DEPARTMENT OF ECONOMICS

A SMALL MACROECONOMETRIC MODEL FOR LESOTHO

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS OF ARTS DEGREE IN ECONOMICS

JUNE 2015

CERTIFICATION

This dissertation has been examined and approved as meeting the requirement for the partial fulfilment of the Masters of Arts Degree in Economics.

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DECLARATION

The dissertation has been undertaken at the University of Botswana. The study is an original work by the undersigned. In cases where additional material from other sources has been used, references are provided.

Puleng Alice 'Mabathoana

Signature: _____ Date: _____

DEDICATION

TO MY HUSBAND AND MY SON. MANY WATERS CANNOT QUENCH MY LOVE TO YOU.

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ACKNOWLEDGEMENTS

I would like to pass my sincere gratitude to Dr J.S Juana, who supervised this work, for his unreserved constructive comments throughout the development of this paper. I also thank him for his patience, encouragement and the interest he has showed for this work. To him, I will always be indebted. I would also like to extend my profound and warmest thanks to Professor M.K.S Nair for the comments, contributions and impetus towards the completion of this dissertation.

My heartily appreciation also goes to Professor F. Okurut for his support and guidance in making sure that this project is a success. I am also immensely thankful to Dr O. Tirimisiyu (University of Ibadan, Nigeria) and Dr A. Salisu (University of Ibadan, Nigeria) for the insight and expertise they have provided in the estimation of the model.

It is also my pleasure to express my gratitude to the Professors, Doctors and staff members of the Department of Economics of the University of Botswana for the knowledge they have imparted, experience they have shared and all the support they have provided throughout the tenure of my studies. My appreciation also goes to my colleagues in MA-Economics programme for their useful companionship.

My thanks also go to my dear husband Kamohelo Mokholokoe for his patience, encouragement, financial and emotional support without which this would not have been achieved. I am forever grateful. I am also grateful for my son Katleho for his forbearance during the course of the study.

Above everything else, I thank the Almighty God (Jehovah El-Shaddai) who has granted me the strength and wisdom to compile this research paper. I love you Lord; you are the source of my strength.

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ACRONYMS

ADF	Augmented Dickey Fuller
AEG	Augmented Engel-Granger
AGOA	African Growth and Opportunity Act
CBL	Central Bank of Lesotho
CPI	Consumer Price Index
DW	Durbin-Watson
EG	Engel Granger
ECM	Error Correction Model
FAO	Food and Agriculture Organisation
FDI	Foreign Direct Investment
FIML	Full Information Maximum Likelihood
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
KK	Keynes-Klein
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
M1	Narrow Money
M2	Broad Money
MCA	Millennium Challenge Account
MS	Muth-Sargent
OLS	Ordinary Least Squares
PB	Philips-Bergstrom
RSA (SA)	Republic of South Africa
SACU	South African Customs Union
TCFP	Third Country Fabric Provision
2SLS	Two stage Least squares
3SLS	Three tage Least Squares
WJ	Walras-Johansen
WL	Walras Leontief

ABSTRACT

This study aims at developing and estimating a small macroeconometric model for Lesotho, a small open developing economy. The model is developed, estimated and evaluated using the annual time-series data from 1980 to 2013. It is made up of four equations, viz, aggregate demand (IS-Curve), money demand (LM-Curve), aggregate supply (Philips-Curve) and the interest rate equations. The equations are estimated using the ordinary least squares (OLS), two stage least squares (2SLS), three stage least squares (3SLS) and full information maximum Likelihood (FIML) methods after taking into account issues of stationarity and cointegration.

The results show among others that, Output is backward looking and is also influenced by real interest rate and the real effective exchange rate; Inflation is positively determined by lagged inflation and negatively influenced by output and real effective exchange rate. Moreover, the forecasting results show that, the predictive power of model is satisfactory.

The key monetary policy variables such as interest rate, inflation and exchange rate depend largely on those of the South African economy making it hard for monetary policy to be independent. As a result, the study recommends that fiscal policy be implemented with caution as it is relatively effective in influencing most macroeconomic variables in the country.

CHAPTER ONE:
INTRODUCTION

1.1 BACKGROUND OF THE STUDY:

Lesotho is a small mountainous country (30,355 square kilometres) situated in the south eastern region of Southern Africa and has a population of around 2.2 million people. The unique characteristic of the country lies in the fact that it is completely surrounded by its neighbour, the Republic of South Africa (RSA). As a result, most macroeconomic indicators (interest rate, inflation and gross national product) in the economy are influenced by those of RSA. Its major exports are water, diamonds, textiles and apparels as well as wool and mohair. Though the country is democratic and sovereign, it is one of the three remaining monarchies in Africa. The major challenges facing the country are political instabilities, army cliques and coup d'état, highest rates of HIV/AIDS prevalence which are accompanied by deep and widespread poverty (The Lesotho National Strategic Development Plan, 2012; Central Bank of Lesotho; 2011; 2012; 2013).

Lesotho got independence in 1966 and then embarked on a number of macroeconomic policies targeted at increasing the economic stability, sustainable equity-based economic growth and socio-economic development during the last three decades or so. These include the structural adjustment programme (1988/1989-1990/1991), Lesotho Vision 2020, Poverty Reduction Strategy (2004/2005-2006/2007), National Strategic Development Plan (2012-2017) and many other international treaties and policies (Patel, 1992: International Monetary Fund, 2014).

Though the country has adopted, formulated and implemented a number of national, regional and international development plans, much has not been done in terms of the development of macroeconomic models which can be used as tools for monitoring and evaluation of the impact and the effectiveness of these policies in the economy. For example, the International Monetary Fund (2014) argues that the National Strategic Development Plan has been poorly implemented resulting in failure to achieve the set goals. This problem could have been circumvented, minimised and addressed accordingly if the model was applied constantly to monitor this policy.

Macroeconometric model building can be traced to the work by Tinbergen (1939; 1951) and has since grown considerably. The largest macroeconometric model for the United States economy was developed by Klein-Goldberger (1950s). The model contained twenty-two structural equations. In recent years, however, large models containing hundreds of equations have become a norm (Thomas, 1993). These models provide insight on the relationships and behaviour of various economic agents by explaining the behaviour of variables that have already been seen or project the behaviour that is yet to be seen (Valadkhani, 2004). As a result, they can be used to explain basic theoretical principles, and analyse the performance of the economy, for evaluating the effects of various policies and external shocks in the economy, simulation and forecasting.

A good model is one that is clearly specified and is theoretically plausible. However, to make sound economic policy analysis and forecasting, the quality of data to be used also matters. The absence of data for some economic variables and the poor quality of data are prevalent in most developing countries and Lesotho is not an exception. However, macroeconometric models can still be built with thoughtful consideration in order to incorporate such limitations in the modelling process (Charemza and Deadman,1997). This thesis therefore aims at developing the macroeconometric model for Lesotho for analysing the dynamics of interactions of key macroeconomic variables in the economy, forecasting as well as policy simulation.

1.2 STATEMENT OF THE PROBLEM:

Implementation of effective and sustainable economic policies requires appropriate strategies and development plans. However, to achieve such goals, monitoring and evaluation are essential. As a result, a well specified macroeconometric model is one of the instruments that can be utilised in order to realise such a quest, since it provides an ideal platform for ascertaining structural reforms and analysing the impact of different policy interventions (Bardsen and Nymoen, 2009).

Furthermore, these models can be extended in many dimensions by introducing new frictions, shocks as well as new interventions in the economy. Models are therefore workhorses in testing ideas and incorporating the economic theories into the real world phenomenon. Hence, they can be used by policy makers and analysts as guidelines to have the correct insight on how the economy functions, to formulate policies and to evaluate the impact

thereof; thus, helping to eliminate views or conclusions which may be based on intuitions (Reifscheneider et al., 1997).

It is vital to point out that availability of data in most developing countries is a restrictive factor in model building activity in general and Africa in particular. As a result, model-building is not an easy task since reliable databases are relatively few and scattered and are in most cases subject to regular revisions. Nevertheless, Valadkhani (2004), advocates that this hiccup can be vanquished by applying robust and simple methods which are less sensitive to data quality.

Moreover, Behrman and Hanson (1979) also argue that macroeconometric modelling for developing countries can be constructed in a more convenient fashion by applying some suitable adjustments. For example, some policy variables such as exchange rates are bound to revolutionise overtime, as a result, it is not proper to make assumptions that they will remain constant for the period under review. In addition, the issue of rational and adaptive expectations are theoretically appealing but are very difficult to apply in developing countries due to information constraints amongst economic agents.

Model-building is a dynamic process which requires perpetual updating to incorporate changes in the economy. Thus, improvements should be frequently made towards a more effective assimilation of blocks or equations from which models are to be fashioned. Sinha (1986) maintained that, it is in the course of this process (model building) where some standardisations would take place along with other related aspects such as notations, computation, solution methods and estimation procedures. By taking into consideration all these aspects, it is important to note that macroeconometric models in Lesotho are at an infant stage. As such, a lot has to be done in order to develop models that would help in the formulation and application of good economic policies, assessment of the economic system and understanding how the economy functions.

1.3 OBJECTIVES OF THE STUDY:

The primary objective of this study is to construct a macroeconometric model for Lesotho to analyse the behaviour of key macroeconomic variables and interrelationships thereof. The specific objectives are:

- To study the interactions of the key macroeconometric variables, including the monetary policy variables.
- To make some forecasts based on predetermined macroeconomic scenarios.

1.4 SIGNIFICANCE OF THE STUDY:

Lesotho has undertaken and implemented various developmental plans in order to revitalize various areas in the economy, however, the government and some stakeholders have not tailored a macroeconometric model which can be used as a structure upon which policy related measures can be embedded and analysed. Behrman and Hanson (1979) postulate that, the macroeconometric model that fulfils the ideal nature of the economic situation of the country is of prodigious prominence. Thus, this study seeks to fill the gap by developing a macroeconometric model that will take into account the key macroeconomic characteristics of the country. This study differs from the one conducted by Dobbelaere et al. (2010) in Lesotho in several ways. Firstly, it is a small macroeconometric model which attempts to provide some determinants and linkages amongst various constituents of the economy using few equations (only four equations will be estimated). Secondly, it employs the Mundell-Fleming (IS-LM) approach to examine factors that influence the economy. Thirdly, it focuses on the effectiveness of monetary policy on macroeconomic variables viz; output, demand for money, inflation and interest rates. Furthermore, the study also attempts to help policy makers to make informed decisions in the execution of different policies. This can be achieved by applying various shocks on important macroeconomic variables and examine how the economy responds to such shocks. Moreover, modelling is a process which requires perpetual updating as a result which this study therefore forms a basis for further studies related to the same area.

