

CHAPTER 5

MODEL SPECIFICATION

5.1 INTRODUCTION

This chapter aims to specify and present the macroeconometric model for Lesotho that is constructed and estimated in this study. The chapter draws heavily on the literature reviewed in chapters three and four, especially on issues of specification and estimation techniques. It also draws on the review of the economy discussed in chapter two for guidance on capturing the specific features and uniqueness of the economy of Lesotho. The following four sectors of the economy are modelled:

The real sector

The real sector consists of the supply side, the demand side and the price block. The supply side determines real aggregate domestic output by estimating a Cobb-Douglas type production function, demands for private investment and labour as well as real wages. The demand side of the real sector determines private consumption expenditure. The price block estimates four relations, *viz*, the producer prices, the consumer prices, export prices and import prices.

The external sector

The external sector consists of identities describing the major accounts in the balance of payments, namely, the capital and financial balance, the current account balance and the overall balance of payments balance. It estimates real exports of goods and services and real imports of goods and services.

The government sector

The government sector consists of identities describing the major components of government expenditure and its relation to other sectors. It determines five kinds of taxes stochastically. These are the individual income tax, company tax, other income tax, goods and services tax and other taxes. Other sources of revenue, namely,

customs revenue and non-tax revenues are assumed exogenous. It defines the government budget deficit as the difference between government revenue and expenditures. The sector also estimates the levels of government external and domestic debt and relates them to the balance of payments and the government budget deficit.

The monetary sector

The monetary sector estimates the demands for three monetary aggregates namely currency in circulation, demand deposits, and time and saving deposits. It also estimates the nominal Treasury bill rate.

5.2 LIST OF VARIABLES

The list of variables in the model is presented below in the order of endogenous, exogenous and dummy variables. Unless otherwise stated, the variables are measured in millions of Maluti.

ENDOGENOUS VARIABLES

| VARIABLE ACRONYM | NATURAL LOG FORM | VARIABLE NAME AND DESCRIPTION | SOURCE |
|------------------|------------------|--|---------------------------|
| BOP | | Overall balance of the balance of payments | CBL |
| COMPTAX | LCOMPTAX | Company tax revenue | CBL |
| CPI95 | LCPI95 | Consumer price index (1995=100) | CBL |
| CU2 | LCU2 | Capacity utilization | (RGDPFC/RGDPFC_POT)*100 |
| CUR | | Nominal currency in circulation | CBL |
| DD | | Nominal demand deposits | CBL |
| DEBT | | Total government debt | CBL |
| DOMDEBT | | Total government domestic debt | CBL |
| ED | LED | Excess Demand | (RGDE/RGDP)*100 |
| EXTDEBT | | Total government external debt | CBL |
| GDPDEF | LGDPDEF | GDP deflator (1995=100) | (NGDP/RGDP)*100 |
| GOVBAL | | Government budget balance | CBL |
| GSTAX | LGSTAX | Goods and services tax revenue | CBL |
| IITAX | LIITAX | Individual income tax revenue | CBL |
| INFL1 | LINFL1 | CPI Inflation rate | ((CPI95/CPI95(-1))-1)*100 |
| INV | | Change in inventories | CBL |

| | | | |
|-----------------|-----------|---|--|
| K | LK | Capital stock | CBL |
| L ⁷⁷ | LL | Labour | CBL |
| LABPROD1 | LLABPROD1 | Labour productivity | (RGDP/L)*1000000 |
| M | | Money multiplier | (MS/RM) |
| MGSRELP1 | LMGSRELP1 | Relative price of imports of goods and services | (PMGS1/CPI95)*100 |
| NCAB3 | | Nominal current account balance | CBL |
| NGCONS | | Nominal government consumption expenditure | CBL |
| NGDP | | Nominal GDP at market prices | CBL |
| NGDPFC | | Nominal GDP at factor cost | CBL |
| NGNP | | Nominal GNP | CBL |
| NKFB | | Nominal capital and financial balance of BOP | CBL |
| NM1 | | Nominal M1 money supply | CBL |
| NM2 | | Nominal M2 money supply | CBL |
| NM3 | | Nominal M3 money supply | CBL |
| NMGS | | Nominal imports of goods and services | CBL |
| NWAGES | LNWAGES | Nominal wages | CBL |
| NXGS | | Nominal exports of goods and services | CBL |
| NYD | | Nominal disposable income | CBL |
| OINCTAX | LOINCTAX | Other incomes tax revenue | CBL |
| OTAX | LOTAX | Other tax revenue | CBL |
| PMGS1 | LPMGS1 | Import prices (1995=100) | (NMGS/RMGS)*100 |
| PXGS | LPXGS | Export prices (1995=100) | CBL |
| RCUR | LRCUR | Real currency in circulation | (CUR/GDPDEF)*100 |
| RDD | | Real demand deposits | (DD/GDPDEF)*100 |
| RGCONS | | Real government consumption expenditure | CBL |
| RGDE | | Real GDE | (RTOTINV+RGCONS+RPCONS) |
| RGDP | LRGDP | Real GDP | CBL |
| RGDPFC | | Real GDP at factor cost | CBL |
| RGINV | | Real government investment | (RTOTINV-RPINV-INV) |
| RGNP | LRGNP | Real GNP | CBL |
| RM31 | LRM31 | Real M3 money supply | (NM3/GDPDEF)*100 |
| RMGS | LRMGS | Real imports of goods and services | CBL |
| RNTOTINV | | Real net total investment | ((RTOTINV-(DEPR*RTOTINV)) |
| RPCONS | LRPCONS | Real private consumption expenditure | CBL |
| RPINV | LRPINV | Real private investment expenditure | CBL |
| RTBRATE1 | | Real treasury bill rate | (TBRATE-INFL1) |
| RTSD | LRTSD | Real time and savings deposits | (TSD/GDPDEF)*100 |
| RUCC | LRUCC | Real user cost of capital | (GDPDEF/100)*((RTBRATE/100)+D EPR)/((1- |

⁷⁷ Measured in thousands.

| | | | |
|------------|-----------------|---|---|
| | | | $((\text{COMPTAX}/\text{GDPDEF}) * 100) / \text{RGDPFC})$ |
| RWAGES2 | LRWAGES2 | Real wages | $(\text{NWAGES}/\text{GDPDEF}) * 100$ |
| RWAGESUCC2 | LRWAGESUC C2 | Ratio of real wages to real user cost of capital | $(\text{RWAGES2}/\text{RUCC})$ |
| RXGS | LRXGS | Real exports of goods and services | CBL |
| RYD | LRYD | Real disposable income | $(\text{NYD}/\text{GDPDEF}) * 100$ |
| STDDEBT | | Short term government debt | CBL |
| TBRATE | LTBRATE | Treasury bill rate | CBL |
| TOTGOVEXP | | Total government expenditure | CBL |
| TOTREC | | Total government receipts | CBL |
| TOTREV | | Total government revenue | CBL |
| TSD | | Nominal time and saving deposits | CBL |
| XGSRELP1 | LXGSRELP1 | Relative price of exports of goods and services | $(\text{PW1}/\text{PXGS}) * 100$ |

