

**ASSESSING POLICY CREDIBILITY OF THE MALAWI GROWTH
AND DEVELOPMENT STRATEGY IN MALAWI**

MA (ECONOMICS) DISSERTATION

By

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**Submitted to the Department of Economics, University of Malawi, Chancellor College, in partial
fulfilment of the requirements for the Masters of Arts Degree in Economics**

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SEPTEMBER 2007

DECLARATION BY THE CANDIDATE

I declare that this dissertation is my own work and that it has not been submitted for a degree in any other university. Acknowledgements and references have been made where work of other people has been used.

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DEDICATION

To my beloved parents (*Gilbert and Faustace*), wife to be (*Towera*) and my daughter
Elsie of whom I cherish the most.

ACKNOWLEDGEMENTS

I am greatly indebted to my supervisors, **Professor Ben Kaluwa** and **Dr. Patrick S. Kambewa**, from the Economics Department, Chancellor College, for their profound guidance and supervision in the process of writing my dissertation. Special thanks also to Professor C. Chipeta, Associate Professor E. W. Chirwa, Dr. W. Masanjala, Dr. E. B. D. Silumbu, Dr. R. Mangani, from the Economics Department, Chancellor College, for their important comments that shaped the final research work. In addition I thank Dr. C. Lawson, Dr. T. Hinks, Dr. H. Feldman, and Dr. P. Dawson from the University of Bath, England, who assisted me in the initial preparation of my dissertation.

Also special thanks go to Mr. F. Zhuwao from the Ministry of Finance and Mr. A. Palamuleni from the Reserve Bank of Malawi who provided me with the relevant data and information that I have used in writing my dissertation. Sincere gratitude goes to my fellow classmates who read and offered some comments that have refined and clarified some concepts in my dissertation.

I must also thank Dr. A. Tench, Ms. C. Banda and all staff from the Capacity Building Programme for Economic Management and Policy Coordination (CBPEMPC) and the Economic Common Service of the Malawi Government for offering me a two-year scholarship to study a Masters of Arts degree in Economics at Chancellor College and further post-graduate training at the University of Bath, England, which has increased and undoubtedly improved my knowledge, capacity and application of skills in the field of Economics.

To my family, relatives and friends too numerous to mention who have all been a source of inspiration, guidance and support. Your contributions are duly respected. Finally to my beloved and wonderful daughter, *Elsie*, whose reflection brings sweet moments of joy, peace and happiness in my life, may God bless you all.

ABSTRACT

The study employs multivariate macro-econometric techniques in assessing the credibility of the Malawi Growth and Development Strategy's (MGDS) implementation plan. The multivariate approach looks at the dynamic relationships over the study period of four macroeconomic variables. Based on the Mundell-Fleming three-sector model, a structural vector autoregressive technique is employed using '*identifying restrictions*' developed by Blanchard and Quah. This approach relies on the *data generating process* to forecast the selected variables during the MGDS implementation period (2006Q1-2011Q4). The SVAR model is used to identify the main macroeconomic factors behind the fluctuations in all six variables except inflation and real effective exchange rate over the 1980Q1-2005Q4 period.

The method applied by the latter projections compares benchmark forecasts generated by the IMF financial programming technique which considers consistency of macroeconomic flows in the accounting framework of real and financial variables. The dynamic relationships generated from the SVAR model shows consistency with the general movements of variables in the Mundell-Fleming framework.

The results show that it is important for government to consider people's perceptions in order to effectively formulate optimal policy rules and regulations. The results also show that forecasts generated by the SVAR methodology employed on real GDP, government budget deficit, Treasury bill rate and the trade balance are consistent with those generated by the IMF financial programming technique. The forecast results also confirm credibility of the government policies that would be followed during the MGDS implementation period.

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LIST OF ACRONYMS

AEH	Adaptive Expectations Hypothesis
AIDS	Acquired Immuno-deficiency Syndrome
ASAC	Agricultural Sector Adjustment Credit
AIC	Akaike Information Criterion
ADF	Augmented Dickey-Fuller
AR	Autoregressive
ARCH	Autoregressive Conditional Heteroscedasticity
ARMA	Autoregressive Moving Average
BDS	Brock, Dechert and Scheinkman Test
CABS	Common Approach to Budgetary Support
COMESA	Common Market for East and Southern Africa
CSO	Civil Society Organisation
DEVPOL	Development Policies
DF	Dickey-Fuller
DFGLS	Dickey-Fuller with Generalised Least Squares
ECOWAS	Economic Community of West African Countries
GBD	Government Budget Deficit
GDP	Growth Domestic Product
GLS	Generalised Least Squares
HIPC	Highly Indebted Poor Countries
HIV	Human Immuno-deficiency Virus
IHS	Integrated Household Survey
IID	Independently and Identically Distributed
IMF	International Monetary Fund
INFL	Inflation
IRA	Impulse Response Analysis
ITPAC	Industry and Trade Policy Adjustment Credit
LM	Lagrange Multiplier

MEGS	Malawi Economic Growth Strategy
MGDS	Malawi Growth and Development Strategy
MK	Malawi Kwacha
MPRS	Malawi Poverty Reduction Strategy
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organisation
OLS	Ordinary Least Squares
PAP	Poverty Alleviation Programme
REER	Real Effective Exchange Rate
REH	Rational Expectations Hypothesis
RESET	Regression Specification Test
RBM	Reserve Bank of Malawi
SADC	Southern Africa Development Community
SAP	Structural Adjustment Policies
SBC	Schwarz-Bayesian Criterion
SMP	Staff Monitored Programme
SVAR	Structural Vector Autoregression
TB	Trade Balance
TBRATE	Treasury Bill Rate
VAR	Vector Autoregression
VECM	Vector Error Correction Mechanism
VMA	Vector Moving Average Representation
WB	World Bank

Chapter One

1.1 Background of the Study

Since 1964 when Malawi attained her independence from Britain, government policy formulation was guided by central planning strategies aimed at promoting sustained economic growth and transforming the nation from a poor country to a relatively middle-income, industrialized nation. The paradigm of development economics during the 1960s was Rostow's (1963) growth theory that focused primarily on the agricultural sector. The agricultural sector was seen as the '*take off*' point towards an industrialised nation and the top priority for the Malawian Government was to raise agricultural productivity (DEVPOL; 1971-80). In Malawi between 1974 and 1979 this approach resulted in an average real gross domestic product growth rate of 6.0% per annum.

The emphasis on agriculture was based on the *comparative advantage paradigm* in that Malawi was seen to have abundant natural resources (land) and a bulk of labour supply. The obvious logic was to follow *labour-intensive* production techniques so that the country could reap its benefits from utilising fully both its abundant labour and land resources. Investments to support the growth theory were to improve on infrastructure development especially on transport and commercial markets paving the way for private sector development.

The *trickle down effect* from such an approach was that government believed the rate of agricultural growth would largely determine and feed into the rate of growth in the manufacturing sector. In other words, there were *backward* and *forward* linkages to be realised and performance of the people was key to such a development. However, the Malawi Government envisaged that such agricultural projects would only affect directly a minority of the population (smallholder farmers) and that even less people would be able to find an appropriate wage employment (DEVPOL, 1971-80).

As a prerequisite for future development of transforming the country from a peasant economy to an industrialised country, the Malawi Government in the 1970s laid down

foundations and significant achievements were realised. These included a rapid reduction in the budgetary deficit and reliance on foreign budgetary aid. The overarching performance was partly a result of sound macroeconomic management by the government due to controlled government budget deficits averaging 10.0% of GDP, low inflation, good and reliable weather conditions, and ready export markets of key agricultural exports such as tobacco, tea and sugar on the international scene.

In addition, the Malawi Government in the 1970s had made important developments that were necessary and vital for private sector development. Some of the notable achievements included the construction of new and improved roads, a new railway line, a hydro-electric scheme and a university for human resource development (DEVPOL, 1971-80). Nevertheless, the economy was still prone to international shocks especially oil shocks in 1973 and 1979. The agricultural sector, the engine for growth, was affected heavily because of its profound reliance on imports such as fertilizers, fuel (petroleum), and other raw materials.

During the 1980s, significant progress was made towards Malawi Government's objective of increased private sector investment, growth in export oriented industrial base, and the development of an entrepreneurial class. Growth in manufacturing output had increased significantly with an annual average rate of 9.6% between 1964 and 1980, GDP at factor cost increased from 9.0% to 12.5% and significant increases in employment were realised from 7,500 to 50,000 during the same period (DEVPOL, 1987-96).

The structure of the industrial base was categorised into food processing, textiles, tobacco and tea processing and there were improvements in capacity utilisation and profitability in almost all firms (DEVPOL, 1987-96). The constraint at this stage, however, was that the industrial base was still in its infant stage and comprised of a small number of firms that were either controlled by parastatals or multinational companies that needed some form of government protection.

The focus in the 1980s was on poverty reduction as government realised that the trickle down effect of the growth theory followed in the 1970s did not materialise fully in transforming a significant proportion of the population from a poor state to a middle-income state. Instead of a '*growth theory with trickle down effect*' paradigm of the 1970s the government now proposed '*economic growth and poverty reduction*' as a guiding principle for the 1980s. At this stage the government's aim was still to increase productivity by exploiting Malawi's natural resources and human capital and to improve on social factors such as income redistribution, reduction of instability of welfare, poverty reduction, improved literacy and health status of the poor.

The DEVPOL (1987-96) recognised that the most significant economic development in the 1970s was the acceleration of instability and insecurity of the Malawian economy mainly from external shocks and concerns were now towards stabilization policies. As a remedy, in the early 1980s most African countries began to adopt the World Bank /International Monetary Fund Structural Adjustment Policies (SAPs) and Poverty Alleviation Programme (PAP). These programmes were designed to provide loans to affected less developed countries to mitigate the consequences of the aftermath of the shocks (Tarp, 1993; Franses, 1995).

By the late 1980s and early 1990s another wave of policies under the SAPs and PAP were implemented aimed at boosting the industrial sector in Malawi. Two major credit facilities from the IMF were allocated known as the Industry and Trade Policy Adjustment Credit (ITPAC) and the Agricultural Sector Adjustment Credit (ASAC) established in 1987 and 1990, respectively. These facilities targeted improving investments in manufacturing and agricultural sectors of the Malawian economy.

In addition the New Partnership for Africa's Development (NEPAD) was established in the 1990s as Africa emphasized customs union in order to improve economic growth and welfare on the African continent. The most prominent economic integration bodies to date include the Southern African Development Community (SADC) and the Common Market for East and Southern Africa (COMESA) in Sub-Saharan Africa and Economic Community for West African Countries (ECOWAS) in West Africa.

In the mid 1990s most African governments were now implementing the World Bank Poverty and Reduction Strategy. The major donors and governments noticed the failure of SAP and PAP in helping poor nations recover from the economic recession. The development paradigm now shifted to '*poverty reduction and then growth*' emphasising that government's aim was to create conditions for the poor to reduce their own poverty such as empowerment.

The Malawi Poverty Reduction Strategy (MPRS) which commenced in 2002 for a three-year span was based on the medium term expenditure framework. It focused on four pillars namely; to promote rapid sustainable pro-poor economic growth and structural transformation, to enhance human capital development, to improve the quality and life of the most vulnerable, and to promote good governance. Issues on HIV and AIDS, gender, environment, science and technology were seen as cross-cutting. It is argued that poor growth in less developing countries was a result of inadequate investment in human capital and focused much on state-led industrial firms (Stewart, 1995).

1.1.1 Macroeconomic Performance in Malawi since 1980

Economic growth in Malawi was not impressive in the 1980s to the mid 1990s despite changes in policymaking. Real average economic growth was between 2.9% and 4.0% per annum, respectively. However, real economic growth in 1981, 1992, 1994 and 2000 was negative particularly due to droughts and the after-effects of changing government regime and elections especially in 1994 and 1999. In the 1980s the average growth rate in real GDP was 2.5% per annum, in the 1990s, 2.4% per annum, and between 2001 and 2005 an average of 1.8% (see figure 1 in appendix B).

The trade balance since 2001 has been worsening and between 2000 and 2005 exports increased by 25% while imports increased by almost 70%. The trade balance was, therefore, grossly affected and increased from 9% to 23% of GDP within the same period. Over the same period interest rates recorded a maximum of 49% in 2000 averaging about 35.6% between 2000 and 2005. Other key macroeconomic variables such as nominal exchange rates were depreciating drastically on major currencies such as

the US dollar and the British Pound. Inflation and monetary growth were also highly volatile.

1.1.2 Current Policies in Malawi: The Malawi Growth and Development Strategy (MGDS)

The economic policies of the Malawian economy since independence can be summarised in three stages: the first period (1964-1980) is regarded as a period of '*economic growth with trickle down effects*'. The second period (1980-1996) was a period of '*economic growth with poverty reduction*'. The third period's (1996-2004) economic paradigm was that of '*poverty reduction and empowerment*'.

At the completion point for the MPRS in 2003/4, the Malawi Government extended the first pillar under MPRS by introducing the Malawi Economic Growth Strategy (MEGS). The MEGS was designed after government realised that the MPRS pillar of rapid sustainable pro-poor growth did not lead to sustainable economic growth. The MEGS was implemented in 2004 and the economy was still susceptible to external shocks such as weather, changes in terms of trade, oil shocks, political developments and fluctuations in foreign aid. Instead, MEGS emphasised on private sector development focusing primarily on spreading the risk in key sectors such as agriculture (tobacco, tea, coffee, cotton, etc.), mining, tourism and manufacturing.

To consolidate the MEGS government in 2005 designed the Malawi Growth and Development Strategy (MGDS) in order to incorporate social policy issues. The MGDS comprises of two parts; the '*growth*' strategy, which emphasizes the creation of a conducive environment for private sector development, and the '*development*' strategy, focusing on social factors. The main agenda of the MGDS is to try to revive the economy through sustainable economic growth and infrastructure development targeted to create wealth and reduce poverty that Malawi has faced for several decades.

The focus on private sector development aims at transforming Malawi from an importing country to a net export-oriented nation. To achieve this goal, five themes have been identified and six-key priority areas, which are expected to promote immediate economic

growth in the medium-term plan (2006/7 to 2010/11), have been highlighted. The thematic areas comprise of sustainable economic growth; social protection; social development; infrastructure development; and improved governance. These themes are groundwork in creating conducive macroeconomic environment for private sector development.

The six key medium-term priority areas that would promote sustainable economic growth and poverty reduction in the medium-term framework are agriculture and food security, irrigation and water development, transport and infrastructure development, energy generation and supply, integrated rural development, and prevention and management of nutritional disorders (focusing on HIV and AIDS).

1.1.3 Assumptions Underlying the MGDS

In the medium term framework the government will play a key role in the implementation of the MGDS and assumes that all stakeholders involved *will align* their strategies accordingly. The Government also assumes that a favourable macroeconomic environment will be created for private sector development. The focus will primarily be on infrastructure development and good governance creating favourable conditions for the improvement of key macroeconomic variables such as a favourable average growth rate of real GDP, a sustainable government budget deficit, low inflation and interest rates, stable and non-volatile exchange rates.

By assumption that stakeholders are expected to align their strategies in accordance with the expectations based on the MGDS framework is an attempt to integrate economic agents' future expectations with government expectations. As Kydland and Prescott (1977) notes, government may be able to maximise its intended social objective function given that economic agents' expectations conform to their plans.

1.1.4 The Main Fiscal and Monetary Policy Objectives

The fiscal policy objective aims at maintaining fiscal discipline while simultaneously balancing government expenditure between the productive and social sectors of the economy. The targets of fiscal deficits are projected at an average of 0.2% of GDP for a

period of five years. Government also aims at reducing the debt-interest repayment burden to an average of 3.0% of GDP in the same period over five years. The government also expects the debt stock to decrease from 21.5% of GDP in 2005 to less than 10.0% of GDP in 2011.

The main monetary policy objective is to follow a disinflationary policy rule and sustain low interest rates which are currently at 20% (2006/07). The government aims to reduce inflation in the country to 5.0% by 2011 with policy instruments focused on broad money, foreign exchange sales and open market operations as the main instruments influencing liquidity in the country.

1.2 Problem Statement

The policy formulation process prior to the MGDS comprised of incorporating informed decisions from various stakeholders, an assessment of previous data and statistics and incorporating lessons learned from the MPRS. The first stage in drafting the strategy involved conducting participatory meetings and forums with various stakeholders ranging from donors, line ministries, Non-Governmental Organizations (NGOs), Civil Society Organizations (CSO), and the private sector. Field visits were also vital to conducting situation analyses which were compared with some basic data and statistics from the Integrated Household Survey (IHS- wave I and II) and the MPRS comprehensive review in order to make informed decisions.

However, the MGDS framework lacks a comprehensive economic assessment of people's perceptions on future movements of key macroeconomic variables that are a source of information in economic decision making¹. In addition, the methodology employed by the Ministry of Finance in Malawi using the IMF financial programming technique only considers consistency of macroeconomic accounts, which is not robust in making projections/forecasts on policy variables. The iterative process in financial programming that involves refinement and convergence is time consuming and one does

¹ In fact at the 2006/07 Joint Country Programme Review held in May 2007 in Lilongwe, Malawi, between the Malawi Government, donors and stakeholders, it was noted that the MGDS priorities lacked sound economic assessment which reduced donor confidence.

not have a clear benchmark as to when the projections become efficient. The study, therefore, provides an alternative economic assessment of the MGDS implementation plan focusing on macroeconomic aggregates and relying on the *data generating process* of these aggregates to make projections/forecasts.