1.5 OUTLINE OF THE STUDY:

The study is structured as follows: chapter two offers a detailed assessment of macroeconomic indicators in the economy and their evolution over time. The period under consideration is 1980 to 2013. The theoretical and empirical literature reviews are discussed in chapter three. The fourth chapter deals with the model specification, estimation techniques and data sources. Chapter five provides the analysis of data and findings of the study, while, the sixth chapter provides the conclusions, policy recommendations and possible areas for further studies.

1.6 CONCLUSION:

This chapter discusses the problem, objectives and significance of the study. The subsequent chapter deals with the brief discussion of the background of the economy of Lesotho and how it has been performing in past 34 years.

CHAPTER TWO

SELECTED MACROECONOMIC INDICATORS FOR LESOTHO

2.0 INTRODUCTION:

This chapter provides the picture of the performance of the economy of Lesotho for 34 years (1980-2013). The analysis provides in-depth understanding of the behaviour of macroeconomic variables which are pertinent to monetary policy analysis in the country. The variables discussed are gross domestic product (GDP in million Maloti), GDP growth rate, inflation rate, interest rate, broad money (M2 in million Maloti) and the real effective exchange rate.

2.1 THE BEHAVIOUR OF KEY MACROECONOMIC VARIABLES:

Table 2.1 presents the summary of the behaviour of key macroeconomic variables. These are GDP, GDP growth rate, inflation rate, real exchange rate interest rate as well as broad money.

Table 2.1: The Key macroeconomic Indicators in Lesotho, 1980-2013 (Periodic Averages)

Period	GDP (M'm)	GDP Growth Rate (%)	Inflation Rate (%)	Real Effective Exchange Rate (L/Major Currencies)	Interest Rate (%)	Broad Money (M'm)
1980-1984	383020000	1.552672158	13.8608476	192.9414412	4.915433723	188189800
1985-1989	825800000	4.419339756	13.85213453	181.3090109	-0.937617351	42812740
1990-1994	2036800000	5.096099347	13.57435537	188.7980733	5.664908395	811029800
1995-1999	4002600000	2.688551118	8.708229584	166.440387	7.666967909	1490088090
2000-2004	6732227036	3.376970005	8.396196889	95.6924641	8.679034464	2107037600
2005-2009	11516674500	4.167363217	7.12362904	89.396583	4.879744651	4162471800
2010- 2013	18660835730	5.58499718	4.913640275	94.96849974	5.638635483	7267092999

Source: World Economic Indicators (1980-2013)

For the entire period the economic growth has been fluctuating as shown in Figure 2.1. Most of the fluctuations or instabilities were experienced prior to 1990. The average growth rate of the economy for the entire period is 3.79 percent per annum. The highest growth rate achieved is 8.56 percent in 1988 and the lowest is -2.74 percent attained in 1980. In post 1990, the economy performed relatively well with less fluctuations. The structural adjustment programmes which took place in fiscal years of 1988/1989 to 1990/1991 can be cited as the main cause of stability in this era. In 1995-1999 however, there was a significant decline in the average annual growth rate (2.69 percent). This fall can be attributed mainly to political unrest that took place in 1998. This had tremendous effect on the economy by scaring away potential investors (especially foreigners) and causing vandalism of property (Patel, 1992; Central Bank of Lesotho, 2009; International Monetary Fund, 2004).

In post 1999 era, the economy performed relatively well (average growth of 4.38 percent per annum). The increase in growth rate of GDP in this era can be attributed mainly to a number of factors. These include;

(i) The discovery of diamond deposits and opening of various diamond mines; Letŝeng Diamond mine (2003), Liqhobong mine (2006) and Kao mine (2007).

(ii) Construction of reservoirs, viz, Katse (1994-1996), Mohale (1994-1996), 'Muela (1994-1998) and Metolong (2009- present). The first three dams are meant to export water to the Republic of South Africa while Metolong dam supplies water to the country's capital city (Maseru) and the surrounding areas. The infrastructural developments which took place during and after the construction of these reservoirs contributed significantly to gross fixed capital formation (GFCF) hence economic growth.

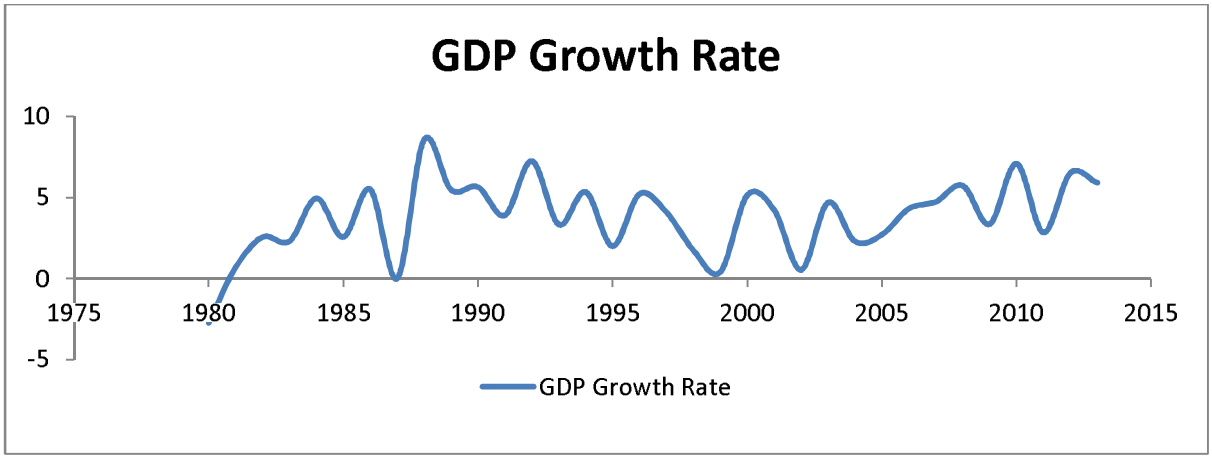
(iii) The Millennium Challenge Account (MCA) Lesotho related projects also have a significant impact on economic growth. The following are but a few developments under MCA; the improvement in private sector development projects (by the removal of barriers to foreign and domestic private sector investment); health related projects (construction and expansion of hospitals and clinics); and water supply and sanitation related developments (construction and expansion of water supply systems and provision of pit latrines to the rural community).

(iv) Construction of referral hospitals, clinics, bridges, roads and factory shells.

(v) The African Growth and Opportunity Act (AGOA) and the Third Country Fabric Provision (TCFP) which boosted production in the manufacturing sector.

(vi) Increased spending by the government due to introduction of free primary education, subsidies on education, building of schools and laboratories as well as employment of new teachers to meet increased enrolment; free consultation and medication in government owned clinics and hospitals; increased spending on social security programs (old age pensions and monthly stipends to given to orphans, vulnerable children and people with disability); and the reviewed salary structures of teachers (2009/2010) and civil servants (2013/2014) (International Monetary Fund, 2004, 2014; Central Bank of Lesotho,2006,2009,2012).

It is noteworthy that the growth rate of the economy in post 1999 has also encountered a number of challenges. High rate of HIV/AIDS pandemic which has undermined the country's labour force and has resulted in increased number of orphans, poverty and vulnerability of the economy. The escalating numbers of retrenched migrant labourers in South African mines and continual job losses due to closure of some textiles and clothing firms in the country have also affected GDP. They have resulted in the reduction in household purchasing power as well as an increase in unemployment level. Moreover, Lesotho is regarded as the leading exporter of textiles and apparels in sub-Saharan Africa, however, the global economic crises of 2008/2009 as well as the expiry of the quota system (2004/2005) adversely affected manufacturing hence GDP (International Monetary Fund, 2014). The agricultural production has been below par as production has not been sufficient to meet domestic cereal demands. The country therefore relies on food import and food aid in order to cover cereal deficits. Though the government had on several occasions (example, fiscal year 2004/2005 and 2010/2011) offered input subsidies to farmers, production has failed to improve. According to the Central Bank of Lesotho (2006), apart from drought, late rainfalls and poor arable land, HIV and AIDS has been cited as the major factor adversely affecting agricultural production and food security in Lesotho.



Source: World Economic Indicators (1980-2013)

Figure 2.1: GDP Growth Rate

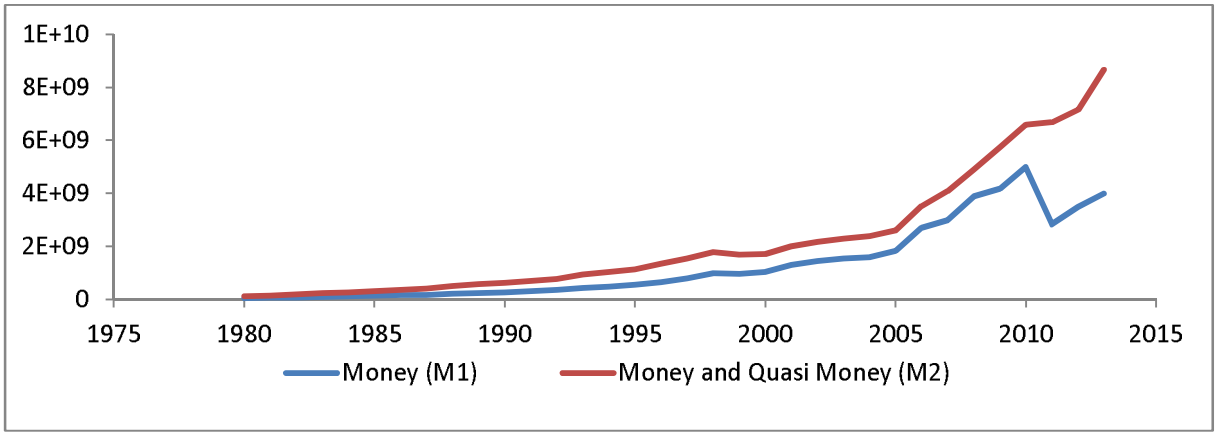
Moreover, for the entire period, inflation has been fluctuating with an average of 10.06 percent per annum. The highest inflation was experienced in 2002 (33.81 percent) while the lowest was in 2005 (3.44 percent). It should be noted that prior to 2000, average annual inflation recorded is 12.50 percent and 6.81 percent in post 2000. It is noteworthy that, Lesotho is a small open economy and does not have any influence in world prices. As such, prices in the country are determined by a number of factors, both domestic and international. According to (Central Bank of Lesotho, 2013) food commodities constitute a larger proportion of the basket of commodities as a result any changes in domestic and international food supplies have an impact on prices in the economy. For instance, the average annual inflation decelerated (in 2012-2013) due to decline in food prices caused by a decline in global food price and cereal price indices as well as the improved production in the agricultural sector. Again, the international price of crude oil influences the overall inflation as fuel is an essential input in most production and distribution processes. Moreover, the exchange rate also plays a crucial role in determining inflation via import prices (Central Bank of Lesotho, 2013).