EXOGENOUS VARIABLES

| | | | |
|-----------|---------|--|--|
| CAPEXP | | Government capital expenditures | CBL |
| CONSDEF | | Deflator for government consumption | $(\text{NGCONS}/\text{RGCONS}) * 100$ |
| CURTRS | | Current transfers in BOP | CBL |
| CUSTREV | | Customs (SACU) revenue | CBL |
| DEPR | | Rate of depreciation | Assumed to be 20% |
| ERR | | Errors and omissions in BOP | CBL |
| EXRATE | LEXRATE | Rand-Dollar exchange rate | CBL |
| FB | | Financial balance in BOP | CBL |
| GDPFCDEF | | Deflator for GDP at factor cost | $(\text{NGDPFC}/\text{RGDPFC}) * 100$ |
| GNPDEF | | GNP deflator | $(\text{NGNP}/\text{RGNP}) * 100$ |
| GOVDEP | | Government deposits | CBL |
| GOVEXPRES | | Total government expenditures residual | $\text{TOTGOVEXP} -$ $(\text{RECUEXP} + \text{CAPEXP})$ |
| GOVRESID | | Residual for nominal government expenditures | $\text{NGCONS} - (\text{RECUEXP} - \text{OGS} -$ $\text{SUBTRS})$ |
| GRANTS | | Grants | CBL |
| INCBAL | | Incomes balance in BOP | CBL |
| KB | | Capital balance in BOP | CBL |
| KRES | | Capital stock residual | |
| LTDDEBT | | Long term government domestic debt | CBL |
| MGSRES | | Residual for imports of goods and services | $\text{NMGS}^{\text{NATIONAL ACCTS}} - \text{NMGS}^{\text{BOP}}$ |
| NNFIB | | Nominal net factor income from abroad | CBL |
| NONTAXREV | | Non-tax government revenue | CBL |
| NTRS | | Net transfers | CBL |
| OGS | | Purchases of other goods and services by government | CBL |

| | | | |
|------------|---------|---|---|
| PNETAX | | Net taxes on production and imports | CBL |
| PW1 | LPW1 | World price | IFS |
| RECUEXP | | Government recurrent expenditure | CBL |
| RF | | SA short-term interest rate (Bankers acceptance rate) | SARB |
| RGDPFC_POT | | Potential real GDP at factor cost | Derived by applying Hodrick-Prescott filter on RGDPFC |
| RM | | Reserve money | CBL |
| RTOTINV | | Real total investment | (RPINV+RGINV+INV) |
| SERVBAL | | Balance of services in current account of BOP | CBL |
| SUBTRS | | Government expenditure on subsidies and transfers | CBL |
| TIME | | Time trend (proxy for technological advancements) | 1,2,3,...,N |
| VALADJ | | Valuation adjustment in BOP | CBL |
| WDEMND | LWDEMND | World demand | IFS |
| XGSRES | | Residual for exports of goods and services | XGS ^{NATIONAL ACCTS} -XGS ^{BOP} |

