, we have also found that the Central Bank needs to have a certain level of credibility to achieve the inflation target. Regarding the inflation transmission mechanisms, we experiment with two types of inflation measure: core and headline inflation. We found that by reacting to core inflation, BI will be able to manage the fluctuations in output much better as compared to when BI is responsive to headline inflation.

In our stochastic simulation exercises, we experimented with two alternative policy rules in the Indonesian SSMM. Our results, interestingly, show that both types of rules (Taylor and McCallum) perform equally well. However, we feel that for a developing country like Indonesia, a policy rule that can reduce output volatility at the expense of a slight increase in inflation variability is more appropriate. The policy frontiers traced out from the Taylor rule by varying the relative weights in the output and inflation gaps show that by giving attention to both output and inflation, the variability in these two very important macroeconomic variables can be reduced. Furthermore, our dynamic simulations show that a Taylor rule augmented with the nominal exchange rate would outperform the simple Taylor rule in reducing the volatility of both output and inflation, although the improvement is relatively minor.

6.2 Policy Implications

In this sub section, we will highlight several important policy implications that can be drawn from our study. Apart from discussing the importance of an SSMM and its usefulness for policy-making in Indonesia, we are also able to answer the key questions posed by Alamsyah et al. (2000) in their study on the framework for implementing inflation targeting in Indonesia. The first question that they ask is: Should the central bank include the exchange rate in its reaction function at times when exchange rate pressures emerge as a result of non-fundamental factors? We address this question below by drawing the implications from the role of the exchange rate in our estimated SSMM for Indonesia.

We are also able to partially answer their second question regarding the appropriate conduct of monetary policy in order to reach the inflation target. We have shown that the Taylor rule might be more appropriate to support the current framework of inflation targeting and thus the interest rate tool is recommended to be used as the operational target for Indonesia at this point in time. The third question that we managed to address within our SSMM is which inflation rate the central bank should target.

The Importance of a Small Scale Macroeconomic Model for Indonesia

The first policy implication that we can draw from this study is that the small scale macroeconomic model that we have built is able to capture the short to medium-term economic dynamics in Indonesia. This finding suggests that the implementation of a small scale model warrants consideration in policy-making and it can also provide a cross-check on results from larger scale models developed and maintained by BI, such as MODBI.

The small scale model that we have constructed in this thesis is dynamic in two ways. Firstly, the dynamic elements, such as the one found in the IS equation to account for adjustment costs, capture the well-known lags that is common in the economy. Secondly, the model explicitly considers the role of expectations in the form of model-consistent expectations. This is important because the lack of any forward-looking element significantly decreases the ability of the model to provide a credible description of the economy which is valuable to policy makers.

The underlying model that we employ, the Batini-Haldane model, is a general equilibrium model in the sense that it attempts to measure the impact of monetary policy on the whole economy, not just particular sectors. This is especially important due to the fact that expectation formations depend on the developments in the overall Indonesian economy and not only in some sectors. We would also like to reiterate that the Indonesian SSMM is detailed and disaggregated enough for a vast developing country such as Indonesia. It is able to capture the main characteristics of the monetary transmission mechanism but is still simple enough to be analytically examined and the model itself is tractable. Moreover, the quality of data is also another major consideration when choosing the scale of a macroeconomic model and based on our study, we have found and shown that by utilizing an aggregated, but detailed enough, model, some meaningful results can be derived to provide guidelines for economic policy-makers. Nevertheless, there is much room for improvement in terms of data quality so that a more sophisticated econometric model can be built such as one that includes an equation for wages. Finally, through this small-scale model, we find that the openness of the Indonesian economy is a very important issue that needs to be examined carefully. This is especially so since Indonesia decided to integrate with international financial capital markets in the 1990s to attract more foreign investments, thus prompting a closer watch on exchange rate management. This feature of openness has been adequately captured in our SSMM and provides a further merit of using an SSMM.

Implications for the Conduct of Monetary Policy

Central banking in Indonesia has hardly ever taken a place in the spotlight. However, with the recent financial crisis unveiling the fragility and vulnerability of the Indonesian macroeconomic structure, some notable changes have been happening in Bank Indonesia. Major changes include the collapse of the historical managed-floating exchange rate system whereby BI follows a policy of gradually depreciating the currency, and the implementation of the new Central Bank Act in May 1999 to ensure the accountability and transparency of the Central Bank. Thus, our research emerges at an appropriate time in order to offer some insights on the conduct of monetary policy based on our model and simulation results.

Based on a dynamic-deterministic simulation exercise in Chapter 5, we show that the credibility of the Central Bank is very important for achieving sustainable non-inflationary economic growth. In the case where the Central Bank has no public credibility at all, it will take an extremely long time for the inflation rate to be brought down to the targeted level. Nevertheless, we see a major improvement when the Central Bank can successfully build some credibility. This finding supports the new Central Bank

Act in 1999 that requires BI to announce the inflation target on a regular basis to the public as to ensure its accountability since by announcing the inflation target, BI can also earn the credibility it requires and the public's beliefs can be built up gradually. When BI can successfully achieve this "critical" level of credibility by announcing and committing itself to the inflation target, we can expect a reduction in inflation volatility that will ensure the sustainability of economic growth in Indonesia.

This brings us to the next issue: the choice between core and headline inflation as a target. The simulation results concerning the choice between core and headline inflation suggested that by reacting to the core inflation measure, BI can achieve a smaller output gap volatility. Specifically, our simulation result has shown that in the face of a temporary supply shock, the volatility of the output gap can be reduced and a recession might be avoided (or, at least, the recession can be alleviated) if the Central Bank targets core inflation. Nevertheless, we acknowledge that many have argued about the impracticality and unfamiliarity of the concept of core inflation to the public. Economic agents are likely to evaluate the performance of the central bank based on headline inflation and this measure of inflation is the one that will probably affect their economic decisions. But, as far as our simulation results regarding the choice between core and headline inflation show, the best response is for BI to react to deviations in core inflation but convey its policy stance to the public in terms of headline inflation for the time being. Eventually, this will call for considerable efforts from BI to educate the public about the difference between core and headline inflation should they decided to announce inflation target in both headline and core measures.

The most important result from this study emerges from the experiments with alternative policy rules: Taylor and McCallum rules. For the Taylor policy rule, we found that output gap volatility can be reduced only at the expense of a slight increase in inflation volatility whereas the converse is true for the latter policy rule. What is interesting is that historically both policy rules perform almost equally well in terms of the trade-off between output and inflation variability. However, most researchers who studied the inflation targeting countries (e.g. New Zealand, Brazil, and Venezuela amongst others) have used a Taylor rule, or at least they used the Taylor rule as a benchmark rule for comparison with other rules. Thus, we feel it is beneficial to examine the Taylor rule in greater detail through policy frontier analysis for the Indonesian economy.

It is found that the best policy response for recent years will be to focus on the Taylor rule with some positive weights given to both the output gap and inflation gap.[1] If this is the case, the economy can be brought to a better state in terms of having less output gap and inflation volatility. Although recent moves by the Indonesian monetary authority suggest some sort of inflation targeting regime, we cannot dismiss the importance of output deviations in the economy. This is because output growth plays a very crucial role in the Indonesian economy, which is significantly driven by domestic consumption (see, for example, Nasution, 2002). Furthermore, output stability is also important to ensure that the economy generates sufficient growth for its people and creates sufficient jobs for the Indonesian people.