Furthermore, Lesotho imports around 73 percent of the commodities from the Republic of South Africa. Therefore, it has been found that, the related prices of imported commodities are driven by the prices in RSA. Though inflation in Lesotho tends to move in the same direction as that of RSA, the general retail prices in the country are lower than those in RSA (FAO, 2007).

Since obtaining independence from Britain in 1966, the Lesotho Loti has been pegged at par to the RSA Rand. The South African Rand is a legal tender in Lesotho though the amount is

regulated. In South Africa however, the Loti can only be used in towns along the borders and is repatriated on a monthly basis just like Rands in Lesotho. The economy is thus indirectly influenced by the depreciation or appreciation of the South African Rand against major currencies (e.g US dollar and Euro). Again, the depreciation and appreciation of the Rand hence the Loti is influenced by among others; changes in SA interest rates relative to those prevailing in developed economies which affect the attractiveness of rand dominated assets hence portfolio investment inflows into RSA markets; and changes in the prices of gold and platinum in international markets. This shows that it is totally impossible for monetary authorities to ensure that the exchange rate is maintained at the optimal level to avoid too much depreciation or appreciation of the domestic currency (Central Bank of Lesotho, 2013). It is important to note that, the real effective exchange which is the ratio of Loti to the weighted sum of major currencies has not been stable. The average real effective exchange rate is 145.67with the highest and lowest of 196.76 (1983) and 54.11 (2002) respectively.

Furthermore, the amount of money in circulation has a crucial role in the economy as it affects interest rates, prices as well as employment (monetary policy argument). The broad money (M2) and narrow money (M1) have been increasing overtime with an average growth rate of 14.18 percent and 11.32 percent respectively. The average annual amount of broad money is M 2205973366 while that of narrow money is M 1317021667. The broad money is affected by among others the amount of net foreign assets, domestic credit, as well as saving and demand deposits (Central Bank of Lesotho, 2003, 2007, 2012).



Source: World Economic Indicators (1980-2013)

Figure 2.2: Behaviour of Narrow Money and Broad Money

In addition the real interest rate which is described as the lending interest rate adjusted for inflation has also been fluctuating, with annual average of 5.11 percent. The highest and

lowest amount recorded are 28.78 (1982) and -21.53 (1980) respectively. Most of the fluctuations were observed prior to 1990. The open market operations (OMO) by the Central Bank indirectly influence interest rate via foreign reserves. The prime lending rate in South Africa also indirectly influences interest rate in the country (Central Bank of Lesotho, 2007).

All in all, the economy has been performing well especially in post 1990 with relatively less fluctuations in economic growth. However, political instabilities had some detrimental effects by lowering the economic growth as they reduce foreign direct investments (by scaring away foreign investors) and cause vandalism of property. Again, HIV/AIDS as well as food insecurity also affect the country negatively as such the strategies and policies aimed at addressing them should be devised accordingly. Moreover, it can also be observed that the economy relies more on South Africa as a result most macroeconomic variables are affected mostly by those of the South African economy (inflation, exchange rate and interest rate). The country is also vulnerable to external shocks as it relies more on imported goods and services.

2.2 CONCLUSION

In summary, this chapter provides the "snapshot" of the behaviour of key macroeconomic indicators in the economy over a period of 20 years. The subsequent section provides the theoretical and empirical literature. The theoretical literature acts as a fundamental framework upon which the model is constructed. It provides some understanding of different theories governing the behaviour of macroeconomic variables. Alternatively, the empirical literature acts as a nexus between reality and theory.

CHAPTER THREE

LITERATURE REVIEW

3.0 INTRODUCTION:

This chapter provides a framework of the theoretical and empirical literatures. The theoretical literature assists in the evaluation, interpretation and understanding of the model in general, with reference to theories governing different sectors and those that are related to developing countries (Garratt et al., 2006). The empirical literature renders insights on the models that have been built in both developing and developed countries.

3.1 THEORETICAL LITERATURE:

The theoretical perspectives concerning model building differ. These views led to two distinct approaches to model building. The Keynesian approach, which favours large structural models disaggregated by sectors and expenditure categories help in thorough understanding of the complexity of the economy. The other approach however prefers small-scale models which bypass the detailed structure of the economy. For instance, they may focus on issues like the effect of monetary changes on aggregate money income and ignore individual expenditure categories (Thomas, 1993).

Macroeconometric modelling has evolved overtime. Traditionally, macroeconometric models were constructed in order to implement the Keynes' General Theory. However, in the 1970s other paradigms such as Monetarist, New Classicals, Post-Keynesian and Rational expectations theories towards modelling were also developed (Valadkhani, 2004). In post 1970 however, a lot of criticisms concerning macroeconometric models especially on issues relating to forecasting, policy analysis as well as model specification and estimation emerged. These include the (1976) Lucas critigue, Shourie (1972) and Sastry (1975), to mention a few.

It is noteworthy that some models still retain the Keynesian income-expenditure (mostly the demand side) structure while some provide more attention to the supply side of the economy. These models can generally be classified into five categories; the KK (Keynes-Klein), the PB (Philips-Bergstrom), the WJ (Walras-Johansen), the WL (Walras-Leontief) as well as the MS (Muth-Sargent) models, Valadkhani (2004).

The KK model focuses on explaining the macroeconomic fluctuations and it is demand-oriented. This model is criticised for the following reasons; (i) it does not consider the supply side of the economy and incorporation of production functions. (ii) It ignores the role of the money market, relative prices and expectations in the economy. The PB model is also a demand oriented model. It employs difference equations to estimate structural parameters of a stochastic model. The main shortcoming of this model is that it is very difficult to implement particularly in large scale models. The WJ on the other hand is a multi-sectoral model which is simply based on the fact that the economy comprises numerous interdependent markets. These markets are linked by their interactions such as purchases and sales from and to each other. It is regarded as the most appropriate model for developing countries. It is an example of the general equilibrium system.

The MS model is based mostly on the theory of rational expectations and is similar to the KK model. The difference lies in the formation of expectations. In this model expectations are not considered as functions of previous values of independent variables. They are not observable but they could be obtained when the complete model is solved (Valadkhani, 2004).

In recent years, the use of macroeconomic models in forecasting and policy analysis has been predominant. However, few developments have been done as far as the theory is concerned. According, to the study conducted by Wieland et al. (2012) on the comparison of various modern macroeconomic models to check their effectiveness in policy analysis. It was found that majority of the models still retain the traditional New Keynesian theory as they incorporate issues such as rational expectations, price rigidities and imperfect competition. However, most of them include recent advances in microeconomic foundations. It was also found that few models follow the monetarists' specification.

It is important to note that, there are many controversies concerning modern macroeconomic models in terms of their forecasting ability and policy analysis. According to Carllin et al., (2012) the modern version of macroeconomic models do not belong to "macro". For instance most specifications on individual preferences and production functions miss the quintessence of macro fluctuations. The parameters that are estimated are not reasonable and fail to capture the dynamics of the economy. Moreover, Taylor et al. (2011) hypothesise that modern economists failed to predict the global economic recession of 2008-2009 due to poor developments in macroeconomic modelling hence forecasting. However, the aforementioned

hiccups in modelling can be addressed through new applications of various tools, methodologies or paradigm.

Based on the discussed issues it is clear therefore that the success or failure of macroeconometric models depends primarily on data availability, good statistical information and knowledge as well as proper estimation tools and techniques.

The workhorse in modelling the structure of the economy is basically the specification of the identities and behavioural equations which show some relationships amongst economic agents. These equations should be in line with the optimisation behaviour of the economic agents under consideration. Thus the model is built based on the literature review at sectoral level (Benedictow, 2008). It is therefore vital to discuss some economic theories relevant to the formulation of the model.

3.1.1: The Aggregate Demand (IS-Curve)

The level of output in the economy is negatively correlated with interest rate and exchange rate. The neoclassical theorists assert that investment is inversely correlated with the rental cost of capital (interest rate and depreciation). Thus, high levels of interest rate reduce investment spending, hence output. Similarly, the appreciation of the domestic currency makes exports less attractive (since they will be expensive) and makes imports less expensive leading to a fall in output. Moreover, output can either be forward-looking or predetermined (backward-looking). If output is predetermined monetary policy in the current period cannot be effective in determining output in the current period. However, if it is forward-looking, monetary policy can only be effective by affecting future expectations of output (Kennedy, 2008).

3.1.2: Money Demand (LM-Curve)

The demand for money is specified under Keynesian liquidity preference theory of interest rate. This proposes that money demand is inversely related to interest rate and positively correlated to the level of income. Keynes further asserts that individuals hold money for transactions (depends mostly on income), speculative (depends on interest rate) and precautionary motives (depends on income). The implication is that, when interest rate is low, individuals may opt to hold all their financial assets in terms of money. On the other hand, a low exchange rate implies that imported commodities are relatively cheaper than the domestically produced commodities. As a result the demand for money increases. Again,

when the level of income increases people have extra money to spend hence the demand for money increases (Snowdon et al., 2005).

3.1.3: Aggregate Supply (Phillips Curve)

The specification of the aggregate supply via Phillips curve captures how inflation responds to output. Inflation can either be forward-looking or backward-looking. When inflation is backward-looking it implies that it responds more to its past values. In this case it may take time for the monetary policy to affect inflation (Czech National Bank, 2005). On the other hand, if inflation is forward-looking it implies that inflation and the output do not depend only on current values of their driving variables but on their expected future values as well. As such, any anticipated monetary policy action will have an impact on current outcomes because it will be easy to have an influence on related expectations (Rodríguez, 2010). Moreover, the real effective exchange rate affects inflation negatively. The appreciation or depreciation of the domestic currency influences inflation via the demand for exports and imports. The appreciation of the domestic currency increases the demand for imported commodities (imports will be relatively cheaper). The continual increase in demand for imported commodities will eventually lead to a rise in general price (Czech National Bank, 2005).