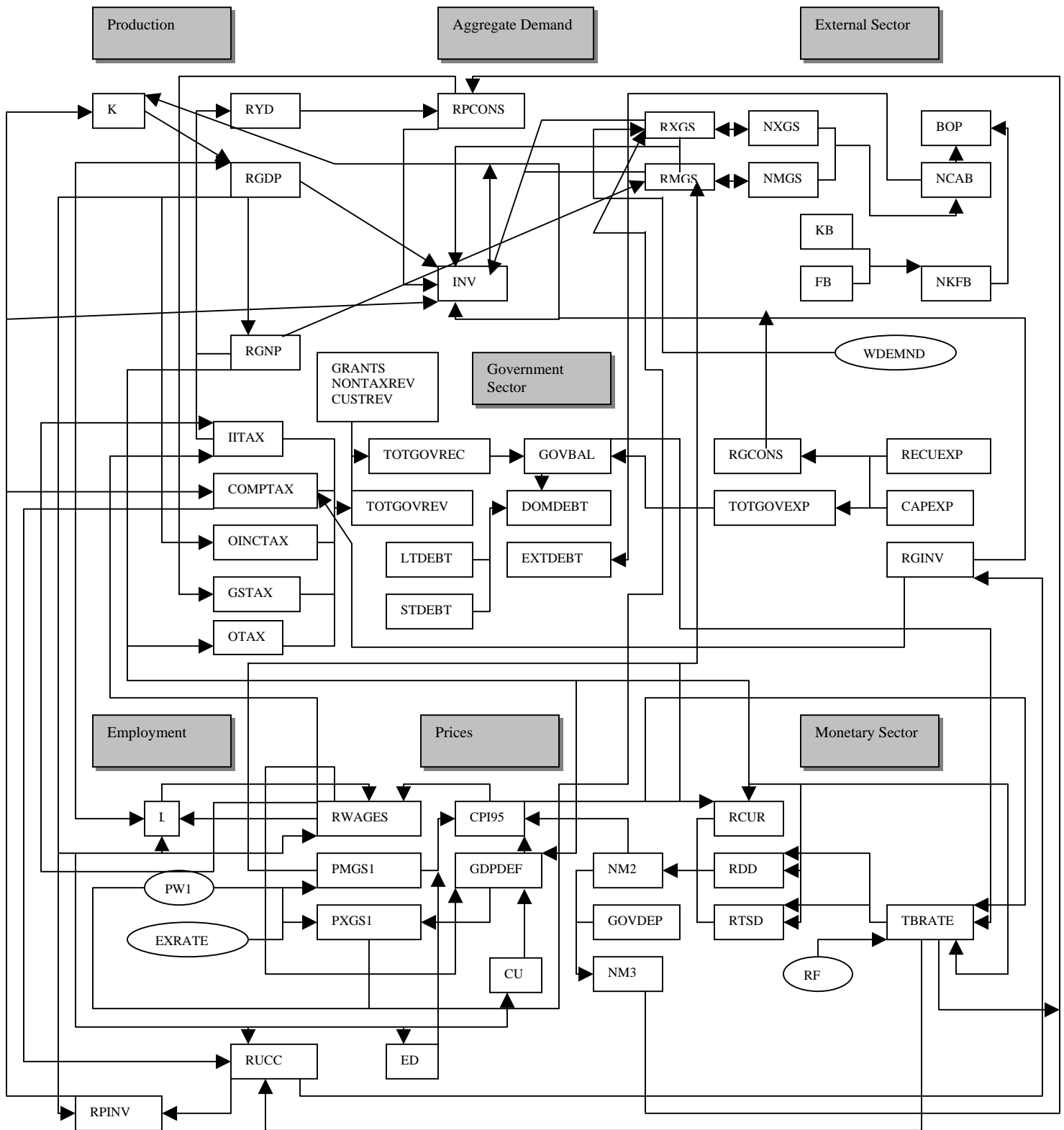
DUMMY VARIABLES

| LABEL | DESCRIPTION | CONSTRUCTION |
|---------|----------------------|---|
| DUM8084 | Tax reforms | 1980-1984 = 1; 0 otherwise |
| DUM8086 | 1986 Coup | 1980-1986 = 1; 0 otherwise |
| DUM8088 | Tax reforms | 1980-1986 = 1; 0 otherwise |
| DUM8090 | Tax reforms | 1980-1990 = 1; 0 otherwise |
| DUM8092 | Tax reforms | 1980-1992 = 1; 0 otherwise |
| DUM82 | Tax reforms | 1981-1983 = 1; 0 otherwise |
| DUM83 | Tax reforms | 1983 = 1; 0 otherwise |
| DUM8384 | Tax reforms | 1983-1984 = 1; 0 otherwise |
| DUM84 | Tax reforms | 1984 = 1; 0 otherwise |
| Dum85 | Tax reforms | 1985 = 1; 0 otherwise |
| DUM86 | 1986 Coup | 1986 = 2; 0 otherwise |
| DUM8687 | 1986 Coup | 1986-1987 = 1; 0 otherwise |
| DUM8691 | 1986 Coup | 1986-1991 = 1; 0 otherwise |
| DUM8695 | 1986 Coup | 1986-1996 = 1; 0 otherwise |
| DUM87 | Inception of LHWP | 1987 = 1; 0 otherwise |
| DUM88 | Inception of SAPs | 1988 = 1; 0 otherwise |
| DUM8892 | Phase 1A of LHWP | 1988=1.1; 1989=1.2; 1990=1.5; 1991=1.8; 1992=1.5; 0 otherwise |
| DUM89 | Inception of the SAP | 1989 = 1; 0 otherwise |
| DUM8992 | | 1989-1992 =1; 0 otherwise |
| DUM90 | Inception of reforms | 1990 = 1; 0 otherwise |
| DUM9020 | Economic reforms | 1990-2000 = 1; 0 otherwise |
| DUM9092 | Inception of reforms | 1990-1992 =1; 0 otherwise |

| | | |
|---------|---|---|
| DUM91 | LHWP expenditure increases | 1991 = 1; 0 otherwise |
| DUM9192 | LHWP expenditure increases | 1991-1992 = 1; 0 otherwise |
| DUM9194 | LHWP expenditure increases | 1991-1994 = 1; 0 otherwise |
| DUM92 | LHWP expenditure increases | 1992 = 1; 0 otherwise |
| DUM93 | LHWP expenditure increases | 1993=1; 0 otherwise |
| DUM9298 | Duration of major LHWP expenditures | 1992-1998=1; 0 otherwise |
| DUM94 | Industrial actions in the manufacturing sector | 1994 = 1; 0 otherwise |
| DUM95 | Industrial actions in the manufacturing sector | 1994-1996 = 1; 0 otherwise |
| DUM9598 | Industrial actions in the manufacturing sector | 1995-1998 = 1; 0 otherwise |
| DUM96 | LHWP expenditure increases | 1996 = 1; 0 otherwise |
| DUM9697 | Interest rate hikes | 1996-1997 = 1; 0 otherwise |
| DUM97 | Interest rate hikes | 1997=1; 1998=1.2; 1999=1.3; 2000=1.4; 0 otherwise |
| DUM9798 | 1998 Political riots | 1997-1998 = 1; 0 otherwise |
| DUM98 | 1998 Political riots/Winding up of LHWP construction activities | 1998 = 1; 0 otherwise |
| DUM982 | 1998 Political riots | 1998=1.5; 1999=1.3; 2000=1.2; 0 otherwise |
| DUM99 | Implementation of SMP | 1999-2000 = 1; 0 otherwise |
| DUM20 | SMP Period | 2000 = 1; 0 otherwise |

5.3 A SCHEMATIC VIEW OF THE MODEL

Figure 5.1 A Flow Chart of the Model



The model is presented in the form of a flow chart in Figure 5.1. The chart highlights the major interactions and basic relationships in the model and keeps the secondary details to the minimum. Aggregate real GDP is produced under the production sector according to the Cobb-Douglas technology and leads to the demand for factors of production, labour and capital. The demand for labour is determined by real output and real wages while investment demand is determined by real output and the real user cost of capital. Real wages depend on the endogenous labour productivity and consumer prices. Real GDP is linked to the real GNP by net factor income from abroad and to real disposable income by indirect taxes net of subsidies and net transfers. The aggregate demand sector determines the private consumption, which depends on real disposable income, real broad (M3) money balances and the real interest rate. The price sector determines consumer and producer prices and export and imports prices. These are affected directly by variables in the monetary and the employment sectors in particular and in turn affect variables in the monetary sector, the employment sector, the government sector, aggregate demand and aggregate supply. Producer prices depend on capacity utilization, real wages and the user cost of capital, while consumer prices depend on producer prices, import prices and the excess demand in the economy. Export prices depend on the world price, the exchange rate and the producer prices while import prices are determined by the exogenous world prices and the exchange rate.

The external sector determines the major balances in the balance of payments, real exports of goods and service and real imports of goods and services. The flow of exports to the rest of the world depends on the exogenous world demand and the relative price of exports. Real GNP and the relative price of imports determine the demand for imports of goods and services. The flows in the balance of payments are directly related to net exports in the aggregate demand sector. The government sector determines the revenues and expenditures as well as the external and internal indebtedness of government. The government receives taxes, non-tax revenues and grants and customs revenue. The latter three are exogenous while the five different types of taxes estimated depend on variables determined in the aggregate demand sector, the supply sector and the employment sector. In turn, government expenditures consist of broader classifications of capital and

recurrent expenditures. The interaction of the receipts and expenditures of government determines the government budget deficit. In general, the government sector is linked directly to the monetary sector, the external sector, the aggregated demand and supply sectors and indirectly to the price and employment sectors. The monetary sector determines the real demand for money and nominal Treasury bill rate of interest and is fed by impulses from the government sector and the production sector. In turn, the monetary sector feeds directly into the price sector and the aggregate demand sector.

5.4 MODEL SPECIFICATION

This section presents the equations of the model. These include the behavioural equations, identities and bridge equations of the sectors. While the specifications are made to be anchored on strong theoretical grounds, it is acknowledged here that, because of the softness and inconsistency of the data, a general-to-specific specification search is employed to obtain short run adjustments equations. In addition, the model makes liberal use of dummy variables in the estimation stage, to capture major events and structural changes in the economy.

5.4.1 The real sector

5.4.1.1 Aggregate supply

Production

The long run specification of the production function follows a Cobb-Douglas structure and relates aggregate output to capital, labour and a measure of technical progress in the form of a time trend.

$$LRGDP = \alpha + \beta_1 LL + \beta_2 LK + \beta_3 TIME + \varepsilon \quad (5.1)$$

The variable, *TIME*, a proxy of technological advancements, is treated as exogenous in the model.