1.3 Objectives of the Study- Key Research Questions

Since the implementation of the MGDS depends on the fiscal and monetary policy interventions, the aim of the study is to look at the *credibility* of the MGDS framework in fulfilling its promises. The government postulates that future expectations on the movements of certain macroeconomic aggregates is to increase real GDP growth by an average of 6.0% per annum, a controlled government budget deficit averaging -5.0% of GDP, favourable interest rates averaging 17.0% and an improved trade balance from an average of -23% to -9.3% of GDP. Policy credibility in this case is assessed by considering *forecasts* of these key macroeconomic variables that the Malawi Government will prioritise during the implementation period of the MGDS (2006-2011). In particular the study aims to answer the following question:

1). Are the new government policies *predictable*?

- This looks at the movements and stability of key macroeconomic variables and their forecasts during the MGDS implementation period (2006-2011). In other words, will real GDP grow by the predicted 6.0% per annum? Will the government budget deficit average the projected -5.0% of GDP?

1.4 Hypotheses to be tested

The outline of the key research question above enables key hypotheses to be tested. Prior to the MGDS implementation period between 2000 and 2005, real GDP growth averaged about 1.8%, GBD was -22.7% of GDP, deposit rates averaged 35.6% and the trade balance was -23.0% of GDP by the end of 2005. The set of hypotheses to be tested are based on *forecasting results* for the MGDS implementation period (2006-2011) as follows:

- 1) Real GDP growth rate will not average 6.0% per annum,
- 2) Interest rates will not decrease to an average of 17.0% per annum,
- 3) The government budget deficit will exceed -5.0% of GDP, and
- 4) The trade balance will not average -9.3% of GDP.

1.5 Outline of the Dissertation

Chapter one has covered the background, assumptions, problem statement, objectives of the research topic and hypotheses to be tested. The next chapter reviews the literature and discusses the theoretical and empirical evidence on credibility and forecasting. Chapter three outlines the methodology which comprises of model specification and data to be used. This chapter also outlines the diagnostic tests to be used and the nature of the data. Chapter four includes the data analysis and diagnostic tests particularly on establishing the time series properties/characteristics of the data. Chapter five discusses estimation and forecasting results using structural VAR modelling. Finally, chapter six covers summary, conclusions, policy implications and recommendations.

Chapter Two

2.1 Literature Review

Pareto (1906) argued that the whole idea in economics is to attain a general equilibrium framework in which welfare is maximized. His approach looks at an agent-optimization principle in a ‘price-taking’ market economy. It emphasises on *efficiency* as a key concept focusing on ‘*tastes and constraints*’ rather than issues of demand and supply as exhibited in the Walras-Cassel models.

Two fundamental theorems characterised the Paretian system which now guide the capitalist ideology. The first fundamental theorem argues that every competitive equilibrium is Pareto-optimal. The second fundamental theorem states that every Pareto-optimal allocation can be achieved as a competitive equilibrium after a suitable redistribution of initial endowments (Gravelle and Rees, 2004). The latter theorem has provided a yardstick for government involvement in maximizing social welfare in any economy.

The aim of domestic firms in a competitive economy is to produce goods and services based on certain determinants that are conducive to private production. Most firms in an economy produce in order to maximize their welfare, usually private profits. Government, on the other hand, maximizes social welfare through redistributing part of the profits from the private agents and to the poor. In such scenarios government will choose simple rules, regulations and policy instruments targeted at maximizing social welfare but at the same time minimizing private sector welfare loss (Kydland and Prescott, 1977; Gravelle and Rees, 2004).

Some of the optimal policy instruments used include optimal tax policies, targets of government expenditure, monetary growth, optimal government deficits, low interest rates, and stable exchange rates. If the government’s aim is to promote sustainable growth with the private sector as the driving force, it needs to control such policy instruments. On the other hand, the private sector’s expectations are such that

government targets and policies are credible aimed at creating a favourable environment for private sector development. In such scenarios private economic agents view government strategies or policies as sets of information used to update their *expectations* on the future movements of key variables in the economy.

2.2 Optimal Policymaking Decisions and Rational Expectations

Expectations of this sort between the government and the private sector are well documented in the literature. The Adaptive Expectations Hypothesis (AEH) and the Rational Expectations Hypothesis (REH) are some of the assumptions made on economic agents' behaviour on how they value and assess information. The AEH literature was first used by Cagan (1956) and Friedman (1956) in assessing movements of inflation (monetary growth) using the Phillips curve. The hypothesis asserts that economic agents re-evaluate their inflationary expectations by assessing past inflation rates by a *fraction* of the error they last made. In this hypothesis, however, criticisms have been made on the irrationality of economic agents' behaviour that only partially assesses the information at hand.

It was Muth (1961) who first coined the rational expectations hypothesis suggesting that expectations may be treated as *informed predictions* of future events which are necessarily predictions of the relevant economic theory. The expectations argument under the rational expectations hypothesis take into account all '*publicly*' available information and make the best use of this information in determining the factors driving a specific variable. In the current situation, it is assumed that individuals or economic agents are making the best use of all the information that is provided in the MGDS in making their private decisions.

A government strategy, if credible, ought to influence private sector decisions in the long run and economic agents will make use of all available information they can find on the movements of these policy instruments in making their decisions. The rationality assumption implies that once economic predictions are different from the agents' rational expectations, economic agents will also alter their utility maximizing behaviour to incorporate the '*news*' or new information provided (Sargent, 1986).

Lucas (1976) argued that it was improper to assume that parameters of large-scale macro-econometric models would be constant over time because economic agents adjust their behaviour once given new information. He stated that in the presence of rational expectations it becomes difficult for policy makers to calculate optimal policy targets and non-inclusion of [*rational*] expectations was seen as a major defect in such models.

Kydland and Prescott (1977), on the other hand, argued that once government's optimal policy targets at time $t = 0$ are different from the expected policy targets at time $t + i$ envisaged by economic agents, then the policy is said to be '*time- or dynamic-inconsistent*'. In order to minimise the problems created by large-scale macroeconometric modelling, Sims (1980) introduced a dynamic modelling technique that has revolutionised the modelling of economic behaviour.

But how does this augur well with the way the MGDS has been formulated? In Kydland and Prescott's argument, optimal control theory is not the best policymaking option because it relies on current and past policymaking decisions and upon the current state of affairs without considering future expectations. This is the reason why most government social objective functions, among other things, are not maximised when implemented. However, policymaking behaviour has changed since the Lucas' critique in the 1970s in which policymakers now incorporate future expectations in their national strategies through identified long-term goals.

In Malawi, the MGDS formulating framework is based on the Malawi Vision 2020 which is a long-term development perspective for Malawi and incorporates all expectations of how the economy should be by the year 2020. It is also apparent that the MGDS formulation considers current as well as past policy decisions and also incorporates people's expectations by aligning all short- and medium-term strategies with long-term goals identified by the Malawi Vision 2020. The methodology to be used, therefore, assumes that rational expectations are already incorporated in national strategies so that the propagations or impulses generated by the Structural Vector Autoregressive (SVAR) model to be employed are robust.

2.3 Forecasting and Non-Structural Macroeconometric Modelling

Vector Autoregressive (VAR) modelling is a reduced (non-structural) form dynamic multi-equation technique that introduces dynamic relationships among macroeconomic variables and places few *a priori* restrictions on the system of relationships. It assumes that each variable in the dynamic system depends on lags of itself and lags of other variables forming the system. The importance of such a dynamic system arises from the fact that *no set of strict hypotheses on structural relationships* are imposed. The specification rather allows regularities or stylised facts within the data or data generating process to be revealed (Haden and Van Tassel, 1988; Charemza and Deadman, 1997)

The model employed will be the *vector autoregression* (VAR) and *Vector error correction* (VEC) models developed by Sims (1980) particularly because the variables to be used are considered to be endogenous. In addition VAR modelling is also suitable for forecasting a system of equations of interrelated time series and analysing the dynamic impact of random disturbances on the system of variables.

To use the VAR approach the macroeconomic variables in use must be integrated of the same order, say $I(1)$. Provided that all variables in the model are non-stationary and integrated of some order, the Engle and Granger (1987) or the Phillips and Hansen (1990) approaches to cointegration may be used. These two approaches to cointegration use the Dickey-Fuller (DF) or Augmented Dickey Fuller (ADF) tests on the residuals from the estimation. The Johansen (1988) cointegration test is appropriate in this case as the study assumes a multivariate relationship amongst the variables used in order to determine the cointegrating equations in the VEC model. The functional form of a reduced form VAR representation is as follows:

$$\mathbf{Z}_t = \Gamma_1 \mathbf{Z}_{t-1} + \dots + \Gamma_p \mathbf{Z}_{t-p} + \Phi \mathbf{D}_t + \varepsilon_t \quad (1)$$

Where $\mathbf{Z}_t = n \times 1$ vector of endogenous variables

$\mathbf{D}_t = k \times 1$ vector of deterministic components

$\Gamma_1, \dots, \Gamma_p$, and Φ are coefficient matrices to be estimated

$\varepsilon_t = n \times 1$ vector of innovations that may be contemporaneously correlated

The VAR modelling technique has an interesting property that since only lagged values of the endogenous variables appear on the right hand side of the equation (1) there is no simultaneous equation bias and using ordinary least squares (OLS) yields consistent estimates.

2.3.1 Structural Vector Autoregressions (SVAR) Modelling

Structural VAR (SVAR) models are one of the three VAR modelling techniques used in dynamic response modelling and have provided a lee-way in using economic theory to justify the contemporaneous links among variables (Bernanke, 1986; Blanchard & Watson, 1986; Blanchard & Perotti, 2002)².

Strictly speaking, an unrestricted $VAR(p)$ –process can be interpreted as a reduced form VAR model and a $SVAR(p)$ –process as a structural form of the reduced form VAR model based on identifying restrictions. Recall equation (1) of the $VAR(p)$ –process

$$\mathbf{Z}_t = \Gamma_1 \mathbf{Z}_{t-1} + \dots + \Gamma_p \mathbf{Z}_{t-p} + \Phi \mathbf{D}_t + \varepsilon_t \quad (=1)$$

The $SVAR(p)$ –process in this case could be represented by

$$\Gamma \mathbf{Z}_t = \Gamma_1^* \mathbf{Z}_{t-1} + \dots + \Gamma_p^* \mathbf{Z}_{t-p} + \Phi^* \mathbf{D}_t + \mathbf{B} \mathbf{u}_t \quad (2)$$

It is assumed that the structural errors (u_t) are orthonormal or white noise and the coefficient matrices Γ_i^* are structural coefficients that may or may not differ from their reduced form counterparts (Pfaff & Taunus, 2006). The main purpose of the $SVAR(p)$ –model is to obtain *non-recursive orthogonalisation* of the error terms for the impulse propagation through *structural decomposition*. The long-run response to structural innovations takes the form

$$\mathbf{C} = \Psi_\infty \Gamma^{-1} \mathbf{B} \quad (3)$$

² There are three types of VARs used in the literature namely: reduced-form VAR, a recursive VAR and structural VAR. Thorough descriptions of the other models are well discussed in the cited references.

where $\Psi_{\infty} = (\mathbf{I} - \Gamma_1 - \dots - \Gamma_p)^{-1}$ is the estimated accumulated response to the reduced form (observed) shocks

This type of restriction has been used by Blanchard and Quah (1989) which exploits information from other variables. They argue that some macroeconomic variables are affected by *more than one economic shock*, for example, real GDP. As a result more information may be exploited by considering other variables using multivariate analysis.

2.4 The Mundell-Fleming Model and the SVAR Representation

The study bases its economic theory on the workings of the three-sector Mundell (1960) and Fleming (1962) models which comprise of the *IS* – framework, the *LM* – framework and the *BP* – framework. The Mundell-Fleming model has the advantage that it treats the variables to be used in the model as being *endogenous*. It is also important as it brings into equilibrium the three-sectors of the economy, vis-à-vis: the real sector, the money market (monetary) sector and the external sector.

The relevance of this model reflects the MGDS framework of making sure that certain key macroeconomic variables that the government intends to monitor follow a general equilibrium trend based on the Mundell-Fleming mechanism of increased real income (real sector), stable and controlled government budget deficit (real sector), low interest rates (monetary sector), stable exchange rates and balance of payments (external sector).

2.5 Empirical Evidence

The credibility of a fiscal discipline can be observed from a monetary policy of disinflation. It is argued that changes in government tax and expenditure regulations aimed at promoting fiscal discipline are critical for a credible monetary policy objective of attaining low inflation rates (Baar, 2002). A permanent deficit reduction should occur if government is to realize a disinflationary policy. It is important, therefore, that a joint credibility and consistency of fiscal and monetary policy is attained when government is formulating its strategies.

However, there are costs associated with disinflation if the government does not implement its fiscal discipline framework. A low rate of inflation implies a tight monetary policy and at least a deceleration of monetary growth. The stylized facts of this trend are that a tight monetary policy would result in an increase in real interest rates, a real appreciation of the exchange rate, and an induced recession. According to Baar (2002), such consequences have a direct negative effect on the government's budget deficit as it may lead lower government seigniorage revenue, high debt servicing costs, and increases in government expenditures through borrowing to finance automatic stabilising components.

The sensitivity of such outcomes has a direct effect on the credibility of the fiscal and monetary policy that the current regime might face. In addition, the type of exchange rate regime followed (flexible or fixed) has implications on the effectiveness of either fiscal or monetary policy. In a flexible exchange rate regime, fiscal policy is completely ineffective and monetary policy completely effective. Conversely, in a fixed exchange rate regime, fiscal policy is completely effective whereas monetary policy is impotent. In a managed or 'dirty' float both policies are effective. On the other hand, a low and stable inflation rate is expected to boost private sector confidence and thus increase output by reducing the uncertainty about future prospects, reducing transaction costs, and economic stability (Sato, 2001; Dodge, 2002).

In terms of forecasting techniques used in developing countries, Musila (2001) who developed an econometric model for Malawi argues that most developing countries have employed a small economy $IS-LM$ aggregate supply framework in generating forecasts. The SVAR methodology used is therefore an extension to the small-economy aggregate supply framework.

Chapter Three

3.1 Methodology

Issues of credibility of government fiscal and monetary policies in the literature have been measured either qualitatively or indirectly through proxy variables. In this study, credibility is treated as an *unobservable* variable and is assumed to arise from rational behaviour amongst economic agents. The assumption in this framework is that the economic agent's aim is to maximize utility based on rational behavioural assumptions.

The assessment assumes that the main strategy that economic agents, industry and government will consider is the MGDS in making their decisions and that movement in key macroeconomic variables aid in individuals' decision making on what to invest. It is also assumed that individuals will consider two investment strategies, either *production* of goods and services or an *investment* in treasury bills. The latter is a risk free investment strategy and decisions to invest in treasury bills are based on the rate of return on Treasury bills versus rate of return in production.

The *forecasting model* that will be considered in this framework is threefold. The first stage assesses time series characteristics of the time series data using Perron (1990) 'additive- and innovational-outlier' model. This approach considers assessing structural breaks using 'shift-in-mean' and 'shift-in-trend' modelling of economic time series.

The second stage of the model will involve establishing the dynamic relationships between the variables and how they impact on each other once a structural shock is initiated from their equilibrium steady state value. This follows a multivariate-type of modelling using structural vector autoregressions (SVAR) methodology based on 'identifying assumptions' developed by Blanchard and Quah (1989). The *impulses* or *propagations* generated by these identifying assumptions trace the response of the dependent variable in the SVAR system to structural shocks in the residual terms. The SVAR model employs the 'error correction mechanism' using the structural

decomposition method and will be used in order to capture both the short- and long-run effects of the new government strategy.

The third stage of the model involves forecasting using the selected endogenous variables in the SVAR system which comprise of real GDP, GBD, TBRATE and TB modelled in that order. The methodology to be followed is the same as forecasting techniques in time series econometrics used by Box and Jenkins (1976) only that this time the forecasts will depend on lags of all endogenous variables to be considered in the system. The forecasts from such regression models will be compared with the government projected targets highlighted in the MGDS.

The data to be used consists of quarterly data obtained largely from the International Financial Statistics for the period 1980Q1-2005Q4. The forecasting period will consider the MGDS implementation period from 2006Q1-2011Q4.

3.2 Unit Root Tests

The first stage assesses time series characteristics of the data and emphasises on modelling the regularities of six macroeconomic variables. The variables to be used include *real GDP* as a proxy for internal macroeconomic performance, the *real exchange rate* (REER) representing the exogenous non-policy variable, the *current account balance* (TB) representing the supply (production) factor, *percentage change in CPI* as a proxy of inflation representing credibility of government policy in controlling inflation, *government budget deficit* also a proxy for government macroeconomic policy credibility, and *treasury bill rate* (TBRATE) representing the expected return from an investment in treasury bills.

3.2.1 Assessing Structural Breaks and Unit Roots

Perron (1989, 1990) found out that a time series that is stationary around a deterministic time trend and has undergone a permanent shift between certain periods may be mistaken by the usual Augmented Dickey-Fuller (ADF) as a unit root. He argues that if these types of unit root tests do not take account of the break then the series will have a very low power of rejecting the null hypothesis. The solution is to include the break(s) as dummy

variables that are part of the deterministic components of the model thereby treating them as exogenous in the system. Testing for unit root in the presence of structural breaks in a time series is provided in Perron (1990) follows:

$$\Delta Y_t = \mu + \alpha D_t + \phi T + \psi^* Y_{t-1} + \sum_{i=1}^{p-1} \psi_i^* \Delta Y_{t-i} + u_t, \quad (4)$$

where $u_t \sim IID(0, \sigma^2)$, $\psi^* = (\psi_1 + \psi_2 + \dots + \psi_p) - 1$ and $\psi_i^* = -\sum_{j=i+1}^p \psi_j$

Where Y_t - a time series under observation and equation (4) includes the structural breaks either as *shift-in-trend* component given by the trend variable ϕT , where k represents the structural break identified for a particular variable.

$$T = \begin{cases} t & \text{for } t > k \\ 0 & \text{for } t \leq k \end{cases} \quad (5a)$$

If the structural break is due to the mean then there is a *shift-in-mean* component given by αD where

$$D = \begin{cases} 1 & \text{for } t > k \\ 0 & \text{for } t \leq k \end{cases} \quad (5b)$$

A significant shift-in-mean coefficient implies evidence of a structural break in the time series under investigation. If it is followed by a significant shift-in-trend coefficient then Perron (1990) argues that the change in mean of the series at the break is not instantaneous but evolves over time.