3.1.4: Interest Rate

Interest rate is assumed to depend on the real output, expected inflation, nominal exchange rate and the money supply. The Central Bank (Reserve Bank) via monetary policy plays a crucial role in determining the level of interest rate in the economy. Since interest rate is the opportunity cost of holding money, as money supply increases, interest rate will fall in order to induce people to hold more money. Similarly, Keynes advocates that the demand and supply of money determine the equilibrium rate of interest. Increases in money demand given a fixed amount of money supply will lead to an increase in interest rate. An increase in interest rate will make demand for money to decrease. Moreover, there is a positive relationship between output and interest rate. Output affects interest rate indirectly by influencing inflation. Inflation is negatively correlated with interest rate (Orabi, 2013). According to Carlstrom and Fuerst (2000) monetary policy is more effective in cases where interest rate responds more to the past inflation rate (backward-looking). In addition, the exchange rate is either positively or negatively related to interest rate. In the case where depreciation is expansionary the impact is negative. The impact is positive in cases where the depreciation is contractionary (Sanchez, 2005).

3.2 EMPIRICAL LITERATURE:

Macroeconometric models have been constructed by many researchers in the quest to analyse the economy, examine the effects of various policy reforms, forecasting and simulation. Macroeconometric models for organisations and central (reserve) banks have also been invented as policy tools to monitor and evaluate the impact of various sectoral and departmental policies. As such, to develop a model for Lesotho, exhaustive empirical literature survey is very important.

Adebiyi et al. (2014) developed the model for Nigerian economy which will be used for forecasting and examining the impact of central bank policy changes on the monetary policy rate using data for the period 1980-2012. Results show that; (i) output gap is forward-looking. (ii) Interest rate is positively correlated with inflation, nominal exchange rate and lagged monetary policy rate. (iii) There is a direct relationship between domestic interest rate and domestic currency. (iv) Inflation is influenced by output gap, interest rate and the expected inflation. (v) Demand for money depends on real income, interest rate and exchange rate. (vi) A fall in monetary policy rate (used by the central bank to control money supply) results in a decline of the lending rate and the exchange rate. Likewise, Gatt et al. (2013) constructed a macroeconometric model for Maltese economy using quarterly data for the period 2000-2011. The model was constructed with the aim of examining the functioning of the economy, the effects of various economic shocks and policies in the economy as well as forecasting. Results indicate that the economy responds relatively faster to economic shocks due to the flexibility of the labour markets and high degree of openness to trade. Simulation results on the other hand reveal that the monetary policy effects are relatively weak while the effect of changes in foreign demand is fairly strong.

Moreover, Were et al. (2013) used data from 1983 to 2011 to build the macroeconometric model to aid the Central Bank of Kenya in forecasting. The model is of the acceptable standard and captures different sectors in the economy and their linkages. The findings show that an increase in money supply leads to a decline in the rate of interest and an increase in prices. The ratio of domestic interest rate to world interest rate affects the depreciation (appreciation) of domestic currency. Furthermore, the macroeconometric model for Rwanda was developed by Gurara (2013) and used data from 1970 to 2009 to analyse the impact of policies, shocks and foreign aid dependency in the economy. Exports, real exchange rate and terms of trade are key determinants of imports, which in turn influence private investment. Fiscal deficit influences money supply which spills over to the domestic prices. High aid

dependency and infrastructural bottlenecks can have an adverse impact in the economy if reduced. Similarly, Abdalla et al. (2013) constructed a model for the economy of Sudan to be used as an analytical tool to describe the operations and performance of the economy. The model is based on the data from 1956 to 2010. Empirical results show that the model is consistent with the economic theory. The economy is also found to respond more to short-run effects as opposed to long-run effects. Exchange rates influence the economy via money supply and prices.

Dufréno et al. (2013) developed a macroeconometric model for Kazakhstan using quarterly data from 1994 to 2008. The model provides a stylised demonstration of the functions of the economy. It has been also used to simulate the consequences of various polices that have been put in place in order to transit the economy into the market economy. It has been found that the economy depends more on commodity prices and that it is vulnerable to external shocks due to high external demand dependency. Monetary policy has proved not to be an efficient policy instrument. In addition, a model for Greece was developed by Asteriou et al. (2012) to examine the effectiveness of policies aimed at tackling high public debt to GDP ratio, using data for the period 1980-2010. Results obtainable indicate that there has been no fiscal policy reform on public finances which seems to be effective enough to combat this problem. Again, the monetary policy is found not to be an efficient policy instrument to resuscitate the economy.

The model for Lithuania was constructed by Gruodis et al. (2012) using annual data 2000-2009 to provide forecasts for average wages and unemployment rate. It was found that the average real wages depend on the ratio of labour productivity. Again, unemployment rate, productivity ratio, export, and size of the labour force are interrelated. Forecasting results indicated that unemployment was at its peak in 2010 and that the economy will recover in 2016 causing an increase in average real wages and a decline in unemployment. Furthermore, to describe the performance of economy of Bangladesh from 1980 to 2006 Khatoon and Rahman (2011) devised a macroeconometric model. The model was also tested for its ability to be used for policy analysis and simulation. The test for forecasting ability of the model shows that the difference between the predicted variables and the actual data was very small and that when various shocks were imposed, the performance of the model appeared to be reasonably well. Thus, the model is powerful and good for forecasting and is also responsive to shocks.

Moreover, the macroeconometric model for Lesotho was developed by Dobbelaere et al. (2010).The objective was to use the model to examine the performance of Lesotho's economy and also for simulation purposes, based on the data from 1982 to 2000. It has been discovered that the value addition in private services is linked to domestic and government intermediate consumption, while value addition in food products & beverages and other manufacturing is correlated with private domestic and government intermediate consumption as well as other exports. The growth in construction industry is determined by both private and public gross fixed capital formation (GFCF). On the other hand, inflation in Lesotho is indirectly determined by CPI-inflation in South Africa. Leow (2010) also built a Keynesian-Neoclassical synthesis macro-model for Malaysia using data from 1980 to 2006. The objective was to study the behaviour of macroeconomic variables particularly the manufactured exports market share in the East Asian region. Some of the important findings are that; firstly, Malaysia's exchange rate has been pegged a long time and is more of a stabilization policy, especially for Malaysia's trade-oriented developing economy. Secondly, foreign direct investment (FDI) plays a principal role in driving the manufacturing sector, resulting in an amplified expansion of the economy. Thirdly, financing domestic investment via credit has helped improve the manufactured market share in the East Asian region, though not as great as FDI in economic development.

Muhdi and Sasaki (2009) invented macroeconometric model for Indonesia using data for 1991-2005 with the aim of analysing and addressing issues that arise in connection with the effects of government borrowing (debt) on the economy. It is concluded that the external debt has been used mainly as a policy tool which helps curb deficit and that it has been of paramount importance in stimulating both investment and economic growth. However, it triggers domestic currency depreciation and causes a rise in external debt repayment on external currency reserves. The domestic debt on the other hand has proved to discourage private investment hence hampers economic growth. Similarly, in order to examine the impact of monetary policy on macroeconomic variables in the Pakistani economy, Batool et al. (2008) built a macroeconometric model. The data used run from 1973 to 2006. The model was used for forecasting future movements of macroeconomic variables as well as simulation. They discovered that investments by the government have crowding-in impact on private investment; exports are determined by the US exchange rate and output; and that monetary policy tools are best transmitted via credit channels. In addition, Benedictow (2008) developed a macroeconometric model for simulation of interactions between the US

macroeconomic environment and the international oil market, using data from 1958 to 2006. The estimates obtained are satisfactory and adhere to the statistical test standards. All variables are specified except for exports and unemployment rate which fit the historical data relatively poorly and therefore need to be revised. Results also show that an increase in oil price is detrimental to the economy as it causes inflation thereby lowering household consumption and GDP and increases unemployment.

Furthermore, Neck et al. (2007) used quarterly data 1995-2005 to construct and test the validity of the macroeconometric model for the economy of Slovenia. The model developed is of a required standard and suitable for policy analysis. Again, simulations conducted were found to be reasonable and qualities of most variables in terms of trends and turning points were also admissible. Likewise, to analyse the performance of the Chinese economy and to evaluate the effect of policy changes on macroeconomic variables from 1994 to 2005 Caqas et al. (2007) developed a macroeconometric model. The model has proved to be immensely useful in the analysis of dynamics of the economy. Gündoğdu et al. (2006) also constructed a macroeconometric model to evaluate the effects of structural developments on the key macroeconomic indicators for Turkey. The data used was from 1950 to 2005. The constructed model is too aggregated and some details are missing hence it can be misleading. Results indicate that since 2005 the country has experienced high inflow of Foreign Direct Investment, diversification of trade and substantial economic growth. However, unemployment, human capital development, large current accounts deficit and vulnerability to global financial shocks still remain a challenge.

Cagas et al. (2005) constructed the model for Philippine with quarterly data from 1990 to 2004 to describe the economy, for forecasting and policy simulation. They found that the main challenges facing the country are high fiscal debts and budget deficits which call for proper attention by the authority. Similarly, the medium-sized Keynesian income-expenditure model for the economy of Nepal was formulated by Ra and Rhee (2005). It was formulated for policy simulations and economic planning using data for the period 1975 to 2004. Results indicate that the long-run growth prospects of the economy are determined by among other things, political stability and external borrowing. Also, the model has a good forecasting capacity and useful for policy simulations. On the other hand, the macroeconometric model for Namibian economy has been developed by Nielsen et al. (2004) using data for 1983-2002. The constructed the model is to be used for simulation and forecasting. Estimated results show that private investment is influenced by disposable income and world prices, while real

interest rate is insignificant. World income and real exchange rate influence the exports of goods and services whilst imports are influenced by gross domestic expenditure and relative price level. Total direct and indirect taxes are correlated with nominal GDP as well the average direct tax rate (for direct taxes) and average indirect taxes (for indirect taxes). Government expenditure is correlated with the nominal GDP and the inflation rate. The money demand for the broad monetary aggregate M2 is positively correlated with nominal GDP.