While labour demand is determined stochastically, the following relation describes the evolution of the capital stock,

$$K = RNTOTINV + (1 + DEPR)K_{-1} - KRES^{78} \quad (5.2)$$

where *RNTOTINV* stands for real net total investment and is derived by means of the following relation.

$$RNTOTINV = RTOTINV - (DEPR * RTOTINV) \quad (5.3)$$

RTOTINV is real gross total investment and is the sum of the real private and government investment and the change in inventories. This definition is captured in the following derivation of government investment expenditure (*RGINV*), which is derived as a residual of the following form:

$$RGINV = RTOTINV - RPINV - INV \quad (5.4)$$

Real private investment demand

Within this framework, real private investment is determined stochastically and is specified in the long run as a function of real output, the real user cost of capital and four dummy variables. This specification combines the accelerator principle with the Jorgenson neoclassical approach.

$$LRPINV = \alpha + \beta_1 LRGDP + \beta_2 LRUCC + \varepsilon \quad (5.5)$$

The user cost of capital is determined endogenously as follows

⁷⁸ *KRES* is a balancing item, created as a difference between the capital stock and the conventional way of deriving capital stock. This difference is a result of the discrepancies in the data set and presumably the assumption of a 20 per cent depreciation of capital stock.

$$RUCC = \frac{\left(\frac{GDPDEF}{100}\right) * \left(\frac{RTBRATE1}{100} + DEPR\right)}{\left(1 - \left(\frac{\left(\frac{COMPTAX}{GDPDEF}\right) * 100}{RGDPFC}\right)\right)} \quad (5.6)$$

where real GDP at factor cost, $RGDPFC$ is defined as

$$RGDPFC = \left(\frac{NGDPFC}{GDPFCDEF}\right) * 100 \quad (5.7)$$

where $GDPFCDEF$ is the exogenous deflator for GDP at factor cost and

$$NGDPFC = NGDP - PNETAX \quad (5.8)$$

where $PNETAX$ is net taxes on production and imports and is determined exogenously.

Labour demand

To portray the surplus labour feature of the economy, only labour demand is modelled. This makes allowance for labour demand to determine employment conditions in the model. Given that labour demand is a derived demand, the long-run relationship is specified as a function of real output and real wages. This specification derives from the micro foundations of profit maximizing behaviour by firms by which the level of employment is determined by the condition that the marginal revenue product of labour is equal to the wage rate. Because of the waning dependency of employment, the idea of the inclusion of foreign GDP, particularly that of South Africa, was considered not relevant (see for example, Elliot *et al.* 1986).

$$LL = \alpha + \beta_1 LRGDP + \beta_2 LRWAGES2 + \varepsilon \quad (5.9)$$

The following relationship serves to explain the derivation of real wages and its relation to nominal wages.

$$NWAGES = \left(\frac{RWAGES2 * GDPDEF}{100} \right) \quad (5.10)$$

In turn, real wages and the GDP deflator are determined stochastically in the following section.

Real wages

The long-run specification of the wages equation presents real wages as a function of labour productivity and the consumer price index. A suitable measure of unemployment could not be obtained because of data limitations, hence, consumer prices are used in this equation as a proxy for the disequilibrium in the economy.

$$LRWAGES2 = \beta_1 LLABPROD1 + \beta_2 LCPI95 + \varepsilon \quad (5.11)$$

While consumer prices are determined endogenously in the price block, labour productivity, *LABPROD1*, is defined as the ratio of labour to real GDP as follows

$$LABPROD1 = \left(\frac{L}{RGDP} \right) * 1000000 \quad (5.12)$$

5.4.1.2 Aggregate demand

Ideally, the expenditure sector determines the aggregate demand for goods and services. Of all the components of aggregated demand, only real private consumption is determined in the expenditure sector in this model.

Real private consumption expenditure

The specification of the real private consumption follows the permanent income and life-cycle hypothesis. In the long run, it is specified as a function of real disposable income, real broad money supply (*M3*) to proxy real wealth and the real Treasury bill rate. This

specification is based on the notion that liquidity-constrained consumers make consumption choices based only on disposable income and that their rate of time preference and rate of return are identical. On the other hand, unconstrained consumers base their decisions on total lifetime resources with the marginal propensity to consume fluctuating over time to account for consumption smoothing (Pauly 2000:6).

$$LRPCONS = \alpha + \beta_1 LRYD + \beta_2 RTBRATE1 + \beta_3 LRM31 + \varepsilon \quad (5.13)$$

In turn, the following relation describes real disposable income.

$$RYD = \left(\frac{NYD}{GDPDEF} \right) * 100 \quad (5.14)$$

Nominal disposable income is defined as the sum of nominal gross national output and net transfers.

$$NYD = NGNP + NTRS \quad (5.15)$$

While net transfers are determined exogenously in this model, national output in nominal terms is defined as the sum of nominal domestic output and nominal net factor income from abroad as follows.

$$NGNP = NGDP + NNFIB \quad (5.16)$$

Nominal net factor income from abroad is determined exogenously, while nominal domestic output is defined as and related to real domestic output by the following relation.

$$NGDP = \frac{(RGDP * GDPDEF)}{100} \quad (5.17)$$

Real broad money ($M3$) is derived in the following relation.

$$RM31 = \left(\frac{NM3}{GDPDEF} \right) * 100 \quad (5.18)$$

where nominal $M3$ is given as the sum of nominal $M2$ and government deposits as follows.

$$NM3 = NM2 + GOVDEP \quad (5.19)$$

While the determination of nominal $M2$ and the real Treasury bill rate of interest are described in the monetary sector, government deposits, $GOVDEP$, is treated as exogenous.

5.4.1.3 Prices

This section presents the modelling of prices, consisting of producer prices, consumer prices, export price, and imports prices.

Consumer prices

The CPI is used to represent consumer prices in the model. In the long run, consumer prices are modelled as a function of the producer prices as represented by the GDP deflator, a measure of excess demand, LED and import prices.

$$LCPI95 = \alpha + \beta_1 LGDPDEF + \beta_2 LED + \beta_3 LPMGS1 + \varepsilon \quad (5.20)$$

Excess demand (ED) is defined and specified as the ratio of expenditures ($RGDE$) to real output ($RGDP$) and hence, captures the demand and supply sides.

$$ED = \left(\frac{RGDE}{RGDP} \right) * 100 \quad (5.21)$$

where RGDE is defined as the sum of total investment (*RTOTINV*) and private and public consumption

$$RGDE = RTOTINV + RGCONS + RPCONS \quad (5.22)$$

Producer prices

Because of limitations in the data, the GDP deflator is used as a proxy for producer prices in the model. In the long run producer prices are specified as a function of capacity utilisation and the ratio of real wages to the user cost of capital.

$$LGDPDEF = \alpha + \beta_1 LCU2 + \beta_2 LRWAGESUCC2 + \varepsilon \quad (5.23)$$

In turn, capacity utilisation is defined as the ratio of actual real GDP at factor cost (*RGDPFC*) to potential real GDP at factor cost (*RGDPFC_POT*).

$$CU2 = \left(\frac{RGDPFC}{RGDP_POT} \right) * 100 \quad (5.24)$$

Potential real GDP at factor cost is derived by fitting a trend on *RGDPFC* using the Hodrick-Prescott filter.

The following relation gives the ratio of real wages to the real user cost of capital:

$$RWAGESUCC2 = \frac{RWAGES2}{RUCC} \quad (5.25)$$

Export prices

Export prices are specified in the long run as a function of world prices, the nominal exchange rate and producer prices.

$$LPXGS = \alpha + \beta_1 LPW1 + \beta_2 LEXRATE + \beta_3 LGDPDEF + \varepsilon \quad (5.26)$$

The exchange rate is considered exogenous in this model.