[1] Specifically, our simulation result shows that an equal weight given to output and inflation deviations will yield the lowest variability of both output and inflation in a Taylor-type policy rule.

Nevertheless, the main policy lesson that we can identify from this simulation result is that should BI drastically move into a strict inflation targeting, it might create too much volatility in output growth, which is undesirable, although the inflation target might be better achieved. After all, the ultimate goal of macroeconomic policy is not inflation stabilization per se but rather welfare maximization and for that reason alone, a “pure” inflation targeting might be too narrow a framework (Debelle 2000)—at least for this point in time. Another way to look at this issue is to recognize that output volatility may serve as an intermediate “route” for BI to bring inflation to its desired level. Our result shows that, for a certain combination of positive weights attached to output and inflation deviations, i.e. by targeting output and inflation, it does not only bring output volatility down but also keeps inflation relatively stable. This is especially important during the recovery period of the Indonesian economy whereby inflation stability is required to bring foreign investors back as well as to ensure the public’s trust in the Rupiah and, at the same time, maintaining the domestic-driven growth by keeping output growth stable. Hence, we suggest that the monetary authority might want to consider the implementation of a Taylor-type rule in the coming years as a guideline for their policy-making activities by taking into account both output and inflation.

The exchange rate is also an important variable to be included in the policy rule in order to capture the open economy aspects of the Indonesian economy. This is evident from the fact that when we introduce an exchange rate argument into the policy equation, the monetary authority can further reduce the variability of the output gap and the inflation rate provided that the condition stated in Chapter 5 is met when assigning the weight on the exchange rate variable. Although the improvement is relatively mild, we still believe that this finding is a crucial indication of how important the exchange rate could be in the future course of monetary policy management. In a small open economy, exchange rates have large impacts on domestic prices and incomes, thereby affecting the trade-offs on which monetary policies are based. Consequently, smoothing exchange rate volatility facilitates the achievement of the targeted level of inflation.

6.3 Limitations and Further Research

The supply side of the Indonesian SSMM is defined solely by the inflation equation because we feel that wage pressures are not the key driving force of inflation phenomena in the Indonesian economy. A more elaborate model with an improved specification of the supply side of the economy through the inclusion of a wage variable might be worth considering in future research.

In this study, we also focused on monetary policy conduct and the best response mechanism. In other studies, such as the one by Siregar and Ward (2002b), they found that the effects of general spending balance (the fiscal side) shocks on key macroeconomic variables such as interest rates, exchange rates, and output are bigger in absolute terms and more persistent than the effects of monetary policy. Thus, it is also important to take into account the fiscal side of the economy in terms of formulating coherent policy actions among Indonesian economic policy-makers. Furthermore, they also argued that the importance of both fiscal and monetary policy shocks in the Indonesian economy has prompted the need for both policies to be employed in stabilizing severe disturbances such as during the recent Asian financial crisis. Thus, further research is needed in this area to takes into account the interplay between fiscal and monetary policy so as to better understand the economic conditions of Indonesia. A deeper understanding about the source of shock is another interesting yet important area to be researched upon further, for example whether it originates from the supply or the demand side.

We would also recommend further study to be done on the specification of the Taylor rule itself (or any other appropriate policy rule), such as a rule with a forward-looking component. This will entail the need to project inflation several periods ahead based on the information available to date. This is commonly known as an inflation-forecast based rule and it requires a robust inflation projection to ensure the reliability of the empirical results. This is an area that deserves more than a chapter in our study (in fact, it requires another thesis!) since this research question will require the use of more sophisticated econometric techniques for forecasting. Nevertheless, answering this research can be quite meaningful for policymakers. For example, Alamsyah (2000) have shown that the optimal weight on the deviation of forecasted inflation from its target—based on an inflation-forecast based rule—is about 0.88 and consequently the weight on output is 0.12. In contrast, we found that in our backward-looking Taylor rule, both inflation and output gap variability can be lowered by introducing equal weights of 0.5 to both terms. The robustness of BI's findings with respect to the modified Taylor rule when the exchange rate is included remains an issue worthy of further study.

All in all, we hope that this research can successfully bring across the important message that "small is indeed still beautiful" in terms of macroeconomic modelling activity. Also, we hope that from this study, we conveyed the importance of central bank credibility, which can be achieved by announcing the inflation target as well as choosing the right measure of the inflation target. Furthermore, a greater focus on research dealing with policy formulation is very central to the success of central banking management, especially in order to lead the Indonesian economy into a better state of sustained and non-inflationary economic growth. To quote a sailing analogy by John Taylor (2000):

"Inflation targeting is not enough. You need to have a policy procedure—a policy rule—to achieve the target…inflation targeting is like the destination for a sailboat, a policy rule is how to sail the boat to get to the destination…"

It seems like Indonesia might just find its way in sailing to reach the "dreamland of prosperity" in the sea of uncertainty.

Bibliography

Aghevli, B.B. (1977), "Money, Prices, and Balance of Payments, Indonesia, 1968–1973," *Journal of Development Studies*, Vol. 13, pp. 37–57.

Aghevli, B.B., Khan M.S and Narvekar, P.R. (1979), "Monetary Policy in Selected Asian Countries," *IMF Staff Paper*, Vol. 26, pp. 775–823.

Alamsyah, Halim., Charles J., Juda A. and Doddy Z. (2000), "Framework for Implementing Inflation Targeting in Indonesia," in C. Joseph and A. H. Gunawan (ed.), *Monetary Policy and Inflation Targeting in Emerging Economies*. Indonesia: Bank Indonesia.

Alamsyah, Halim., Charles J., Juda A. and Doddy Z. (2001), "Towards Implementation of Inflation Targeting in Indonesia," *Bulletin of Indonesian Economic Studies*, Vol. 37, pp. 309–24.

Arndt, H.W. (1979), "Monetary Policy Instruments in Indonesia," *Bulletin of Indonesian Economic Studies*, Vol. 15, pp. 107–122.

Arreaza, A., Enid Blanco and Miguel Dorta (2003), *A Small Scale Macroeconomic Model for Venezuela (Second Draft)*. Banco Central de Venezuela Vicepresidencia de Estudios.

Azis, Iwan J. (1988), "Interregional Disparity and the Role of Inpres Program," Mimeograph, University of Indonesia.

Azis, Iwan J. (1990), "Inpres' role in the reduction of interregional disparity," *Asian Economic Journal*, Vol. 4, pp. 1–27.

Azis, Iwan J. and Erina Ekawati (1990), "A Simulation Study of Changing External Trade Situations: Econometric Model for Indonesia," in J. T. Yap and Y. Nakamura (ed.), *ASEAN Link*, Singapore: Longman Publishers.

Azis, Iwan J. and Erina Ekawati (1984), *The Indonesian Economy: Collected Papers*, Singapore: Chopmen Publishers.

Bahmani-Oskooee, M., H. Mohtadi and G. Shabsigh (1991), "Exports, Growth and Causality in LDCs: A Re-Examination," *Journal of Development Economics* Vol. 36, pp. 405–415.

Balassa, B. (1985), "Export, Policy Choices, and Economic Growth in Developing Countries after the 1973 Oil shock," *Journal of Development Economics* Vol. 18, pp. 23–35.

Ball, L. (1997), "Efficient Rules for Monetary Policy," NBER Working Paper No. 5952, New York: NBER.

Ball, L. (1999), "Policy Rules for Open Economies," in J. B. Taylor (ed.), *Monetary Policy Rules*, National Bureau of Economic Research Conference Report.
Bank for International Settlements (1998).