Kannapiran (2003) built a macroeconometric model for the economy of Papua New Guinea with the quarterly data for 1975 to 1995. The macroeconomic model was developed under the concepts of IS-LM and Mundell-Fleming model framework and will be used for analysing the economy, forecasting and assessing the effects of policy changes in the economy. The model describes the economy well; it is of acceptable standard in terms of the predictive accuracy and structural stability. Moreover, key results indicate that; (i) National income and real interest rates are essential determinants of investment. (ii) Exports demand is influenced by prices (price index based on overseas currency) and real exchange rate, while imports depends on private disposable income and government spending. (iii) Money demand is positively correlated with income and lagged money demand. Likewise, García et al. (2003) proposed and estimated a macroeconomic model of the Chilean economy for the period 1986 to 2001. The model is designed mainly as a short and medium-term inflation forecasting tool, aimed at identifying the transmission mechanism followed by monetary policy in Chile. It focuses particularly on the exploration and quantification of the effect of monetary policy on inflation and how monetary policy is transmitted to inflation. Some of the major findings are that monetary policy reacts to expected inflation because expected inflation tends to affect real ex ante rates within the economy, which in turn influence consumption and investment decisions. Again, the output gap is one of the main variables affecting medium-term inflationary pressures. Moreover, Szeto (2002) developed the so called "New Zealand Treasury Model" which provides a theoretically consistent framework for forecasting. The historical data utilised runs from 1988 to 2001. Results indicate that the dynamic path of the external export price shock is different from that of the import price shock. Thus, the suggestion is that it is really not appropriate to treat exports and imports as a composite good when there are changes in the terms of trade.

The summary of key findings from the empirical survey is given in Table 3.1.

Table 3.1: Synthesis of Literature Review

Study	Year of Publication	Author (s)	Objective(s) of the Study	Results Obtained
Macroeconometric model-Nigeria	2014	M.A Adebiyi, et al. *(Central Bank Nigeria)*	Forecasting and examining the impact of central bank policy changes on the monetary policy rate.	Forward-looking output and inflation. Interest rate depends on inflation, exchange rate and lagged monetary policy rate.
Macroeconometric Model-Malta	2013	W. Gatt, et al. (*Central Bank of Malta*)	Forecasting, examining the effects of shocks and policies.	Economy responds faster to shocks. Monetary policy effects are weak.
Macroeconometric Model-Kenya	2013	M. Were, et al.	Help in forecasting.	Money supply affects interest rate and prices. Exchange rate have negative on net exports.
Macroeconometric Model-Rwanda	2013	D.Z. Gurara	Analyse impact of policies, shocks and foreign aid dependency in the economy.	High aid dependency. Fiscal deficit affects money supply and prices. Exports depend on exchange rate.
Macroeconometric Model-Sudan	2013	S.Z.S. Abdalla,et al.	To describe the performance of the economy.	Exchange rates influence the economy via money supply and prices.
Macroeconometric model-Kazakhstan	2013	G. Dufréno,et al.	The model describes the functions of the economy.	The economy depends more on commodity prices, is vulnerable to external shocks. Monetary policy is not effective.
Macroeconometric Model-Greece,	2012	D. Asteriou, et al.	To examine the effectiveness of policies that are meant to tackle high public debt to GDP ratio.	No fiscal policy reform has been effective enough to combat high public debt. Monetary policy is not effective.
Macroeconometric model-Lithuania	2012	A.Gruodis et al.	To provide forecasts for average wages and unemployment rate.	Average real wages depend on the ratio of labour productivity. Unemployment, productivity, and size of the labour force are interrelated.
Macroeconometric Model-Bangladesh	2011	R. Khatoon, et al	To describe the performance of the economy.	The model is good for forecasting and responsive to shocks.

Macroeconometric model-Lesotho	2010	L. Dobbelaere, et al.	To examine the economy of Lesotho.	Inflation is determined by that of RSA. Construction depends on private and public GFCF.
Macroeconometric Model-Malaysia	2010	G.Y. Leow	Study the behaviour of macroeconomic variables (manufactured exports market share) in the East Asian region.	Manufacturing is influenced by FDI and availability of credit to the private sector.
Macroeconometric model-Indonesia	2009	Muhdi and K. Sasaki	To analyse and address issues that arise in connection with the effects of government borrowing (debt) in the economy.	External debt curbs fiscal deficit and stimulates investment and economic growth. It triggers domestic currency depreciation. Domestic debt discourages private investment.
Macroeconometric Model-Pakistan	2008	I. Batool, et al.	To examine the impact of monetary policy on macroeconomic variables.	Monetary policy is best transmitted via credit channels. Public investment has crowding-in impact on private investment.
Macroeconometric model-US	2008	A. Benedictow	Simulation of interactions between the US macroeconomic environment and the international oil market.	Increase in oil price causes inflation thereby lowering household consumption and GDP and increases unemployment.
Macroeconometric model-Slovenia	2007	R. Neck et al.	To construct the model and test its validity.	The model is of a required standard and suitable for policy analysis.
Macroeconometric model-China	2007	M.A. Carqas et al.	To analyse the performance of the Chinese economy and to evaluate the effect of policy changes on macroeconomic variables.	The model is immensely useful in the analysing dynamics of the economy.

Macroeconometric model-Turkey	2006	M.K. Gündoğdu et al.	To evaluate the effects of structural developments on the key macroeconomic indicators.	There is high inflow of FDI and substantial economic growth. Unemployment, human capital development and large current accounts deficit still remain a challenge.
Macroeconometric model-Philippines	2006	M.A. Cargas et al.	To describe the economy, for forecasting and policy simulation	Main challenges facing the country are high fiscal debts and budget deficits.
Macroeconometric model-Nepal	2005	S. Ra and S.Y. Rhee	For policy simulations and economic planning.	The long-run growth prospects of the economy are determined by political stability and external borrowing.
Macroeconometric model-Namibia	2004	H. Nielsen et al.	To construct the model for simulation and forecasting.	Private investment depends on the disposable income and world prices. World income and real exchange rate influence the exports whilst imports are influenced by gross domestic expenditure and relative price level.
Macroeconometric model-Papua New Guinea	2003	C. Kannapiran	To analyse the economy, forecasting and assessing the effects of policy changes in the economy.	Investment depends on the national income and real interest rates. Exports demand is influenced by prices. Imports depend on private disposable income and government spending.
Macroeconometric model-Chile	2003	C. García et al.	To analyse the effects of monetary policy on inflation and how monetary policy is transmitted to inflation.	Monetary policy reacts to expected inflation. Output gap also causes some medium-term inflationary pressures.
Macroeconometric model-New Zealand	2002	K.L. Szeto	For forecasting.	Dynamic path of the external export price shock is different from that of the import price shock.

3.3 CONCLUSION

The key issues discussed concerning the theoretical and empirical literatures are the mainstay of this study via the ample knowledge acquired from them. The following are but a few lessons acquired from the empirical survey; (i) the availability of data has been cited as the major constraint in model building. (ii) Macroeconomic variables behave differently across countries due to the nature of the economy as well as the transmission mechanisms through which shocks are administered. For instance, Adebiyi et al. (2014) found that the exchange rate has a positive impact on output and that monetary policy is effective in stimulating the economy. However, Dufréno et al. (2013) has found that the exchange rate has a negative impact on output by affecting net exports and that the monetary policy is not effective. (iii) A well specified model coupled with appropriate estimation techniques can be used effectively to analyse the performance of the economy regardless of the size (in terms of the number of equations estimated).

This study seeks to use the small macroeconometric model to describe the economy of Lesotho. Researchers such as Dobbelaere et al. (2010) developed a macroeconometric model for Lesotho with the aim to describe the performance of the economy. The model developed comprised nineteen equations disaggregated into five blocks. This study on the other hand, uses four equations to examine the performance of key macroeconomic variables in Lesotho. The model is developed under the IS-LM framework. The distinctive feature of the model is that it uses the monetary approach to model a small open economy whose currency is pegged to that of its only neghbouring country; South Africa (one of the biggest economies in Africa).

The next chapter is devoted in explaining the methodology. This entails the theoretical framework, the model specification, the estimation techniques as well as the explanation of the data to be used.

CHAPTER FOUR
METHODOLOGY

4.0 INTRODUCTION

According to the noble prize winner Lawrence Klein (1983) a macroeconometric model is a systematic simplification which uncovers the indispensable inner workings and designs of a complicated mechanism. Again, a macroeconometric system is a macro-system whose relationships are expressed in a mathematical form characterised by various parameters such as intercepts and coefficients. All parameters are estimated in one way or the other from relevant statistical data (Valadkhani, 2004). In a nutshell, a macroeconometric model is simply a set of behavioural equations and (or) identities constructed based on the theoretical underpinnings regarding the behaviour of economic agents.

This chapter presents the theoretical framework which is a regulatory base upon which the model is to be constructed. It provides the specification of the model together with the expected behaviour of the variables derived from the relevant theory (theories), as well as the estimation technique to be employed and explanation of diagnostic tests to be carried out to ensure that the model is of good standard.

4.1 THEORETICAL FRAMEWORK:

Macroeconometric modelling involves fully studying and explaining the empirical behaviour of the actual economy including its growth, cyclical and erratic patterns (Jansen, 2002). It is therefore mandatory to be accustomed to relevant theories governing the behaviour of all the variables to be used. The model for Lesotho comprises four equations viz; aggregate demand (IS-Curve), money demand (LM-Curve), aggregate supply (Phillips Curve) and interest rate.

4.1.1: The Aggregate Demand (IS-Curve)

Output in the economy is negatively correlated to interest rate and exchange rate. The rental cost of capital indirectly affects output by affecting investment. Moreover, the appreciation or depreciation of the domestic currency affects output via changes in exports and imports demand. Backward-looking output renders monetary policy in the current period to be ineffective in influencing output in the current period. However, if output is forward-looking

monetary policy can be effective if it can influence future expectations of output (Kennedy, 2008).

4.1.2: Money Demand (LM-Curve)

According to Keynes the demand for money is negatively related to interest rate and positively related to income. Lower levels of interest rate induce people to hold more money and the opposite is true. Again, when the level of income increases people have extra money to spend hence the demand for money increases. Moreover, when the exchange rate is low, imported commodities become relatively cheaper. This results in an increase in the demand for money (Snowdon et al., 2005).

4.1.3: Aggregate Supply (Phillips Curve)

The Phillips curve captures the impact of output changes on inflation. Backward-looking inflation makes it hard for monetary policy in the current period to influence inflation (Czech National Bank, 2005). However, forward-looking inflation makes it easy for any anticipated monetary policy action to have an impact on current outcomes by influencing the related expectations (Rodríguez, 2010). Moreover, the appreciation or depreciation of the domestic currency influences inflation via the demand for exports and imports (Czech National Bank, 2005).