Import prices

In the long run, import prices are specified to be a function of the world price, the nominal exchange rate and *DUM8088*.

$$LPMGS1 = \alpha + \beta_1 LPW1 + \beta_2 LEXRATE + \varepsilon \quad (5.27)$$

5.4.1.4 Closure of the real sector

Specifying the national income identity closes the real sector. The change in inventories is derived by an identity and as a residual such that it is defined as the difference between real domestic output and final expenditure. Thus,

$$INV = RGDP - RPCONS - RGCONS - RPINV - RGINV - RXGS + RMGS \quad (5.28)$$

5.4.2 The external sector

The scope for modelling the external sector in Lesotho is fairly limited by the fixed exchange rate regime and existing institutional arrangements. The sector is described in this model by a set of identities that describe the current account and the capital and financial accounts of the overall balance of the balance of payments. The sector stochastically estimates the demand for exports and imports in real terms.

5.4.2.1 The current account

The current account balance is explained in one identity describing the nominal current account balance. It is defined as the trade balance, derived as the difference between exports and imports.⁷⁹ To this, the services balance, the incomes balance and current transfers are added. While the exports and imports of goods and services are derived stochastically in real terms, the services balance, the incomes balance and the current transfers are determined exogenously.

$$NCAB3 = NXGS - XGSRES - NMGS + MGSRES + SERVBAL + INCBAL + CURTRS \quad (5.29)$$

Real exports of goods and services

In the long run specification, demand for real exports of goods and services is a function of the level of world demand and the relative price of exports. This specification includes an own price, prices of related goods and an income variable as dictated by standard economic theory. Given that the destination of exports from Lesotho is spread over a large number of countries, in particular, the USA, the EU and the Far East, a broader definition of income is chosen over the narrower definition of income of the major trading partners.

$$LRXGS = \alpha + \beta_1 LWDEMND + \beta_2 LXGSRELP1 + \varepsilon \quad (5.30)$$

⁷⁹ The terms *XGSRES* and *MGSRES* were created as balancing items for nominal exports of goods and services and nominal imports of goods and service respectively because of the discrepancies in the data. *XGSRES* is derived as the difference between the nominal exports of goods and services as reported in the balance of payments and the nominal exports of goods and services as reported in the national accounts. Similarly *MGSRES* is the difference between the nominal imports of goods and services as reported in the balance of payments and the nominal imports of goods and services as reported in the national accounts. It is noteworthy that the trade statistics in Lesotho are notorious of discrepancies and imbalances. The disparities in data between the national accounts and the balance of payments are explained to arise from differences in the timing of recording transactions and errors in data. The two accounts are hence connected in the model by statistical means.

While world demand is treated as exogenous, the relative price of exports of goods and services is determined as follows.

$$XGSRELP1 = \left(\frac{PW1}{PXGS} \right) * 100 \quad (5.31)$$

where the world price ($PW1$) is exogenous and the price of exports of goods and services ($PXGS$) is determined by a stochastic behavioural equation in the price sector of the model.

The following relation links real exports of goods and services to the nominal exports of goods and services in the balance of payments.

$$NXGS = \frac{(RXGS * PXGS)}{100} \quad (5.32)$$

Real import of goods and services

Demand for real imports of goods and services is a function of real gross national output and the relative price of imports.

$$LRMGS = \alpha + \beta_1 LRGNP + \beta_2 LMGSRELP1 + \varepsilon \quad (5.33)$$

The relative price of imports of goods and services is determined as the ratio of import prices and the consumer prices as represented by the CPI .

$$MGSRELP1 = \left(\frac{PMGS1}{CPI95} \right) * 100 \quad (5.34)$$

Both the import prices and the consumer prices are determined by behavioural equations in the price sector of the model.

The following relation links the real imports of goods and services to the nominal imports of goods and services in the goods and services balance of the balance of payments.

$$NMGS = \frac{(RMGS * PMGS1)}{100} \quad (5.35)$$

Real national output is linked to nominal national output by the following identity.

$$RGNP = \left(\frac{NGNP}{GNPDEF} \right) * 100 \quad (5.36)$$

The deflator for *GNP*, *GNPDEF*, is exogenously determined.

5.5.2.2 The capital and financial balance

The capital and financial balance is defined as the sum of the capital account and the financial account balances and is given as,

$$NKFB = KB + FB \quad (5.37)$$

where the both the capital balance (*KB*) and financial balance (*FB*) are treated as exogenous.

5.4.2.3 The overall balance of payments

The overall balance of payments is given as the sum of the nominal current account balance, the nominal capital and financial balance, errors and omissions and valuation adjustments such that,

$$BOP = NKFB + NCAB3 + ERR + VALADJ \quad (5.38)$$

where errors and omissions and valuation adjustments are treated as exogenous to the model.

5.4.3 The government sector

Modelling the government sector in this study is intended to establish how government influences economic activity through a comprehensible yet simple representation of the main features of the public sector. The multiplier analysis is the cornerstone of the model and is used to highlight the impact of a policy shock on the economy through its interaction with other sectors. The study models the government sector with a description of government expenditures, revenues, the budget financing requirements and debt accumulation. It is assumed that the main instruments by which government can influence economic activity are taxation and government expenditures. Hence, the specific aim is to determine the impact of changes in government expenditures and taxation on the different sectors as well as on the aggregate economy. This will elicit information on the extent to which government can influence economic activity and the implications of fiscal policy on the economy. The fiscal sub-model consists of 14 equations of which six are stochastic behavioural equations and eight are identities.

5.4.3.1 Government revenues

Five types of tax revenues are modelled and determined endogenously. The reason for disaggregation here is to obtain a better fit, as well as to assess the individual importance of each of the taxes.⁸⁰ Other revenues, including customs revenues and non-tax revenues, as well as other receipts of government, such as grants, are also treated as exogenous. The tax revenues determined by behavioural stochastic equations are individual income tax, goods and services tax, company tax, other income tax and other taxes. The individual taxes are made to depend on suitable bases.

⁸⁰ See Brooks and Gibbs (1994) and Randakuwa *et al.* (1995).

Individual income tax

The long-run equation for individual income tax is modelled as a function of the level of nominal wages.

$$LIITAX = \alpha + \beta_1 LNWAGES + \varepsilon \quad (5.39)$$

Other income taxes

Other income taxes are modelled in the long-run as depending on the overall economic activity. They are hence expressed as a function of gross domestic output.

$$LOINCTAX = \alpha + \beta_1 LRGDP + \varepsilon \quad (5.40)$$

Company tax

The long-run equation for company tax is such that the level of company tax is a function of private investment.

$$LCOMPTAX = \alpha + \beta_1 LRPINV + \varepsilon \quad (5.41)$$

Goods and service tax

Goods and services taxes are modelled in the long run as a function of the level of private consumption and the level of exports of goods and service.

$$LGSTAX = \alpha + \beta_1 LRPCONS + \beta_2 LRXGS + \varepsilon \quad (5.42)$$

Other taxes

Other taxes are made a function of gross national output.

$$LOTAX = \alpha + \beta_1 LRGNP + \varepsilon \quad (5.43)$$

Total receipts of government are determined as the sum of total government revenue and grants;

$$TOTREC = TOTREV + GRANTS \quad (5.44)$$

In turn, total government revenue comprises individual income tax, company tax, other income taxes, goods and services tax, other taxes, customs revenue and non-tax revenue.

$$TOTREV = IITAX + COMPTAX + OINCTAX + GSTAX + OTAX + CUSTREV + NONTAXREV \quad (5.45)$$

Of these components, customs revenue and non-tax revenue are exogenous.