Bank Indonesia (2003), *Quarterly Report, October*.

Bank Indonesia (2004), *Quarterly Report, January*.

Bank of England (1999), *Economic Models at the Bank of England*, Bank of England.

Batini, N. and Haldane, A.G. (1999), "Forward-Looking Rules for Monetary Policy," in J. B. Taylor (ed.), *Monetary Policy Rules*, National Bureau of Economic Research Conference Report.

Batini, N., Harrison, R. and Millard, S.P. (2001), "Monetary Policy Rules for an Open Economy," Conference paper at SIEPR, Stanford University.

Basurto, G. and Gosh. A. (2001), "The Interest Rate-Exchange Rate Nexus in Currency Crisis," in Proceedings of the IMF Annual Research Conference 2001 Vol. 47 (Special Issue), pp. 99–1230, *IMF Staff Papers*.

Bautista, Romeo M., Robinson, Sherman and El-Said, Moataz (2001), *Restructuring Asian Economics for the New Millennium*, Vol. 9B, pp. 773-790, Elsevier Science B.V.

Beechey, M., N. Bharucha, A. Cagliarini, D. Gruen and C. Thompson (2000), *A Small Model of the Australian Macroeconomy*, Research Discussion Paper No. 2000-05, Economic Research Department, Reserve Bank of Australia.

Bird, Kelly (1996), "Survey of Recent Developments," *Bulletin of Indonesian Economic Studies*, Vol. 32, pp. 3–32.

Blake, A. (1996), "Forecast Error Bounds by Stochastic Simulation," *National Institute Economic Review* Vol. 64, pp. 72–78.

Blake, A.P., and P.F. Westaway (1996), "Credibility and the Effectiveness of Inflation Targeting Regimes," *Manchester School* Vol. 64, pp. 28–50.

Boediono (1998), "Merenungkan Kembali Mekanisme Transmisi Moneter di Indonesia (Revisiting Monetary Transmission Mechanism in Indonesia)," *Buletin Ekonomi Moneter dan Perbankan*, Vol. 1, pp. 1–4.

Booth, A. (1981), *The Indonesian Economy during the Soeharto Era*, Kuala Lumpur: Oxford University Press.

Booth, A. (1986), “Survey of Recent Developments,” *Bulletin of Indonesian Economic Studies*, Vol. 22, pp. 1–26.

Brigden, A., Ben Martin and Chris Salmon (1997), “Decomposing Exchange Rate Movements According to the Uncovered Interest Rate Parity Condition”, *Bank of England Quarterly Bulletin*, November.

Buiter, W.H. and I. Jewitt (1981), “Staggered Wage Setting with Real Wage Relativities: Variations on a Theme of Taylor,” *Manchester School* Vol. 49, pp. 211–228.

Central Bureau of Statistics. *Economic Indicators* (various issues).

Chapman, B.J. (1990), “The Labour Market,” in S.A. Grenville (ed.), *The Australian Macroeconomy in the 1980s*, Proceedings of a Conference, Reserve Bank of Australia, Sydney, pp. 6–78.

Chevapatrakul, Thanaset, Paul Mizen and Tae-Hwan Kim (2001), “Using Rules to Make Monetary Policy: The Predictive Performance of Taylor Rules Versus Alternatives for the United Kingdom 1992-2001,” Mimeograph.

Chote, R. (1996), “Interest Rates Still Flout All the Rules,” *Economics Notebook Financial Times*, July 22.

Chow, G. and Lin, A. L (1971), “Best Linear Unbiased Distribution and Extrapolation of Economic Time Series by Related Series,” *Review of Economic and Statistics*, Vol.53, pp. 372–375.

Clarida, R., Gali, J. and Gertler, M. (1998), “Monetary Policy Rules in Practice: Some International Evidence,” *European Economic Review*, Vol. 42, pp. 1033–1067.

Clarida, R., Gali, J. and Gertler, M. (1999), “The Science of Monetary Policy: A New Keynesian Perspective,” *Journal of Economic Literature*, Vol. 37, pp. 1661–1707.

Cumby, R and Obstfeld, M (1981), “A Note on Exchange Rate Expectations and Nominal Interest Differentials: A Test of the Fisher Hypothesis”, *Journal of Finance*, Vol. 36, pp. 1231–44.

de Brouwer, G. (2003), “Towards Improved Monetary Policy in Indonesia: A Comment,” *Bulletin of Indonesian Economic Studies*, Vol. 39, pp. 325–8.

de Brouwer. G., I. Ng. and R Subbaraman (1993), *Modelling Inflation in Australia*, Reserve Bank of Australia Research Discussion Paper No. 9510.

de Freitas P.S. and Muinhos M.K (1999), *A Simple Model for Inflation Targeting in Brazil*, Central Bank of Brazil-Research Department, May.

de Brouwer, G. and J O'Regan (1997), "Evaluating Simple Monetary-policy Rules for Australia," in PW Lowe (ed.), *Monetary Policy and Inflation Targeting*, Proceedings of a Conference, Reserve Bank of Australia, Sydney, pp. 244–276.

Duesenberry, J.S. (1949), *Income, Savings, and the Theory of Consumer Behaviour*, Cambridge, Massachusetts: Harvard University Press.

Estrella, A. and Frederic M. (1999), "Rethinking the Role of NAIRU in Monetary Policy: Implication of Model Formulation and Uncertainty," in J. B. Taylor (ed.) *Monetary Policy Rules*, National Bureau of Economic Research Conference Report.

Eviews (2005), Software Manual, *Quantitative Micro Software* (QMS): USA.

Fane, G. (2000a), "Indonesian Monetary Policy during the 1997–1998 Crisis: A Monetarist Perspective," *Bulletin of Indonesian Economic Studies*, Vol. 36, pp. 49–64.

Fane, G. (2000b), "Indonesian Monetary Policy: A Rejoinder," *Bulletin of Indonesian Economic Studies*, Vol. 36, pp. 49–64.

Feder, G. (1983), "On Exports and Economic Growth," *Journal of Development Economics*, Vol. 12, pp. 59–73.

Fisher, P., Tanna, S., Turner, D., Wallis, K. and Whitley, J (1990), "Econometric evaluation of the exchange rate," *Economic Journal*, Vol. 100, pp. 1230–44.

Fuhrer, J.C. and G.R. Moore (1995a), "Forward-looking Behaviour and the Stability of a Conventional Monetary Policy Rule," *Journal of Money, Credit and Banking*, Vol. 27, pp. 1060–70.

Fuhrer, J.C. and G.R. Moore (1995b), "Inflation Persistence," *Quarterly Journal of Economics*, Vol. 110, pp. 127–59.

Fuhrer, J.C. (1997), "The (Un)importance of Forward-looking Behaviour in Price Specifications," *Journal of Money, Credit and Banking*, Vol. 29, pp. 338–50.

Fukuchi, T. (1968), "An Econometric Analysis of the Indonesian Economy," *The Developing Economies*, Vol. 6, pp. 324–355.

Furman, J. and Stiglitz, J. E. (1998), "Economic Crises: Evidence and Insights from East Asia," *Brooking Papers on Economic Activity*, Vol. 2, pp. 1–35.

Corsetti, G., Pesenti, P., and Roubini, N. (1998a), *What Caused the Asian Currency and Financial Crisis?: Part I A Macroeconomic Overview*, Working Paper No 6833, New York: NBER.

Corsetti, G., Pesenti, P., and Roubini, N. (1998b), *What Caused theAsian Currency and Financial Crisis? : Part II The Policy Debate*, Working Paper No 6834, New York: NBER.