3.2.2 The Additive and Innovational-Outlier Models

Badawi (2006) argues that the main aim for testing structural breaks in dynamic systems is to discriminate between *genuine* non-stationarity and the tendency of autoregressive coefficients to drift towards unity. He considers such drifts in the series as due to *regime shifts* and are responsible in exhibiting breaks in series which render results based on the usual ADF test dubious. In Perron's (1990) argument, sometimes the shift-in-mean (structural break) may be affected by the *dynamic behaviour* (or persistence) of the data

generating process. He concludes that such changes should be viewed as *exogenous* that are not necessarily part of the stochastic structure of the noise process.

In this study, structural breaks are tested using equation (4) suggested by Perron (1990). The model provides Monte Carlo evidence on the finite sample behaviour of the test equation. To run the model, the series are *detrended* prior to carrying out the test. The specification implies that, if the shift-in-trend coefficient dummy variable is significant, the change in the mean of the series is not instantaneous. He concludes that such a process enables the change in mean due to the structural break not to occur instantaneously but to change over time.

3.3 Model Specification- The SVAR Representation

3.3.1 Real Sector Equilibrium- IS – Schedule

The real sector assumes an income-expenditure identity of an open economy in which real income is a linear function of consumption expenditure, investment expenditure, government expenditure and the trade balance given as

$$Y = C + I + G + (X - M) \quad (6a)$$

Each variable on the right hand side of equation (6a) is endogenous and are determined as stated below

$$C = \bar{C} + cY_d, \quad c > 0 \quad (6b)$$

In which c is the marginal propensity to consume, $\bar{C}$ is autonomous consumption not defined by disposable income and Y_d is disposable income given by the following identity

$$Y_d = Y + (TR_g - T) \quad (6c)$$

Given that TR_g are government transfer payments, T are government taxes and Y is the level of real income

The tax and investment functions are given as follows

$$T = \bar{T} + tY, \quad 0 < t < 1 \quad (6d)$$

$$I = \bar{I} - \delta(r), \quad \delta > 0 \quad (6e)$$

In equations (6d-e) t is the tax rate, δ is the interest sensitivity of investment and $\bar{T}$ and $\bar{I}$ are both autonomous tax and investment coefficients. The government sector is represented by the following equation which includes fiscal policy instruments that are exogenously determined.

$$GBD = T - (TR_g + G) = (\bar{T} + tY) - (TR_g + G) \quad (6f)$$

Finally, the external sector is represented as follows

$$BP = CA + KA = \bar{CA} + qe - mY + \bar{KA} + n(r - r_f) = 0 \quad (6g)$$

with $q > 0$, $n \rightarrow 0$, and $m > 0$

In equation (6g), CA is the current account, e represents the real exchange rate, q represents that Marshall-Lerner condition, m is the marginal propensity to import, n represents the interest sensitivity of the capital account (KA) with respect to interest rate differential between domestic (r) and foreign interest rates (r_f) in the perfectly elastic case. Therefore, the real sector can be represented by incorporating the identities in equations (6a-g) as follows:

$$\begin{aligned} Y &= \bar{A} + (c - t - ct - m)Y - \delta(r) + GBD + (X - M) \\ Y &= \gamma\bar{A} - \gamma\delta(r) + \gamma GBD + \gamma(X - M) \end{aligned} \quad (7)$$

In (7) $\bar{A} = \bar{C} + c(TR_g - \bar{T}) - \bar{T} + TR_g + \bar{I} + \bar{KA} + qe + n(r - r_f)$, $\gamma = 1/(c - t - ct - m)$ and $(X - M) = CA$, the current account balance can be derived from the linear function in equation (6g). In equation (7) $Y = f(Y, r, GBD, TB)$ and the coefficients for the variables in parenthesis are the respective dynamic multipliers of the system of endogenous variables. To incorporate expectations, the model includes lags of the dependent variable and other variables in the system for a specified order.

Therefore, the *IS* – framework can be represented as a function of predetermined values of the endogenous variables in the system as required in the VAR methodology given in equation (8). It is assumed by the *IS* – framework that the Marshall-Lerner condition holds and that there is perfect capital mobility ($n \rightarrow 0$). Therefore, the equation can be formulated as follows

$$QRGDP = f(QRGDP_{-i}, GBD_{-i}, TB_{-i}, TBRATE_{-i}) + u_{1t} \quad (8)$$

In which $-i$ represents lags of the variable

Equation (8) is our stochastic model implying that shocks from the system errors (u_{1t}) represent the internal macroeconomic performance (or aggregate demand shocks).

3.3.2 Deriving the *LM* – Schedule (Money Market Equilibrium)

Conventional economic theory stipulates that the *LM* – framework follows the *Keynesian-type demand* for real money balances function given as

$$m_d = f(Y, r) = kY + \ell r, \quad k > 0, \text{ and } \ell < 0 \quad (9a)$$

In equation (9a), m_d is demand for real money balances, ℓ is the interest sensitivity of real money balances and k represents a proportion of precautionary and transactional balances that economic agents hold. Since issues of interest rates are dealt at the Central Bank and that issues of monetary policy are embedded in the *LM* – framework, the approach to be used adopts a variant to the conventional Keynesian-type of modelling and assumes that monetary policy in Malawi follows a ‘*Taylor rule*’ framework³ given as

$$R_t = r^* + 1.5(\bar{\pi}_t - \pi_t^*) - 0.5(\bar{Y}_t - Y_t^*) + \text{lags of } R_t, \pi_t, Y_t + u_t \quad (9b)$$

³ The model can be modified to include other variables (see Stock & Watson, 2001, who substituted the output gap with unemployment gap) and in our model it is assumed that real interest rates are also determined by the trade balance which will be estimated by the VAR in an equilibrium format.

In equation (9b) $(\bar{\pi}_t - \pi_t^*)$ and $(\bar{Y}_t - Y_t^*)$ represent the inflation and output gaps, respectively, and the constant term (r^*) represents real interest rate. The variables $\bar{\pi}_t$ and $\bar{Y}_t$ are mean values based on a four-quarter period and π_t^* and Y_t^* are the desired levels of inflation and real output, respectively.

The validation also follows Sato (2001) who stipulated that the tool used in controlling inflation set by the government and the Reserve Bank of Malawi is by considering movements in domestic interest rates. Given that the level of inflation is predetermined and that the second and third terms on the right hand side of equation (9b) are exogenously determined, the Taylor rule can be represented as a stochastic function to be used as follows

$$R_t = \mu_0^* + \text{lags of } R_t, Y_t + u_t \quad (9c)$$

Finally, with Sims (1980) assumption that ‘*everything causes everything else*’ the interest rate equation can be represented as a function of predetermined variables

$$TBRATE = f(QRGDP_{-i}, GBD_{-i}, TB_{-i}, TBRATE_{-i}) + u_{2t} \quad (9d)$$

Notice that other variables have been included into the Taylor rule following Stock and Watson’s (2001) framework of the Taylor Rule in which they substituted the income-gap for the unemployment gap suggesting that the Taylor rule can be modified. Also through the identities it is assumed that the current account balance and the government budget deficit are affected by the rate of interest as well based on the endogeneity assumption. Therefore, shocks from the system errors (u_{2t}) represent monetary policy intervention.

3.3.3 Deriving the BP – Framework (External Sector Equilibrium)

It is shown through equation (6g) that the BP – framework can be represented by the current account balance or trade balance given as follows

$$BP = CA + KA = \bar{CA} + qe - mY + \bar{KA} + n(r - r_f) = 0 \quad (=6g)$$

In the income-expenditure identity, $(X - M) = CA$, therefore, an expression for the trade balance is needed using equation (6g) with an identity of

$$CA = BP - KA = BP - \overline{KA} + n(r - r_f) = BP - \overline{KA} = 0 \quad (10a)$$

As Bannaga (2004) noted, economic theory does not really show a clear relationship between the current account and real income and let alone the relationship between the current account and government budget deficit. But stylized facts have shown that it depends on the stage of the development process of a country. In developing countries, tends portray a negative relationship between real income and the trade balance.

This owes to the fact that more capital inflows are used in increasing domestic production in developing countries than in developed countries. Similarly, mostly in developing countries an improvement in the government budget deficit translates into fewer imports thereby improving the trade balance. Therefore, in our formulation, the trade balance is represented by

$$TB = f(QRGDP_{-i}, GBD_{-i}, TB_{-i}, TBRATE_{-i}) + u_{3t} \quad (10b)$$

The shock to the system errors (u_{3t}) therefore represents external non-policy factors such as technology or production shocks. The three equations complete the Mundell-Fleming three-sector model and to complete the VAR framework, the fourth equation, which is part of the real sector, will represent fiscal policy interventions. It is argued that government fiscal discipline follows some tax code and expenditure rule [given in equation (6f)] and economic theory has shown that the higher the level of domestic interest rates, the higher is the budget deficit. Also in the *IS* – framework, an expansionary fiscal policy has a positive effect on real income but also crowds-out private investment. Using the same argument in the trade balance function, the fourth model is given as

$$GBD = f(QRGDP_{-i}, GBD_{-i}, TB_{-i}, TBRATE_{-i}) + u_{4t} \quad (11)$$

In equation (11) the errors (u_{4t}) represent structural economic shocks from fiscal policy intervention. These four ‘*identifying assumptions*’ enable us to form the SVAR model to be used and, therefore, regard any contemporaneous correlation in VAR modelling (suggested in the literature) as causality. Through structural decomposition the long-run parameters of the SVAR model can be identified. An intercept is included in the VAR estimation so that it captures the mean value in the equations.

Finally, the last step in the analysis based on the suitability of the SVAR model to be estimated will consider forecasting the four key macroeconomic variables estimated. The projected values from the SVAR model are then compared with the projected values obtained from the Economic Affairs Department in the Ministry of Finance in Malawi. The latter projected values are obtained from a financial programming technique developed by expatriates working with the International Monetary Fund (IMF) in collaboration with Ministry of Finance officials.

3.4 Data Transformation

To calculate real GDP, data was collected on annual nominal GDP and the GDP deflator (based on 1994 prices) from 1980-2005 and a simple calculation was made to come up with real GDP as the ratio between nominal GDP and the GDP deflator. Quarterly real GDP is calculated as a weight using industrial production indices and the methodology used is displayed in equation (12) below. This method is useful especially when making simulations or forecasts as the sum of real GDP per quarter add up to the annual real GDP figure for that particular year.

$$QRGDP = \frac{IP_i}{\sum_{i=1}^4 IP_i} \times \text{Annual Real GDP} \quad (12)$$

In equation (12) IP is industrial progress index for a particular quarter of the year. This approach has the advantage when assessing for quarterly dependence and seasonality tests unlike the method of dividing the real GDP value into four equal parts within the four-quarters of the year which brings in problems of smoothing.

REER is collected from the IFS database and inflation (INFL) will be based on the percentage change in the consumer price indices over the period 1980Q1-2005Q4. The government budget deficit (GBD) is already calculated in both the IFS and RBM economic and financial statistics. The current account balance is represented by the trade balance (TB) as the aim is to focus our analysis on production and consumption of goods and services. The rate of interest will be represented by the expected return on the investment in securities given by the Malawi Treasury bill (TBRATE) rate of return⁴.

⁴ Movements in the TBRATE are not different from movements in the Bank or Discount rate but also the TBRATE dictates movements in the discount rate.

Chapter Four

4.1 Data Analysis

4.1.1 Descriptive Statistics

Table 1 (see appendix G) displays summary statistics for the macroeconomic data to be used over the sample period 1980Q1-2005Q4. Quarterly real GDP, government budget deficit, and the trade balance are all measured in Millions of Kwacha (MK, the local currency for Malawi). Inflation represents changes in relative prices expressed as a percentage based on consumer prices with a base year in 1994. The real effective exchange rate represents an index number of a trade-weighted real exchange rate based on a basket of currencies of Malawi's trading partners. The Treasury bill rate is expressed as a percentage per period (quarter).

The average value for real GDP during the sample period 1980Q1-2005Q4 was MK20, 676.1 million per quarter. The maximum value attained per quarter was MK53, 514.0 million obtained in 2005Q1 and the lowest value was in 1981Q1 with a value of MK2, 514.0 million. Real GDP is highly seasonal (see figure 2 in appendix C) owing to the fact that most of the production activities in Malawi rely on rain-fed agriculture, which commences in the fourth quarter (October-December) of the year continuing into the first quarter (January-March).

The government budget deficit averaged with a deficit of MK513.0 million between 1980Q1 and 2005Q4. The highest deficit during the period was MK7, 321.4 million in 2002Q4 and government registered a maximum surplus in 2005Q3 of MK1, 951.8 million. Variability of the dispersion in terms of the deficits or surplus is MK1, 521.2 million, indicating how volatile or unstable the government budget deficit has been during the period of study.

The trade balance has also been registering large deficits (see figure 2 in appendix C) and the average trade balance over the period was a deficit of MK1, 967.6 million. The maximum deficit over the period was MK22, 094.3 million in 2005Q4 particularly due to

government's programme of fertiliser subsidy and maize imports during the drought period used to promote food security in the country and high levels of private consumption. Malawi also registered a maximum surplus of MK720.7 million in 1997Q2. The dispersion has also been large about MK4, 371.9 million over the sample period.

The real effective exchange rate averaged about MK124.9 over the period 1980Q1-2005Q4, registering a maximum of MK173.5 in 1985Q1 and a minimum of MK65.8 in 1994Q4. The REER has been on average appreciating over the period of study (see figure 2 in appendix C) reducing the international competitiveness of domestic goods and services thereby decreasing terms of trade in Malawi.

Treasury bill rates have been stable since 1980 till 1992 due to the fixed interest policy that government pursued in the one party regime. As a result of government deregulating some of its controls in 1989 the Treasury bill rate began to rise mostly due to increases in public debt (see figure 2 in appendix C) through government borrowing on the domestic market. The rates averaged 23.2% over the period of study with a maximum government borrowing rate in 1995Q2 of 49.4%. The minimum rate over the same period was 11.0% which stabilised from 1980Q1 to 1985Q1.

4.2 Testing for Seasonality

Stationarity in many time series can be achieved by simply differencing or detrending the series. Specification of such a process whether to include an intercept, trend or both is important. It has been argued that it is usually not obvious as to which correct way to proceed and taking the incorrect way would lead to false results which affect the power of the test (Harris, 1995; Greene, 2000).

The first approach using DF test for unit root in the time series is important to identify whether all series to be used in the VAR model are integrated of the same order. Seasonal patterns, on the other hand, are present in most monthly and quarterly time series data and it becomes important to remove seasonal effects in order to concentrate on other components such as the trend (Gujarati, 2003; p. 312). When using the Dickey-Fuller test in testing for non-stationarity there is a tendency for unit root tests to be biased towards

not rejecting the null hypothesis of non-stationarity in the presence of seasonal patterns. Harris (1995) argues that time series with seasonal processes may be non-stationary if seasonal patterns vary over time. Therefore, it is important to concentrate our analysis on *seasonally adjusted series*.

Seasonality tests have been conducted for the six series using the dummy variable technique by creating a dummy variable for each season. For each series a simple linear regression with only seasonal dummy variables is estimated. Table 2 (appendix G) shows the results for seasonality tests using the dummy variable technique with no intercept. The values are the corresponding t – statistics and their p – values. The results show that all variables are affected by seasonal factors. Real GDP, real effective exchange rate and the Treasury bill rate have seasonal effects that are statistically significant in all quarters at the 1% significance level.

GBD has a seasonal effect that is statistically significant in the fourth quarter at the 1% level and statistically significant at the 10% level in the first quarter. The TB series are affected by seasonal effects in the first (5% level), second and fourth quarters (1% level). Seasonal effects for inflation (INFL) are in the first (1% level), third (10% level) and fourth (1% level). Seasonal effects are removed from each series by obtaining residuals from each test equation of the series and used in subsequent sections to test for unit roots.

4.2.1 Unit Root Test Results using ADF and DFGLS Detrending Tests

To determine the appropriate lag-length Eviews 5.1 uses an *automatic* selection method of the lag-length by choosing p (which is less than the specified maximum) to minimise either the Akaike information criterion, $AIC(p)$, or Schwarz Bayesian criterion $SBC(p)$. The null hypothesis assumes that the series is a random walk with a possible drift and the alternative is stationarity around a possibly non-zero deterministic trend. An initial maximum lag-length of 24 is considered.

Three test results are reported- one based on the $\tau(\tau)$ –statistic, which is the ADF-test statistic, the t –statistic for the trend coefficient and the other based on the calculated

F – statistic used to test for the joint significance of including the intercept and trend into the test equation.

Table 3 (appendix G) display the test results and indicate that the joint F – test of the null hypothesis $H_0 : \mu = \gamma = \psi^* = 0$, is rejected at the 1% level for five variables except for the TBRATE which is statistically significant at the 10% level. Therefore, intercept and trend are included in the test equation for all the variables under analysis. A test for unit root with the null hypothesis $H_0 : \psi^* = 0$ against the alternative $H_0 : \psi^* < 0$, is rejected for the series of real GDP, GBD, TB, INFL and TBRATE except for REER, which is stationary at the 1% significance level. The latter is thus a trend stationary process.

As for the TB unit root test results the ADF-test statistic is positive (5.24) which indicates that the TB series may be explosive. According to Badawi (2002), who encountered similar results when testing for unit root in real output, this suggests the appropriateness of including more deterministic exogenous variables such as a trend for the TB series. Because of the impact that the exogenous variables such as the intercept, or intercept and trend, might have on the ADF test, the ADF test is modified.