5.4.3.2 Government expenditures

The sector is modelled in a way that treats government expenditures and transfers as exogenous. Total government expenditure is the sum of recurrent expenditures and capital expenditures. A term, *GOVEXPRES* is added to this identity as a balancing item because of the existing discrepancy in the data.⁸¹ Thus

$$TOTGOVEXP = RECUEXP + CAPEXP + GOVEXPRES \quad (5.46)$$

The expenditures of government are linked to the expenditure sector by the nominal government expenditures. Nominal government expenditures are defined as the recurrent expenditures of government less government expenditures on other goods and services,

⁸¹ Because of the discrepancy inherent in the data, a variable, *GOVEXPRES*, equivalent to the difference between total government expenditure and the sum of recurrent expenditure and capital expenditure, was created to balance the identity.

and expenditures on subsidies and transfers. Again, because of discrepancies inherent in the data, a balancing item, *GOVRESID*, was created and added to the identity.⁸²

$$NGCONS = RECUEXP - OGS - SUBTRS + GOVRESID \quad (5.47)$$

The linkage of total government expenditure to the national income identity is then made operational by transforming the nominal government expenditures to real values by the following identity:

$$RGCONS = \left(\frac{NGCONS}{CONSDEF} \right) * 100 \quad (5.48)$$

where *CONSDEF* is the deflator for government consumption expenditures.

The government budget balance is defined by an identity as total receipts of government less total government expenditures.

$$GOVBAL = TOTREC - TOTGOVEXP \quad (5.49)$$

5.4.3.3 Government debt

The model makes a distinction between five concepts of debt. These are total government debt, government external debt, government domestic debt, short-term domestic debt and long-term domestic debt. The former four are determined endogenously while long-term domestic debt is exogenous. Government domestic debt and government external debt are determined by stochastic behavioural equations while total government debt and short-term domestic debt are determined by identities.

⁸² *GOVRESID* is the difference between nominal government consumption expenditure and recurrent expenditure less government expenditure on other goods and services and subsidies and transfers.

Government's domestic debt

In the long run, the level of government domestic debt is modelled to be a function of the government budget balance and the nominal Treasury bill interest rate following Easterly and Schmidt-Hebbel (1994) and Randakuwa *et al.* (1995). The relationship between domestic debt and the government budget balance is expected to be negative, reflecting a fall in domestic debt as the government budget moves towards a surplus position.

$$DOMDEBT = \alpha + \beta_1 GOVBAL + \beta_2 LTBRATE + \varepsilon \quad (5.50)$$

Government's external debt

In line with Randakuwa *et al.* (1995), government external debt is specified as a function of the nominal current account balance in the long run. The justification for this specification is that higher export earnings reduce the need for external borrowing while higher import payments raise the need for external borrowing. Thus external debt is expected in this relation to be a negative function of the surplus of the nominal current account balance.

$$EXTDEBT = \alpha + \beta_1 NCAB3 + \varepsilon \quad (5.51)$$

Total government debt is defined as the sum of domestic debt and external debt as follows:

$$DEBT = DOMDEBT + EXTDEBT \quad (5.52)$$

Short-term domestic debt is defined as domestic debt less long-term domestic debt as follows:

$$STDDEBT = DOMDEBT - LTDDEBT \quad (5.53)$$

5.4.4 The monetary sector

The modelling of the monetary sector in this study is intended to elicit information regarding the extent to and the manner in which the monetary variables feed in to the other sectors of the economy. The monetary sector consists of 17 equations of which four are stochastic behavioural equations and ten are identities. The sector is modelled to explain the behaviour of the monetary aggregates and the nominal Treasury bill interest rates. Because of the perfect substitutability of the Rand and Loti in the economy, and because of the absence of an instrument to estimate the amount of Rand circulating in the economy, it is assumed that total money supply in the economy is given by the Maluti denominated money supply. This assumption seems reasonable, given that the amount of Rand in the economy is immediately wiped up by the Central Bank to be converted into foreign reserves. The model assumes that money supply is determined exogenously and adjusts to meet money demand. The key variables determined in this model are the money demand and the nominal Treasury bill rate. For purposes of modelling money demand, broad money ($M2$) is disaggregated into currency in the hands of the public, demand deposits and time and saving deposits. Thus,

$$NM2 = NM1 + TSD \quad (5.54)$$

where

$$NM1 = CUR + DD \quad (5.55)$$

5.4.4.1 Money demand

Currency

Real currency in the hands of the public is specified simply as a function of real gross national output in the long run. This specification follows the transactions balance approach to money demand by which public holdings of currency represent the money held for purposes of effecting transactions.

$$LRCUR = \alpha + \beta_1 LRGNP + \varepsilon \quad (5.56)$$

In turn, nominal currency is defined as a product of real currency to the GDP deflator according to the following relation.

$$CUR = \frac{(RCUR * GDPDEF)}{100} \quad (5.57)$$

In turn, the rate of inflation is determined endogenously as the rate of change in the consumer price index

$$INFL1 = \left(\frac{CPI95}{CPI95(-1)} - 1 \right) * 100 \quad (5.58)$$

Demand deposits

Real demand deposits are specified in the long run as a function of real national output and the real Treasury bill rate.

$$LRDD = \alpha + \beta_1 LRGNP + \beta_2 RTBRATE1 + \varepsilon \quad (5.59)$$

The following relation translates real demand deposits to nominal demand deposits.

$$DD = \frac{(RDD * GDPDEF)}{100} \quad (5.60)$$

While the real Treasury bill rate (*TRBRATE1*) is derived as the nominal Treasury bill rate less the annual *CPI* rate of inflation.

$$RTBRATE1 = TBRATE - INFL1 \quad (5.61)$$

Time and saving deposits

In the long run specification, real time and saving deposits are a function of real national output and the real Treasury bill rate.

$$LRTSD = \alpha + \beta_1 LRGNP + \beta_2 RBRATE1 + \beta_3 DUM8084 + \beta_4 DUM9020 + \beta_5 DUM97 + \beta_6 DUM20 + \varepsilon \quad (5.62a)$$

The following relation translates real time and saving deposits to nominal terms.

$$TSD = \frac{(RTSD * GDPDEF)}{100} \quad (5.63)$$

5.4.4.2 Interest rates

The nominal Treasury bill rate is modelled and determined stochastically in this study. In principle, interest rates are treated as exogenous if the monetary authority directly controls interest rates in the economy (Pauly 2000:10). This situation is prevalent in many developing countries in which interest rates play a very limited role. In such cases money demand determines the volume of money supply in the economy. The modelling of interest rates in this study is made to follow recent changes in the determination of interest rates, in particular the Treasury bill rate in the economy of Lesotho. From an administrative determination regime, the Treasury bill rate is currently determined by the system of quarterly auctions of Treasury bills.