Gillis, M. (1984), "Episodes in Indonesian Economic Growth," in A. C. Harberger (ed.) *World Economic Growth*, pp. 231–64, San Fransisco: ICS Press.

Gillis, M. and Dapice, D. (1988), "Indonesia," in R. Dornbusch and F. L. C. H. Helmers (ed.), *The Open Economy: Tools for Policy Makers in Developing Countries*, EDI series in Economic Development.

Goldfajn, I. and Baig, T. (1999), *Monetary Policy in the Aftermath of Currency Crises: The Case of Asia*, IMF Working Paper 98/170, Washington D.C.: IMF.

Goodfriend, M. and R.G. King (1997), "The New Neoclassical Synthesis and the Role of Monetary PolicyThe New Neoclassical Synthesis and the Role of Monetary Policy," in B. S. Bernanke and J. J. Rotemberg (ed.), *NBER Macroeconomics Annual 1997*, Cambridge, Massachusetts: MIT Press.

Goodhart, C.A.E. (2001), "Monetary Transmission Lags and the Formulation of the Policy Decision on Interest Rates," *Federal Reserve Bank of St. Louis Review*, pp. 165–181.

Greenaway, D. and Sapsford, D. (1994), "What Does Liberalization Do for Exports and Growth?," *Weltwirtschaftliches Archiv*, Vol. 130, pp. 152–73.

Grenville, S. (2000), "Indonesian Monetary Policy: A Comment," *Bulletin of Indonesian Economic Studies*, Vol. 36, pp. 65–70.

Haldane, A. G. (ed. 1995), *Targetting Inflation*, London: Bank of England.

Haldane, A. G. (1998), "On Inflation-Targeting in the United Kingdom," *Scottish Journal of Political Economy*, Vol. 45, pp. 1–32.

Heikensten, L. (1999), "The Riksbank's Inflation Target-Clarification and Evaluation," *Sveriges Riksbank Quarterly Review*, No. 1, pp. 5–17.

Hill, H. (1999), *The Indonesian Economy in Crisis: Causes, Consequences and Lessons*, Singapore: Institute of Southeast Asian Studies.

Iljas, A. (1999), *Peranan Bank Indonesia dalam Pengendalian Inflasi*, Paper presented in a seminar on "The role of Bank Indonesia in Inflation Control", 6 December.

International Monetary Fund (1999), *World Economic Outlook: International Financial Contagion*, Washington D.C.: International Monetary Fund.

Iriana, R. and Sjoholm, F. (2001). "Indonesia's Economic Crisis: Contagion and Fundamentals," Working Paper # 134. *The European Institute of Japanese Studies*.

James, William E. (1995), "Survey of Recent Developments," *Bulletin of Indonesian Economic Studies*, Vol. 31, pp. 3–38.

Jap, V. (2003), *Financial Crisis in Indonesia*, Unpublished Honours Thesis.

Jung, W. S. and P. J. Marshall (1985), "Exports, Growth and Causality in Developing Countries," *Journal of Development Economics* Vol. 18, pp. 1–12.

King, M.A. (1994). Monetary Policy in the U.K. *Fiscal Studies* 15 (3): 109–128.

King, M.A. (1997), "The Inflation Target Five Years On," *Bank of England Quarterly Bulletin*, November, 434–442.

King, M.A. (1999), "Challenges for Monetary Policy: New and Old," Paper presented at Symposium on "New Challenges for Monetary Policy", Federal Reserve Bank of Kansas City. Jackson Hole, Wyoming.

Klein, L. R. (1989), Econometric aspects of input–output analysis. In R. E. Miller, et al. (ed.), *Frontiers of input–output analysis*, pp. 3–21, Oxford: Oxford University Press.

Kobayashi, K., Hasdungan T. and Mitsuo E. (1985). "Indonesia Model", in Shinichi Ichimura and Mitsuo Ezaki (ed.), *Econometric Models of Asian Link*, Tokyo: Springer-Verlag.

Kobayashi, K. et al. (1989), "Indonesia Model," in Ichimura, S. and Ezaki, M. (ed.), *Econometric Models of Asian Link*, Tokyo: Springler-Verlag.

Kokko, A. (2002), "Export-Led Growth in East Asia: Lessons for Europe's Transition Economies," *National Europe Centre Paper* No. 31.

Kuribayashi, S. (1987), "A Medium-Term Macroeconometric Model for Economic Planning in Indonesia," in *South East Asia Studies*, Vol. 24, No. 4, pp. 350–376.

Leiderman, L. and L. E. O. Svensson (ed. 1995), *Inflation Targets*, London: Centre for Economic Policy Research.

Leitemo, K. and Røisland, Ø. (2000), "The Choice of Monetary Policy Regime for Small Open Economies," Working Paper 2000/05, Norwegian Central Bank.

Leitemo, K. and Söderström, U. (2000), "Simple Monetary Policy Rules and Exchange Rate Uncertainty," *Monograph*, unpublished paper available at: http://home.c2i.net/kai_leitemo.

Levin, A., Volker W. and John W. (1999), "Robustness of Simple Monetary Policy Rules under Model Uncertainty," in J. B. Taylor (ed.), *Monetary Policy Rules*, National Bureau of Economic Research Conference Report.

Lowe, P.W. and L. Ellis (1997), "The Smoothing of Official Interest Rates," in P. W. Lowe (ed.), *Monetary Policy and Inflation Targeting*, pp. 286–312.

Mann, R. (1998), *Economic Crisis in Indonesia: The Full Story*, Santa Cruz, CA: Gateways Books.

Manning, C. and Sisira Jayasuriya (1996), "Survey of Recent Developments," *Bulletin of Indonesian Economic Studies*, Vol. 32, pp. 3–43.

McCallum, B.T. (1988), "Robustness Properties of a Rule for Monetary Policy," *Carnegie-Rochester Conference Series on Public Policy*, Vol. 29, pp. 173–204.

McCallum, B.T. (1998), "Choice of Target for Monetary Policy," in G. Wood (ed.), *Money, Prices and the Real Economy*, United Kingdom: Edward Elgar.

McCallum, B.T. and Edward Nelson (1999), "An Optimizing IS-LM Specification for Monetary Policy and Business Cycle Analysis," *Journal of Money, Credit, and Banking*, Vol.31, pp. 296–316.

McLeod, Ross H. (1997a), "Postcript to the Survey of Recent Developments: Causes and Cures for the Rupiah Crisis," *Bulletin of Indonesian Economic Studies*, Vol. 33, pp. 35–52.

McLeod, Ross H. (1997b), "Survey of Recent Developments," *Bulletin of Indonesian Economic Studies*, Vol. 33, No. 1, pp. 3–43.

McLeod, Ross H. (2003), "Towards Improved Monetary Policy in Indonesia," *Bulletin of Indonesian Economic Studies*, Vol. 39, pp. 303–24.

Meese, R. and Rogoff, K (1983), "Empirical exchange rate models of the seventies," *Journal of International Economics*, Vol. 14, pp 3–24.

Monetary Authority of Singapore (1998), "Measures of Core Inflation for Singapore," *MAS Occasional Paper* No. 10, December.

Morón, E. A. and Zegarra, L. F. (1998), "Measuring Core Inflation in a Small, Open and Dollarized Economy: The Peruvian Case," Working Paper.

Nasution, A. (1983), *Financial Institutions and Policies in Indonesia*, Singapore: Institute of Southeast Asian Studies.