The new methodology was proposed by Elliot, Rothenberg and Stock (ERS, 1996) and is called the *Dickey-Fuller test with generalised least squares detrending* (DFGLS). ERS (1996) suggest a simple modification of the ADF test whereby the data are ‘*detrended*’ or ‘*devoid of the explanatory variables*’ such as the intercept and/or trend before running the DF test equation. The results are displayed in table 4 in appendix G and clearly show that all variables are non-stationary except for REER.

4.3 Misspecification Test

4.3.1 Ramsey Regression Specification Error Test (RESET)

At this stage a number of diagnostic tests are conducted on the appropriate unit root test equations employed. The motivation is to see whether the Perron (1990) test equation that incorporates structural breaks is an appropriate model for assessing unit root. The

Ramsey (1969) Regression Specification Test (RESET) is used to test for model misspecification. The RESET test is a general test for omitted variables, incorrect functional form and correlation between the regressors and the errors. In the presence of such specification errors, OLS estimates are biased and inconsistent and conventional inference procedures are invalidated.

The test results in table 6 show that the test equation of real GDP, TB, TBRATE, INFL, and REER are correctly specified but not for the GBD test equation. This owes to the fact that there are many outliers in the GBD series and volatility after the year 2000 rendering the test equation to be regarded as incorrectly specified.

4.3.2 BDS Test for Independence

The test was first developed by Brock, Dechert, Scheinkman and Le Baron in 1996 and is called the BDS test for independence. It is a *portmanteau* test for time based dependence in a series. The test is applied for testing linear dependence, non-linear dependence or chaos but also can be applied to a set of residuals to check whether they are independently and identically distributed (iid)⁵. The null hypothesis under the latter is the assumption of independence against the alternative that the residuals are not independent. This assumption is important especially when carrying out unit root tests (Dickey and Fuller, 1979, 1981; Harris, 1995)⁶.

A view of the series in appendix C and D shows that most of the series have an unusual distribution and according to Brock et al (1996) the distribution of the BDS test statistic can be quite different from the asymptotic normal distribution. For us to compensate for this anomaly Eviews offers the option of calculating bootstrapped p – values for the test statistic and select the number of repetitions at 10, 000. It is argued that a greater number of repetitions will provide more accurate estimates of the p – values.

⁵ Tests for unit roots expressed in equations (4) assume that the errors are independently and identically distributed.

⁶ For a detailed procedure of how the BDS test is estimated see Brock et al (1996) or consult Eviews 5.1 user manual, chapter 11 on series, pp. 329-332.

The test results in table 5 (appendix G) shows that the null hypothesis of independence cannot be rejected and thus all the residuals obtained from test equation (4) are independently and identically distributed (*iid*) which concur with the requirement assumed by Perron (1990) and others. The test statistic for the GBD series show values close to zero in four out of the six dimensions leading us to the conclusion that the residuals for the GBD series are also independent. Therefore, the test equation (4) can be used to test for unit root based on movements in key macroeconomic indicators using Perron (1990) critical values.

4.3.3 Autoregression (AR) or Serial Correlation (LM) Test

A common problem in using time series regressions is that the estimated residuals are correlated with their own lagged values. Such a problem makes OLS estimates to be inefficient; standard errors to be underestimated that result in biased and inconsistent estimates especially when lagged dependent variables are included on the right hand side of the test equation.

Autoregression (AR) tests are used to detect any form of finite order autocorrelation using the Breusch-Godfrey serial correlation Lagrange Multiplier (LM) test. The test is used to test for higher order *ARMA* errors and is applicable in large sample cases. The null hypothesis is the assumption of no serial correlation up to the specified order in the residuals or they are ‘*white noise*’ against the alternative of the presence of serial correlation.

Using the $AIC(p)$ criterion with a lag-length of 2 in all variables, the test results in table 6 show that serial correlation in the residuals in all six variables is not statistically significant or the p – values are too high to reject the null hypothesis of no serial correlation. As such all OLS estimates are not biased and consistent and can be used in making inferences.

4.3.4 White's Heteroskedasticity Test

White's (1980) test assumes a null hypothesis of homoskedasticity against the alternative of heteroskedasticity of some *unknown* general form. The test follows the F – distribution which is an omitted variable test for the joint significance of all squared terms included (no cross terms) excluding the constant.

The test results in table 6 show that there is some form of inefficient estimation of the standard errors. Therefore, the test equation will be estimated using White's Heteroskedastic-Consistent Covariances and Standard errors to enable us to make inferences of the findings below.

4.3.5 Autoregressive Conditional Heteroskedasticity (ARCH) Test

The ARCH test is a Lagrange Multiplier (LM) test that was proposed by Engle in 1982. The test assesses the relationship of the magnitude between past residuals and recent residuals. It is argued that ARCH in itself does not invalidate standard OLS inference but ignoring ARCH effects may result in loss of efficiency (Eviews 5.1 user guide, p. 582). The null hypothesis assumes that there are no ARCH effects up to some order q .

The ARCH test follows the F – distribution which is an omitted variable test for the joint significance of all lagged squared residuals. The residuals of the models to be used are taken from the test equation (4) on assumption that this is the appropriate model specification. The test results in table 6, using a lag-length of 3, show that the null hypothesis of no ARCH effects cannot be rejected.

4.3.6 Unit Root Test Results in the Presence of Structural Breaks

The test results for each series using Perron (1990) additive- and innovational model are given in tables 7 and 8 (appendix G). The coefficients are represented by t – statistics and the results in parenthesis are their respective p – values. The selection of structural breaks is through visual inspection of the graphs of these variables as suggested by Perron (1990, p. 161).

For the real GDP series, a visual inspection of real GDP in figure 3 (appendix D) show signs of a shift-in-mean in the seasonally adjusted and detrended real GDP series. Prior to the break, 1980Q1-1992Q4, the mean in real GDP was at MK8, 827.0 million per quarter and after the break, 1995Q1-2005Q4, the average was MK32, 784.0 million per quarter.

The GBD series exhibit a structural break in 2000Q1 which alters its mean. The structural break represents a period in which donor support was stopped due to poor governance and macroeconomic mismanagement in Malawi. The possibility that the trend in the series alters the slope during this period is also evident. In fact by splitting the sample into two periods, 1980Q1-1999Q4 and 2000Q1-2005Q4, the mean in the first sample is a deficit of MK66.0 million while in the second sample the mean-deficit is MK2, 003.0 million per quarter.

A visual inspection of TB series in figure 3 (appendix D) show evidence of a structural break in the year 2001Q1. The break is after the second multiparty elections and after donor aid was stopped. Before the break the mean in the current account balance was a deficit of MK359.3 million and in the second sample the average was a deficit of MK8, 722.2 million.

The Treasury bill rate exhibits a shift from 1992Q2 (figure 3) highlighting a permanent shift-in-mean. Prior to 1992Q2, the mean was 12.5% over the period 1980Q1-1992Q1 and it was 32.8% over the period 1992Q2-2005Q4 again emphasising the existence of a structural break and a permanent shock.

The inflation variable exhibits a structural break in the year 1990 and in the first period, 1980Q1-1989Q4 the mean was 3.7% per quarter whilst in the second sample, 1990Q1-2005Q4 the average was 6.1% per quarter.

Finally, the structural break for real effective exchange rate is assumed to be in 1994Q1 and in the first sample period from 1980Q1-1993Q4 the mean of the series was MK148.8 per quarter whilst in the second sample 1994Q1-2005Q4 the mean of the series was MK101.1 per quarter.

Critical values for unit root tests in the presence of structural breaks are obtained from Perron (1990). The proportion, λ , which Perron (1990) regards as the *break fraction*, is the proportion of the structural break in the sample to the total sample size. For GBD the break fraction is $\lambda = 0.23$, for TBRATE, $\lambda = 0.53$, for TB, $\lambda = 0.19$, for QRGDP, $\lambda = 0.42$, for REER, $\lambda = 0.5$, and for INFL, $\lambda = 0.44$.

The critical values, given the break fraction for each variable, are provided in table 9 (appendix G) obtained from statistical tables from Perron (1990). Tests for unit root in four of the variables (real GDP, GBD, TB, and TBRATE) are insignificant thereby unable to reject the null hypothesis of non-stationarity. The INFL and REER series, on the other hand, are stationary at the 1% significance level.

4.3.7 Testing for Stationarity using Differences in Variables

The last section showed that four variables in the analysis are non-stationary. However, the analysis does not indicate at what level of integration these variables are or how many times the series have to be differenced in order to attain stationarity. In this section tests for non-stationarity using the difference approach or changes in the variable is used and the null hypothesis is still the same that a unit root exists in differences of the time series. The series to be used will be the seasonally adjusted detrended series used by test equation (4) to test for unit root in differences. The Perron (1990) test is used and the results are displayed in table 10 (appendix G).

All variables that were non-stationary in table 9 were stationary after differencing once and the null hypothesis is rejected at the 1% significance level. The four variables are integrated of order one $I(1)$, therefore, to achieve stationarity all four variables need to be differenced once.

4.5 Conclusion

In summary, this chapter has assessed the time series characteristics of the selected macroeconomic variables. Out of the six variables, only real GDP, government budget deficit, Treasury bill rates and the trade balance are non-stationary. Having considered

the time series properties of the selected macroeconomic variables expressed in the MGDS, the next chapter considers an optimal forecasting technique. The model employed is the SVAR methodology that relies on the data generating process to make sound projections. Credibility in this case will be evaluated depending on whether the four variables used follow the *desired paths* as projected in the MGDS over its implementation period (2006-2011).

Chapter Five

5.1 Structural VAR Modelling and Forecasting

5.1.1 Determining the Appropriate Lag-Length and Cointegration Tests

The study specifies a four-dimensional VAR with $\mathbf{Z}_t = [QRGDP, GBD, TBRATE, TB]'$, where $\mathbf{Z}_t$ represents a vector comprising of natural logarithms of quarterly real GDP, a measure of the government budget deficit, a nominal interest rate based on a three-month Treasury bill rate, and the trade balance. The study employs a lag structure selection criteria based on six information criterion methods reported in table 11 (appendix H). All the selection criteria except for the SBC show significance at the 5% level of a lag-length of 4 in the VAR model.

The cointegration test to be used is a multivariate VAR-based cointegration test developed by Johansen (1988). The vector $[1 - \beta]$ is said to be the *cointegrating vector* of the system of equations⁷. The cointegration test involves transforming equation (1) in a form such as

$$\Delta \mathbf{Z}_t = \Pi \cdot \mathbf{Z}_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta \mathbf{Z}_{t-i} + \varepsilon_t, \text{ for } p \geq 2 \quad (14)$$

Where

$$\Gamma_i = -\left(A_{i+1} + A_{i+2} + \dots + A_p\right) = -\sum_{j=i+1}^p A_j \quad i = 1, \dots, p-1$$
$$\Pi = -\left(\mathbf{I} - A_1 - A_2 - \dots - A_p\right) = \sum_{i=1}^p A_i - \mathbf{I}$$

The model described in equation (14) is a form of a vector error correction model (VECM) which is used to distinguish between long- and short-run dynamics thereby providing a suitable tool for policy analysis. The Johansen's method, therefore, determines the rank of the long-run Π matrix using an unrestricted VAR and tests whether the restrictions at some rank order implied by the reduced rank of Π can be rejected.

⁷ Other properties of integrated series are explained by Gujarati (2003, p. 805)

The matrix Π is decomposed into two matrices α and β in which the matrix α , called the *adjustment matrix*, holds long-run adjustment coefficients and matrix β (the *cointegration matrix*) contains long-run coefficients or elasticities (Engle & Granger, 1987; Charemza & Deadman, 1997). The null hypothesis concerning cointegration is that the rank of the matrix Π is $r \leq 0$ against the alternative that $r > 0$. According to the Granger Representation theorem, if the null is rejected then it follows that the product $\beta'Z_{t-p}$ is stationary and constitutes a set of r – error correction mechanisms separating out the long- and short-run responses in the model (Engle & Granger, 1987).

The cointegration test results are reported in table 12 (appendix H) and reports the rank, trace statistic, eigenvalues and the p – value. The null hypothesis is accepted at rank 2 ($r \leq 2$) at the 5% significance level. Normalised estimates for two cointegrating vectors and their respective adjustment coefficients (feedback effects) are reported in tables 13 and 14, respectively.

5.2 Short-Run Dynamics

The cointegrating vectors in table 13 of β'_1 and β'_2 represent the long-run adjustment coefficients of the variables. It forms the cointegrating relationship to be used in the vector error correction model (VECM) defined as the *restricted long-run stationary* relationship. Since the four variables entering the VAR model are all integrated of the same order, $I(1)$, in the VECM they become integrated of the order $I(0)$ as only changes in the variables are used.

The result of the error correction mechanism of the VECM is estimated by unrestricted OLS and is reported in table 14 (appendix H). The error correction terms in table 14 appear to have dominant long-run feedback effects in real output, GBD and the trade balance series as it reports the largest magnitude of feedback effects of -0.221, -0.532 and -0.531 (with significant t – values), respectively. The estimated short-run version of the Mundell-Fleming model based on the VECM, therefore, converges towards its equilibrium steady state level given by negative error correction parameters in table 14.

5.3 Long-Run Dynamics

When considering the economic interpretation of the normalised cointegrating vectors in table 13 shows that the relationship between real GDP, GBD, TBRATE and TB series have expected signs based on the Mundell-Fleming model. In the long-run, movements in the trade balance series have a negative impact on the movements of real output. The effect on real output from the long-run elasticity of the trade balance is a magnitude of -0.985 per quarter. Also the level of interest rates have a positive impact on the future movements of real output given by a positive long-run coefficient of the TBRATE and the long-run elasticity for the TBRATE is 2.152.

The long-run elasticity of the level of interest rates on the government budget deficit has a negative effect of -0.089 indicating that there is a negative relationship between the GBD and the TBRATE. When the level of interest rate decreases it is expected that the government budget deficit will worsen further as lower interest rates create a favourable condition for government borrowing on the domestic market. Similarly, there is a negative relationship between GBD and the trade balance with a long-run elasticity of -0.402 per quarter. Therefore, government savings are expected to worsen the trade balance through the trickle down effects as private agents have more resources to increase imports thereby worsening the trade balance further.

5.4 Structural Inference and Impulse Response Analysis

Several empirical questions can be answered from the SVAR representation. Some of the specific questions are: is there evidence of an improvement in real GDP? Will the government budget deficit decrease over time? Is the interest rate showing any signs of decreasing over time? How does the trade balance behave over time? What is the relationship between the trade balance and real GDP or between the trade balance and GBD?

5.4.1 Identifying Permanent and Temporary Shocks

Before assessing the econometric results of the structural specification that is being estimated, a few comments are in order based on the estimation output. The study employs Blanchard and Quah's (1989) identification method based on the long-run properties of the impulse responses which assumes an upper triangular matrix form. This can be achieved by imposing just enough restrictions so that the structural shocks and their long-run effects may be given an economic interpretation.

According to Blanchard and Quah (1989), the economic interpretation on structural disturbances that have *temporary effects* may be interpreted as originating from *demand disturbances*. Most demand disturbances converge towards an equilibrium steady state value that can be detected through impulse response analysis. On the other hand, disturbances that have *permanent shocks* may be interpreted as *supply shocks*.

The ordering of the endogenous variables becomes important in this case and the way they have been ordered implies that real output has an impact on all other variables in the matrix Z_t and the second endogenous variable has an impact on the last two endogenous variables and so on. The *identifying restrictions* are estimated by *structural factorisation* in Eviews 5.1 based on the method of scoring.

However, as Christiano, Eichenbaum and Evans (1999) point out, there is no convergence in the literature on a particular set of assumptions for identifying the effects of an exogenous shock to monetary shocks which also applies to the other shocks in the system. On the other hand, Iacoviello (2000) argues that the inference on the effects of many of these shocks is robust across a large subset of identifying schemes used in the literature.

5.5 Goodness of Fit Measures and Diagnostic Tests

A selection from the estimation output of the unrestricted reduced form VAR relating to the parameter estimates are shown in appendix H, table 15. The table reports goodness of fit measures for the unrestricted reduced form VAR estimates based on R-squared,

adjusted R-squared, the log of the determinant of Ω (which stands for the covariance matrix of the multivariate residual term), the log-likelihood value, and the correlation matrix for the residuals.

The latter shows correlations that are not substantial depicting the first indication that the impulse responses to be calculated may not differ much from their structural econometric dynamic multipliers. Multivariate residual tests have been conducted for the VAR model based on serial correlation, White's heteroscedasticity and normality tests.

5.5.1 Autocorrelation LM – Test

Table 16 reports the multivariate LM – test statistic for the residual serial correlation up to a specified lag-length of 5. The unrestricted VAR model in equation (3) assumes that there is no serial correlation existing within the errors. The LM – test statistic at lag-order 5 is computed by running a residual auxiliary regression with only predetermined regressors and lagged residual terms. Under the null hypothesis of no serial correlation of order 5, the LM – statistic is asymptotically distributed with 16 degrees of freedom. Based on the results displayed in table 16, the null hypothesis of no serial correlation cannot be rejected at the 5% significance level.

5.5.2 Heteroskedasticity Tests

The multivariate heteroskedasticity test is an extension of White's (1980) heteroskedasticity test discussed by Kelejian (1982) and Doornik (1995). The test regression is similarly run by the same White's procedure to regress each cross product of the residuals on the cross products of the regressors and then testing the joint significance of the regression. The 'no cross terms' method is used which only uses the levels and squares of the original regressors. Under the null hypothesis of no heteroskedasticity (or no misspecification) the results in table 17 show that the non-constant regressors are jointly insignificant and the estimated variances of the SVAR model are efficient.