4.1.4: Interest Rate

Interest rate depends on real output, expected inflation, nominal exchange rate and money supply. An increase in money supply results in a decline in interest rate. Again, the demand and supply of money determine the equilibrium rate of interest. As such, an increases in money demand given a fixed amount of money supply will lead to an increase in interest rate. Output affects interest rate by influencing inflation (Orabi, 2013). In addition, the exchange rate is either positively (contractionary depreciation) or negatively (expansionary depreciation) related to interest rate (Sanchez, 2005).

4.2 MODEL SPECIFICATION:

The macroeconometric model for Lesotho is a simple New Keynesian monetary model which is suitable for execution of the monetary policy analysis. As a result, repercussions of inflation, exchange rate and output inherent in various monetary policy rules can easily be evaluated. The model is adopted from Adebiyi et al. (2014) and is a small, dynamic linear representation of an open economy. It should be noted however that, the equation for

exchange rate (uncovered interest parity) has been omitted in this study. The reason being that the domestic currency (Loti) is pegged to RSA Rand, as such, the specification is not relevant. The following are the four equations that have been modelled:

4.2.1: The Aggregate Demand Equation (IS-Curve)

In this case output (Y_t) is specified as a function of lagged output (Y_{t-1}), real interest rate ($i_{t-1} - \pi_t^e$) and real exchange rate (S_{t-1}). This suits the specification for a small open economy.

$$Y_t = \beta_1 Y_{t-1} + \beta_2 (i_{t-1} - \pi_t^e) + \beta_3 S_{t-1} + \varepsilon_t^y \quad (1)$$

Note that i_t is nominal inflation, π_t^e is expected inflation, while ε_t^y is the error term. Theoretically, both interest rate and exchange rate are inversely related to the level of output. High levels of interest rate reduce investment spending, hence output. Similarly, the appreciation of the domestic currency makes exports less attractive (since they will be expensive) and makes imports less expensive leading to a fall in output. The impact of lagged output on current output is not known a priori.

4.2.2: Money Demand Equation (LM-Curve)

The demand for money is given as an amalgamated function of output, nominal interest rate and nominal exchange rate (e_t).

$$m_t - p_t = \gamma_1 Y_t + \gamma_2 i_t + \gamma_3 e_t + \varepsilon_t^m \quad (2)$$

Where; m_t is nominal money, p_t is price level and ε_t^m is the error term. The other variables are as defined.

It is hypothesised that the demand for money (transaction demand for money) is positively correlated with real income. The reason being as income increases, individuals' demand for goods and services also increase. On the other hand, demand for money is negatively influenced by interest rate and exchange rate. These variables are regarded as the opportunity cost of holding money.

4.2.3: Aggregate Supply (Phillips Curve)

This is a price setting equation in which inflation is presumed to be a function of the lagged inflation (π_{t-1}), output and real exchange rate (S_t).

$$\pi_t = \alpha_0 \pi_{t-1} + \alpha_1 Y_t + \alpha_2 S_t + \varepsilon_t^{\pi} \quad (3)$$

Where; ε_t^{π} is the error term and the other variables are as defined.

The lagged and expected values of inflation capture the trade-off between inflation and output. The impact thereof is not known a priori.

4.2.4: Interest Rate

In this study interest rate is assumed to be a function of real output, expected inflation, nominal exchange rate and the money supply. Interest rate is influenced negatively by expected inflation and money supply. It is positively influenced by output. The impact of exchange rate on interest rate is not known a priori.

$$i_t = \varphi_1 Y_t + \varphi_2 \pi_t^e + \varphi_3 e_t + \varphi_4 MS_t + \varepsilon_t^i \quad (4)$$

4.3 ESTIMATION TECHNIQUES:

The choice of the estimation technique (s) forms an integral part in economic research. Inappropriate estimation method yields misleading results which may in turn lead to wrong conclusions concerning the behaviour of economic agents. To ensure that the model is of a good standard and statistically plausible, the equations have been estimated using the ordinary least squares (OLS), two stage least squares (2SLS), three stage least squares (3SLS) and the full information maximum likelihood (FIML) methods. OLS and 2SLS are single equations estimating methods, while 3SLS and FIML methods are suitable in estimating a system of equations. However, all the techniques have been employed in estimating the system of equations. OLS estimates are linear, unbiased and efficient. However, the estimates are biased and inconsistent in simultaneous models (Maddala, 2001). 2SLS is an extension of OLS. It is useful in cases where the error term is correlated with the explanatory variables. The estimates obtained are consistent and asymptotically efficient. However, it is also not suitable for estimating the system of equations. The two methods were also used to estimate the single equations in the model to establish the relationship between the explained and explanatory variables. It should be noted that, if all individual equations are statistically and theoretically plausible, it does not guarantee that when all the equations are solved simultaneously they will yield a reliable model (Valadkhani, 2004).

The estimates obtained from 3SLS and FIML methods are relatively more precise. However, they are more sensitive to model specification errors and use as compared to single equation ones (Einicke et al., 2012). 3SLS is an extension of the 2SLS method with estimates that have desirably large sample properties (asymptotically efficient and consistent). In addition the FIML method selects values of parameters that maximise the log likelihood function. It is also desirable in cases where data for some variables are missing or not available. The estimates are consistent, asymptotically normal and more efficient than the 3SLS estimates (Greene, 2002). The regression in this study is estimated using Eviews 8.0 package and TSP Version 5.0.

4.4 DATA SOURCES:

The data used in this study are from secondary sources. They were obtained from the Central Bank of Lesotho (CBL) annual reports and statistical bulletins as well as the World Bank Development Indicators. The coverage is for 34 years (1980-2013) (Central Bank of Lesotho, 2003, 2006, 2007, 2009, 2012, 2013; World Bank Data Bank; 2015). It should be noted however that 99.9 percent of the data used is obtained from the World Bank Development Indicators. The researcher found it to be more convenient to use more data which comes from one source as opposed to multiple sources to take into account the discrepancies in data produced by domestic and the international institutions.

4.5 CONCLUSION:

This chapter provides the discussion concerning the methodology to be used in the study. It has outlined the theoretical underpinnings concerning the behaviour of explained variables in relation to the explanatory variables. It has also provided the structure of the macroeconometric model for the economy of Lesotho in terms of the number of equations to be estimated. The estimation techniques and sources of data are also conferred. The succeeding chapter entails the detailed empirical estimates. It provides some nexus between the theory and reality.

CHAPTER FIVE
RESULTS AND DISCUSSION

5.0 INTRODUCTION

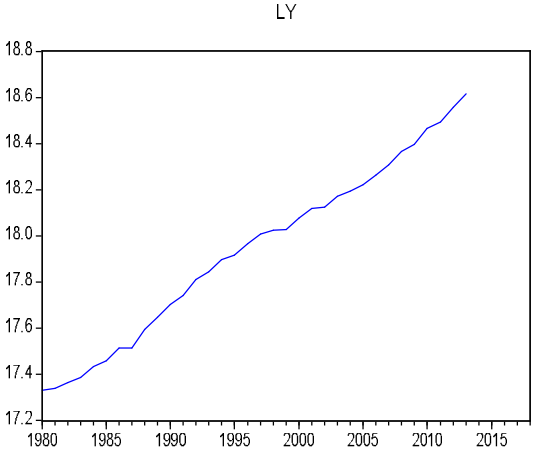
This chapter presents the empirical results which reflect the linkages amongst key macroeconomic variables for the period 1980 to 2013. The period of study is chosen based on the nature and availability of data at the time of study. This period is characterised by among others, the before and after structural adjustment programmes of 1988/1989 to 1990/1991; periods of high and low remittances of Basotho workers in RSA (most retrenchments occurred in post 1990); a sphere of political instabilities which worsened in 1998; exportation of water and diamonds; free primary education and health care; and inadequate agricultural production.

5.1 PRELIMINARY ANALYSIS

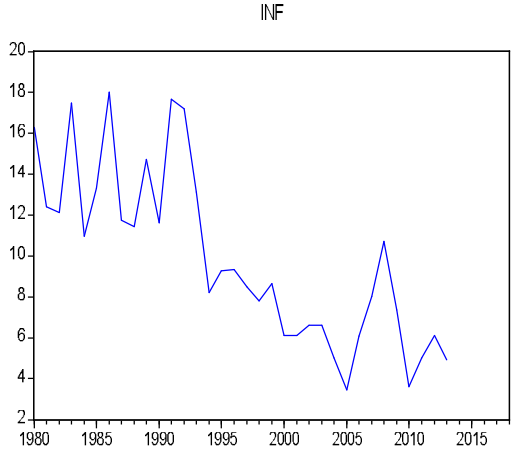
Simultaneous equations approach was used to evaluate the behaviour of key macroeconomic variables and the interaction thereof in Lesotho. In order to ensure that the model specified is of a good standard some diagnostic tests have been carried out. Figure 5.1 presents the graphical analysis of key indicators (output, inflation, money demand and interest rate). Output and money demand have been expressed in logs while interest rate and exchange rate have been expressed as percentages. It is noteworthy that output and broad money are valued in the Lesotho currency (Lesotho Loti).

Figure 5.1: Behaviour of Key Macroeconomic Variables

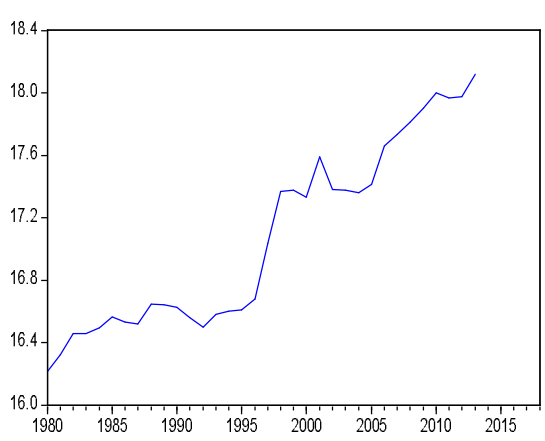
(a) ***Graph for Real Output (in log)***



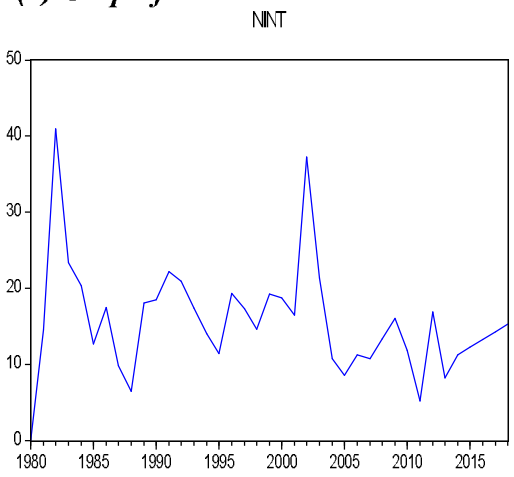
(b) Graph for Inflation



(c)Graph for Money demand (in log)



(a) Graph for Interest Rate



Output has been increasing overtime and has been relatively stable (a). It has been growing at an average of 3.79 percent per annum. The demand for money has also been increasing as well but is relatively unstable (c). It has been increasing with an average growth rate of 14.18 percent. On the other hand, inflation (b) and interest rate (d) have been fluctuating for the entire period. The average inflation rate is 10.06 percent per annum whilst real interest rate recorded an annual average of 5.11 percent.