Nasution, A. (1999), "Recent Issues in the Management of Macroeconomic Policies in Indonesia," in Asian Development Bank, Vol. 6 (Indonesia), *Rising to the Challenge in Asia: A Study of Financial Markets*, Philippines: Asian Development Bank.

Nasution, A. (2002), "The Indonesian Economic Recovery from the Crisis in 1997–1998," *Journal of Asian Economics*, Vol. 13, pp. 157-180.

Nelson, E. (2000), *UK Monetary Policy 1972–1997: A Guide Using Taylor Rules*, Monetary Assessment and Strategy Division, Bank of England.

Nobay, R.P. and David A.P. (1998), "Optimal Monetary Policy in a Model of Asymmetric Central Bank Preference," *FMG Discussion Paper* No. 306.

Panggabean, M. (2004), "Measure of Core Inflation," *Bank Mandiri Quarterly Report*, Bank Mandiri: Jakarta.

Parikh, A., Booth, A. and Sundrum, R.M. (1985), "An Econometric Model of the Monetary Sector in Indonesia," *Journal of Development Studies*, Vol. 21, pp. 406–422.

Pincus, J. and Ramli, R (2001), "Indonesia: From Showcase to Basket Case," in Chang, Palma, Gabriel, and Whittaker, D. Hugh (ed.), *Financial liberalization and the Asian crisis*, New York: Palgrave.

Ram, R. (1985), "Exports and Economic Growth: Some Additional Evidence," *Economic Development and Cultural Change*, Vol. 33, pp. 415–422.

Radelet, Steven and Sachs, Jeffrey (1998a), "The East Asian Financial Crisis: Diagnosis, Remedies, Prospects," *Brooking Papers on Economic Activity*, Vol. 1, pp. 1–75.

Radelet, Steven and Sachs, Jeffrey. (1998b), *The Onset of the East Asian Financial Crisis*, Working Paper No. 6680, New York: NBER.

Iriana, R. and Sjoholm, F. (2001), "Indonesia's Economic Crisis: Contagion and Fundamentals," Working Paper # 134, *The European Institute of Japanese Studies*.

Rotemberg, J. J. and M. Woodford (1997), "An Optimization-Based Econometric Framework for the Evaluation of Monetary Policy," in B. S. Bernanke and J. J. Rotemberg, *NBER Macroeconomics Annual 1997*, Cambridge, Massachusetts: MIT Press.

Rotemberg, J. J. and M. Woodford. (1999), "An Optimization-based Econometric Framework for the Evaluation of Monetary Policy", *NBER Macroeconomics Annual*, Cambridge, Massachusetts: MIT Press.

Rothenberg, T.J. (1990a), "Full and Limited Information Methods," in J. Eatwell, M. Milgate and P. Newman (ed.), *Econometrics*, United Kingdom: Macmillan Press.

Rothenberg, T.J. (1990b), "Simultaneous Equation Models in J. Eatwell, M. Milgate and P. Newman (ed.), *Econometrics*, United Kingdom: Macmillan Press.

Ruge-Murcia, F.J. (1999), "Inflation Targeting Under Asymmetric Preferences," Working Paper.

Sadli, Mohammad (1999), "The Indonesian Crisis", in H. Hill and H. W. Arndt (ed.), *Southeast Asia's Economic Crisis Origins, Lessons, and the Way Forward*, Singapore: Institute of Southeast Asian Studies.

Salvatore, D. and Hatcher, T. (1991), "Inward Oriented and Outward Oriented Trade Strategies," *Journal of Development Studies*, Vol. 27, pp. 7–25.

Saxegaard, M. (2001), "A Framework for Analysing the Inflation/Output Variability Trade-off in Norway," *Unpublished M. Phil Economics Thesis*, Nuffield College, University of Oxford.

Shuetrim, G.C. and C.J. Thompson (1999), *The Implications of Uncertainty for Monetary Policy*, Reserve Bank of Australia Research Discussion Paper No. 1999-10.

Siregar, H. and Ward, B.D. (2002), "Were Aggregate Demand Shocks Important in Explaining Indonesian Macroeconomic Fluctuations?," *Journal of the Asia Pacific Economy*, Vol. 7, pp. 35–60.

Siregar, R. (1999), "Real Exchange Rate Targeting and Inflation in Indonesia: Theory and Empirical Evidence," *Applied Financial Economics*, Vol. 9, pp. 329–36.

Siregar, R. and Rajan, R. (2003), "Exchange Rate Policy and Foreign Exchange Reserves: Evaluating the Benefits of East Asian Reserve Pooling for Indonesia," *Monograph*, University of Adelaide, Australia.

Simatupang, P. (1986), "An Econometric Model of the Indonesian Economy", Dissertation, Iowa State University, Ames.

Soesastro, H. (1995), "Recent Economic Developments", Paper Presented to the Indonesia update 1995 Conference, Indonesia Project, ANU, Canberra, August.

Stevens, G.R. (1992), "Inflation and Disinflation in Australia: 1950–91," in A Blundell-Wignall (ed.), *Inflation*, *Disinflation and Monetary Policy*, Proceedings of Conference, Reserve Bank of Australia, Sydney, pp. 182–244.

Sundrum, R.M. (1988), "Indonesia's Slow Economic Growth: 1981–86," *Bulletin of Indonesian Economic Studies*, Vol. 24, pp. 37–72.

Svensson, L.E.O. (1997a), "Inflation-Forecast Targeting: Implementing and Monitoring Inflation Targeting," *European Economic Review*, Vol. 41, pp. 1111–46.

Svensson, L.E.O. (1997b), "Inflation Targeting: Some Extensions," NBER Working Paper No. 5962, New York: NBER.

Svensson, L.E.O. (1997c), "Optimal Inflation Targets, 'Conservative' Central Banks, and Linear Inflation Contracts," *American Economic Review*, Vol. 87, pp. 98–114.

Svensson, L.E.O. (1998), "Inflation Targeting as a Monetary Policy Rule," NBER Working Paper No. 6790, New York: NBER.

Svensson, L.E.O. (2000), "Open Economy Inflation Targeting," *Journal of International Economics*, Vol. 50, pp. 155–83.

Svensson, L.E.O. (2002), "Monetary Policy and Real Stabilization," *Rethinking Stabilization Policy*, Kansas City: FRB Kansas City.

Svensson, L.E.O. (2003a). The Inflation Forecast and the Loss Function in P. Mizen (ed.), *Central Banking, Monetary Theory and Practice: Essays in Honour of Charles Goodhart, Volume I* , pp. 135–152, United Kingdom: Edward Elgar.

Svensson, L.E.O. (2003b), "What is Wrong with Taylor Rules? Using Judgment in Monetary Policy through Targeting Rules," *Journal of Economic Literature*, Vol. 41, pp. 426–477.

Taylor, J.B. (1980), "Aggregate Dynamics and Staggered Contracts," *Journal of Political Economy*, Vol. 88, pp. 1–24.

Taylor, J.B. (1993), "Discretion versus Policy Rules in Practice," *Carnegie-Rochester Conference Series on Public Policy* Vo39, pp. 195–214.

Taylor, J.B. (1999), *Monetary Policy Rules*, NBER: Chicago University Press.

Taylor, J.B. (2000), "Alternative Views of the Monetary Transmission Mechanism: What Difference Do They Make for Monetary Policy?," *Oxford Review of Economic Policy* Vol. 16, pp. 60–73.