5.5.3 Normality Tests

Apart from serial correlation and heteroscedasticity the SVAR model assumes that the residuals are normally distributed. The normality test is a multivariate extension of the Jarque-Bera residual normality test based on the third (skewness) and fourth (kurtosis) moments of the residuals compared to those of the normal distribution. Under the null hypothesis of normality, table 18 reports the test statistics for each orthogonal component based on structural factorisation and report the skewness (m_3) and kurtosis or degree of excess ($m_4 - 3$) measures.

The results show that there is more of a problem of kurtosis than skewness in the independent residuals of the SVAR model and the former leads to the joint rejection of the null hypothesis of normality. Sims (1980) also notes that when distributions of residuals have fat tails it creates a bias toward rejection of the null hypothesis. Based on the central limit theorem, therefore, it is argued in this study that the cumulative distribution function of the data generating process of each of the variables will asymptotically converge to normality (that is, as the sample size increases).

5.5.4 Variance Decompositions of the Selected Endogenous Variables

Table 19 displays the percentage of the variance or the *forecast prediction error* made in forecasting the endogenous variables due to a specific structural shock at a given period. They assess the interactions among the variables and provide the information about the relative importance of each random shock on each endogenous variable in the SVAR system. The forecast error decompositions are calculated using structural decomposition based on the identifying assumptions made above.

In table 19, the second column contains the forecast standard error for the endogenous variable at a given period of time. The forecast standard errors over the forecasting period (2006Q1-2011Q4) are relatively small regardless of the structural economic shock which enables the SVAR model to produce fairly accurate simulations. The results show that contributions to the FPE originate from different sources of shocks. For example, about

94.11% of the error in the forecast of real GDP is attributed to the aggregate demand, fiscal policy and technological shocks in the SVAR system. The forecast prediction error for GBD series mostly originate from fiscal shocks (about 97-98%). The other endogenous variables are interpreted in the same manner.

5.6 Impulse Responses Based on Structural Decomposition

Impulse responses are defined as traces of the response of current and future values of each of the variables to a one unit increase in the current value of one of the VAR errors. The impulse response analysis assumes that this error or shock will return to zero in subsequent periods for demand (temporary) shocks while the effect of supply disturbances increases steadily over time (Blanchard and Quah, 1989, p. 656).

Since it is assumed that the VAR errors are contemporaneously correlated, orthogonalisation at this stage is important so that by shocking one error the other disturbances can be held constant. Having set the identifying assumptions on the SVAR model the impulse responses for the four-dimensional structural VAR ($SVAR(4)$) model are calculated in Eviews 5.1 by a method of structural decomposition which uses the orthogonal transformation estimated from the structural factorisation matrices.

Estimation of the unrestricted reduced form VAR for our model is in the form set by equation (1). The original series that are not seasonally adjusted in their logarithmic form are used so that the deterministic component in the unrestricted VAR system includes a constant, a trend and seasonal variables (s2, s3 and s4) in which a total number of 84 parameters are estimated by the structural VAR model.

The graphs in figure 4 and 5 show the time paths for the structural shocks of four modelled variables. Each column represents the respective shocks identified above. In figure 4 all disturbances are temporary shocks as they converge towards the equilibrium steady state value. All shocks are, therefore, demand shocks. The structure of movements in real GDP from all shocks, for example, have a humped-shaped structure which is similar to the one identified by Blanchard and Quah (1989). Temporary shocks from GBD, TBRATE and TB have a sine-wave pattern.

It can be concluded that policy shocks of the MGDS framework are demand shocks that will converge towards its original state once a structural shock has been initiated. The individual shocks, therefore, represent demand shocks. According to government policy, shocks from fiscal discipline are assumed to be contractionary and that the monetary policy rule is to follow a disinflationary monetary policy particularly by lowering interest rates. It is also assumed that expectations on technological or production shocks represent an improvement in the trade balance.

5.7 Dynamic Relationships of Macroeconomic Variables

5.7.1 Internal Macroeconomic Performance (Aggregate Demand Shock)

The results displayed in the first column of figure 5 and table 20 show the time paths of the four modelled variables to demand shocks in their logarithmic form. An expansionary aggregate demand shock to real GDP initially worsens in the first period by a dynamic elasticity of 0.02-basis points and by the end of the fourth quarter in 2006 the interim response of the dynamic elasticity increases to 0.03-basis points. Considering the whole period of 24 quarters, the demand shock would have improved real GDP by an accumulated interim elasticity of 0.38-basis points.

In the second equation, an aggregate demand shock has a positive impact on the government budget deficit. This owes to the fact that high GDP growth rates associated with high productivity rates have a positive impact on the government budget deficit. The demand shock initially improves the budget deficit by a dynamic elasticity of 0.06-basis points. However, the shock converges towards its equilibrium steady state and by the end of the 24-period the demand shock would have accumulated the interim elasticity of the government budget deficit to an average of about 0.12-basis points above the equilibrium steady state level.

In the third equation, the demand shock has a negative impact on the Treasury bill rate in the initial period and the dynamic response is to decrease the level of interest rates by an elasticity of -0.13-basis points below the equilibrium steady state level. At the end of the 24-period the accumulated response of the Treasury bill rate due to an expansionary

aggregate demand shock is to lower the level of interest rates by an interim elasticity of 0.92 basis points below the equilibrium steady state level.

Finally, an aggregate demand shock has an accumulated negative impact on the trade balance and this owes to the fact that Malawi is still a developing nation. Therefore, further capital inflows are expected that would worsen the trade balance. The initial aggregate demand shock worsens the trade balance by a dynamic elasticity of 0.15-basis points and by the end of the 24-period the dynamic response from an aggregate demand shock would have accumulatively worsened the trade balance by an elasticity of 0.72-basis points.

In summary, based on the specification of the pattern matrix the unexpected rise in the aggregate demand shock has been identified to lead to an increase in real output, improves the government budget deficit, decreases inflationary pressures on the Treasury bill rate and worsen the trade balance.

5.7.2 Government Policy Intervention (Fiscal Policy Shock)

In this section the impulse responses are based on a contractionary fiscal policy shock. On assumption that the government will pursue fiscal discipline over the MGDS implementation period the emphasis is to see whether the government budget deficit converges to an equilibrium position once a fiscal policy shock has been initiated. The second column of figure 5 shows the responses of the endogenous variables to a structural one standard deviation contractionary fiscal policy shock.

In the first graph a fiscal policy shock has a positive impact on real GDP and in the first period the dynamic response due to a one-unit fiscal policy shock improves real GDP by an elasticity of 0.03-basis points above the equilibrium steady state level. By the end of the 24-periods the accumulated response due to a one-unit fiscal policy shock would have improved real GDP by an interim elasticity of 0.36-basis points above the equilibrium steady state level. Therefore, government savings improve real GDP in future periods.

The second graph of the second column in figure 5 clearly shows that an unexpected contractionary fiscal policy shock has a positive dynamic impact on the government budget deficit. A one-unit increase from a fiscal policy intervention increases the government budget deficit by an elasticity of 0.74-basis points in the first period and improves over the implementation period by registering an overall interim elasticity of 1.24-basis points above the equilibrium steady state level.

The contractionary fiscal policy shock has a negative impact on the Treasury bill rate. The initial impact is to raise the level of interest rates from its equilibrium steady state level by an elasticity of 0.02 basis points and then falls. By the end of the 24 period the shock returns to its equilibrium steady state level and accumulatively the interim elasticity falls to -1.78 basis points. It is expected that improvements in GBD are associated with reductions in the level of interest rates. In other words improving the government budget deficit or pursuing a contractionary fiscal policy shock will result into interest rates falling.

Finally, the results show that an unexpected contractionary fiscal policy shock improves the trade balance throughout the period. In period one the trade balance's dynamic response from a contractionary fiscal policy shock deviates from its equilibrium steady state level by an elasticity of 0.17-basis points. The trade balance then worsens and reaches its maximum by the end of the first 4 quarters but accumulatively improves till the 24th quarter returning towards its equilibrium steady state level.

Overall the general trend of the TB is an upward improvement from a contractionary fiscal policy shock. However, the interim elasticity would have accumulatively worsened the trade balance to -1.28 basis points owing to the fact that it still registers largely deficits. Therefore, there seems to be a positive relationship between an improvement in the government budget deficit and the trade balance signifying government's role in improving or worsening the trade balance.

In summary, a contractionary fiscal policy shock has a positive impact on real GDP in the long-run owing to the fact that other forces might be at work such as new resources being

channelled into other alternative uses such as private sector investment. The effect of a fiscal policy shock is to improve the government budget deficit in the long-run, lower the Treasury bill rate and overall improve the trade balance.

5.7.3 Monetary Policy Intervention

In this section focus will be on the likely response of the endogenous variables towards their equilibrium values due to an unexpected disinflationary monetary policy shock. In the first graph of column 3 in figure 5, the dynamic multiplier from an unexpected monetary policy shock initially raises real output by an elasticity of 0.01 basis points and by the end of the 24 quarters the interim elasticity for real output would have deviated above its equilibrium level by an elasticity of 0.43 basis points. The dynamic response is in line with economic theory as it is expected that a contractionary monetary policy intervention that lowers the level of interest rates should have a positive impact on the level of real output.

In the second graph of column 3, the impact of a disinflationary monetary policy shock is to improve the government budget deficit. The initial dynamic response is to deviate from its initial equilibrium steady state level by an elasticity of 0.02 basis points. After the first quarter the level of interest rates returns to its equilibrium steady state level and continues to rise accumulatively. After 24 quarters the interim elasticity is 0.05 above the equilibrium steady state level. Thus, in a sense there is a negative relationship between a monetary policy shock and the government budget deficit.

In the third graph of column 3, a disinflationary monetary policy shock results in a dynamic response on the Treasury bill rate in the initial period by an elasticity of 0.08 basis points above the equilibrium value but then falls towards its equilibrium steady state level (see figure 5) over the period. The convergence of the Treasury bill rate towards its equilibrium steady state signifies the credibility of the disinflationary policy rule that Malawi is to follow over the MGDS implementation period.

Finally, a disinflationary monetary policy shock has a permanent negative effect on the trade balance. In the first period the dynamic response results in worsening the trade

balance by an elasticity of 0.23 basis points and continues to worsen until the 24th quarter registering an accumulated interim elasticity of 0.66 basis points below the equilibrium steady state level. This is so because it is expected that a disinflationary monetary policy shock will lower interest rates which induce private borrowing. Assuming increased productivity and capacity utilization, economic agents will use their excess money balances *inter alia* to import capital goods to be used in production activities, hence worsening further the trade balance.

In summary, a disinflationary monetary policy shock increases real output, has a negative impact on the government budget deficit, lowers the Treasury bill rate and worsens the current account balance.

5.7.4 Technological or Production Shocks

It has been pointed out that the government's policy on external trade is to pursue an export oriented trade growth as opposed to import-substitution. The philosophy behind the ideology is to transform Malawi from a poor nation to a middle class-industrialised nation. It has also been suggested that the shock from the trade balance equation represents technological/production shocks or external non-policy factors such as terms of trade shocks. The latter has been the cause of concern on food security issues in the country over a decade prior to 2005.

In the first graph of column 4 in figure 5, a technological shock has an initial positive impact on real output by an elasticity of 0.08 basis points above the equilibrium steady state level. The interim dynamic elasticity increases accumulatively and by the end of the 24th quarter the response of real output would have increased from its equilibrium steady state level by an elasticity of 0.67 basis points. The results also show that real output converges to its equilibrium steady state level after the initial shock at the end of the 24 quarters.

In the second graph, the dynamic elasticity from an expansionary technological shock on the government budget deficit has mixed reactions as it first improves then worsens throughout the period under investigation. The initial impact is a positive dynamic

response on the government budget deficit by an elasticity of 0.02 basis points. The budget deficit then worsens due to the expansionary technological shock and by the end of the 24 quarters the interim elasticity worsens by -0.09 basis points. Thus, an expansionary technological shock has an overall negative impact on the government budget deficit.

In the third graph, the dynamic response from an expansionary technological shock has an initial negative impact on the Treasury bill rate by an elasticity of -0.05 basis points. However, at the end of the 24 periods the interim dynamic elasticity on the Treasury bill rate converges towards its equilibrium steady state level and the expansionary technological shock dies down and still increases the level of interest rates by an elasticity of 0.27 basis points.

Finally, in the fourth graph of column 4, an expansionary technological shock registers a positive permanent impact on the trade balance as expected owing to improvements in internal productivity. The initial technological shock improves the trade balance from its initial equilibrium level by an elasticity of 0.02 basis points and by the 24th quarter the interim elasticity on the trade balance improves accumulatively by 0.29 basis points. In summary, an expansionary technological shock has an overall positive impact on real output, worsens the government budget deficit, increases the Treasury bill rate and improves the trade balance.

5.8 Forecasting

Having estimated the structural VAR, how well does this multivariate model forecast future values of the endogenous macroeconomic variables? It was stated earlier (chapter one) that the study intends to assess whether the Malawi Government's policy on, for example, real GDP growth rate of an average of 6% per annum is *credible*. Other questions to be tackled in this section include future directions on the level of interest rates, trade balance and government budget deficit.

The forecasts to be generated are stochastic joint forecasts rather than deterministic. These stochastic joint forecasts are preferred as they incorporate uncertainty into the

model by constructing confidence intervals. The simulation results are based on scenarios adopted from projections developed by the Ministry of Finance in Malawi compiled by Thomas Dalsgaard that provide the benchmarks for the forecasts which are given in table 14 (appendix H)⁸.

The financial programming technique considers consistency of macroeconomic accounts such as the BOP, fiscal accounts, monetary accounts and national accounts and thereafter makes projections based on a five-year implementation framework. The projections used in this study include annual and quarterly data from the MGDS implementation period 2006Q1-2011Q4 from which simulated quarterly data on real GDP, government budget deficit, interest rates, and the trade balance were obtained. These projections will be compared with the data generating process or forecasts that are to be generated by the SVAR model.

The first step in forecasting is to find how well the SVAR model can provide one-step ahead forecasts of the endogenous variables. Figure 6 (appendix F) shows a plot of the historical data against the predicted (fitted) values of the endogenous variables of the estimated SVAR model. This is a type of static simulation that is based on the sample period 1980Q1-2005Q4. The results show that the SVAR model provides a good fit.

The second step involves assessing how well the SVAR model can be used to forecast future periods based on dynamic forecasting that uses simulations on forecasts already generated from the previous period (not on historical data). The forecasting period is chosen to be 2000Q1-2005Q5 and the results displayed in figure 7 (appendix F) shows that by using dynamic forecasting technique to generate simulations for the four endogenous variables, the SVAR model would have performed relatively well. The slight deviations displayed in the graphs for the government budget deficit and the trade balance are of no surprise as there was a fiscal crisis in the year 2000 explained in chapter four.

⁸ Thomas Dalsgaard is an Economist for the Fiscal Affairs Department in the IMF

With these results the forecasting performance from the SVAR model is good and forecasts for the four endogenous variables based on the MGDS implementation period 2006Q1-2011Q4 can be generated. A stochastic simulation h – step technique, therefore, is employed. The simulations are displayed in figure 8 based on the mean forecasts with ± 2 – standard deviations (or 95%) confidence intervals given by the dotted bounds or limits. The vertical dotted line represents the start period for the forecasts (2006Q1). Table 21 (appendix H) shows the actual and forecasted values of the four endogenous values together with the upper and lower confidence intervals in levels of the variables⁹. The quarterly forecasts are aggregated into annual levels.

In table 21, the forecast results show that real output in the year 2006 was expected to grow by 8.3% with forecasted confidence intervals within the ranges of -10.4% to 29.7%¹⁰. In 2011 real output growth rate is forecasted to be about 6.2% and within the forecasting range -13.1% to 27.1%. The overall real GDP growth rate during the MGDS implementation period (2006Q1-2011Q4) is an average of 6.0% per annum as projected by the Malawi Government.

The government budget deficit over the MGDS implementation period is expected to range between -0.1% and -6.3%. The year 2006 registers the lowest percentage ratio of the simulated government budget deficit at a rate of -0.1% owing to the fact that Malawi benefited from the debt relief programme under the Highly Indebted Poor Countries (HIPC) initiative. On average, the government budget deficit will average about -5.0% of GDP compared to the same benchmark already projected by the Ministry of Finance (-5.0% of GDP) over the MGDS implementation period.

The trade balance, on the other hand, still shows signs of a further deficit but slightly improving during the MGDS implementation period. For instance, in 2007 it is predicted that the trade balance forecast averages -15.5% of GDP whilst in 2011 the trade balance would have improved to an average of -15.0% of GDP. However, comparing the actual

⁹ The estimation results are in logarithmic form and are transformed back into their levels.

¹⁰ In fact for the fiscal year 2006/07 government reported an annual real GDP growth rate of 8.5% in mid-year review presented at the National Assembly in Lilongwe by the Honourable Minister of Finance, March 2007.

projected values from Ministry of Finance fiscal tables and the simulated values from the SVAR model shows that the TB series is over-projected as compared to the simulated results from the SVAR data generating process. Overall the trade balance is expected to average about -15.0% of real GDP between 2005Q1-2011Q4 comparing a benchmark of -9.3% set by the Ministry of Finance.

Finally, the h – step ahead forecast for the TBRATE shows that the government’s plan of lowering interest rates may be realised. It is expected that the level of interest rates would range from 24.3% (16.3%-27.7%) in 2006 to an average of 19.3% (14.6%-25.3%) in 2011. The simulation results, however, are different from the actual projections from Ministry of Finance (projecting an average benchmark of 17.0%), whilst the SVAR simulations record an average value of 19.7% for the MGDS implementation period.

In summary, the forecasts perform well and the results show that both projected and simulated results are mostly within the generated confidence intervals. Figure 8, however, shows that the government forecasts for the Treasury bill rate and the trade balance are slightly different from the projected results from the SVAR data generating process. Therefore, assuming that there is political will and that all stakeholders align their activities with the government’s plan, real GDP is expected to grow by the estimated average of 6.0% per annum, the government budget deficit is likely to be controlled (-5.0% of GDP), the level of interest rates are bound to fall and the current account balance is likely to improve over the MGDS implementation period but still registering a current account deficit.