The nominal Treasury bill rate

In the long run specification, the nominal Treasury bill rate is modelled as a function of real national output, the government budget balance and the CPI inflation rate.

$$LTBRATE = \alpha + \beta_1 LRGNP + \beta_2 GOVBAL + \beta_3 LINFL + \varepsilon \quad (5.64)$$

In the short run, the nominal Treasury bill rate is specified as a function of the change in real national output, the nominal short-term SA bankers' acceptance rate, the change in CPI inflation rate and a one-period lagged nominal Treasury bill rate.

In closure of the monetary sector, the money multiplier is determined and defined as the ratio of the nominal broad money ($M2$) to reserve money. Thus,

$$M = \frac{NM2}{RM} \quad (5.65)$$

5.5 ESTIMATION TECHNIQUES

5.5.1 Background to the methodology

Time series data is used to estimate the model. Developments in econometric techniques have progressed to extensive use of cointegration methodologies. These developments derive from the realisation that firstly, most economic time series are non-stationary and tend to have a long memory of past errors, and secondly, that while traditional specifications elicit information about the long-run behaviour of variables, they provide little insight into the short-run dynamics of the variables. The first concern implies that the statistical properties of regression analysis in such cases become dubious. Because of the statistical properties of the series, the OLS estimators are rendered inefficient. OLS estimation that disregards these characteristics of the data produces promising results and diagnostic test statistics while there is no sense in the regression analysis. The second concern implies that the classical methods of estimation tend to ignore short-run dynamics that explain the evolution of the long-run relationships.

Recent time series techniques aim to highlight and capture the characteristics of time series and data generating processes, as well as taking into consideration the short- and

long-run dynamics to achieve a better representation of reality in econometric models. The application of cointegration and error-correction techniques in models represent these revisions in modelling macroeconomic relationships. The basic departure point of these techniques is that econometric time series contain one or more unit roots and are therefore subject to fluctuations that render them non-stationary over time.⁸³ With these characteristics, random shocks tend to have permanent effects on economic variables (Perron 1989:1362). This implies that the error terms produced by non-stationary series do not exhibit the usual desirable characteristics of being white noise. The idea is then to test for the presence of unit roots in time series and to apply transformations by which the series can be declared stationary. This would then make it possible for the data to be used in estimations that can be rendered efficient using standard OLS procedures.

5.5.2 Tests for the order of integration of variables

To investigate the possibility of the existence of unit roots in the error terms, a series of tests such as the Dickey-Fuller (DF) test due to Dickey and Fuller (1979), Augmented Dickey Fuller (ADF) test and the Phillips-Perron (PP) test have been developed.

Given the following data generating mechanism:

$$y_t = \alpha y_{t-1} + \mu_t; \quad y_0 \equiv 0 \quad (5.91)$$

The series is considered stationary if $|\alpha| < 1$, with statistical properties of a finite, time independent mean, a finite variance and that the series tends to return to its mean value. Conversely, the series is considered non-stationary if $|\alpha| \geq 1$. This implies that the series has at least one root. In this case the mean and variance are asymptotically infinite. The use of OLS methods of estimation on such series tends to produce spurious regressions whose interpretations are misleading.

⁸³ See for example, Nelson and Plosser (1982) and Perron (1988).

5.5.3 Cointegration analysis

Cointegration analysis is based on the long-run or equilibrium relationship between variables. Tests for cointegration are a means of investigating the existence of such relationships. The basic notion is that if economic theory is correct, we then expect a specific set of variables to be related to each other. Thus, there should be no tendency for economic variables to drift further away from each other with time. This type of analysis requires the satisfaction of two basic conditions. The first is that all variables should exhibit similar statistical properties. The variables must in particular be integrated of the same order. A series is considered to be integrated of order d if it has a stationary invertible ARMA (p,q) representation after differencing the series d times, but which is not stationary after differencing $d-1$ times. Thus, the series has d unit roots. It is then denoted $x_t \sim I(d)$, where d is the order of integration (Adam 1998:11). The second condition for cointegration is that there should exist a vector such as z_t (a linear combination of the series for x and y) that must be stationary or integrated of a lower order than the original variables. The vector z_t is given by the residuals from a static OLS regression of the variables.

5.5.4 The Engle-Granger method

Following the Engle-Granger (1987) methodology, cointegration analysis involves a two step procedure corresponding to the two conditions of the process as mentioned above. The first step involves determining the order of integration of the data series. The second step involves the examination of the residuals from the static cointegration regression or the long-run relationship for the existence of a cointegrating vector. If the null hypothesis of non-stationary residuals is rejected, it can be concluded that there is cointegration among the variables in the long run relationship. Otherwise the hypothesis of no cointegration is upheld. In the former case in which there is cointegration, the Granger representation theorem states clearly that an error correction model becomes a valid representation of relationship between variables.

5.5.4.1 Error correction models

The problem of spurious regressions associated with regressions of non-stationary series and/or series of varying statistical properties is avoided by the use of error correction models (ECM). In its simplest form, a two variable ECM can be written as:

$$\Delta y_t = \delta \Delta x_t - \lambda(y_{t-1} - \beta x_{t-1}) + \varepsilon_t \quad (5.92)$$

where δ measures the short-run effect of changes in x on y , β is the long-run or equilibrium solution of the dynamic model, λ is the error correction of the current level of y towards its equilibrium level.

By design, this formulation is meant to avoid problems of non-stationary data by using differences rather than levels while it also avoids the problem of losing information conveyed by the levels about any long-run relationships by incorporating these relationships into the differences specification describing short-run relationships between variables. Thus, the approach has several distinct advantages:

- In the event that the concerned variables are cointegrated, the ECM captures both the short-run and long-run effects. The short-run component of the model becomes non-zero during periods of disequilibrium and imparts information about the distance of the system from equilibrium;
- Assuming cointegration and that estimates of the concerned parameters exist, all terms within the ECM model are stationary. This implies that standard (OLS) estimation techniques can be applied;
- Since the ECM is directly linked to the concept of cointegration, Granger's representation theorem for dynamic modelling effectively implies that the presence of cointegration renders the ECM immune to the problem of spurious regressions; and
- Because it is possible to specify the ECM in a multivariate form, it is also practically possible therefore to allow for a set of cointegrating vectors.