Taylor, J.B. (2001), "The Role of the Exchange Rate in Monetary Policy Rules," *American Economic Review Paper and Proceedings*, Vol. 91, pp. 263–267.

Tongzon, J.L. (2002), *The Economies of Southeast Asia: Before and After the Crisis* (2nd Edition), United Kingdom: Edward Elgar.

Valadkhani, A. (2004), "History of Macroeconometric Modelling: Lessons from Past Experience," *Journal of Policy Modeling*, Vol. 26, pp. 265–81 van der Meulen Rodgers, Y. (1994), “Indonesia’s Macroeconomic and Trade Performance,” *Development Discussion Paper*, No. 495. Harvard Institute for International Development, Harvard University: Cambridge, Massachusetts.

Vincent, N. (2002), “NAOMI/US: A Small-Scale Model of the U.S. Economy,” Working Paper #2002/09, Department of Finance Canada.

Wadhwani, S.B. (1999), *Currency Puzzles*, London School of Economic Lecture on 16th September.

Wang, Y.K. (1983), “The Econometric Models of South Korea and Indonesia,” The Institute of Economics, Academia Sinica, Taipei, Taiwan, pp. 303–383.

Warjiyo, P. (2001), “Towards Inflation Targeting: The Case of Indonesia in,” *Inflation Targeting—Theory, Empirical Models and Implementation in Pacific Basin Economies* (The 14th Pacific Basin Central Bank Conference, 2001).

Warr, P.G. (1984), “Exchange Rate Protection in Indonesia,” *Bulletin of Indonesian Economic Studies*, Vol. 20, pp. 53–89.

Warr, P.G. (1986), “Indonesia’s Other Dutch Disease: Economic Effects of the Petroleum Boom,” in J. Peter and Van Wijnbergen, *National Resources and the Macroeconomy*, pp. 288–323, Oxford: Basil Blackwell.

Williams, J. (1997), “Simple Rules for Monetary Policy,” Washington D. C.: Board of Governors of the Federal Reserve System, Manuscript.

Woodford, M. (2000), “Pitfalls of Forward-Looking Monetary Policy,” *American Economic Review*, Vol. 90, pp. 100–104.

Woodford, M. (2001), “The Taylor Rule and Optimal Monetary Policy,” *American Economic Review Paper and Proceedings*, Vol. 91, pp. 232–237.

World Development Indicators CD ROM (World Bank, 2004)

World Bank (1998a), *East Asia: The Road to Recovery*, Washington, D.C, pp 75.

World Bank (1998b), *Addressing the Social Impact of the Crisis in Indonesia: A Background Note for the 1998 CGI*, in the World Bank Web Site: <http://www.worldbank.org/html/extdr/offrep/eap/cgi98/soccris.htm>

World Bank (2000), *Contagion of Financial Crisis*, in the World Bank Web Site: <http://www1.worldbank.org/economicpolicy/managing>

Internet resources:

http://www.unibw-hamburg.de/WWEB/math/uebe/modelle/Indonesia/Indonesia.html

http://www.worldbank.org/html/extdr/offrep/eap/cgi98/soccris.htm
http://www1.worldbank.org/economicpolicy/managing

http://www.bi.go.id/bank_indonesia2/utama/publikasi/upload/SUPLEMEN%202003-Final_Engl.pdf

http://www.bi.go.id

Appendix 1

Selected Historical Macroeconomic Models of Indonesia

AUTHOR(S)	EQNS	STO	ID	MON	EXO	PERIOD
FUKUCHI (1968)	179	*NS*	*NS*	*NS*	*NS*	ANNUAL
WANG (1983)	28	20	8	7	26	ANNUAL
KURIBAYASHI (1987)	59	24	35	*NA*	30	ANNUAL
AZIS (1988)	15	6	9	18	39	ANNUAL
KOBAYASHI et al. (1989)	73	22	51	0	21	ANNUAL
SIMATUPANG (1986)	29	19	10	10	39	QUARTER
AZIS (1990)	42	18	24	8	15	ANNUAL
BAUTISTA et al (2001)	48	28	20	5	*NS*	ANNUAL

Notes:

EQNS denotes the total number of equations, i.e. the size of model.

STO denotes the number of stochastic equations, i.e. the number of those relations for which numerical parameters have to be determined numerically. It is also equal to the number of endogenous variables in the model.

ID denotes the number of identities or non-stochastic equations.

MON denotes the number of monetary and/or financial variables among the number of endogenous variables. It represents the number of endogenous monetary variables such as interest rates, exchange rates, money items (e.g. money M1, M2, M3,), financial assets, credit, capital account, etc, which describe the transmission of real shocks into the financial sector of the economy and vice versa.

EXO denotes the number of exogenous variables, which are not determined by the model and which must be known for any use of the model.

NS denotes not specified.

Data Appendix

The datasets used in the Indonesian SSMM come from several sources. The Indonesian consumer price index (CPI) data, the world CPI data, the domestic short-term interest rate as given by the 1-month SBI (Sertifikat Bank Indonesia) rate, the foreign interest rate as given by the US 3-month T-Bill rate, the oil price, exchange rates, and annual Indonesian government expenditure are taken from the *International Financial Statistics* (IFS) CD-ROM (latest edition for April 2004 by the International Monetary Fund). The data on real GDP, money supply as given by M1, and the core inflation data from 1988 to 2004 is by courtesy of Dr. Martin Panggabean, Chief Economist at Bank Mandiri, Indonesia. The quarterly data on real oil output from 1993 to 2004 is obtained from the website of Bank Indonesia (www.bi.go.id). All data used in this thesis are seasonally adjusted data.

Regarding the oil output data, we have to resort to the Chow-Lin interpolation method to construct the data from 1983 to 1993. The average oil price series (in US Dollars) is obtained from the *International Financial Statistics* (IFS) CD ROM. In doing so, we found some interesting points to note. The full sample data from 1983 to 2003 yielded a cross-correlation between oil output and oil price of 0.40, confirming that the oil price is a good related series for interpolating oil output. However, the positive and strong relationship between the oil price and oil output seems to be distorted by the occurrence of the Asian financial crisis. During the crisis, the Indonesian authority abandoned the historical managed floating exchange rate system, thus subjecting the Rupiah/US dollar to high volatility. Since we use the Rupiah oil price as the related series, the change in the exchange rate regime will affect the relationship between the oil price and output. As a remedy, we excluded the permanent structural break starting from 1998, the year when the impact of financial crisis was most severe for Indonesia. By doing so, the cross-correlation between oil output and the oil price improved to 0.68[1]. (see Figure DA. 1)