Chapter Six

6.1 Summary and Conclusions

The study has employed multivariate macro-econometric tools in assessing policy credibility in Malawi. The multivariate approach has considered the SVAR model based on the Mundell-Fleming framework. The SVAR model is used to validate the Malawi Government (and MGDS) projected outcomes on real output, government budget deficit, Treasury bill rate and the trade balance. Though the SVAR model may seem to be under-parameterised, the model produces good approximations and simulations compared to the respective projected outputs provided by the Ministry of Finance in Malawi.

The results of the impulse response analysis in almost all aspects closely match the predictions of the standard *IS – LM – BP* paradigm thereby providing an important robustness check for the SVAR model. The fact that the SVAR model used shows signs of converging towards its equilibrium steady state values provide an indication of the *temporary nature* of the structural disturbances generating output, budget deficits, Treasury bill rates, and trade balance dynamics. According to Blanchard and Quah (1989), these temporary shocks could be interpreted as *demand shocks*.

As for the long-run cointegrating vectors the estimated results show that the Treasury bill rate has a positive long-run impact on real output. The results also show that the trade balance has a negative long-run impact on real output that concurs with Bannaga's (2004) argument that most developing countries have a negative relationship between output and the trade balance. The results have also shown that both the Treasury bill rate and the trade balance show negative long-run relationships with the government budget deficit. The implication is that low interest rates would induce more government borrowing thereby worsening the budget deficit while high interest rates would improve the budget deficit as government borrows less.

Finally, the simulated results from the SVAR model in comparison with the IMF projections given by government under the MGDS show that the projections are in line

with government intentions. Real GDP is expected to grow by a projected average growth rate of 6.0% (benchmark, 6.0%) per annum, the government budget deficit is expected to be controlled averaging -5.0% of GDP (benchmark, -5.1%), interest rates are expected to be lowered averaging 19.7% by the end of 2011 (benchmark, 17.0%) and the trade balance improved from -23% of GDP (2000Q1-2005Q4) to an average of -15.0% of GDP (against a benchmark of -9.3%) during the MGDS implementation period (2006-2011).

6.2 Policy Implications, Recommendations and Limitations

As regards to individual expectations, economic agents during the MGDS implementation period (2006Q1-2011Q4), see future movements in real GDP, government budget deficit, Treasury bill rate and the trade balance as moving in the appropriate direction. The forecasting results predict improvements in these four variables thereby improving policy credibility of government policies over the MGDS implementation period.

This has implications on government policy when it is maximising its social objective function. Policy measures and rules that government should concentrate over this period should concentrate on creating favourable conditions for improving real GDP, government budget deficit, Treasury bill rates and the trade balance over the MGDS implementation period.

By aligning the MGDS to the Malawi Vision 2020, economic agents are able to understand government's '*social objective function*' and how the structure of the economy is to be in the current framework and deduce the way policy will be formulated in the future. Perhaps at this stage it is still not clear what the magnitude would be and the impact on expectations resulting from a change in administration of some policy rules such as tax rates, a government regime change or even stakeholder misalignment of activities. It all depends on the degree of the change and this requires more empirical

evidence and more room for further research¹¹. Generally in this case, policy rules that incorporate expectations are indeed appropriate in the Malawian context.

The SVAR model is not by any means estimated without some faults. The identifying assumptions have been estimated using a basic methodology introduced by Blanchard and Quah (1989) implemented in Eviews 5.1. More advanced approaches have been proposed in the literature that link causal connections with institutional factors such as, *inter alia*, estimating the exact elasticities of both government revenue and expenditure coefficients as introduced by Blanchard and Perotti (2002). This, however, provides room for further empirical analysis on the MGDS implementation plan.

The study also faced some limitations on availability of information as data was not available for consumer price indices, Treasury bill rates and real effective exchange rate before 1980Q1. This constrained the study to only consider a sample after the post-independence period particularly the period after SAPs.

¹¹ An alternative analysis would be to create baseline scenarios using the same methodology adopted and assess the impact it has on the projections.

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Appendices

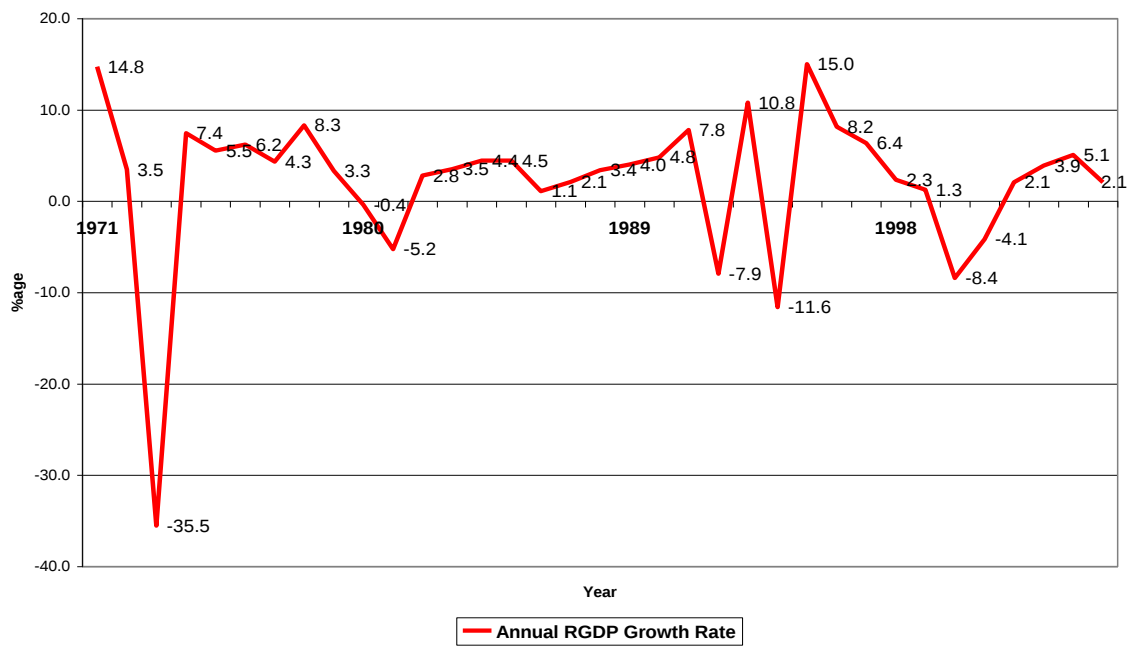
Appendix A: Datasets

International Financial Statistics Data Ready for Submission: obtained from the Department of Research and Statistics, Reserve Bank of Malawi

Malawi Fiscal Spreadsheet: obtained from the Economic Affairs Department- Macro Section, Ministry of Finance, Capital Hill. File Compiled by Thomas Dalsgaard, FAD

Appendix B: Real GDP Growth per Annum

Figure 1: Annual Growth in Real GDP



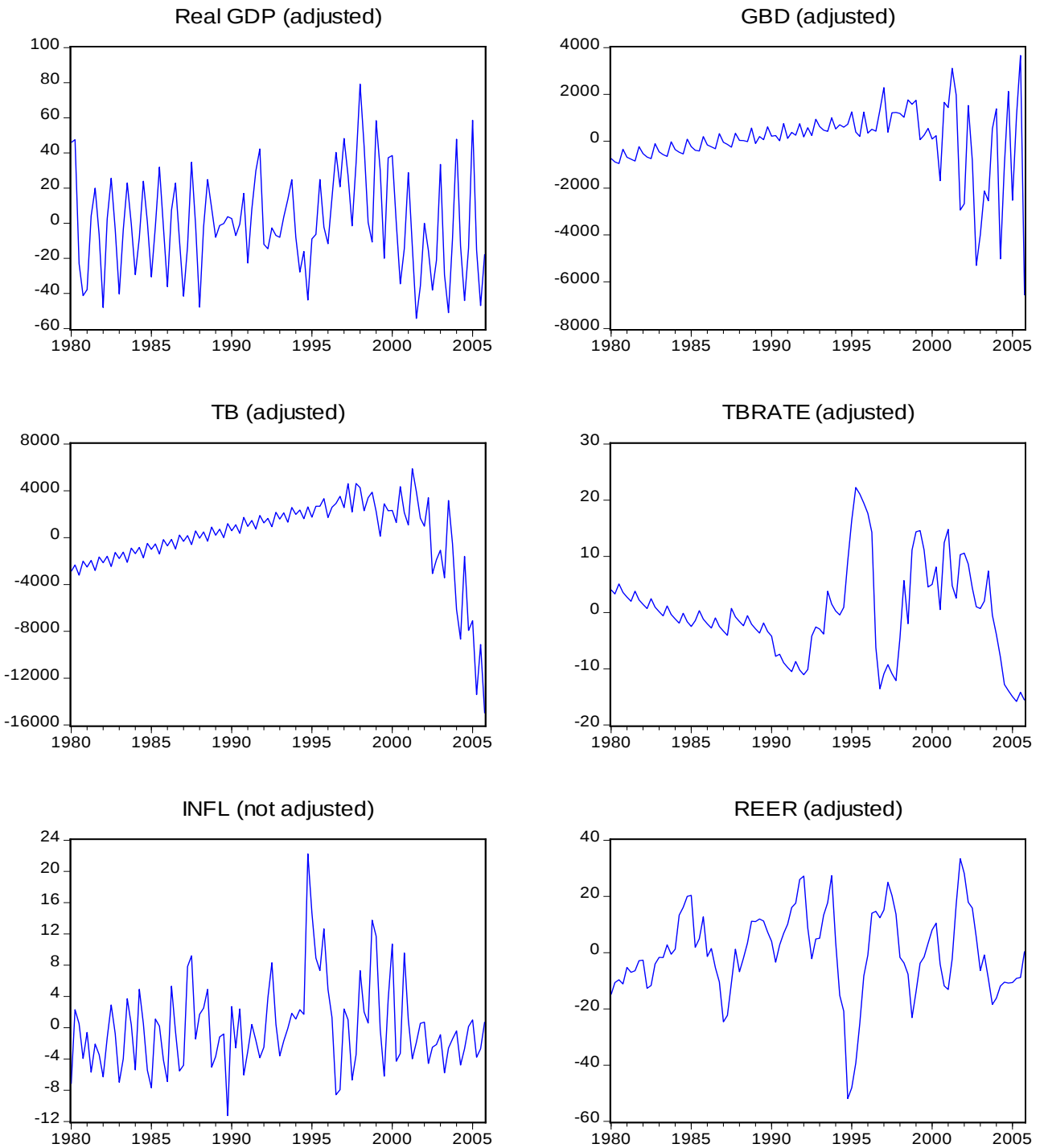
Appendix C: Graphs of Macroeconomic Variables Used

Figure 2: Trends in Quarterly Data of Six Macroeconomic Variables



Appendix D: Deseasonalised and Detrended Series

Figure 3: Deseasonalised and Detrended Series



Appendix E: Impulse Response Analysis Results

Figure 4: Stability of the Estimated SVAR Model

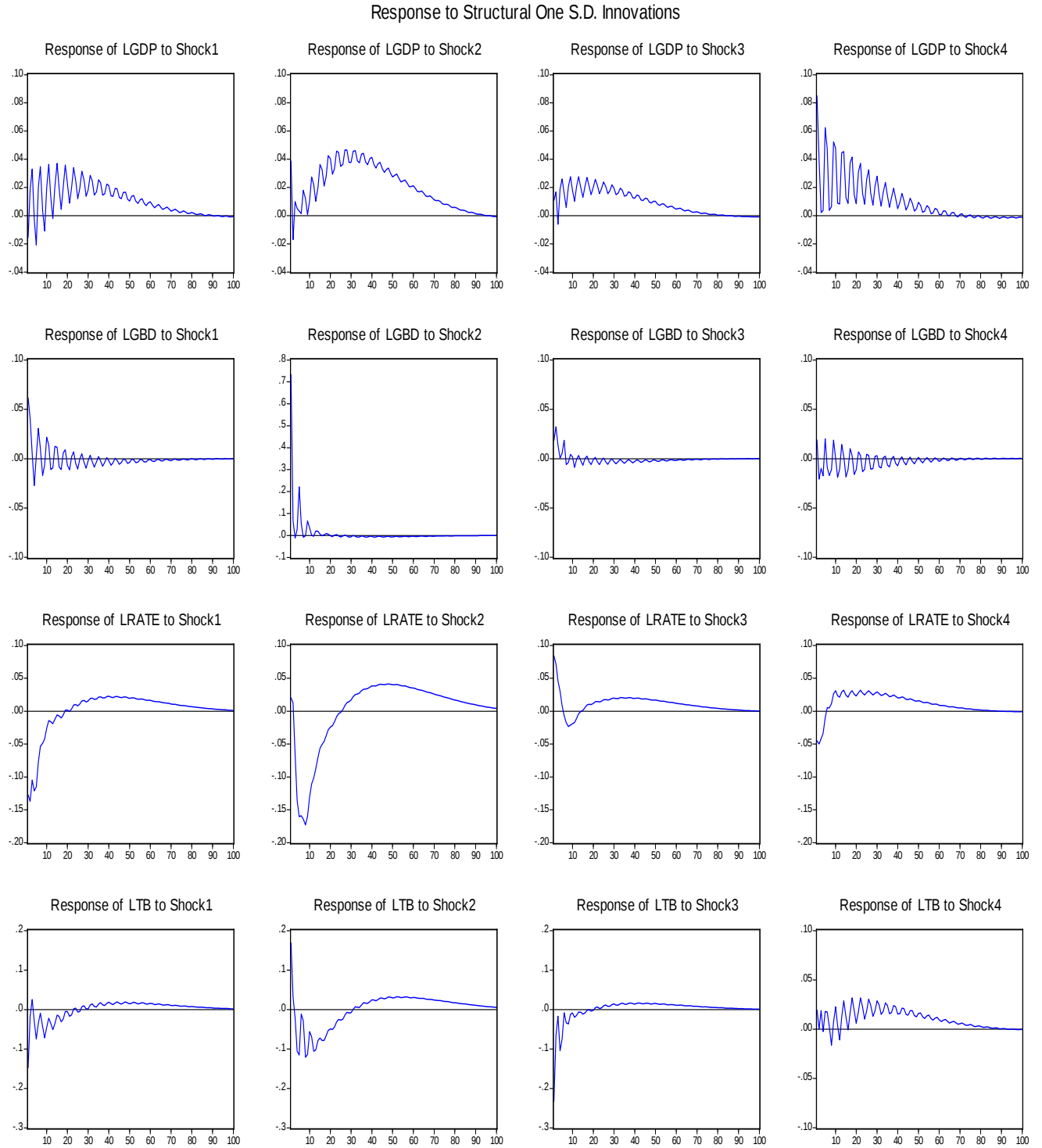
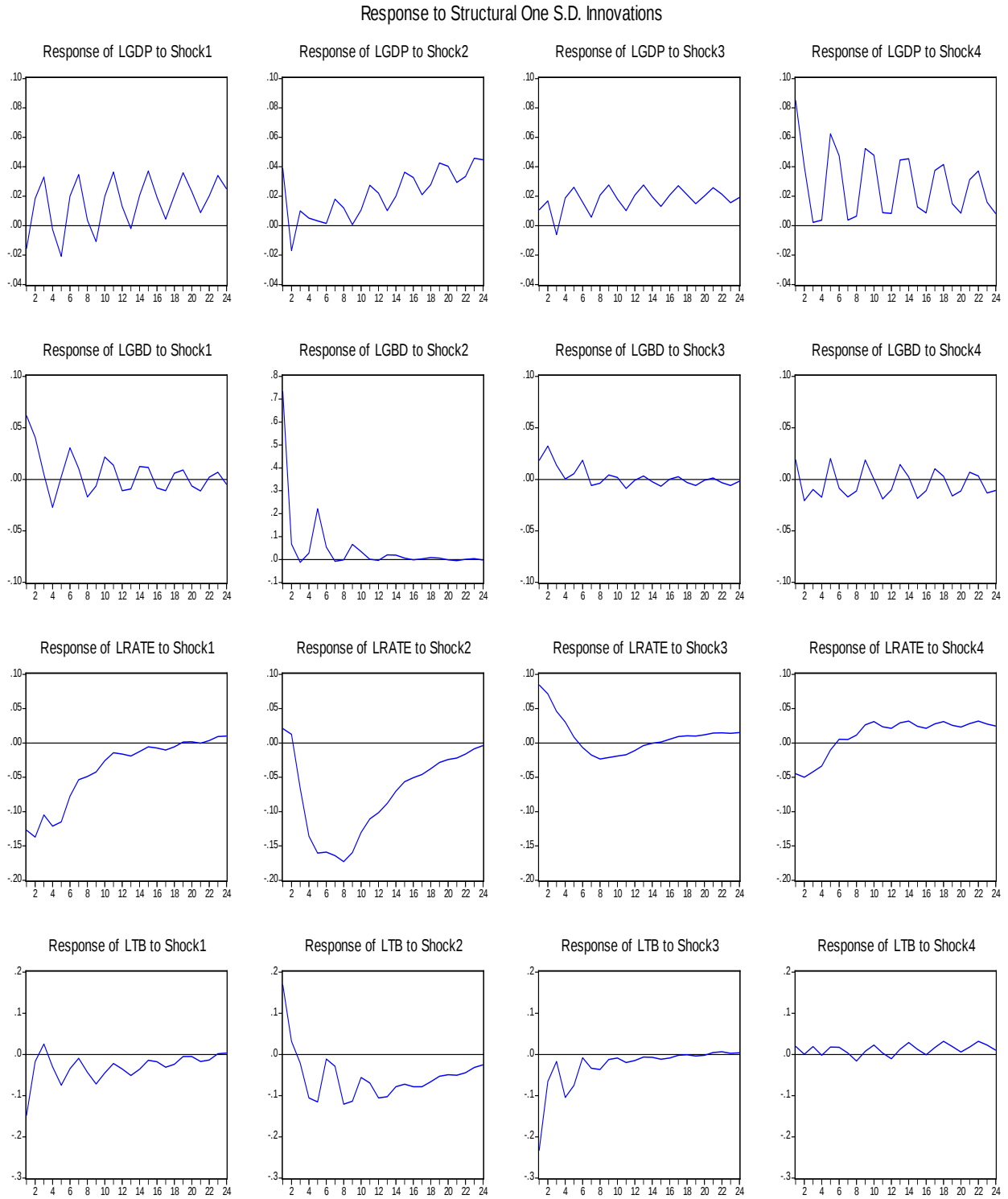