The Engle-Granger procedure is usually praised for its computational ease. For example, Harris (1995:57) mentions two merits of using this procedure. Firstly, the static, short-run model can easily be estimated by OLS after which unit root tests can be performed on the residuals. Secondly, the second stage involves only estimating the short-run ECM and using the estimates of the extent of the disequilibrium to obtain information on the speed of adjustment to equilibrium. Although this procedure has been widely used in empirical applications it has faced heavy criticism from its implicit assumption of a unique cointegrating vector. It is argued that in the case of a multivariate regression, the cointegrating vector may not necessarily be unique and there may be other linear combinations of the variables in the vector which determine the evolution of the variables in the vector x . Secondly, the procedure yields results that are not invariant with respect to the direction of normalization or the choice of a dependent variable. The predetermination of a set of endogenous and exogenous variables and the assumption of zero restrictions in the system tends to bind the model onto strict economic foundations and hence pre-empt the outcomes of the model.⁸⁴

5.5.5 The Johansen Procedure

The shortcomings and criticisms of the Engle-Granger procedure when it comes to the multivariate case, call for consideration of other methods of estimation. An attractive option is the maximum likelihood approach suggested by Johansen (1988). The desirable characteristics of the Johansen framework is the consideration of the possibility of multiple cointegrating vectors and the allowance for determining causality and the testing of hypotheses in a more satisfactory way. Unlike the Engle-Granger procedure, this method makes use of the general Vector Autoregressive (VAR) model of the form

$$x_t = \Pi_1 x_{t-1} \dots \Pi_k x_{t-k} + \varepsilon_t \quad (5.93)$$

to derive a vector error correction model (VECM) of the following form

⁸⁴ See Sims (1980).

$$\Delta x_t = \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-k} + \varepsilon_t, \quad t = 1, \dots, T \quad (5.94)$$

where $\Gamma_i = -(I - \Pi_1 - \dots - \Pi_i)$ and $\Pi = (I - \Pi_1 - \dots - \Pi_k)$. The Γ_i are the dynamic vector parameters of the model and the Π matrix contain the long-run static parameters of the model which may or may not be cointegrated.

The procedure involves determining the rank of the Π matrix with the aim of identifying the number of cointegrating vectors within the eigenvector matrix. The significant vectors are then determined by the value of the maximum eigenvector statistic and are examined with the aim of isolating a set of uniquely identified cointegrating vectors binding the levels of the variables. In cases where only one significant cointegrating vector is identified, the assumption of weak exogeneity as well as single equation estimation is validated. In cases of multiple cointegrating vectors, which individually enter more than one equation, the assumption of weak exogeneity does not hold and hence simultaneous equation estimation is required.

The Johansen procedure has numerous advantages over the Engle-Granger procedure, particularly for multivariate analysis. Firstly, it produces results that are invariant with respect to the direction of normalization since it makes all variables explicitly endogenous. Secondly, it captures the underlying time series properties of the data and lastly it allows for direct hypothesis testing on the coefficient of the cointegrating vectors. This means that the Johansen procedure produces statistical properties that are generally better than that of the Engle-Granger procedure in the sense that the power of the cointegration test is higher.

Testing and analysing cointegration within a VAR framework is often considered a superior and desirable feature of the Johansen procedure over the Engle-Granger procedure. It is however notable that the VAR framework that is needed in the Johansen procedure requires large sample sizes especially with multivariate analysis that involves a

system of equations. Since data limitations in terms of the sample size, in particular, represent a major constraint in this study, the use of the Johansen procedure could make the entire modelling process impossible. This leaves us with the option of the Engle-Granger method notwithstanding its shortcomings. The EViews software package is used to carry out the estimation of the model as well as model simulations.

5.5.6 Unit root and cointegration tests

The study employs the ADF and PP statistics to test for the order of integration of the individual time series used in the behavioural equations. Unless otherwise stated, natural logarithms of variables are used in the estimations. The Engle-Granger test for cointegration that makes use of the ADF or PP statistics and the McKinnon (1991) critical values are used to test for cointegration among the variables.⁸⁵

5.5.7 Diagnostic tests

The analysis of the individual equations of the model involves assessment of whether the variables conform to the theoretical predictions, their statistical significance and the overall explanatory power of the equation. This involves examination of the signs and magnitudes of the individual coefficients in each equation, the corresponding t statistics and the adjusted R^2 and F statistics. In addition, all short-run equations are subjected to a battery of tests to assess the appropriateness of the specification, the stability of the equation and the statistical properties of the residuals of the equations. Normality of the distribution of the residuals is tested using the Jarque-Bera (JB) statistic. The Ljung-Box Q and the Breusch-Godfrey statistics test the existence of serial correlation in the residuals while the presence of heteroscedasticity is tested by means of the autoregressive conditional heteroscedasticity (ARCH) Lagrange multiplier (LM) test and the White test. The Ramsey RESET test is used to assess the existence of misspecification errors while the recursive estimates are used to examine the stability of the parameter estimates.

⁸⁵ The actual tests are performed in chapter six.

5.5.8 Forecast accuracy of endogenous variables

It is desirable to have some measure of how closely individual variable estimates track their actual data series. The predictive performance of the model is evaluated by means of four statistics, namely the root mean square error (RMSE), the mean absolute error (MAE), the mean absolute percentage error (MAPE) and the Theil inequality coefficient (U).⁸⁶

5.5.9 Issues relating to data availability and quality

One of the requisites for consistency in a macroeconomic model is a good data set. The forecasting ability of a macroeconomic model does not depend only on the accurate presentation of the structural features of the economy being studied, but also on how well the model approximates theoretical standards. A consistent data set is at the centre of these two qualities. As in many developing countries, the Lesotho data series hardly portray good consistency and quality.

The national accounts statistics are available in a continuous series from 1975 onwards with minor changes in definitions and classifications and shifts in the base years. The quality of the series on national accounts is hardly up to standard as a result of institutional weakness within the BOS and adjustments made by both the CBL and IMF. The monetary series are however available only from 1980, corresponding with the establishment of the CBL. Thus, a full data set can be obtained from 1980. The year 2000 was chosen as the end of sample period in this study because of the imbalances that result from year to year revisions that the CBL carry out.

The government accounts series also suffer from quality problems. This is again partly because of the institutional problems and partly because of lack of adequate response from government ministries (CBL 1999). Data on capital expenditures in particular are not adequately reported.

⁸⁶ See Pindyck and Rubinfeld (1991) and Greene (2003) for detailed discussions of these statistics.

Major problems exist in the balance of payments statistics. The series for exports and imports hardly tally with the series in the national accounts. In addition, data on imports of goods and services and capital flows is subject to serious under-reporting (CBL 1999). Other weaknesses relate principally to the wage-employment data and capital stock. The BOS keeps records of employment in the manufacturing and government sectors but not in other sectors. Labour market surveys that are carried out from time to time permit approximations of employment by assuming that employment grows at the same rate as output. The data on wages is also made possible by approximations derived from the GOL wage bill. Like in many developing countries, data on capital stock has been non-existent for a long time. It is only recently that estimates of the capital stock from the investment series have been made by the CBL.

5.6 CONCLUSION

This chapter has presented the empirical macroeconomic model for the economy of Lesotho. The construction of the model follows from, and is driven by the deductions made about the structure of the economy, as discussed in chapter two, and the theoretical and empirical guidelines, as discussed in chapters three and four respectively. The discussions in these chapters have formed a basis for the formulation hypotheses about interrelationships between different variables and the linkages between sectors. It is the framework that is developed in this chapter that is estimated in the next chapter, and used to analyse policy scenarios in the following chapters.