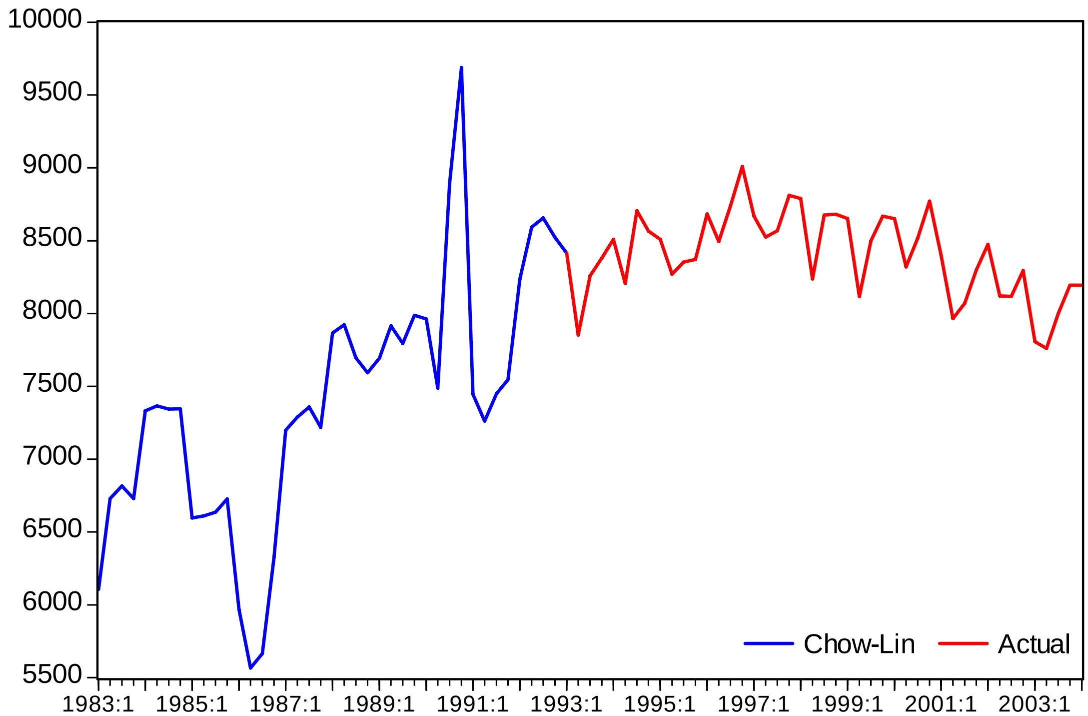
In constructing the foreign income level and the nominal effective exchange rate indices we use are the export shares to Indonesia's major trading partners as weights. The export data that we utilized is the data on merchandise exports between countries to measure bilateral trade flows. This is obtained from the Econometric Studies Unit (ESU) of the Department of Economics, National University of Singapore. The export-share matrix (*W)* is calculated as a 12-quarter moving average of export shares. This method has benefits according to Abeysinghe and Forbes (2001). It allows the export share matrix to vary smoothly over time. Although a constant *W* matrix would facilitate estimation and forecasting, this is not realistic since trade patterns change significantly over the long time period under consideration. Our final data set consists of 11 real foreign GDP series and 121 export share series, all compiled on a quarterly basis from 1983:Q1 through 2004:Q1. Formally, the construction of the foreign income level in the Indonesian SSMM is as follows:

$$y_t^f = \sum_{i=1}^{11} w_{it} y_{it} \qquad \forall \qquad i \neq j$$

$$w_{it} = \frac{\text{export}_{it}}{\sum \text{export}_{it}}$$

[1] The regression result also shows an improvement in the R^2 from 0.16 to 0.58 after eliminating the permanent structural break, showing a much better fit of the model.

Figure DA.1 Interpolation of Oil Output



We specify the inflation target to be time-varying over three different sub-periods: 1983:Q1–1996:Q4, 1997:Q1–1998:Q4, 1999:Q1–2004:Q1, in which the inflation target is the average inflation rate in each of these sub-periods. The inflation targets are 2% for 1983:Q1–1996:Q4, 8.33% for 1997:Q1–1998:Q4, and 1.85% for 1999:Q1–2004:Q1.

Tables DA.1, DA.2 and DA.3 below contain variable descriptions, ADF unit-root test results and descriptive statistics respectively. We plot the graphs of variables in Figures DA.2 and DA.3. We use the Akaike Information Criterion (AIC) to determine the lag(s) to be included in the ADF tests, with 8 being the maximum number of lags. We also included both a trend and intercept in the ADF test, except for the domestic interest rate for which only a constant was included. All variables are found to be integrated of order one at the 5% level of significance, except for the domestic interest rate and oil output, which seem to be stationary. We decided to treat foreign prices as an I(1) variable, although the ADF test statistic suggests that it might be an I(2) variable.

Table DA.1 Variable Description

Variable	Description (1993 = 100 for real variables)
y	Real GDP
y^{o}	Real oil output
y^{no}	Real non-oil output
oil	Average oil prices (in Rupiah)
m	Money Supply
p	Domestic Consumer Price Index (CPI)
p^{f}	World Consumer Price Index (CPI)
i	Nominal short-term interest rates
i^{f}	US 3-Month T-Bill rates
y^{f}	Foreign income index using export shares as weights
e	Exchange rate index using export shares as weights
g	Government spending

Table DA.2 Augmented Dickey-Fuller Unit-Root Tests

Variable	Number of lags for levels	ADF test statistics for levels	Number of lags for first-differences	ADF test statistics for first-differences
$ln(y)$	0	-1.721321	0	-10.06089 ***
$ln(y^{o})$	0	-3.197531*	3	-6.773218 ***
$ln(y^{no})$	0	-1.803143	0	-10.40400***
$ln(oil)$	2	-2.124384	1	-7.436519 ***
$ln(m)$	5	-2.872608	4	-4.500336 ***
$ln(p)$	3	-1.781602	2	-5.053029 ***
$ln(p^{f})$	8	-0.502955	6	-2.149174
i	3	-4.377577 ***	3	-5.413668 ***
i^{f}	8	-2.134718	7	-4.480990 ***
$ln(y^{f})$	2	-2.440192	0	-6.247035 ***
$ln(e)$	3	-2.515189	2	-5.584517 ***
$ln(g)$	4	-1.907916	3	-3.943814 **

Note: *, **, and *** denotes 10%, 5%, and 1% levels of significance.