Furthermore, the individual equations have been estimated to establish the validity and reliability of the explanatory variables used. Again, macroeconomic variables in the country are expected to behave in a weird way as Lesotho relies more on South Africa.

5.2 RESULTS ANALYSIS

This section presents the estimation of results and the justification of the obtained results (based on economic theory and empirical studies). Forecasting and simulation results are also provided with the necessary policy implications. The regression results estimated from four techniques viz; OLS, 2SLQ, 3SLS and FIML are given in Table 5.1. The analysis is based on the P-Values and the t-statistics.

5.2.1 The Aggregate Demand Equation

The estimates of the aggregate demand function are consistent with economic theory (in terms of the expected signs). Output is positively related to its lag indicating that the economy is backward-looking. Real interest rate and the real effective exchange rate are negatively related to real output. Since interest rate indirectly affects output via investments, it therefore signifies the negative relationship between investment and interest rate. An

increase in interest rate has a detrimental effect on investment hence output. On the other hand, the appreciation of the domestic currency in relation to major currencies affects output by encouraging imports over exports and the reverse is true. The results differ from that obtained by Adebiyi et al. (2014) in the sense that output is forward-looking (lagged output has been found to be positive but not significant). Again, the impact of the exchange rate on output has been found to be positive. This can be explained by the fact that if the country imports more machinery and equipment the appreciation of the domestic currency will translate to increases in investment spending (Reserve Bank of New Zealand; 2007). However, Dufréno et al. (2013) and Were et al. (2013) have found that the impact of exchange rate on output is negative.

5.2.2 The LM Equation

The demand for money is inversely related to income. The implication here is that an increase in output leads to a fall in money demand. This is contrary to the economic theory. On the other hand, nominal interest rate is positively related to money demand which is also contrary to economic theory. This unusual behaviour of interest rate and income in influencing money demand stems from the country's high dependency on the South African economy. The parity of Loti to Rand as well as the joined circulation of both currencies in the country makes it hard for monetary authorities to conduct an independent monetary policy. Moreover, the risk premiums on loans are large and the real lending rates are high due to few potential credit borrowers. As a result most potential borrowers use South African banks where rates are comparatively low. The deposit rates by commercial banks are also low leading to capital flights to South Africa where deposit rates are relatively high (IMF report, 2012). The nominal exchange rate is positively related to demand for money. This relationship implies that as the value of domestic currency depreciates the demand for money increases. The depreciation of the domestic currency increases the value of the foreign owned asserts by domestic entities. This increase in value signifies an increase in wealth, hence an increase in money demand (Adebiyi et al., 2014). The results differ from those of (Adebiyi et al., 2014) due to the aforementioned reasons.

5.2.3 The Aggregate Supply Equation

Inflation is positively correlated with lagged values of inflation. This implies that inflation in Lesotho is backward looking. In this case economic agents use information pertaining to the previous economic policies and the about development of other variables to draw the price expectations (adaptive expectation). This feature is conspicuous in countries with low and

moderate inflation rate (Strum, 2010). Again, there is a negative relationship between inflation and the real output. According to the inflationary theory by Keynes, inflation depends on the level of aggregate demand. Excess demand for goods and services (beyond the country's production capacity) triggers an increase in prices. Moreover, Palley (1996) asserts that inflation is a consequence of localised output bottlenecks combined with aggregate demand growth. In a developing economy like Lesotho food items constitute a higher percentage of the basket of commodities as a result, any disruptions in food supply cause inflation (Central Bank of Lesotho, 2012). The real effective exchange rate is also negatively related to inflation. The appreciation of the Loti against major currencies reduces prices of imported commodities, consequently leading to the deceleration in inflation. Results obtained are consistent to the ones by Adebiyi et al. (2014). However, it is noteworthy that though the lagged inflation was significant in this study (by Adebiyi et al.) inflation responded more to the expected inflation. Hence it is forward-looking not backward-looking.

5.2.4 The Interest Rate Equation

Interest rate is negatively correlated with expected inflation and money supply. An increase in money supply by the Central Bank leads to a decline in interest rate. Since interest rate is the opportunity cost of holding money, as money supply increases interest rate falls. This induces people to hold more money as opposed to alternative asserts such as bonds and treasury bills. Likewise, an increase in the expected inflation rate leads to a decline in interest rate. Fisher (1867; 1947) asserts that an increase in the expected inflation reduces the profitability of bonds hence the demand thereof, leading to a decline in interest rate (Ang et al., 2006). Conversely, interest rate is positively influenced by expected nominal exchange rate and the real output (income). Higher levels of income increase the demand for money given a fixed money supply interest rate increase to discourage people to hold more money. Similarly, the negative relationship between interest rate and expected exchange rate symbolises the case of expansionary depreciation (Sanchez, 2005). Were et al. (2013) obtained similar results on the relationship between interest rate and money supply, while Adebiyi (2014) obtained the same results on interest rate and expected inflation.

Table 5.1: The Estimated Coefficients

Regressors	OLS	2SLQ	3SLQ	FIML
1. AD Equation				
Intercept	5.801**	0.3001	3.758*	5.801**
Lagged Output	0.6545***	1.044**	0.7874**	0.6545***
Real Interest Rate	-0.0164**	-0.7238E-02	-.2651E-03	-0.0164
Real Effective Exchange Rate	-.2327E-03	-0.0446**	-.3474E-02	-.2327E-03
Time	0.0196***	0.5683E-02	0.8148E-02	0.0196***
2. LM Equation				
Intercept	57.96**	67.36**	62.72***	57.96***
Real Output	-2.674***	-3.514**	-2.992***	-2.674***
Nominal Interest Rate	0.1089**	0.3979*	0.0877	0.1089**
Nominal Exchange rate	0.5438***	1.145**	0 .6535***	0.5438***
Time	0.1984***	0.2692***	0.2171***	0.1984***
3. AS Equation				
Intercept	132.9***	103.1*	193.7***	132.9***
Lagged Inflation	0.3111**	0.4303**	0.0687	0 .3111**
Output	-6.863***	-5.586**	-9.961***	-6.863***
Real Effective Exchange Rate	-0.4960	-0.4694	-0.9368**	-0.4960
4. Interest Rate Equation				
Intercept	-104.8**	-15.48	-161.6***	-104.8
Expected Inflation	-0.2213	-0.2905	-0.4071	-0.2213
Real Effective Exchange Rate	0.5649**	0.2131	0.0697	0.5649
Real Output	8.049**	0.2489	12.23***	8.049
Money Supply	-1.673**	-1.212	-2.153***	-1.673
Time	-0.1817	-0.2381	-0.3864*	-0.1817

*** Significant at 1 percent , ** Significant at 5 percent, * Significant at 10 percent

For each regression presented in Table 5.1 above the corresponding coefficient of determination ($\bar{R}^2$), adjusted $\bar{R}^2$ for the degrees of freedom, the F-statistics and the Durbin-Watson (DW) statistics are provided in Table 5.2.

The results for aggregate demand equations estimated using four techniques (OLS, 2SLS, 3SLS and FIML) show that lagged output, real interest rate and real effective exchange rate are jointly significant in determining the level of output in the economy. This is given by high $\bar{R}^2$ and the adjusted $\bar{R}^2$ as well as high values of the F-statistics. The DW-Statistics is in most cases closer to two, except in the case of 3SLS. These show that the equation is well specified. Moreover, the money demand equation is also well specified with high values of $\bar{R}^2$, adjusted $\bar{R}^2$ and the F-statistics. It is important to note that DW-Statistics is in most cases less than two but still greater than the $\bar{R}^2$.

In addition, the results also reveal that lagged values of inflation, output and the exchange rate jointly determine inflation in the current period. This is evident from high values of $\bar{R}^2$, adjusted $\bar{R}^2$ and the F-statistics. The DW- statistics is in most instances closer to two. Likewise the interest rate equation is well specified. However, it has relatively lower values of $\bar{R}^2$ and adjusted $\bar{R}^2$. The DW and F-statistics are of required standard.

Table 5.2: The Statistical Properties of the Estimated Equations

Statistical Properties	OLS	2SLQ	3SLQ	FIML
1. AD Equation				
$\bar{R}^2$	0.9974	0.9932	0.4894	0.9972
Adjusted $\bar{R}^2$	0.9948	0.9919	0.4147	0.9945
DW- Statistics	1.034	2.474	1.054	1.034
F-Statistics	137.8693	658.3	740.9356	713.0995
2. LM Equation				
$\bar{R}^2$	0.9771	0.9091	0.4213	0.7925
Adjusted $\bar{R}^2$	0.9548	0.8939	0.4003	0.7280
DW- Statistics	1.316	1.844	1.448	1.316
F-Statistics	136.3145	59.13	849.1854	684.2047
3. AS Equation				
$\bar{R}^2$	0.8074	0.6434	0.654	0.9756
Adjusted $\bar{R}^2$	0.7818	0.6006	0.6514	0.9519
DW- Statistics	1.809	1.834	1.613	1.809
F-Statistics	120.5083	16.21	993.9852	120.5083
4. Interest Rate Equation				
$\bar{R}^2$	0.6112	0.1944	0.4030	0.6409
Adjusted $\bar{R}^2$	0.6035	0.1890	0.4000	0.6108
DW- Statistics	1.702	1.479	1.732	1.702
F-Statistics	77.7898	44.26	78.4676	164.7206

5.3 FORECASTING

A good model is the one that possesses plausible and consistent forecasts. If done successfully forecasting reduces uncertainty concerning future functioning of the economy or the behaviour of macroeconomic variables. The estimates from the ordinary least squares regression have been used for forecasting. These are easy to apply, the sample size is reasonably large (more than 30 observations), and the errors across the equations in the recursive model like this one are uncorrelated (Adebiyi et al., 2014). The other estimates (2SLS, 3SLS and FIML) have relatively large variances.