Figure 5: Impulse Response Analysis of Four Structural Shocks



Appendix F: Forecasting Results

Figure 6: H-Step Forecasts for the Estimated SVAR Model (1980Q1-2005Q4)

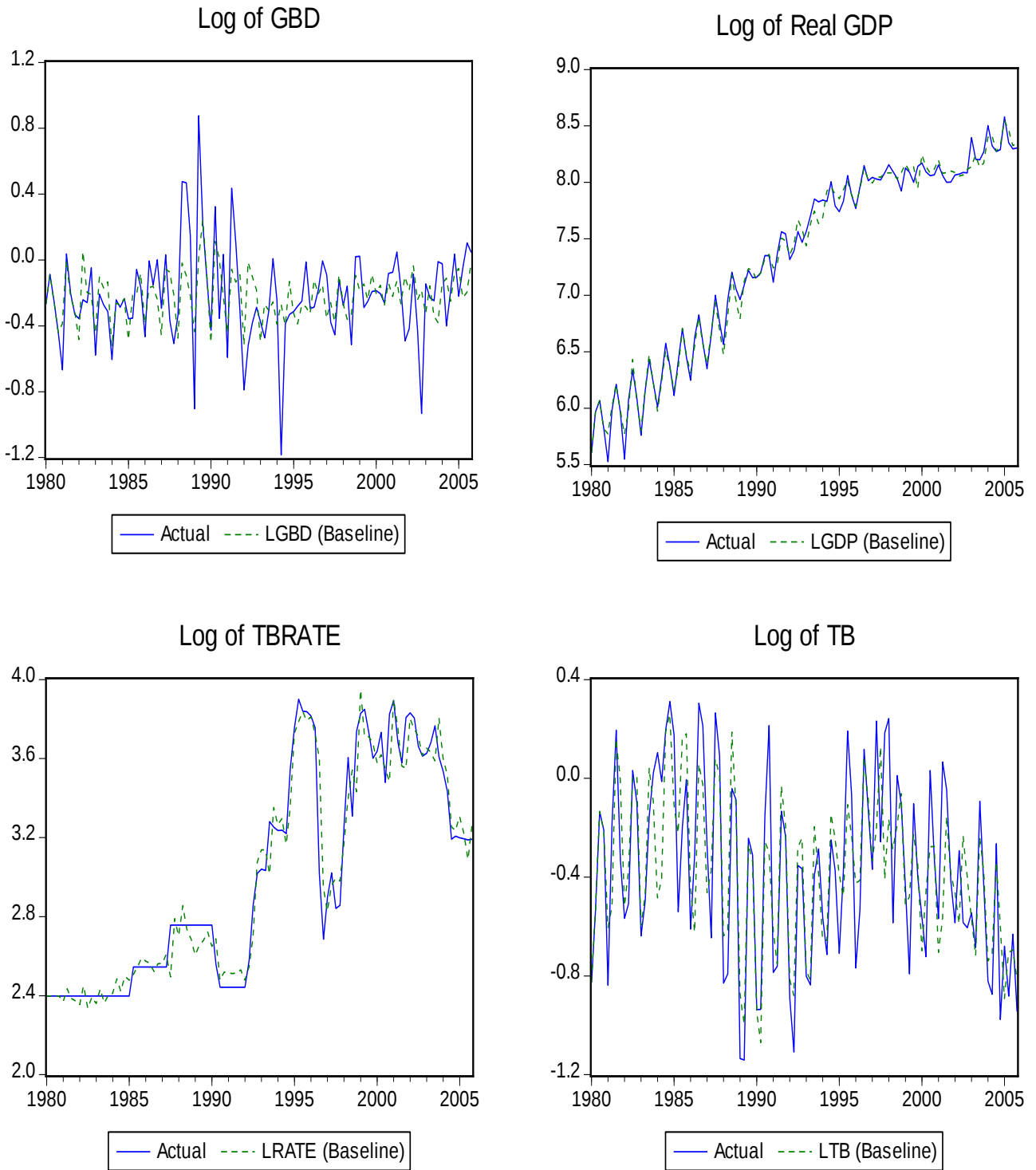


Figure 7: Dynamic Forecasts for the Estimated SVAR Model (2000Q1-2005Q4)

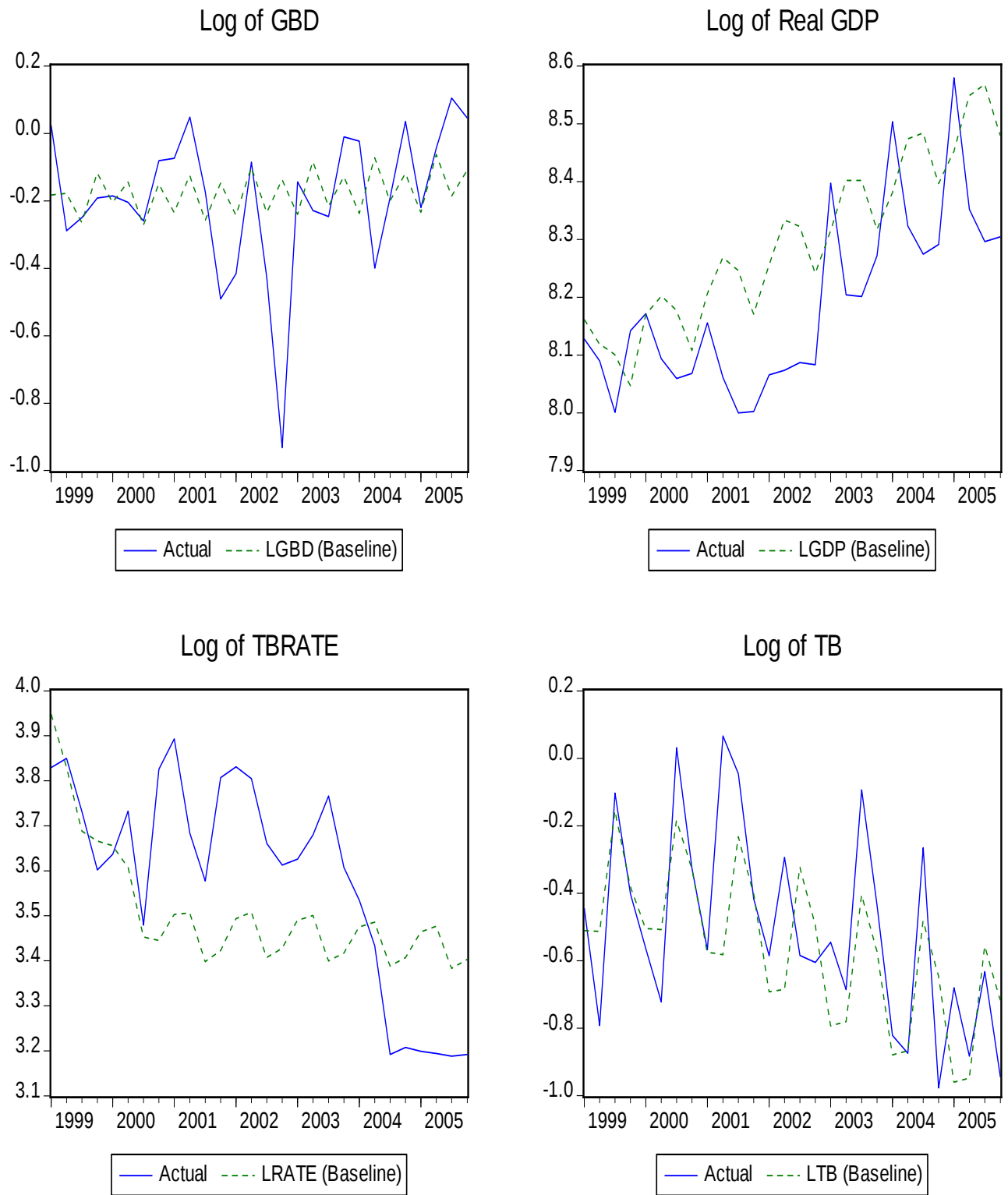
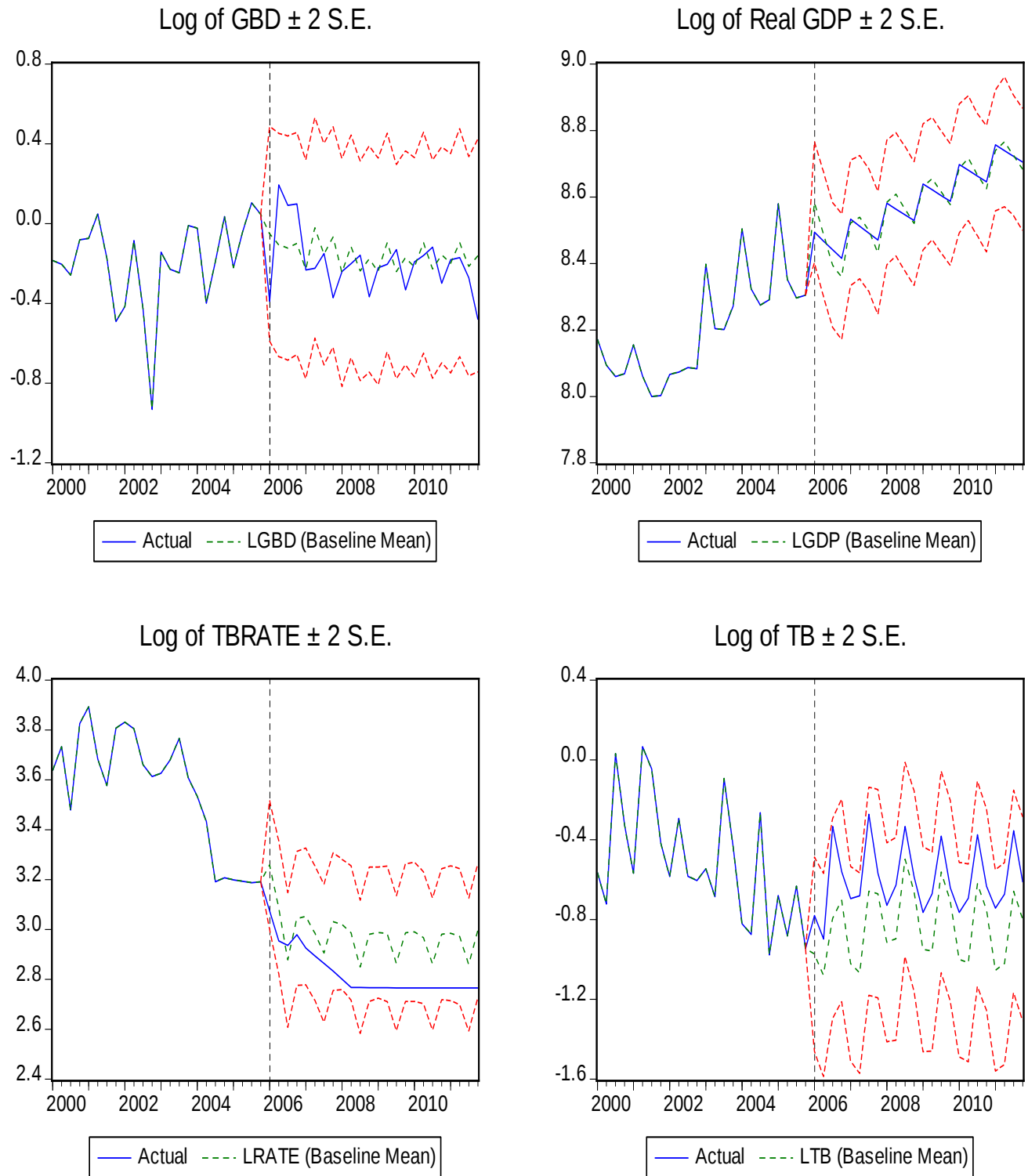


Figure 8: H-Step Forecasts for the Estimated SVAR Model (2000Q1-2011Q4)



Appendix G: Diagnostic Test Tables

Table 1: Descriptive Statistics

	QRGDP	GBD	TB	TBRATE	INFL	REER
Mean	20676.1	-613.2	-1967.6	23.2%	5.2%	124.9
Median	19308.0	-33.3	-181.5	17.3%	3.9%	130.5
Maximum	53214.0	1951.8	720.7	49.4%	30.0%	173.5
Minimum	2514.0	-8913.7	-22094.3	11.0%	-6.7%	65.8
Std. deviation	13255.8	1717.4	4371.9	12.8%	6.5%	29.9
Skewness	0.21	-2.8	-2.8	0.7	1.2	-0.4

Table 2: Seasonality Tests

Variable	t_{Q1}	t_{Q2}	t_{Q3}	t_{Q4}
QRGDP	21.04 (0.000)***	22.69 (0.000) ***	25.27 (0.000) ***	23.28 (0.000) ***
GBD	-1.91 (0.058)*	-1.36 (0.177)	-1.10 (0.272)	-2.86 (0.005) ***
TB	-2.14 (0.035)**	-2.65 (0.009) ***	-1.51 (0.135)	-2.79 (0.006) ***
TBRATE	9.30 (0.000) ***	9.46 (0.000) ***	8.63 (0.000) ***	9.11 (0.000) ***
INFL	8.45 (0.000) ***	1.53 (0.128)	1.72 (0.087)*	7.04 (0.000) ***
REER	21.22 (0.000)***	20.92 (0.000) ***	21.03 (0.000) ***	20.86 (0.000) ***

Table 3: Unit Root Test Results using a Model with Intercept and Trend based on ADF

Variable	p	Critical Value	t_{γ}	F – statistic	Inference
QRGDP	3	-2.54 (0.31)	2.35 (0.02)**	36.93 (0.00)***	Non-stationary, significant trend
GBD	20	-4.06 (0.01)	-2.16 (0.04)**	20.17 (0.00)***	Non-stationary (?), significant trend
TB	22	5.24 (1.00)	1.87 (0.07)*	21.24 (0.00)***	Non-stationary (?), significant trend
TBRATE	0	-2.39 (0.38)	1.56 (0.12)	2.97 (0.06)*	Non-stationary, insignificant trend
INFL	4	-3.58 (0.04)	0.65 (0.51)	15.52 (0.00)***	Non-stationary (?), insignificant trend
REER	1	-4.48 (0.00)***	-3.93 (0.00)***	3.62 (0.00)***	Stationary, significant trend

The critical values for the ADF test including intercept and trend are 1%***= -4.05, 5%***= -3.45, and 10%*= -3.15. All unit root tests based on seasonally adjusted series.

Table 4: Unit Root Test Results using a Model with Intercept and Trend Based on DFGLS

Variable	p	Critical Value	1%	5%	10%	Inference
QRGDP	3	-1.89	-3.58	-3.03	-2.74	Non-stationary
GBD	19	-1.87	-3.64	-3.08	-2.79	Non-stationary
TB	23	-2.15	-3.66	-3.09	-2.80	Non-stationary
TBRATE	0	-2.46	-3.57	-3.03	-2.74	Non-stationary
INFL	4	-3.17	-3.58	-3.03	-2.74	Non-stationary
REER	1	-4.21	-3.58	-3.03	-2.74	Stationary

The critical values for the DFGLS test including intercept and trend based on critical values obtained from Elliot-Rothenberg-Stock (1996) table 1 and all unit root tests based on seasonally adjusted series.