Figure DA.2 Graphs of Macroeconomic Variables in the Indonesian SSMM

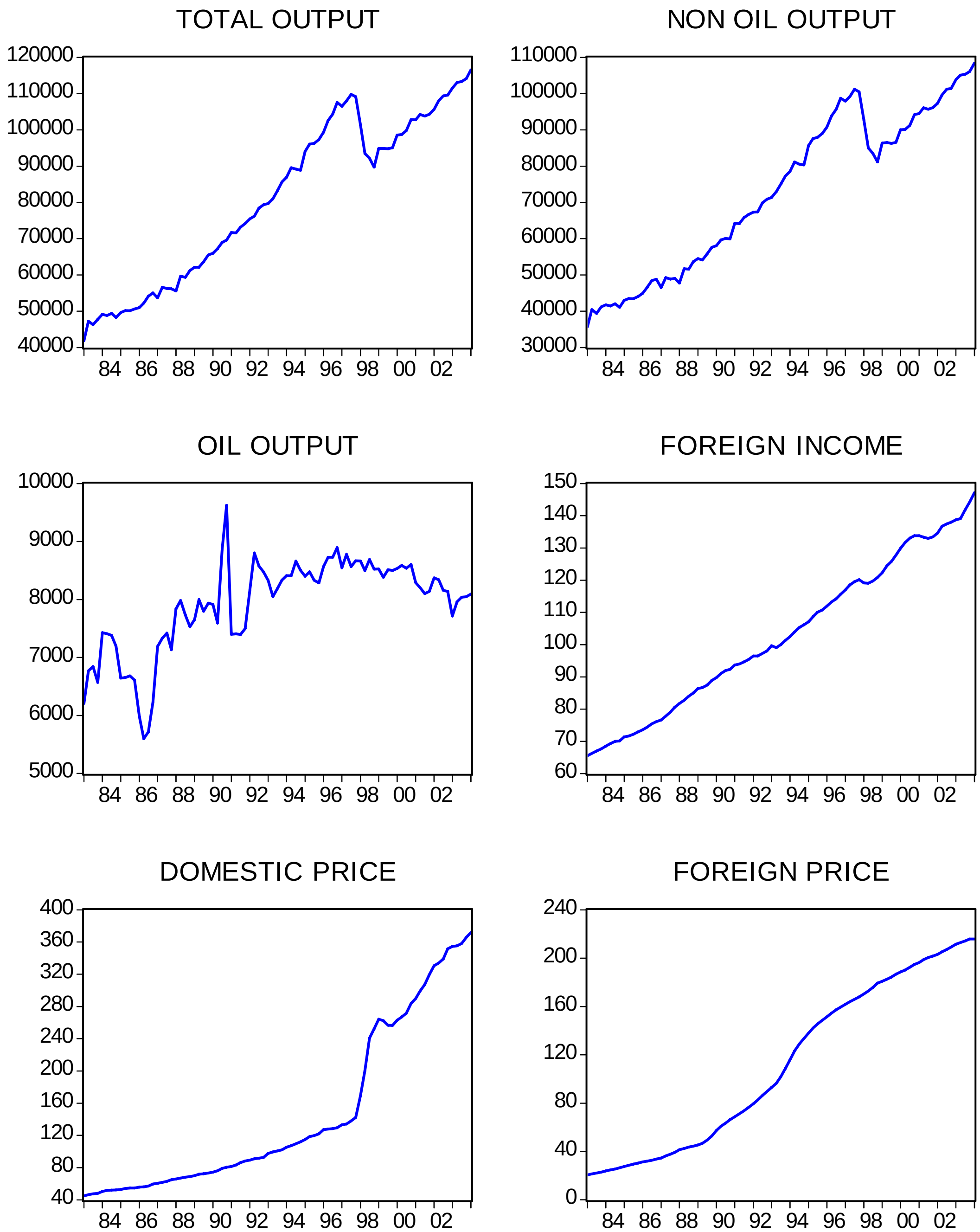


Figure DA.3 Graphs of Macroeconomic Variables in the Indonesian SSMM

(Continued)

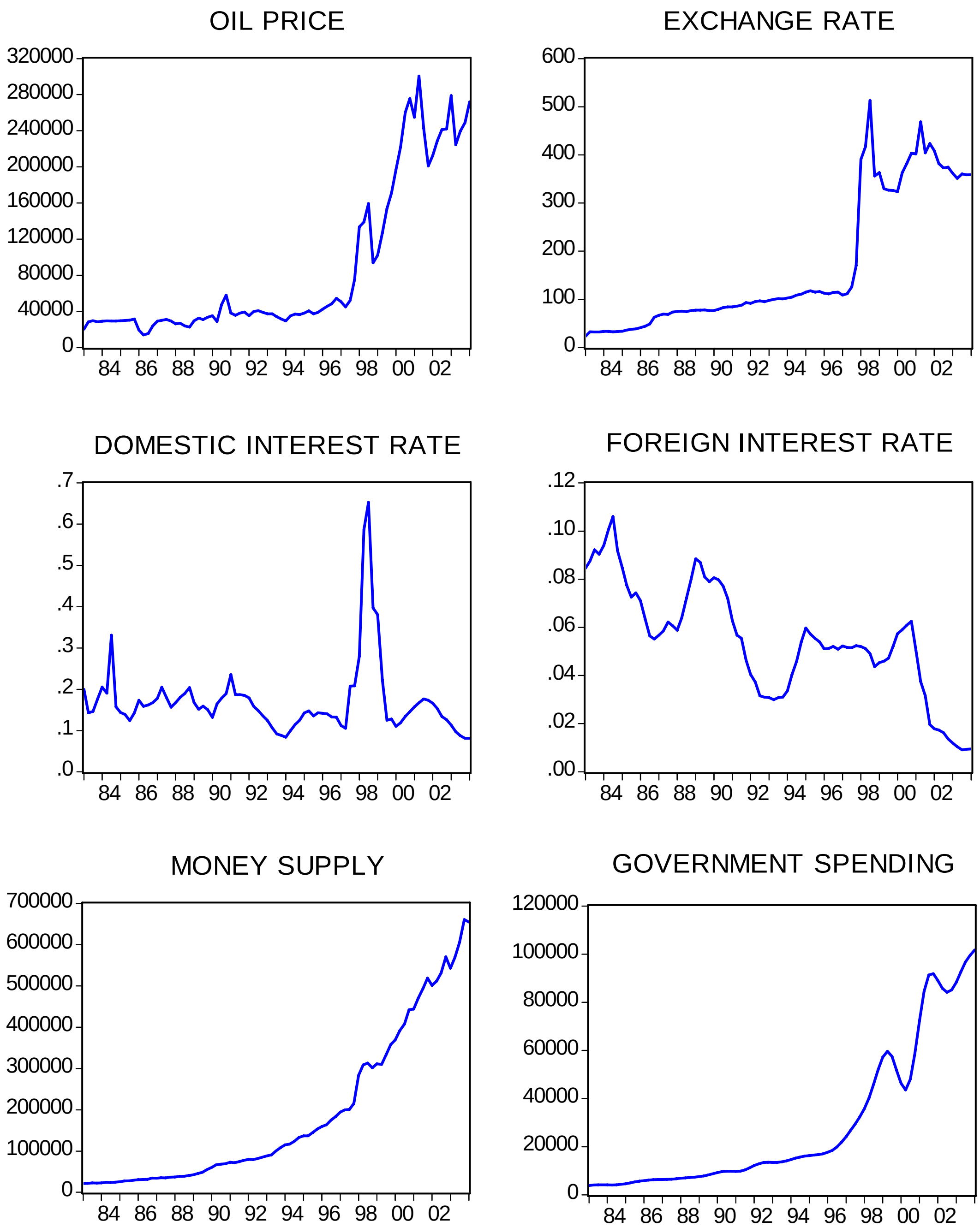


Table DA. 3 Descriptive Statistics for Variables

	GDP real (Constant 1993)	Real OIL_GDP (Constant 1993)	Real NON_OIL_GDP (Constant 1993)	Domestic CPI (Base 1993)
MEAN	80751.69	7920.74	72830.95	145.81
MEDIAN	83285.21	8140.13	75094.90	100.74
S.D.	22490.64	797.67	21916.83	103.46
KURTOSIS	1.57	3.51	1.57	-0.56
MAXIMUM	116547.88	9623.67	108453.91	371.86
MINIMUM	41878.03	5598.80	35671.47	44.98

	Domestic Short Term Interest Rate	Foreign Interest Rate (US 3 Month T-Bill)	Exchange Rate Index (Base 1993)	Government Expenditure
MEAN	17.21	5.46	165.96	28608.98
MEDIAN	15.24	5.42	100.56	13843.44
S.D.	9.06	2.31	140.80	29988.57
KURTOSIS	16.74	-0.38	-0.81	0.16
MAXIMUM	68.76	10.73	506.48	100505.25
MINIMUM	8.31	0.93	21.21	3818.98

	Oil Price (in Rupiah)	Money Supply (M1)	World CPI (Base 1993)	Foreign Income Index (Base 1993)
MEAN	85996.28	187592.91	110.20	102.87
MEDIAN	38054.54	100215	99.18	100.04
S.D.	86153.92	186410.17	68.15	23.62
KURTOSIS	-0.07	-0.10	-1.60	-1.21
MAXIMUM	300453.54	660731	215.04	147.14
MINIMUM	14020.11	21287	20.73	65.52