Since it is not possible to forecast the future precisely there is always a range of errors allowed for in the forecast (Thomas, 1993). The Root Mean-Squared Percentage Error (RMSPE) and the Theil' Inequality Coefficient (U) have been used to evaluate the forecasting performance of the model. The desired value of (U) is one that is closer to zero because it indicates that predicted values are closer to the actual values. In addition, the small values of RMPSE show that the forecasting performance of the model is good. For all the estimated equations RMSPE and Theil's inequality coefficients (Table 5.3) are biased towards zero, signifying a small forecasting error.

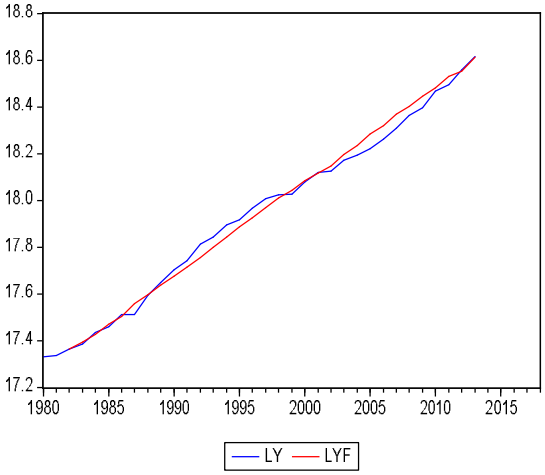
Table 5.3: The Model Evaluation

Variable	RMSPE	U
Real Output	0.0270	0.0124
Money Supply	0.1301	0.0547
Inflation Rate	0.3064	0.1187
Nominal Interest Rate	0.5087	0.1698

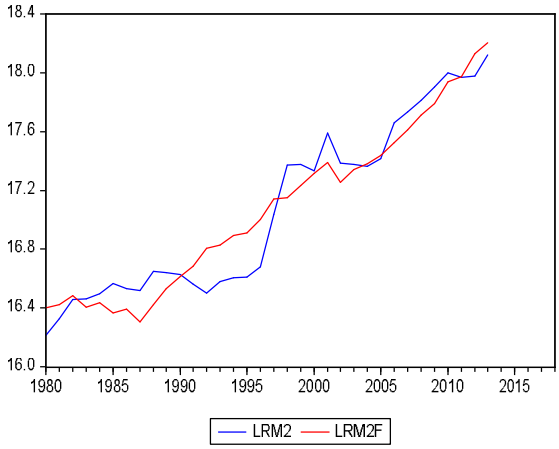
Furthermore, Figure 5.2 shows the forecasts of real output, money demand, inflation as well as interest rate. The figure 5.2 (a), (b), (c) and (d) below in general show that the predictive values of real output, money demand, inflation and interest rate do not lie far from the actual fitted values. In some instances however, like in the case of money demand and interest rate the turning points of the actual and the forecasted values slightly differ. The fact that the actual values and their predicted counterparts seem to be close implies therefore that the forecasting ability of the model is satisfactory. The model can therefore be used for policy analysis and simulation.

Figure 5.2: Forecasting Results

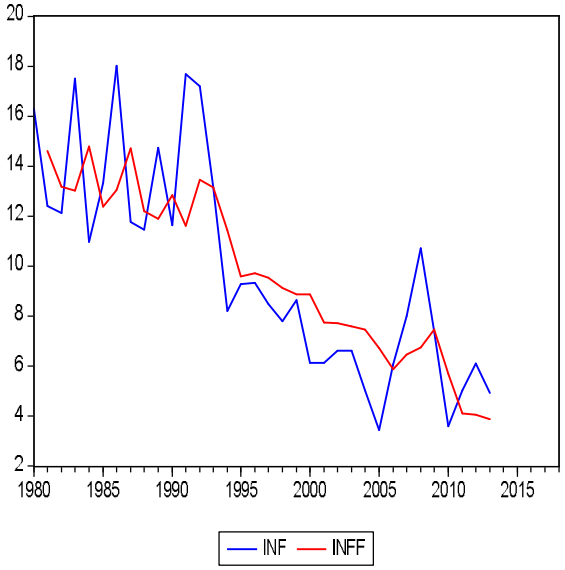
(b) ***Forecasting for Real Output***



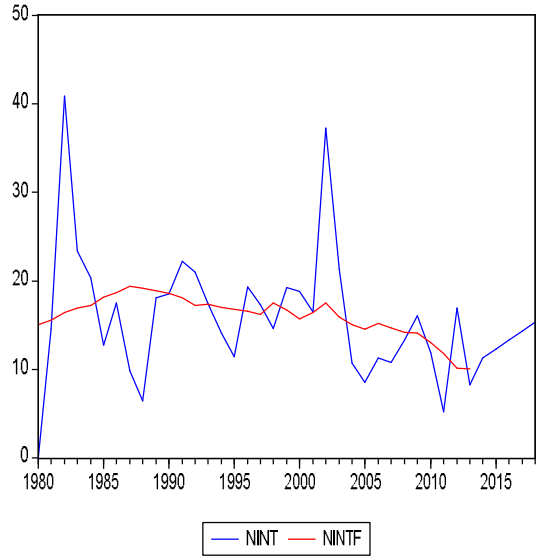
(b) Forecasting for Money Demand



(c)Forecasting for Inflation



(a) Forecasting for Interest Rate



5.4 CONCLUSION

This chapter provides the discussion of the estimated model. Results show that most variables used in the regression are stationary in level and are cointegrated. It has been discovered that some of the variables are not consistent with the economic theory due to high dependency of the economy on the South African economy. The estimated model is of the required standard, thus, it can be used for policy analysis and simulation. Again, monetary policy seems to be less effective in stimulating the economy. Similar results on the inefficiency of the monetary policy in resuscitating the economy has been found by Dufréno et al. (2013), Gatt et al. (2013) and Asteriou et al. (2012) as well. The next chapter entails the conclusions derived from the study, the policy recommendation as well as areas for further study.

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS:

This study sets out to develop a macroeconometric model for the economy of Lesotho to demonstrate the relationship amongst key macroeconomic variables. The data used is time-series in nature and ranges from 1980 to 2013. The complete model is discussed under four equations, viz; aggregate demand (IS-Curve), money demand (LM-Curve), aggregate supply (Phillips-Curve) and interest rate. All the equations in this model are specified based on the economic theory. The individual behavioural equations are estimated using ordinary least squares (OLS), two stage least squares (2SLQ), three stage least squares (3SLS) and full information maximum likelihood (FIML) methods after incorporating all the necessary econometric techniques. The analysis undertaken for individual equations indicate that all behavioural equations are well specified, with good forecasting performance. This chapter provides a summary of major conclusions, the policy recommendations and suggests areas for further research.

Output is positively and significantly determined by lagged output (output is backward looking). It is negatively determined by real interest rate and the real effective exchange rate as well. In addition, the demand for money is highly responsive to output (income), nominal interest rate and nominal exchange rate. The impact of nominal interest rate and exchange rate on money demand is positive while that of income is negative. Moreover, inflation is backward-looking (influenced by inflation previous period) and is also influenced by real exchange rate and output. Furthermore, the expected inflation, nominal exchange rate, output and money supply are very effective in determining interest rate.

6.2 RECOMMENDATIONS:

The preceding section provided some conclusions derived from the estimated model, this section provides policy recommendations made on the basis on these conclusions. The following are the policy recommendations:

- It is not possible for the Central Bank to implement an independent monetary policy, however, policies that will ensure flexibility of interest rates should be adopted to

allow competition amongst banks and finance houses. Money supply seems to be well administered to adjust interest rate.

- Fiscal policy should be implemented cautiously. The recommendation is that it should be applied in such a way that will provide the favourable environment to enable further economic growth. This may entail advancement in infrastructure which may ultimately boost private investment.
- Output has proved to be an engine behind economic growth. Therefore policies that aim at improving economic growth are mandatory. This includes policies that encourage private investment by both domestic and foreign entities.

6.3 AREAS FOR FURTHER STUDY:

The model constructed has highlighted the structure of the economy of Lesotho. However, it is important to bear in mind that macroeconometric modelling or modelling in general, is a dynamic process which needs continual updating to incorporate changes and developments in the economy. This implies therefore that, there is always scope for substantial expansion and advancement of any estimated econometric model. The model presented in this study is definitely not an exception. The policy simulation has not been conducted due to time constraint. The specification of some other important equations and inclusion of some variables in the estimated equations has been a major challenge encountered. This has been caused by lack of (and inadequate) data pertaining to some variables as well as the economy's high reliance on the South African economy. For example, data on treasury bill rates which the Central Bank of Lesotho uses to control money supply is not adequate (starts from 1994). Again, interest rates and inflation in the country are determined based on those of the Republic of South Africa.

The specification of the equations can also be modified. For instance, instead of specifying the aggregate supply using the Phillips's curve approach, the production approach (which includes factors influencing output in the economy) could be used. The other equations which can be incorporated are the ones for the fiscal, external and price sectors (import and export deflator, and the producer price index). Thus, based on this limitations and the nature of model building, improvements can be made by taking into account some specifications in this study.

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APPENDIX

A.1 LIST OF VARIABLES

Number	Acronym	Endogeneous variable	Exogeneous Variable	Period	Data Source
1	Y_t	Output		1980-2013	World Bank Data Bank and CBL
2	$m_t - p_t$ (Rm2)	Real Broad Money		1980-2013	World Bank Data Bank and CBL
3	π_t (Inf)	Inflation Rate		1980-2013	World Bank Data Bank and CBL
4	e_t (Ner)	Nominal Exchange Rate		1980-2013	World Bank Data Bank and CBL
5	(Intrles)	Lending Rate Lesotho		1980-2013	World Bank Data Bank and CBL
6	π_t^e (Infe)		Expected Nominal Inflation Rate	1980-2013	World Bank Data Bank and CBL
7	(Infsa)		Inflation Rate (SA)	1980-2013	World Bank Data Bank
8	e_t^e (Nere)		Expected Nominal Exchange Rate	1980-2013	World Bank Data Bank and CBL
9	(Intrsa)		Lending Rate (SA)	1980-2013	World Bank Data Bank
10	Y_t^g (Ystar)		Potential Output	1980-2013	World Bank Data Bank and CBL
11	MS		Monetary Supply	1980-2013	World Bank Data Bank and CBL
12	$Rexr_t$		Real Effective Exchange Rate	1980-2013	World Bank Data Bank and CLB