Table 5: BDS Test for Independence of the Residuals

Dimension [@]	QRGDP	GBD	TB	TBRATE	INFL	REER
2	0.00 (0.67)	-0.00 (0.90)	0.01 (0.14)	0.00 (0.65)	0.00 (0.28)	-0.00 (0.92)
3	0.01 (0.36)	0.01 (0.26)	0.02 (0.15)	0.00 (0.69)	0.00 (0.47)	0.00 (0.76)
4	0.01 (0.35)	0.02 (0.20)	0.02 (0.22)	-0.00 (0.82)	0.01 (0.49)	0.09 (0.40)
5	0.01 (0.57)	0.05 (0.07)*	0.04 (0.17)	-0.00 (0.82)	0.01 (0.63)	0.02 (0.29)
6	0.01 (0.49)	0.07 (0.04)**	0.05 (0.14)	-0.00 (0.80)	0.00 (0.75)	0.02 (0.31)

[@]The BDS statistic is presented in each column and the bootstrap *p*-values in parenthesis

Table 6: Diagnostic Tests for Unit Root Models

Variable	RESET Test	AR [@] Test	Heteroscedasticity Test	ARCH Test [§]
QRGDP	1.57 (0.21)	0.86 (0.43)	1.61 (0.07)*	0.18 (0.91)
GBD	9.32 (0.00)***	0.99 (0.38)	10.12 (0.00)***	2.02 (0.12)
TB	1.53 (0.21)	2.67 (0.08)*	20.67 (0.00)***	2.26 (0.09)*
TBRATE	0.08 (0.78)	0.48 (0.62)	2.64 (0.00)***	0.34 (0.79)
INFL	0.31 (0.58)	2.11 (0.13)	1.95 (0.03)**	0.73 (0.54)
REER	0.68 (0.41)	0.26 (0.77)	1.71 (0.08)*	1.43 (0.24)

[@] Based on Breusch-Godfrey Serial Correlation LM Test *F*-statistic at lags 2

[§] Based on ARCH LM Test at lags 3

Table 7: Unit Root Tests in the Presence of Structural Breaks

Variable ^{&}	Lag	t_{μ}	t_{α}	t_{φ}	<i>F</i> – statistic
QRGDP	8	-2.51 (0.01)***	2.45 (0.02)**	-2.45 (0.02)**	15.32 (0.00)***
GBD	17	2.97 (0.00)***	-0.16 (0.88)	-2.52 (0.01)***	19.89 (0.00)***
TB	8	2.98 (0.00)***	0.90 (0.37)	-2.53 (0.01)***	16.19 (0.00)***
TBRATE	9	-2.69 (0.01)***	2.24 (0.03)**	-1.75 (0.08)*	2.95 (0.01)***
INFL	5	4.35 (0.00)***	2.37 (0.02)**	-2.40 (0.02)**	31.23 (0.00)***
REER	3	0.85 (0.40)	-0.50 (0.61)	0.15 (0.88)	6.28 (0.00)***

[&]All OLS estimates based on White Heteroscedasticity-Consistent Standard Errors and Covariance

Table 8: Coefficient Values in the Presence of Structural Breaks

Variable ^{&}	Lag	t_{μ}	t_{α}	t_{φ}	<i>F</i> – statistic
QRGDP	8	-56.89***	154.47**	-4.67**	15.32 (0.00)***
GBD	17	947.93***	-129.99	-355.24***	19.89 (0.00)***
TB	8	508.02***	-1509.99	-530.07**	16.19 (0.00)***
TBRATE	9	-0.75***	2.88**	-0.07*	2.95 (0.01)***
INFL	5	4.48***	7.32**	-0.21**	31.23 (0.00)***
REER	3	0.86	-1.58	0.01	6.28 (0.00)***

[&]All OLS estimates based on White Heteroscedasticity-Consistent Standard Errors and Covariance

Table 9: Perron Critical Values for Unit Root Test in the Presence of Structural Breaks

Variable	Lag	ADF	λ	1%	5%	10%	Inference
QRGDP	8	-2.97	0.4	-4.03	-3.38	-3.05	Non-stationary
GBD	17	-1.11	0.2	-3.86	-3.22	-2.91	Non-stationary
TB	8	-1.17	0.2	-3.86	-3.22	-2.91	Non-stationary
TBRATE	9	-1.35	0.5	-4.04	-3.38	-3.08	Non-stationary
INFL	5	-4.74	0.4	-4.03	-3.38	-3.05	Stationary
REER	3	-5.81	0.5	-4.04	-3.38	-3.08	Stationary

Table 10: Stationarity Tests using Perron Test

Variable	Lag	ADF	λ	1%	5%	10%	Inference
D(QRGDP)	7	-13.67	0.4	-4.03	-3.38	-3.05	I(1)
D(GBD)	16	-11.43	0.2	-3.86	-3.22	-2.91	I(1)
D(TB)	7	-13.15	0.2	-3.86	-3.22	-2.91	I(1)
D(TBRATE)	9	-7.28	0.5	-4.04	-3.38	-3.08	I(1)

Appendix H: VAR Analysis and Results

Table 11: Lag-Structure Test based on $Z_t = [QRGDP, GBD, TBRATE, TB]'$

Lag	Log-likelihood	LR	FPE	AIC(p)	SBC(p)	HQ(p)
0	-47.351	NA	4.65e-05	1.375	1.902	1.587
1	85.499	241.299	4.29e-06	-1.010	-0.061*	-0.626
2	94.888	16.286	4.93e-06	-0.875	0.496	-0.320
3	152.501	95.237	2.12e-06	-1.725	0.069	-0.999
4	186.753	53.825*	1.48e-06*	-2.097*	0.118	-1.201*
5	204.297	26.137	1.49e-06	-2.129	0.509	-1.061
6	212.594	11.684	1.76e-06	-2.971	1.088	-0.734

*indicates lag-order selected by the criterion

LR is the sequential modified LR test statistic (each test at 5% level); FPE is the Final Prediction Error; AIC is the Akaike information criterion; SBC is the Schwarz-Bayesian criterion; HQ is the Hannan-Quinn information criterion

Table 12: Cointegration Rank based on Johansen Test

Rank: $H(r) = r \leq$	Eigenvalues	Trace Statistics	Probability Value@
None *	0.331774	64.29937	0.0000
At most 1 *	0.143819	24.38959	0.0484
At most 2	0.053677	9.017512	0.1680
At most 3	0.035277	3.555517	0.0704

*denotes rejection of the hypothesis at the 5% level

@denotes MacKinnon-Haug-Michelis (1999) p-values

Table 13: Normalised Cointegrating Coefficients (Std. errors in parenthesis)

	QRGDP	GBD	TBRATE	TB
β'_1	1.00 (rest.)	0.00 (rest.)	-2.152 (-22.50)	0.985 (1.38)
β'_2	0.00 (rest.)	1.00 (rest.)	0.089 (4.06)	0.402 (2.45)

Table 14: Short-Run Dynamics Adjustment Coefficients (t – statistics in parenthesis)

Error Correction	D(QRGDP)	D(GBD)	D(TBRATE)	D(TB)
$ECM1_{t-1}$	0.036 (2.59)	-0.037 (-0.82)	0.074 (3.36)	-0.024 (-0.53)
$ECM1_{t-2}$	-0.221 (-3.59)	-0.532 (-2.67)	-0.058 (-0.59)	-0.531 (-2.74)

Table 15: Unrestricted Reduced Form VAR Estimates by OLS

Variable	LGDP	LGBD	LTBRATE	LTB
LGDP_1	0.443 (4.68)	-0.259 (-0.92)	-0.059 (-0.85)	-0.114 (-2.96)
LGDP_2	-0.288 (-2.84)	0.043 (0.15)	-0.011 (-0.08)	0.182 (0.67)
LGDP_3	0.258 (2.52)	-0.148 (-0.48)	0.056 (0.06)	-0.333 (-1.22)
LGDP_4	0.603 (6.13)	0.301 (1.03)	0.141 (0.99)	0.414 (1.58)
LGBD_1	-0.022 (-0.60)	0.141 (1.28)	-0.021 (-0.39)	-0.000 (-0.01)
LGBD_2	0.043 (1.13)	-0.027 (-0.25)	-0.093 (-1.69)	-0.031 (-0.31)
LGBD_3	-0.030 (-0.79)	0.031 (0.28)	-0.103 (-1.82)	-0.202 (-1.94)
LGBD_4	-0.058 (-1.43)	0.237 (1.96)	-0.048 (-0.81)	-0.222 (-2.02)
LTBRATE_1	-0.104 (-1.36)	-0.039 (-0.17)	1.012 (9.16)	-0.120 (-0.58)
LTBRATE_2	-0.047 (-0.44)	0.031 (0.10)	-0.303 (-1.95)	-0.084 (-0.29)
LTBRATE_3	0.232 (2.18)	0.086 (0.27)	0.284 (1.84)	-0.026 (-0.09)
LTBRATE_4	-0.108 (-1.48)	-0.067 (-0.31)	-0.201 (-1.89)	0.312 (1.59)
LTB_1	-0.090 (-2.20)	-0.153 (-1.25)	0.055 (0.93)	0.232 (2.10)
LTB_2	0.021 (0.53)	-0.015 (-0.12)	-0.026 (-0.44)	-0.062 (-0.57)
LTB_3	-0.049 (-1.20)	0.057 (0.47)	0.063 (1.08)	0.371 (3.41)
LTB_4	0.033 (0.79)	0.035 (0.29)	-0.008 (-0.14)	0.125 (1.12)
Constant	0.062 (0.21)	0.165 (0.19)	-0.260 (-0.61)	-1.288 (-1.64)
Trend	-0.001 (-0.78)	0.001 (0.32)	-0.000 (-0.10)	-0.007 (-1.86)
S2	0.012 (0.32)	0.082 (0.70)	-0.032 (-0.56)	-0.060 (-0.57)
S3	0.002 (0.06)	-0.052 (-0.40)	-0.136 (-2.13)	0.319 (2.70)
S4	-0.030 (-0.77)	0.140 (1.11)	-0.015 (-0.26)	0.237 (2.22)
R-squared	0.98	0.68	0.92	0.93
Adj. R-squared	0.97	0.60	0.89	0.91
Determinant residual covariance (dof adj.)			7.14E-07	

Determinant residual covariance		2.78E-07	
Log-likelihood		187.1924	
Residual Correlation Matrix			
	QRGDP	GBD	TBRATE
QRGDP	1		
GBD	0.21	1	
TBRATE	-0.18	-0.07	1
TB	0.10	0.12	-0.14
			1

Table 16: VAR Diagnostic (Residual) Tests

VAR Residual Serial Correlation LM Tests*		
Lags	LM-statistic	P-value
1	19.17	0.2595
2	15.95	0.4562
3	12.80	0.6867
4	20.06	0.2171
5	24.06	0.0882

**assumes no serial correlation at lag order h based on probability values from χ^2_{16} – distribution.*

Table 17: White’s Multivariate Heteroscedasticity Test

VAR Residual Heteroscedasticity Tests: No Cross Terms		
Joint Test	Dof.	P-value
379.8675	370	0.3505

Table 18: VAR Residual Normality Tests

VAR Residual Normality Tests				
Component	Skewness	χ^2_{16} – statistic	Dof	P-value
1	0.117108	0.228570	1	0.6326
2	-0.013053	0.002840	1	0.9575
3	-0.216533	0.781441	1	0.3767
4	0.063672	0.067568	1	0.7949
Joint		1.080419	4	0.8974
Component	Kurtosis	χ^2_{16} – statistic	Dof	P-value
1	1.234683	12.98476	1	0.0003
2	0.063891	35.91975	1	0.0000
3	1.308001	11.92859	1	0.0006
4	3.117312	0.057342	1	0.8107
Joint		60.89044	4	0.0000
Component	Jarque-Bera	Dof	P-value	
1	13.21333	2	0.0014	
2	35.92259	2	0.0000	
3	12.71003	2	0.0017	
4	0.124910	2	0.9395	
Joint	61.97086	8	0.0000	

Table 19: Variance Decompositions for the Estimated SVAR Model

Variance Decomposition of QRGDP					
		Variance Decompositions (%age points)			
Forecast Period	Forecast Std Error	Real GDP Shock	GBD Shock	TBRATE Shock	TB Shock
4	0.115	12.67	14.52	5.886	66.91
8	0.153	15.94	10.30	9.319	64.43
16	0.211	17.74	14.88	12.39	54.97
20	0.238	17.94	19.88	12.91	49.25
24	0.263	17.91	24.95	13.03	44.09
Variance Decomposition of GBD					
Forecast Period	Forecast Std Error	Real GDP Shock	GBD Shock	TBRATE Shock	TB Shock
4	0.745	1.127	98.37	0.281	0.215
8	0.781	1.246	98.08	0.324	0.343
16	0.787	1.431	97.64	0.345	0.578
20	0.788	1.474	97.51	0.353	0.657
24	0.788	1.504	97.42	0.361	0.712
Variance Decomposition of TBRATE					
Forecast Period	Forecast Std Error	Real GDP Shock	GBD Shock	TBRATE Shock	TB Shock
4	0.326	56.82	21.90	14.31	6.953
8	0.490	35.43	54.58	6.765	3.209
16	0.578	26.53	64.24	5.251	3.968
20	0.585	25.92	64.10	5.248	4.724
24	0.589	25.60	63.41	5.412	5.566
Variance Decomposition of TB					
Forecast Period	Forecast Std Error	Real GDP Shock	GBD Shock	TBRATE Shock	TB Shock
4	0.369	17.65	30.36	51.42	0.559
8	0.427	17.92	38.40	42.76	0.907
16	0.509	17.78	50.26	30.60	1.348
20	0.528	17.13	52.50	28.50	1.856
24	0.536	16.78	53.07	27.66	2.473

Table 20: Accumulated Responses for Selected Quarters

Accumulated Response of QRGDP				
Period	Real GDP Shock	GBD Shock	TBRATE Shock	TB Shock
1	-0.0157	0.0390	0.0106	0.0853
4	0.0332	0.0371	0.0400	0.1315
8	0.0707	0.0717	0.1086	0.2514
16	0.2040	0.2315	0.2658	0.4800
20	0.2880	0.3632	0.3489	0.5826
24	0.3760	0.5164	0.4307	0.6750
Accumulated Response of GBD				
Period	Real GDP Shock	GBD Shock	TBRATE Shock	TB Shock
1	0.0619	0.7356	0.0183	0.0193
4	0.0804	0.8189	0.0645	-0.0284
8	0.1070	1.0857	0.0787	-0.0452
16	0.1312	1.2279	0.0694	-0.0681
20	0.1287	1.2441	0.0620	-0.0822
24	0.1216	1.2428	0.0523	-0.0960
Accumulated Response of TBRATE				
Period	Real GDP Shock	GBD Shock	TBRATE Shock	TB Shock
1	-0.1270	0.0207	0.0845	-0.0450
4	-0.4904	-0.1685	0.2321	-0.1706
8	-0.785	-0.8251	0.1924	-0.1595
16	-0.9295	-1.5935	0.1257	0.0489
20	-0.9424	-1.7303	0.1671	0.1565
24	-0.9199	-1.7809	0.2249	0.2686
Accumulated Response of TB				
Period	Real GDP Shock	GBD Shock	TBRATE Shock	TB Shock
1	-0.1490	0.1696	-0.2334	0.0198
4	-0.1709	0.0751	-0.4208	0.0367
8	-0.3330	-0.2012	-0.5753	0.0589
16	-0.6269	-0.8785	-0.6656	0.1346
20	-0.6924	-1.1261	-0.6743	0.2078
24	-0.7183	-1.2789	-0.6566	0.2903

Table 21: *h*– Step Forecasts for the Estimated Endogenous Variables (2006Q1-2011Q4)

Real GDP(MK100'000'000)								
			Bounds		Growth Rate p.a.			
Year	Actual	Forecast	Upper	Lower	Actual	Forecast	Forecast range	
					Benchmark		Upper	Lower
2005	4359.0	4359.0	--	--				
2006	4675.1	4722.1	5653.3	3904.9	7.25%	8.3%	29.7%	-10.4%
2007	4914.8	4914.8	5943.2	4023.9	5.13%	4.1%	27.1%	-13.9%
2008	5166.8	5271.1	6374.1	4402.8	5.13%	7.3%	29.7%	-10.4%
2009	5486.2	5541.4	6634.2	4582.5	6.18%	5.1%	28.4%	-11.3%
2010	5825.5	5825.5	6974.4	4817.4	6.18%	5.1%	27.1%	-12.2%
2011	6185.7	6185.7	7405.7	5064.4	6.18%	6.2%	27.1%	-13.1%
Average					6.0%	6.0%	28.2%	-11.9%
Government Budget Deficit (MK'000'000)								
			Bounds		As %GDP			
Year	Actual	Forecast	Upper	Lower	Actual	Forecast	Forecast range	
					Benchmark		Upper	Lower
2005	-731.2	-620.2						
2006	-239.6	-321.3	47793.4	-119157.4	-0.1%	-0.1%	10.2%	-25.5%
2007	-30124.0	-29814.1	38957.9	-102546.3	-6.1%	-6.1%	7.9%	-20.9%
2008	-33039.4	-33121.3	35203.2	-135207.5	-6.4%	-6.3%	6.8%	-26.2%
2009	-33204.9	-32825.4	38975.0	-153813.6	-6.1%	-5.9%	7.1%	-28.0%
2010	-31350.2	-31327.0	46035.8	-167515.6	-5.4%	-5.4%	7.9%	-28.8%
2011	-39260.1	-39081.0	42684.1	-137710.3	-6.3%	-6.3%	6.9%	-22.3%
Average					-5.1%	-5.0%	7.8%	-25.3%
Trade Balance (MK'000'000)								
			Bounds		As %GDP			
Year	Actual	Forecast	Upper	Lower	Actual	Forecast	Forecast range	
					Benchmark		Upper	Lower
2005	-70333.0	-70333.0			-16.1%	-16.1%		
2006	-58024.8	-91855.3	-31019.2	-196040.1	-12.4%	-19.5%	-19.5%	-41.5%
2007	-40568.6	-75769.2	-23690.6	-164579.9	-8.3%	-15.4%	-15.4%	-33.5%
2008	-43784.5	-63031.0	-16064.5	-139819.8	-8.5%	-12.0%	-12.0%	-26.5%
2009	-50020.9	-73484.9	-19221.4	-166069.2	-9.1%	-13.3%	-13.3%	-30.0%
2010	-52001.7	-84328.4	-26193.9	-179531.2	-8.9%	-14.5%	-14.5%	-30.8%
2011	-52778.0	-93081.2	-29646.5	-196161.3	-8.5%	-15.0%	-15.0%	-31.7%
Average					-9.3%	-15.0%	-15.0%	-32.3%
Treasury Bill Rate (% per annum)								
			Bounds					
Year	Actual	Forecast	Upper	Lower	Actual	Forecast	Forecast range	
					Benchmark		Upper	Lower
2005	24.3	24.3			24.3	24.3		
2006	19.9	21.5	27.7	16.3	19.9	21.5	27.7	16.3
2007	17.8	19.9	26.0	15.2	17.8	19.9	26.0	15.2
2008	16.1	19.3	25.0	14.9	16.1	19.3	25.0	14.9
2009	16.0	19.1	25.0	14.7	16.0	19.1	25.0	14.7
2010	16.0	19.1	24.8	14.6	16.0	19.1	24.8	14.6
2011	16.0	19.3	25.3	14.6	16.0	19.3	25.3	14.6
Average					17.0	19.7	25.6	15.1